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ONLINE - 2020

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2013 KONYA GIDA VE TARIM ÜNİVERSİTESİ

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PREFACE

The International Eurasian Congress of Agriculture and Natural Sciences is a series of congresses that bring together all partners of agriculture, food and related natural sciences. The congress was held in Bishkek, the capital of Kyrgyzstan in 2017, and in Baku, the capital of Azerbaijan in 2018. The third is on 17 to 20 October 2019, hosted by Turkey, was held in Antalya, one of the city in the foreground with agricultural potential. Our congress, which we were planning to hold in Odessa, Ukraine this year, was held on online 30-31 October 2020 due to the pandemic that affected the whole world. With the participation of valuable scientists from different countries a total of 110 oral presentations were presented in our online congress. Besides, 47 poster presentations were also presented at our congress. Today, sustainable agriculture and food supply have become the most important component of the independence of countries. Although the name of our congress is Eurasia, the main purpose of our congress is to bring together scientists who are actively working with agriculture, food and natural science. In addition to this, valuable scientists from different countries participated in our congress and shared their valuable work with the participants. The scientists participated in our congress from Turkey, Kyrgyzstan, Ukraine, Kazakhstan, India, Iran, Italy, Chile, Australia, Russia, United Kingdom and Latvia. In the presentations, different problems, approaches and solutions in different areas of agriculture were discussed. From this point of view, the problems, opportunities and the similarities in the areas studied and required to be studied have attracted attention. Thus, the main mission of the congress, scientists with scientists in those countries to bring together in Turkey, there has been a successful convention process in developing the culture of common sense and cooperation. Although such scientific congresses are widely held, the success achieved in our previous congresses, where strong collaborations have been formed within the framework of the basic mission of our congress, has emerged in this congress as well. In other words, it was aimed to contribute to the development of culture of cooperation between countries and to introduce scientific wealth of our country to other scientists and to form the basis of scientific unity.

In this context, we would like to thanks Prof. Dr. Cumhur COKMUŞ the Rector of Konya Food and Agriculture University, Prof Dr Metin AKSOY the Rector of Selçuk University, Prof Dr Mykhailo BROSHKOV the Rector of Odesa State Agrarian University, and Prof Dr Alpaslan CEYLAN the Rector of Kyrgyz Turkish Manas University for their contribution to our congress as honorary president.

Sincerely yours.

Prof. Dr. Önder TÜRKMEN

On Behalf of the Organizing Committee

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GROUNDWATER DOC AND DON TRENDS IN TWO CONTRASTING SOILS CULTIVATED VIA CONSERVATION AGRICULTURE

L. Alessandrino[1], M. Gervasio[3], F. Vincenzi[3], N. Colombani[2,], G.Castaldelli[3],M.Mastrocicco[1]

Corresponding author: luigi.alessandrino@unicampania.it

1 DiSTABiF - Department of Environmental, Biological and Pharmaceutical Sciences and Technologies, Campania University "Luigi Vanvitelli", Via Vivaldi 43, 81100 Caserta, Italy

2 SIMAU - Department of Materials, Environmental Sciences and Urban Planning, Polytechnic University of Marche, Via Brecce Bianche 12, 60131 Ancona, Italy

3 SVeB - Department of Life Sciences and Biotechnology, University of Ferrara, Via L. Borsari 46, 44121 Ferrara, Italy

Abstract

Conservation agriculture is one of the most popular practices to mitigate climate stress on crops; it is a technique that combines organic matter addition with minimal soil disturbance. The present study investigated the effects of compost application combined with minimum tillage followed by traditional fertilization in the groundwater, where dissolved organic carbon (DOC) and dissolved organic nitrogen (DON) were monitored for three years (2016-2019) via several campaigns. The study area is located in the Po valley lowland (Ferrara Province, Italy). Here two field sites, named Gualdo and Bando, characterized by contrasting soil types and depositional environments, were selected as representative of the most common environments of the Po valley lowland. The two field sites were instrumented with multi-level samplers (MLS) for groundwater samples collection and hydrogeological measurements (Fig.1, lower panel). At the Gualdo experimental site, the piezometers were installed at -2, -3, -4 m below ground level (b.g.l.). At the Bando experimental site, the piezometers were installed at -1, -2, -3 m b.g.l.. For each experimental field three treatments were carried out: a control with traditional tillage and no compost application, a treatment with traditional tillage and compost application and a treatment with minimum tillage and compost application. The trends of DOC and Norg in the groundwater , both in Gualdo and Bando field, highlighted that there are no significant variations between the control and the two treatments. Therefore, the application of compost does not yet had an impact on the groundwater, but only on the unsaturated zone.

Keywords: dissolved organic carbon, compost, minimum tillage, organic nitrogen, groundwater

INTRODUCTION

The environment within which agricultural crops and agro-nomic practices developed over the past 10,000 years is rapidly changing due to human-induced climate change, that has and will have a negative impact on agricultural soil fertility due to changes in rainfalls and temperatures (IPCC, 2014). The climatic changes of recent years represent a great stress for many of the most important crops in the world (Teixeira et al. 2013). Global warming has a highly negative impact on agricultural production, and more generally on food production (Schmidhuber and Tubiello, 2007).

Conservation agriculture is one of the most popular practices to mitigate climate stress on crops. It is a technique that combines organic matter addition with minimal soil disturbance (Eze et al., 2020). Minimum tillage improves the availability of nutrients for plants, the conservation of organic carbon in the soil, the water retention capacity and it decrease nutrients leaching (Khan et al., 2017).

Compost application involves adding nutrients and organic matter to the soil, improving its fertility and structure (Diacono and Montemurro, 2011). Compost is derived from the biodegradation of organic waste especially of the agri-food type in line with the postulates of the circular economy (Hargreaves et al., 2008). Excessive compost application can, however, lead to an increase of dissolved organic carbon and (DOC) organic nitrogen (DON) in groundwater (Esteller et al. 2009), on the other hand, the addition of organic matter by compost could decrease N leaching towards groundwater by increasing the soil denitrification capacity (Colombani et al., 2020).

The present study investigated the effects of compost application combined with minimum tillage followed by traditional fertilization in the groundwater, where DOC and inorganic carbon (DIC), DON and dissolved total nitrogen (DTN) were monitored for three years (2016-2019) via several campaigns in two contrasting soils.

The study area is located in Gualdo and Bando (Figure 1) in the Po valley lowland (Ferrara province, Italy), where intensive cultivation and excessive use of fertilizers is widespread (Lasagna et al., 2016). The two soils chosen for this study are the most representative of the area. The soil in Gualdo is a Hypocalcic Haplic Calcisol and this site is characterized by fluvial plain depositional environments (Colombani et al. 2020); while the soil in Bando is a Calcaric Gleyic Cambisol and it is characterized by coastal lagoon marsh depositional environments (Colombani et al. 2019).

In a recent study carried out with stable isotopes by Colombani et al. (2019) has been found that the Gualdo site is affected by a plume produced by old upstream manure fertilizations; while the Bando site is affected by DON plume coming from geogenic sources due to the presence of peat lenses in the lower part of Bando's profile (Figure 2).

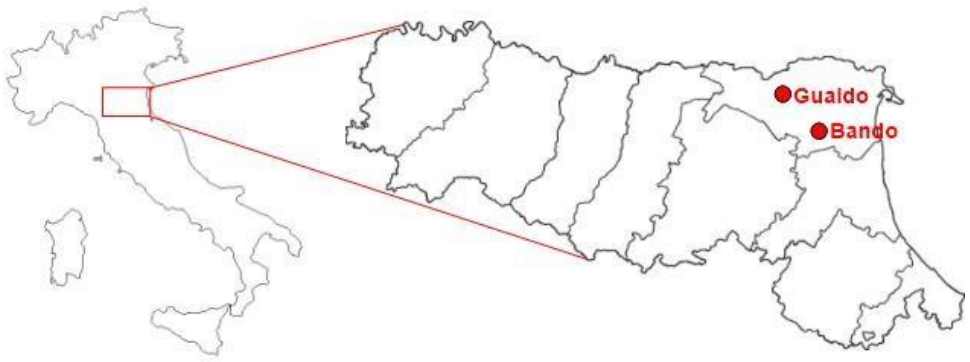

Figure 1. The two site's location and the geological map of the Area. Bando site (GPS coordinates 44° 47' 41" N and 11° 42' 20" E) is located in the south-eastern part of the Ferrara province; and Gualdo site (GPS coordinates 44° 39' 31.657'' N, 11° 52' 14.4019'' E) is located in the central-eastern part of the Ferrara province.

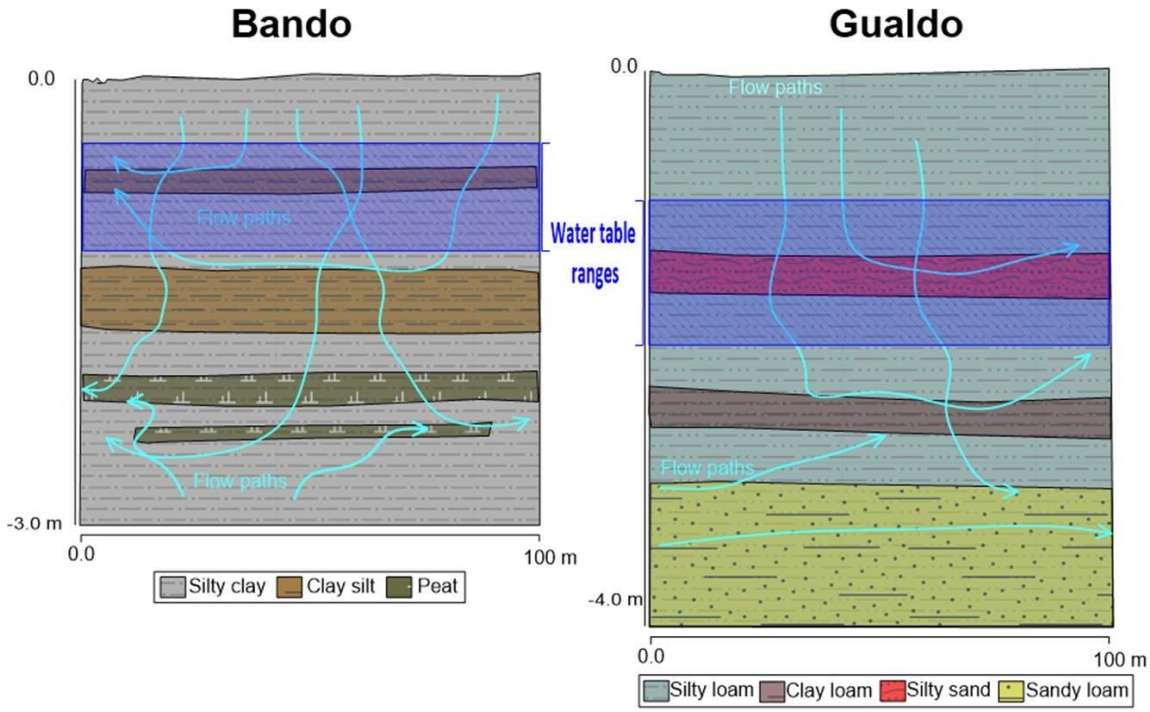

Figure 2. Geological profile of Bando site (on the left) and Gualdo site (on the right). White-blue arrows represent the flow paths, and the blue rectangles show the average water table ranges. Modified by Colombani et al. 2019.

MATERIALS AND METHODS

Experimental design

The experimental design involved three different treatments: A, C and M. Treatment A includes classical tillage only, this treatment was used as a control. Treatment C includes the application of compost coupled with classic tillage. The M treatment, on the other hand, includes the application of compost coupled with minimum tillage. Each treatment was followed by traditional fertilization with ammonium nitrate and urea and each site underwent rotational

cultivation of winter wheat and maize.

Groundwater collection and analysis

The two field sites were instrumented with multi-level samplers (MLS) for groundwater samples collection, respectively at 2 and 3 meters below ground level (m b.g.l.) for bando site and 3 and 4 m b.g.l. for Gualdo site. Groundwater sampling was done on a monthly basis for three years. The samples were taken from each piezometer using a bailer, after low flow purging for at least 3 well's volumes. Then samples were poured into 0.5 L HDPE flasks, which were stored inside a portable fridge and successively frozen until analysed. DIC and DOC were analysed with an elemental analyser Shimadzu TOC-V-CSM. DTN was analysed with a Technicon Autoanalyzer II. DON was obtained indirectly using the following equation:

$$DON = DTN - DIN$$

Where DIN is the dissolved inorganic nitrogen. DIN was, also, obtained indirectly using the following equation:

$$DIN = NH_4^+ + NO_3^- + O_2^-$$

Where ammonium (NH_4^+), nitrate (NO_3^-) and nitrite (NO_2^-) were analysed with a double beam Jasco V-550 UV/VIS spectrophotometer.

RESULTS AND DISCUSSION

Gualdo site

Figure 3 schematizes and summarizes the results obtained during the three years of monitoring in the Gualdo site for the DOC at 3 and 4 m b.g.l. At 3 m b.g.l. C treatment shows higher value of DOC than the control (A treatment), while there are not large differences between the M treatment and the control one. At 4 m b.g.l. there are not very important differences between the three treatments. DOC values are higher at 4 m b.g.l. than 3 m b.g.l. due to the old upgradient manure fertilizations. DIC values (Figure 4) show not important differences between the three treatments both at 3 and 4 m b.g.l. Figure 5 shows the results obtained for the organic nitrogen in Gualdo Site at 3 and 4 m b.g.l. There are no large differences between the three treatments both at 3 and 4 m b.g.l. In the last part of the monitoring period at 4 m.b.g.l. a climbing trend is present due to the upgradient manure plume that is passing through the plots. This is evident from the fact that the highest concentrations are found in the lower monitoring well, indicating that the DON is not coming from the vadose zone and thus from the monitored plots. DTN concentrations (Figure 6) show not significant differences between the treatments and the trends are very similar to those of DON.

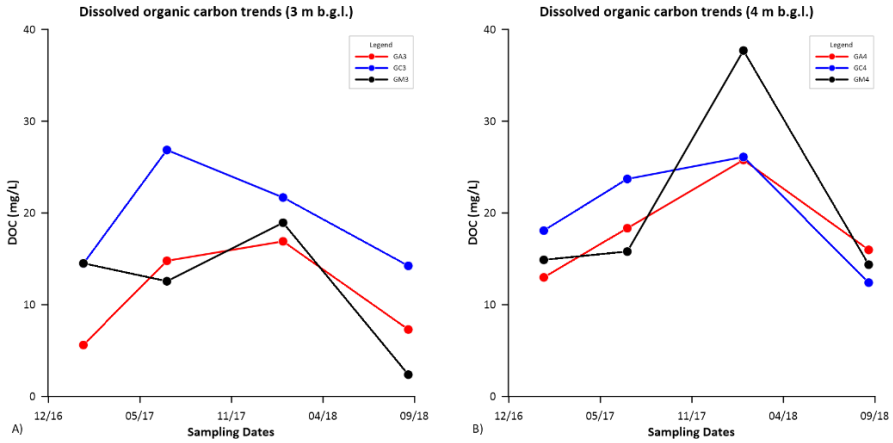

Figure 3. Gualdo site DOC values during a three years monitoring time at 3 m b.g.l. (left panel) and 4 m b.g.l. (right panel). The blue line shows C treatment trend and black line shows M treatment trend, while red line shows the control plot A.

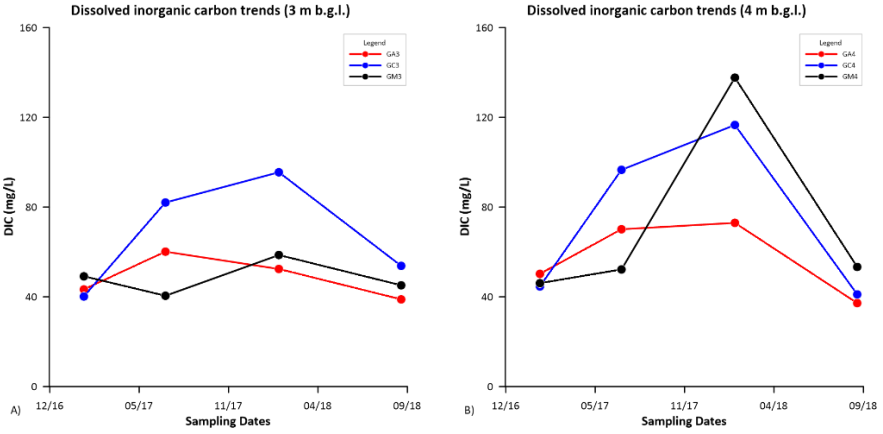

Figure 4. Gualdo site DIC values during a three years monitoring time at 3 m b.g.l. (left panel) and 4 m b.g.l. (right panel). The blue line shows C treatment trend and black line shows M treatment trend, while red line shows the control plot A.

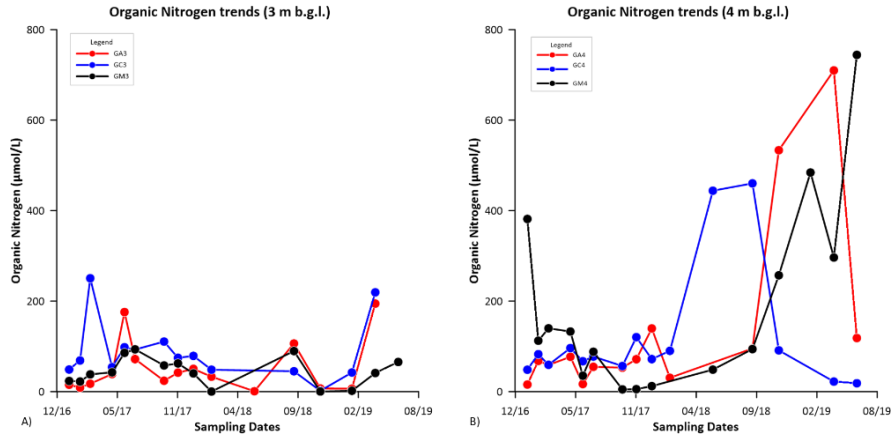

Figure 5. Gualdo site Norg values during a three years monitoring time at 3 m b.g.l. (left panel) and 4 m b.g.l. (right panel). The blue line shows C treatment trend and black line shows M treatment trend, while red line shows the control plot A.

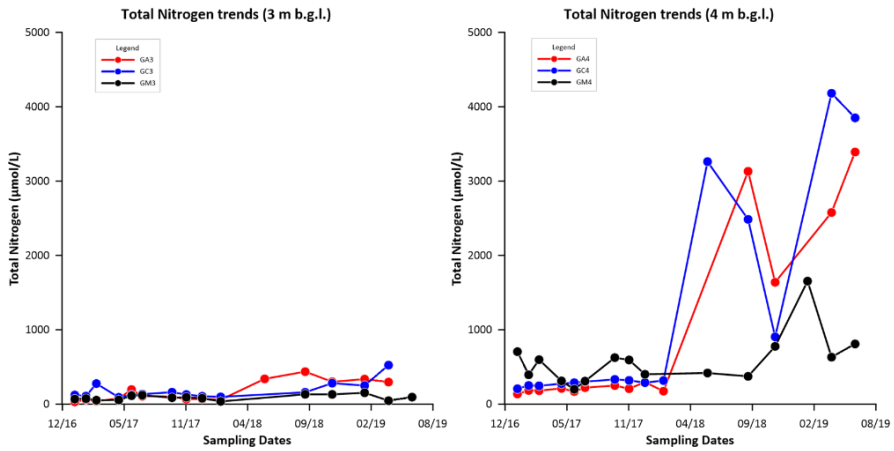

Figure 6. Gualdo site Norg values during a three years monitoring time at 3 m b.g.l. (left panel) and 4 m b.g.l. (right panel). The blue line shows C treatment trend and black line shows M treatment trend, while red line shows the control

Bando site

Figure 7 schematizes and summarizes the results obtained during the three years of monitoring in the Bando site for the DOC at 2 and 3 m b.g.l. At 2 m b.g.l. the C treatment shows higher value of DOC than the control one (A treatment), while there are no appreciable differences between the M treatment and the control plot. At 3 m b.g.l. there are no important differences between the three treatments. DOC values are higher at 3 m b.g.l. than 4 m b.g.l. due to the upward groundwater flow induced by the "Polder" like environment that promotes exfiltration, thus enhancing the transport of DOC from geogenic source like peat lenses. DIC values (Figure 8) show not important differences between the three treatments both at 2 and 3 m b.g.l. Figure 9 shows the results obtained for the DON in Bando Site at 2 and 3 m b.g.l. There are no important differences between the three treatments both at 2 and 3 m b.g.l. In the last part of the monitoring period at 3 m.b.g.l. there is a rising trend due to the DON generated by seasonal oxidation of peat lenses driven by water table oscillation. DTN concentrations (Figure 10) show not significant differences between the treatments and the trends are very similar to those of DON.

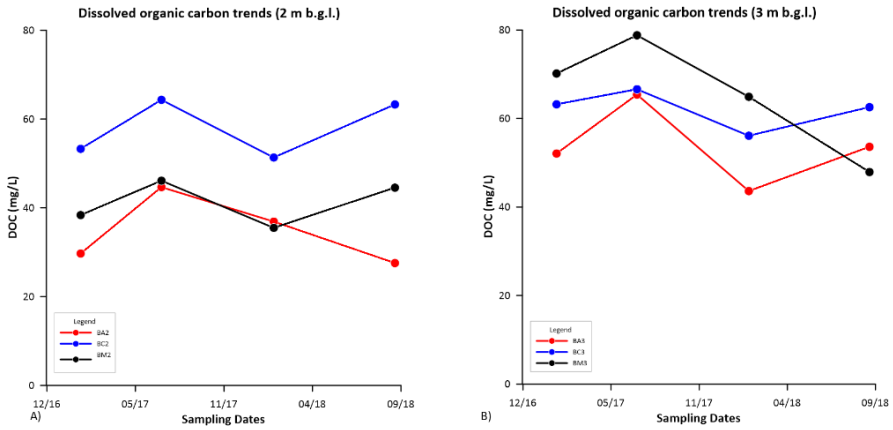

Figure 7. Bando site DOC values during a three years monitoring time at 2 m b.g.l. (left panel) and 3 m b.g.l. (right panel). The blue line shows C treatment trend and black line shows M treatment trend, while red line shows the control plot A.

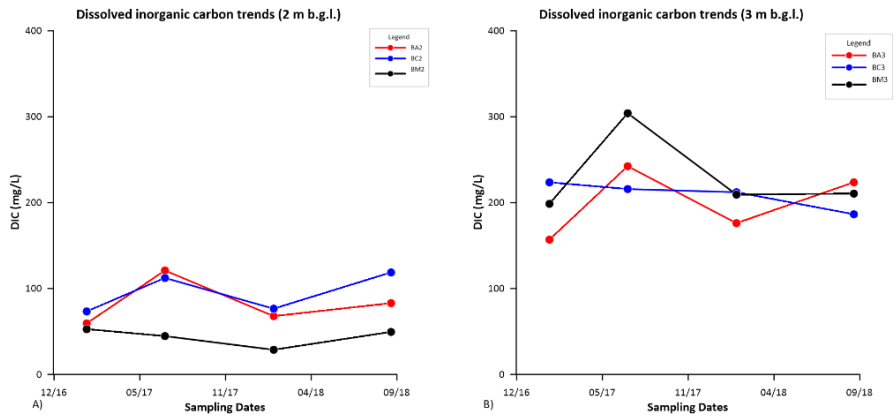

Figure 8. Bando site DIC values during a three years monitoring time at 2 m b.g.l. (left panel) and 3 m b.g.l. (right panel). The blue line shows C treatment trend and black line shows M treatment trend, while red line shows the control plot A.

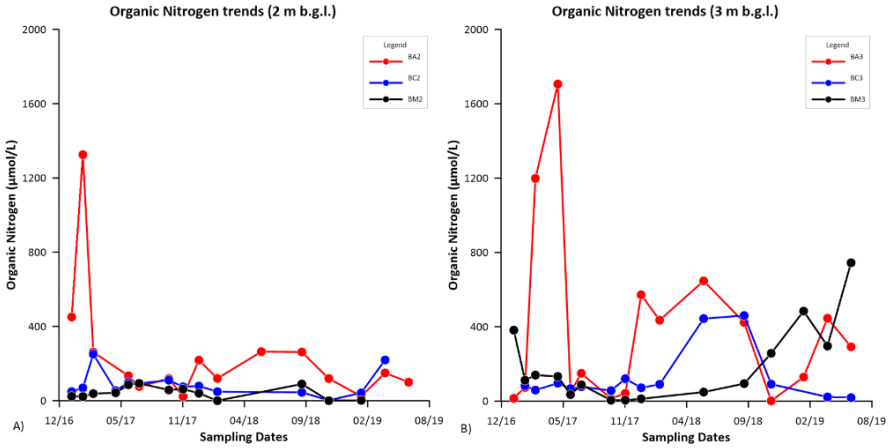

Figure 9. Bando site Norg values during a three years monitoring time at 2 m b.g.l. (left panel) and 3 m b.g.l. (right panel). The blue line shows C treatment trend and black line shows M treatment trend, while red line shows the control plot A.

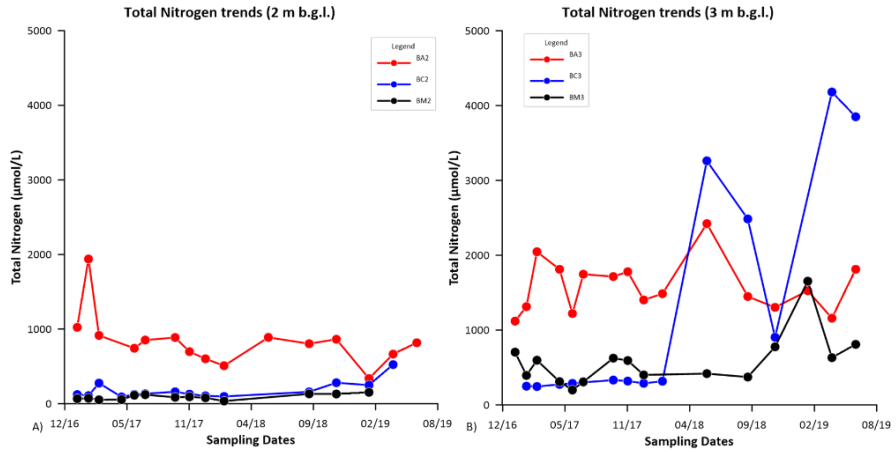

Figure 10. Bando site Norg values during a three years monitoring time at 2 m b.g.l. (left panel) and 3 m b.g.l. (right panel). The blue line shows C treatment trend and black line shows M treatment trend, while red line shows the control plot A.

CONCLUSIONS

This study evaluated the effects of compost application combined with minimum tillage followed by traditional fertilization in the groundwater, where DOC, DIC, DON and DTN were monitored for three years via several campaigns in two contrasting soils. Compost was applied

only once in 2016 (start of monitoring) then during the whole monitoring period conventional fertilization with synthetic fertilizers was carried out.

The trends of DIC, DON and DTN in groundwater highlights that there are no significant variations between the control and the two treatments both in Gualdo and Bando fields.
In both the sites, the classical tillage combined with compost application showed DOC values higher than the control for the upper piezometer, therefore classic tillage may have favoured the leaching of organic carbon derived from the application of compost. Minimum tillage, on the other hand, did not show any differences with the control for the DOC, therefore this practice tends to slow down the leaching of organic carbon despite the application of compost. DON leaching was minimal with negligible impact on shallow groundwater quality. Therefore, the application of compost did not have a major impact on groundwater during the monitored period.

Nevertheless, N and C compounds leaching was superimposed on pre-existing contaminations from anthropogenic sources in Gualdo and geogenic sources in Bando (Colombani et al. 2019).

The experimental design proved to be highly efficient and cost effective, especially since the use of multi-level samplers allowed to sample and discretize the aquifer at different levels without creating mixing of different waters resulting from different pollution sources. Therefore, to study the impact of agricultural practices on shallow groundwater bodies, monitoring groundwater quality parameters via multi-level samplers is essential to have a real picture of the system and avoid biased results induced by the overlap of different sources.

ACKNOWLEDGMENTS

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EFFECT OF VERMICOMPOST ON SEEDLING QUALITY AND GROWTH IN WATERMELON (*Citrullus lanatus* L.)

A. Aydın [1], H. Yetişir[2], F. Ulaş [2], A. Ulaş[3]

[1]Ahi Evran University, Agricultural Faculty, Horticulture Department, Kırşehir, Turkey

[2]Erciyes University, Agricultural Faculty, Horticulture Department, Kayseri, Turkey

[3]Erciyes University, Agricultural Faculty, Soil Science and Plant Nutrition Department, Kayseri, Turkey

Abstract

In this study carried out under greenhouse conditions in summer period, a mixture of field soil, soil and farm manure (1:1 v:v) was used as growth medium. 0 (control), %2.5, %5 and %10 vermicompost were added to each soil. In the study using one liter pots, the amount of vermicompost was adjusted according to weight. A total of 8*9*2 = 144 seeds were used. In this study, the effects of watermelon (*Citrillus lanatus* L.) on seedling growth were investigated. The parameters measured in plants were measured plant height, stem and leaf fresh and dry weights and leaf area. According to the results obtained in the study, plant growth was observed in the highest soil and farm manure mixture and 5% vermicompost application, while the lowest plant seedling growth was observed in unmixed field soil. In both soil mix, after 10% vermicompost application, plant seedling growth decreased. As a result, it is seen that vermicompost application increases plant growth but has a negative effect on plant growth after a certain place. For this, the mixture should be prepared for each plant species and according to the content of the vermicompost used.

Keywords: Farm manure, Seedling development, Vermicompost, Watermelon

Introduction

Watermelon is a short duration vegetable crop belonging to Cucurbitaceae family, and is a high value crop in Turkey and in many countries in the world. Watermelon seedlings are produced in the greenhouse in the mixture of commercial hydroponic bed plant growing medium before the nature is transported out of the greenhouse. It is very sensitive to the factors that cause the growth of the medium in the early stages of growth, where high substrates are present in the foundation organic seedling foundation. Peat moss is used as a hydroponic potting substrate in horticulture due to its desirable physical properties and high nutrient exchange capacity (Raviv et al., 1986). In recent years, however, environmental and ecological concerns have been increasing against peat use, because the harvest is destroying the extinct swamp ecosystems worldwide. Other organic materials such as fertilizer compost, vermicompost, rice, ash, tea wastes, cotton bolls, coconut powder etc. (Agbo and Omaliko, 2006; Ercisli et al., 2005; Sahin et al., 2004)

Vermicomposts have been described by several authors as humus-like materials and their degree of humification has been investigated fairly thoroughly. The humifying capacity of earthworms, in the production of vermicomposts, was reported by Businelli et al. (1983) after *Lumbricus rubellus* processed a range of mixtures: cow and rabbit dungs, cattle and horse dungs, cow and sheep dungs and municipal waste compost.

Orlov and Biryukova (1996) reported that the total organic matter concentration of vermicomposites contains 17-36% humic acid and 13-30% fulvic acid. Senesi et al. (1992) compared the quality of the humic acids found in vermicomposites by using the spectroscopic analysis procedures in natural soils.

Among their superior chemical attributes, Edwards and Burrows (1988) reported that vermicomposts, especially those from animal waste sources, usually contained more mineral elements than commercial plant growth media, and many of these elements were changed to forms more that could be readily taken up by the plants, such as nitrates, exchangeable phosphorus, and soluble potassium, calcium, and magnesium.

Werner and Cuevas (1996) reported that most vermicomposts contained adequate amounts of macronutrients and trace elements of various kinds but were dependent on the sources of the earthworm feedstock.

Vermicomposts have many outstanding biological properties. They are rich in bacteria, actinomycetes, fungi (Edwards, 1983; Tomati et al., 1987; Werner and Cuevas, 1996) and cellulose-degrading bacteria (Werner and Cuevas, 1996). In addition, Tomati et al. (1983) reported that earthworm castings, obtained after sludge digestion, were rich in microorganisms, especially bacteria. Nair et al (1997) compared the microorganisms associated with vermicomposts with those in traditional composts.

The objective of this research was to evaluate the effect of different vermicompost combinations on the seedling growth and to determine the most effective formula for organic seedling production of watermelon.

Materials and Methods

An experiment was conducted un a greenhouse conditions at the Faculty of Agriculture, Erciyes University, Kayseri- Turkey. For the vegetation period, the average day/night temperatures was 25/30 °C, the relative humidity was 60-80% . Crimson Tide watermelon variety was use as a plant material.

Experimental design. The experiment was carried out as a pot experiment in greenhouse environment. Regular field soil (RFS) and mixture of soil and composted farm manure (S&M) (1:1 v:v) was used as growth medium. 0 (control), 2.5, 5 and 10 % vermicompost were added to each type of soil. The amounts of vermicompost in the experiment where one liter pots were used were adjusted based on the weight. The experimenatl design was complete rondomized plot and each teratment replicated 9 times with 2 seedlings. In total, 8 * 9 * 2 = 144 seeds were used. After the seeds were planted in the pots, they were irrigated until water drains from the bottom of the pot. After the emergence, the pots were manually irrigated twice a week. The plants were harvested 40 days after seeding and the results were evaluated.

Soil sample and analysis

Table 1. Some physical, chemical and biological properties of soil used in the experiment

Properties	Value
Sand (%)	62.60
Silt (%)	27.10
Clay (%)	10,30
pH	7.50
EC	0,27
Organic Matter (%)	0.60
Lime (%)	1,10
Suitable Phosphorus (kg P2O5/da)	6.40
Total N (%)	0.052
Interchangeable K (cmol / kg)	1,10
Exchangeable Na (cmol / kg)	0.19
Interchangeable Ca (cmol / kg)	9.30
Interchangeable Mg (cmol / kg)	0,76
KDK (cmol / kg)	11.10
B (ppm)	0.68
Fe (ppm)	1.10
Mn (ppm)	2.14
Zn (ppm)	0.81
Cu (ppm)	1.21

Growth measurements. At the end of the experiment plants were harvested by separating them into shoot and leaves. Main stem length (cm) was measured by using a ruler. For the fresh weight determination plant organs were fractioned into the leaf, stem and leaves and then weighed. The total leaf area for each treatment was determined by LI 3100 C Model Leaf Area Measuring Device in cm^2.The stem and leaf samples were placed in paper bags and allowed to dry until they reached constant weight at 70 ^oC for 48 h. Then dried stem and leaf samples were removed from the oven and weighed to determine their dry weight.

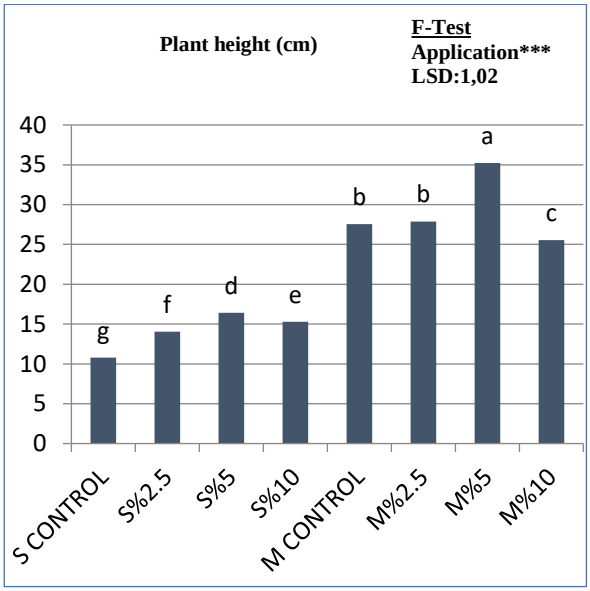
Statistical analysis. Analysis of variance (ANOVA) was performed using the SAS program (SAS Institute, Cary NC, USA). If ANOVA determined that the effects of the treatments were significant ($P < 0.05$ for F -test), then the treatment means were separated by Duncan's Multiple Range Test.

Results and Discussion

The plant hieght was significanly affected by both soil type and vermicompost application. Farm manure and soil mixture (29.06) produced longer plants than field soil (14.13). While the longest plant was recorded in S&M amanded with 5 % vermikompost with 35 cm, the shotest plant were harvested from RS control treatments. The mean height of the plants increased significantly by increasing vermicompost amount in both soil types up to 5%, but 10% vermicompost application caused significant reductions in plant height (Figure 1).

The leaf area is also significantly influenced by both vermicompost application and soil type. Similar to the height of the plant, S&M produced larger leaf area than RS. The largest leaf area wasmeasured in S&M with 5% vermikompost with 155.3 cm^2/plant and the lowest leaf area

was recorded in RS control treatments with 47.1 cm^2/plant. (Figure1). These result are agreement with many previous studies before about effect of vermicompost on vegetable seedling growth. Atiyeh et al. (2000, 2001) reported that a wide range of vegetables germinated better in mixed substrates with vermicompost than in commercial growth media (. The increased plant hight, stem diameter and leaf number per plant by vermicompost application of 1/3 and ¼ to soil were determined in tomato by Gutierrez-Miceli et al. (2007). Paul and Metzger (2005) also reported that 20% vermicompost additions to Metro-Mix36 (commercial substrate) caused a significant increase in plant height, leaf area and root dry weight compared to control.. Leaf area, number of strawberry suckers, number of flowers, shoot weight, and commercial fruit yields of strawberries all increased significantly in response to supplemented vermicompost applications compared to those from strawberries that produced by only inorganic fertilizers. (Arancon et al. 2004). Black pepper cuttings raised in vermicomposts were significantly taller and had more leaves than those grown in commercial potting mixtures. Plant heights, numbers of branches, and the longest taproots were on cloves grown in the vermicompost mixtures (Vadiraj et al. 1998).



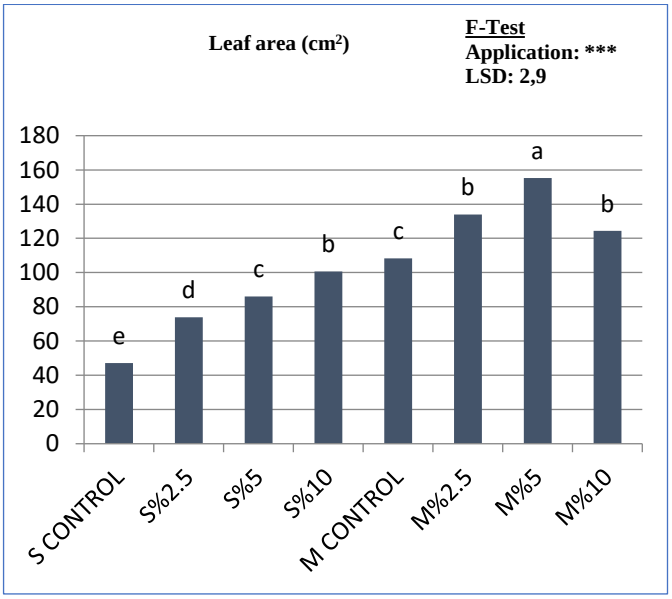


Figure1. Influence of vermicompost application on plant height (cm) and leaf area (cm^2/plant) of watermelon plants grown into two different soil types. RS(S): Regular soil control, S&M (M): Soil and farm manure mixture. Each soil type was substituted with 2.5, 5 and 10 % vermicompost.

Addition of vermicompost and soil type significantly affected plant stem fresh and dry weight. While S&M produced higher stem fresh and dry weight than RS, the addition of vermicompost significantly increased stem dry and fresh weight in all treatments except for R&S with 10 % vermicompost treatments. The highest stem fresh weight was obtain from S&M with %5 vermicompost mixture with 9,54 g/plant, and the lowest plant stem fresh weight was recorded in RS control with (2.28g/plant. With regard to plant stem dry weight, the lowest value was obtained from RS control with 0.17g/plant and the highest stem dry weight was recorded in S&M with %5 vermicompost mixture treatments with 0,47g/plant (Figure 2). Similar to the current study, the positive effects of vermicompost on vegetative and generative development in several vegetable species were reported in previous studies. Edwards and Burrows (1988) reported that vermicomposts increased vegetable seedling emergence compared with those in control commercial

plant growth media, using a wide range of test plants such as pea, lettuce, wheat, cabbage, tomato and radish.

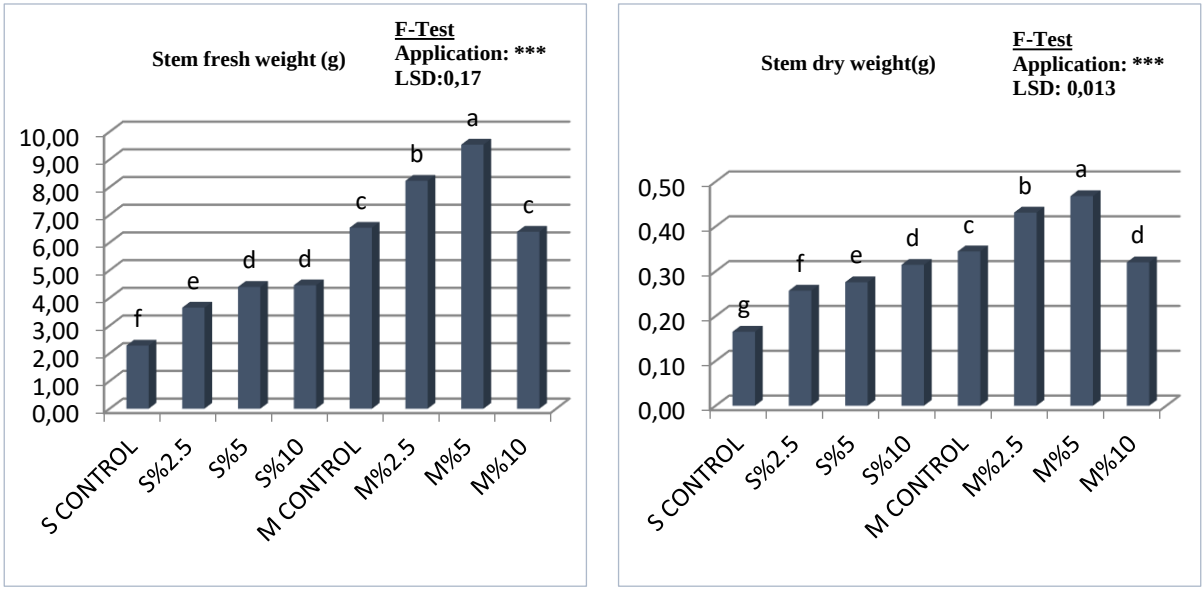


Figure2. Influence of vermicompost application on stem fresh (g/plant) and dry weight (g/plant) of watermelon plants grown into two different soil types. RS(S): Regular soil control, S&M(M): Soil and farm manure mixture. Each soil type was substituted with 2.5, 5 and 10 % vermicompost.

The leaf fresh and dry weight was significantly affected by soil types and vermikompost rate added to growth medium. As in previous parameters given above, S&M produced higher leaf fresh and dry weight than that RS produced. S&M substituted with 5% vermikompost produced the highest leaf fresh weight with 8,82 g/plant and tha lowest leaf fresh weight was recorded in RS control treatment with 2.51 g /plant. In the same trend, the highest leaf dry weight obtained from %5 vermikompost added soil and farm manure mixture (0,69g) and lowest leaf dry weight was determined in RS control tratmnet with 0.29 g/plant. The reduction due to high doses was observed in only S&M with substituted with 10% vermicompost. The application of vermicompost resulted in a two-fold increase in the frsh weight of the leaf under the field soil conditions, but only a 40% increase in the use of soil and farm manure mixture (Figure3). In accordance with current reseach, Vadiraj et al (1998) reported enhanced growth and dry matter yield of cardamom (*Electtaria cardamomum)* seedlings in vermicomposted forest litter compared with that in other growth media tested. Increased yield in onion (Allium cepa) by vermicomposts produced from coir dust application was reported by Thanunathan (1997). Atiyeh (2000) demonstrated that vermicompost produced from pig manure substituted into Metro-Mix 360, at a range of concentrations increased vegetable and ornamental seedling growth, even at low concentrations, when all the nutrients needed by the crops were available. However, the larger percentages of vermicomposts substituted into the soilless commercial growth medium (MM360) did not always improve plant growth possibly because of salt content or other factors. They demonstrated further, that as little as 5% of vermicompost substituted into MM360 was enough to produce conciderable growth responses of tested crops.

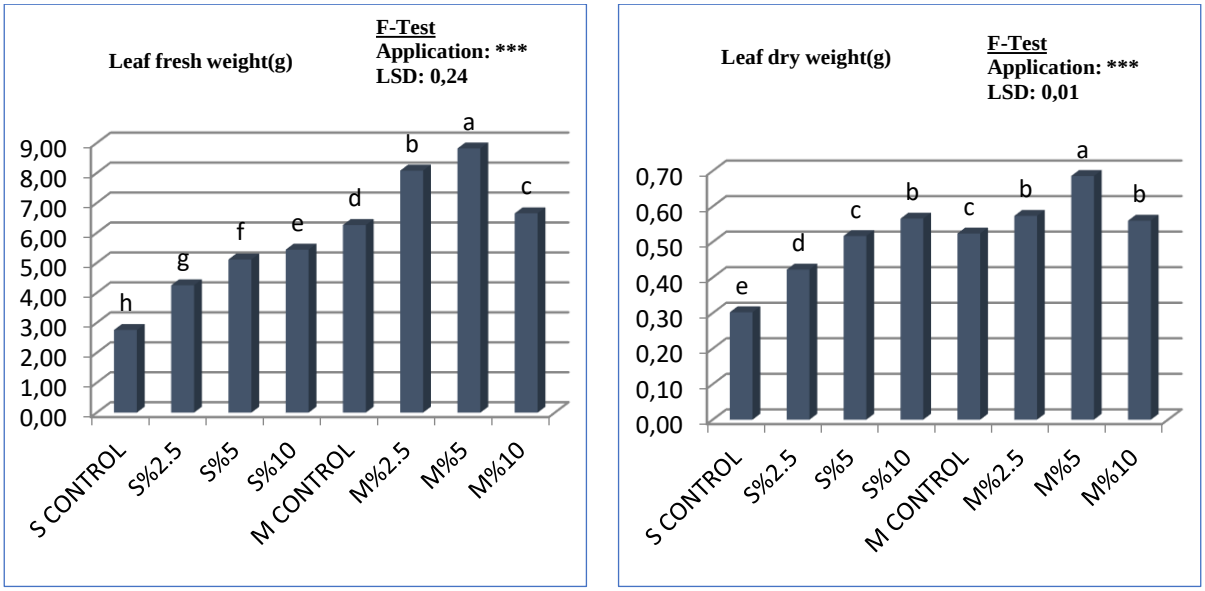


Figure3. Influence of vermicompost application on plant leaf fresh weight (g/plant) and leaf dry weight (g/plant) of watermelon plants grown into two different soil types. RS(S): Regular soil control, S&M(M): Soil and farm manure mixture. Each soil type was substituted with 2.5, 5 and 10 % vermicompost.

Conclusions

As a result, it is seen that vermicompost application increases plant growth but has a negative effect on plant growth after a certain place. For this, the mixture should be prepared for each plant species and according to the content of the vermicompost used.

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THE EFFECTS OF DIFFERENT ROOTSTOCKS (*C. maxima* × *C. moschata*) ON THE YIELD AND FRUIT QUALITY OF W-135 F_1 AND GABRIEL F_1 WATERMELON VARIETIES

Alim AYDIN[1]*, Hamide BOZOK[2]

[1]Agriculture and Geothermal Project Coordinator, Kırşehir Ahi Evran Pilot University, Kırşehir, Turkey

[2]Erciyes University, Department of Horticulture, Kayseri, Turkey

*Corresponding author: alim.aydin@ahievran.edu.tr

ABSTRACT

The experiment was conducted between April and August 2020 in TETA seed company (Kahramanmaraş). Two watermelon scion genotypes (Gabriel F1 and W135) and 5 different rootstock *C. moschata* × *C. maxima* hybrids genotypes (R172, R173,R174, Nun9075 and TZ-148) Non-grafted plants were used as control in experiment. However non-grafted plants died due to soil-borne diseases and measurements of these plants could not be made. Harvest was determined by a dead tendril at the point where the fruit attached to the vine, along with a yellow ground spot. Nine fruits from each replicate were randomly chosen to determine the yield per plant number of fruit per plant, soluble solids content (Brix), fruit length, fruit diameter and thickness of rind. According to the results, R172/W135, R174/W135, R172/Gabriel F1 grafting combinations had a positive effect on yield and quality compared to other grafting combinations. As in our land, the use of grafted plants may be preferred in areas where nun-grafted watermelon production is limited due to soil-borne diseases. In addition, use of rootstocks (use of grafting plant) is also economically feasible to the producer and can be considered as an alternative way in production to increase the net revenue.

Keywords: Grafting, Rootstock, Scion, Yield, Watermelon

INTRODUCTION

Watermelon (*Citrullus lanatus*) is a member of the cucurbit family (Cucubitaceae) and is a high commercial value crop in Turkey and in many countries in the World. China is the world leader in watermelon production with 60.6 % of the total production in 2018. Other leading countries are Iran (3.9%), Turkey (3.8 %) and Brazil (2.1%) (FAO 2018). To meet the growing consumption demand worldwide, monocultures become the major cropping system for watermelon production recently. However, watermelon subjected to consecutive monoculture is susceptible to biotic (virus, bacteria, fungus, pests etc.) and abiotic stress (salinity, drought, alkalinity, low and high temperatures, deficiency or excess of nutrients, heavy metals, air pollution, radiation and etc) (Rivero et all., 2001; Uygur and Yetişir 2006; Li et all., 2017; Rouphael et all., 2008; Hamurcu et

all., 2020; Kaya et all., 2003; Colla et all., 2010; Mo et all., 2016; Njoroge et all., 2008; Huang et all., 2016).

Vegetable grafting is most common in European and Asian countries where crop rotation is no longer an option and available land is under intense use. Grafting is an alternative approach to reduce crop damage resulting from soilborne pathogens and increase plant biotic and abiotic stress tolerance, which increases crop production (Hassell et al., 2008; Soteriou et al., 2014; Bertucci et all., 2018; Tripodi et all., 2020). Rootstocks commonly used in watermelon grafting are *C. moschata, C. maxima, C. pepo, Benincasa hispida, Lagenaria siceraria, Sicyos angulatus Citrullus lanatus* var. *citroides C. moschata* × *C. maxima* hybrids (Lee, 1994).

Grafting with cucurbits was originally initiated as a preventive measure against a soil-borne disease, fusarium wilt Since than, it has been demonstrated that grafting of selected rootstocks is useful for increasing cultural efficiency and crop yield it promotes crop growth and enhances environmental adaptability, the grafting procedure has been widely (Kawaide, 1985). This is due to the use of Cucurbita spp. rootstock that induces vegetative growth (Kawaide, 1985). In a similar study, Yamasaki et al. (1994) determined that grafts to interspecific hybrid squash cause more vigorous growth. Grafted plants of Reina de Corazones watermelon cultivar onto Shintosa rootstock increased the fruit yield as compared to non-grafted plants. However, fruit set was not affected by the rootstock (Miguel et al., 2004). The average yields of grafted plants were much higher than the yields of the non-grafted plants. The yield increase was 44% and 84% respectively for melon and watermelon (Besri, 2008). Reports indicated that the use of rootstock alters yield and quality attributes of the scion fruit. The main purpose of this study was to investigate the effects of grafting on fruit yield, characteristics and quality attributes of two watermelon plants, ‘W135’, ‘Gabriel F1’.

MATERIALS AND METHODS

Plant Material, Treatments and Experimental Design

The experiment was conducted between April and August 2020 in TETA seed company (Kahramanmaraş). Two watermelon scion genotypes (Gabriel F_1 and W-135 F_1) and 5 different rootstock *C. moschata* × *C. maxima* hybrids genotypes (R 172, R 173,R 174, Nun 9075 and TZ-148) Watermelon seeds were sown in a mixture of 2: 1 peat and perlite ratio, and one week later, pumpkin seeds were sown. Seedlings were grafted at the beginning of May and were planted at the end of May in open field. Grafts were performed as follows; seedlings were grafted by hand, the tongue approach grafting method was applied (Lee, 2003). Grafting was carried out in the glasshouse shaded and sheltered from wind to avoid wilting of the grafted plants. Grafting combinations of scion / rootstock were shown (Table 1).

Tablo 2 Grafting combinations

Rootstock	Scion
R172	Gabriel F1
R172	W135
R173	Gabriel F1
R173	W135
R174	Gabriel F1
R174	W135
Nun9075	Gabriel F1
Nun9075	W135
TZ-148	Gabriel F1

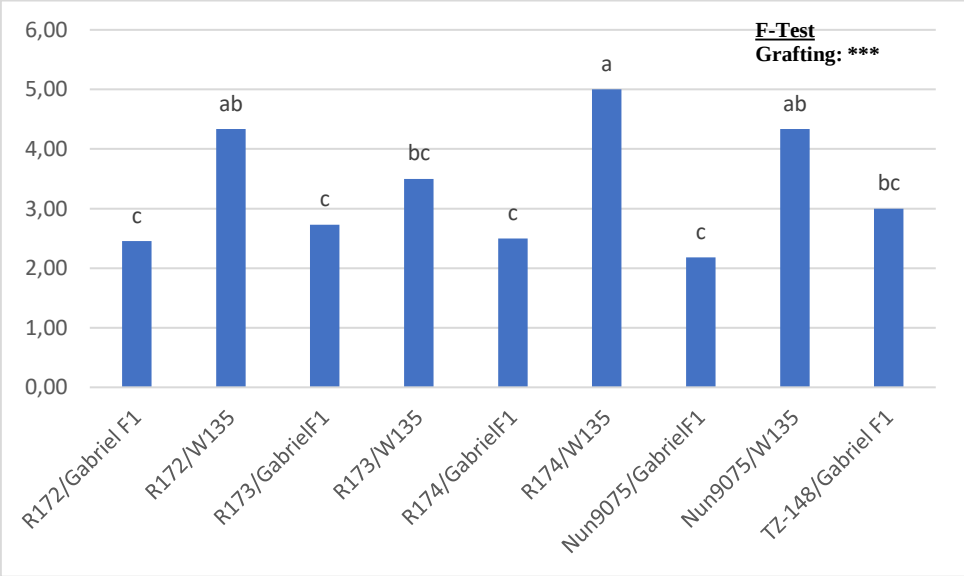
After grafting the plants were kept at 28-30 C^0 and with more than 95% relative humidity for three days of healing, and then the relative humidity was gradually lowered and light intensity increased. Foliar spraying of grafted plants with water was effective in helping them survive when wilting was observed. The grafted and non-grafted seedlings were transplanted at the end of May in open field conditions. Plants were spaced at 2 m between plants and 2 m between rows, with a density of 2500 plants/ha as indicated. Non-grafted plants were used as control in experiment. However non-grafted plants died due to soil-borne diseases and measurements of these plants could not be made.

The experiment was ended at end of the August. The experiments were arranged as a randomized complete block design with three replications of nine plants for each treatment. Ripe fruits were harvested in August, when ripe. Harvest was determined by a dead tendril at the point where the fruit attached to the vine, along with a yellow ground spot. nine fruits from each replicate were randomly chosen to determine the yield per plant, number of fruit per plant, soluble solids content (Brix), fruit length, fruit diameter and thickness of rind. Statistical analysis: Analysis of variance (ANOVA) was performed using the SAS program Mean separations were performed when appropriate using the least significance difference at $P \leq 0.05$.

RESULTS AND DISCUSSION

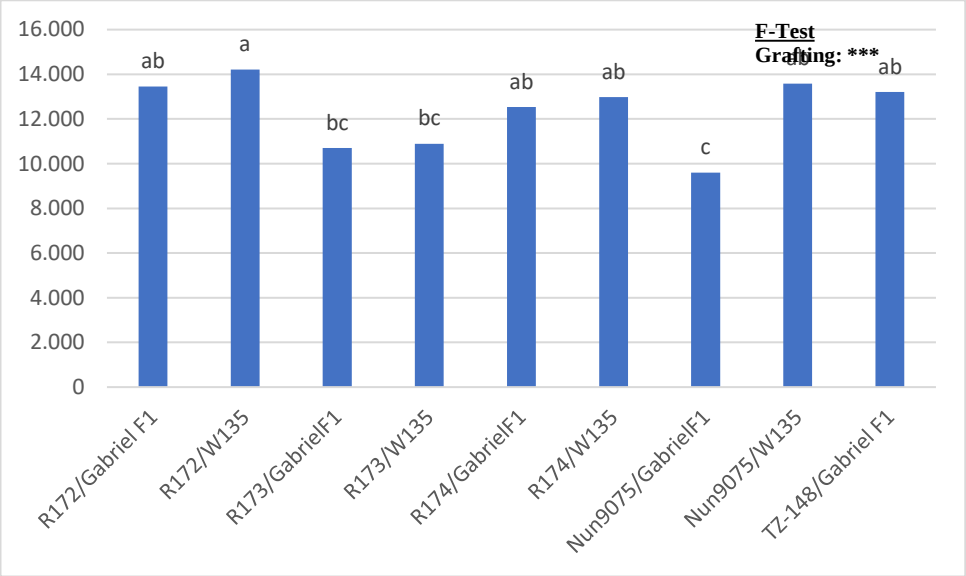
In the present research the rootstock genotypes significantly influenced the increase of the number of fruit per plant (Fig. 1). Avarega fruit number per plant of R174/W135 was significantly higher than other grafted plants. The lowest fruit number was obtained in Nun 9075/GabrielF1 grafting combination. Pumpkin rootstock is associated with very strong growth vigor, which can promote rapid canopy growth and the rapid growth of lateral stems, and thereby increase the number of fruits on each plant and the total yield (Fallik et all., 2014; Kumar et all., 2019). The obtained data agreed with those obtained by Salam et al. (2002) found that, grafting also produced higher number of fruits per plant. Yield was increased by grafting in watermelon (Ruiz and Romero, 1999 and Yetisir and Sari, 2003).

Figure 1. Number of fruit per plant



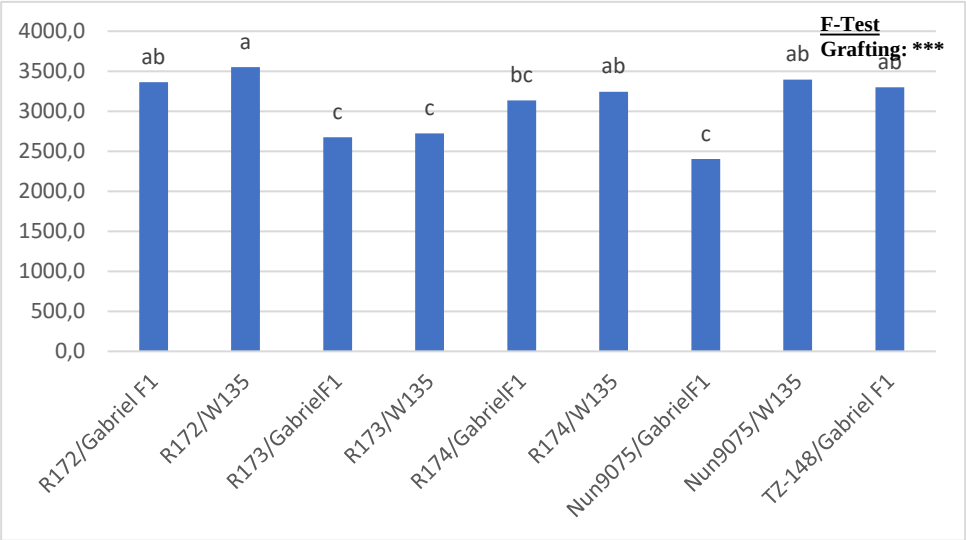
The yield per plant was the highest per plant in R172/W135, Nun 9075/Gabriel F1, R172/Gabriel F1 and TZ 145/Gabriel F1 grafting combinations, respectively. the lowest yield per plant was measured in the Nun9075/Gabriel F1 grafting combination. Similar to our results, average fruit weight of watermelon is strongly influenced by grafting, and it is an important component of yield (Fig. 2) (Ramírez et al., 2009). These increases can be explained by an interaction of some or all of the following phenomena: increased water and plant nutrient absorption (Kato and Lou, 1989), augmented endogenous hormone production (Zijlstra et al., 1994), and enhanced scion vigor (Leoni et al., 1990), resistance to soil pathogens (Lee, 1994 and Edelstein et al., 1999).

Figure 2. Yield per plant (kg)



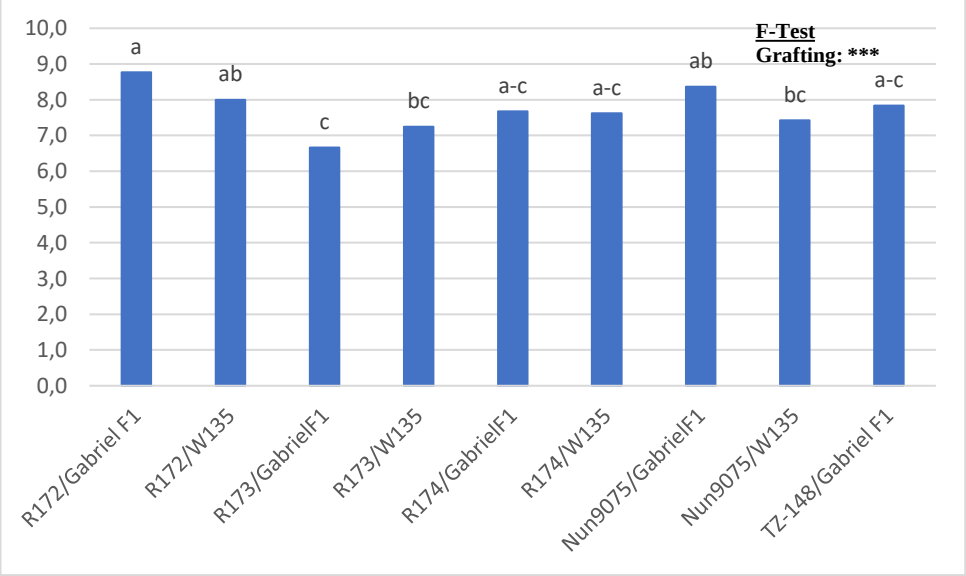
Significant difference in total yield per decare was recorded among grafting combinations. The highest yield (3552.9 kg de^{-1}) was obtained at R172/W135 grafting combonation while the least value (2401.6 t de^{-1}) was obtained at Nun9075/Gabriel F1 grafting combonation(Fig. 3). There are several reports of increased productivity by grafting watermelon. Yield increases of 3.5 (Salam et al., 2002) and two to 3.5 times have been obtained depending on the rootstock used. These increases are the result of control of Fusarium oxysporum sp. niveum and the increase in the number and weight of fruits, even with reduction to half the plant density of nongrafted plants (Yilmaz et al., 2007).

Figure 3. Total yield per decare(kg)



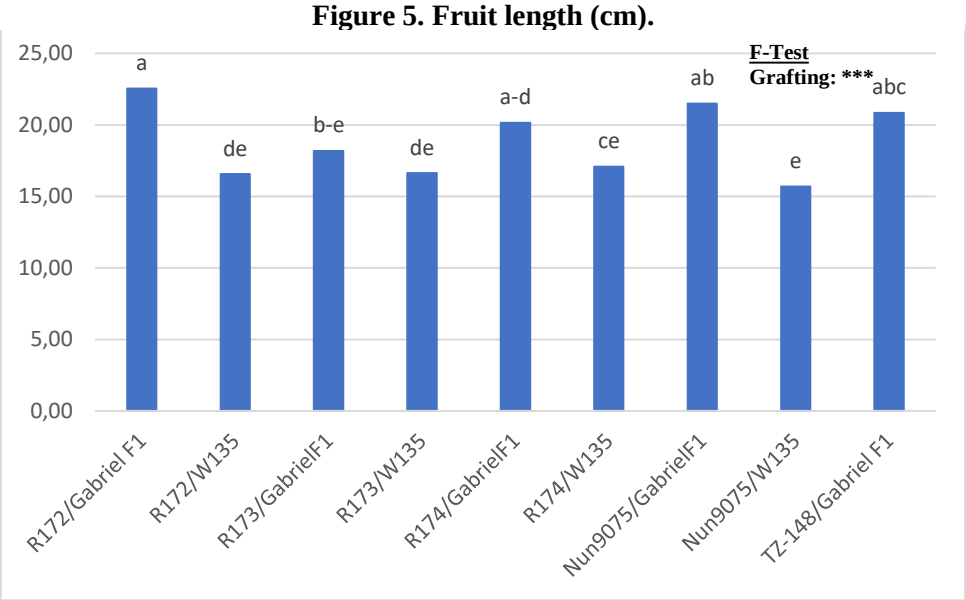
The analysis of my data showed that different grafting combinations had a significant effect on SSC(%) of watermelon juice. SSC(%) of samples (R173/Gabriel F1 to R172/Gabriel F1) ranged from 6.70 to 8.80 (Fig. 4). Similar to our results, during the 2 years, the content of soluble solids was unaffected by grafting or fumigation (Ramírez et al., 2009). These results were similar to those observed by Colla et al. (2008), Miguel et al. (2004), Roberts et al. (2007), and Schultheis et al. (2008) in watermelon and by Crino et al. (2007) in melon. In this respect, several investigators showed similar results e.g., Salam et al. (2002), Yetısır et al. (2003) Yetisir and Sari (2003) and Alan et al. (2007) in watermelon. Miguel et al. (2004) found no difference in SSC(%) of watermelon fruit from scions grafted onto Cucurbita interspecific hybrid versus than in self-rooted watermelons control.

Figure 4. Soluble solids content (Brix)



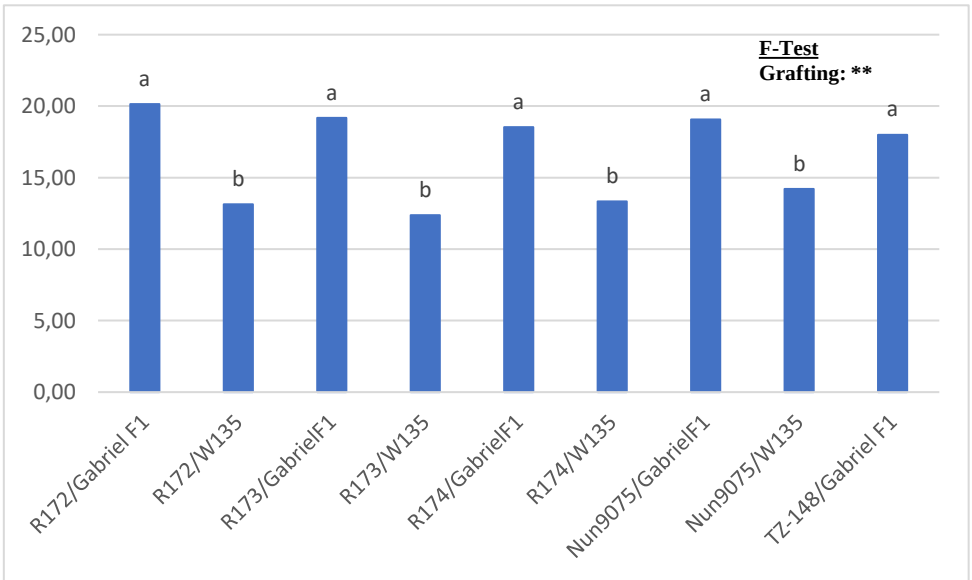
Different grafting combinations of showed a significant effect on watermelon fruit length (Fig. 5). Fruit length was relatively more with R172/Gabriel F1 (22.54 cm) followed by Nun9075/Gabriel F1 (21.49 cm) and lowest in Nun9075/W135 (15.70 cm). Grafting increased fruit size, and this causes higher yields than in the control. These results agree with that of Miguel et al. (2004), who mentioned that grafting watermelon on Shintoza rootstock increased both fruit set and fruit size compared to the non-grafted plants. Bletsos, (2005) recorded that, grafting due to positively affected on fruit yield and quality, fruit size in early production. In Egypt Kapiel et al. (2005) who observed that the fruit size of watermelons grafted to rootstocks having vigorous root systems is often significantly increased compared to fruit from intact plants.

Figure 5. Fruit length (cm).



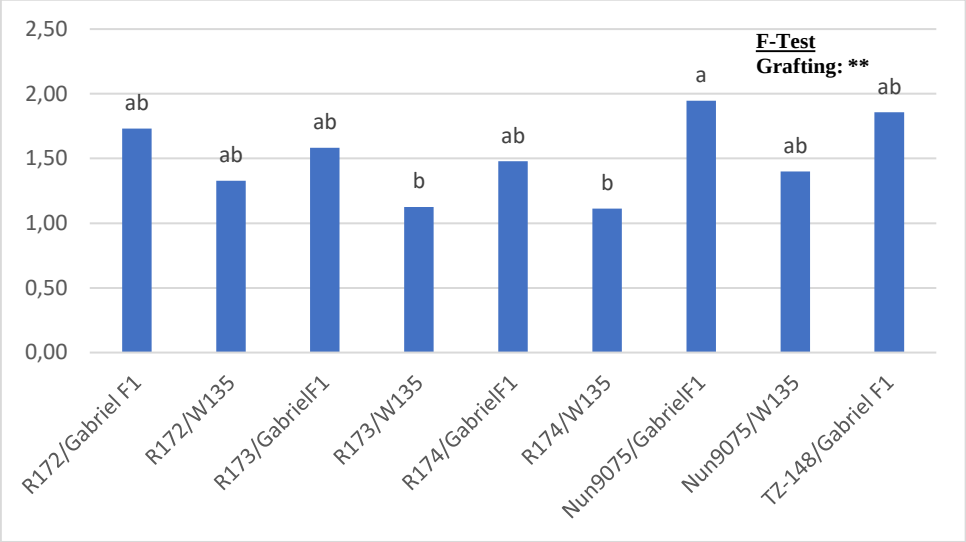
Different grafting combinations of showed a significant effect on watermelon fruit diameter (Table 2). Fruit diameter was relatively more with R172/Gabriel F1 (20.15 cm) followed by R173/Gabriel F1 (19.17 cm) and lowest in R173/W135 (12.38 cm) (Fig. 6). These results agree with that of El-Eslamboly (2010), who mentioned that grafted watermelon on gourd rootstock produced larger fruits as shown from fruit size, length and diameter in both seasons without any significant effect on fruit shape.

Figure 6. Fruit diameter (cm)



Fruit rind thickness in the grafting combinations tested in this experiment ranged from 1.11 to 1.95 mm. The highest rind thickness was measured in the Nun9075/Gabriel F1 grafting combination, while the lowest was measured in the R174/W135 grafting combination. Fruit rind thickness and average fruit weight were increased in all grafted plants (Fig. 7). The increase in rind thickness and average fruit weight were higher by 15 and 18% in 'Crimson Tide'/'Dynamo', 8 and 22% in 'Dumara'/'RS-841', 22 and 21% in 'Farao'/'Shintosa' combination, respectively (Turhan et al., 2012).

Figure 7. Fruit rind thickness(cm).



CONCLUSION

According to the results, R172/W135, R174/W135 and R172/Gabriel F1 grafting combinations had a positive effect on yield and quality compared to other grafting combinations. As in our land, the use of grafted plants may be preferred in areas where nun-grafted watermelon production is limited due to soil-borne diseases. In addition, use of rootstocks (use of grafting plant) is also economically feasible to the producer and can be considered as an alternative way in production to increase the net revenue.

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MARKETING CHANNELS OF ORGANIC AGRICULTURAL PRODUCTS IN TURKEY

Y. E. Erturk, A. N. Sahin

Igdır University, Igdır, Turkey.

Abstract

Organic agricultural production in Turkey, to meet the demand for organic products from Europe began in the mid-1980s. The first exports of organic agricultural products from Izmir in 1985. The types of organic products subject to export have continuously increased in terms of both variety and quantity over the years. As a result of the formation of local demand since the late 1990s, in order to meet the domestic demand, boutique shops selling only organic products were established in big cities, in some districts with a high foreign population. Subsequently, while producers in ecological markets established in big cities started to market their products directly to consumers, supermarkets and hypermarkets started to sell organic products in separate sections. In addition, large amounts of organic products are processed in the food industry. These products are exported or offered to the domestic market. In addition, exporting companies put up for sale their own products, products that have been obtained from other companies in Turkey, their imported agricultural and non-agricultural products (aromatic oils, personal care products, etc.) in their own organic product stores. Today, organic products are marketed as direct sales through ecological neighborhood markets and open-air shops, stores selling natural products (specialized stores), in separate departments in special outlets, supermarkets and hypermarkets, and as home delivery via e-commerce. In this study, there have been examined organic products marketing channels in Turkey and evaluation.

Keywords: Organic Products Marketing, Distribution channels, Organic product

1. INTRODUCTION

The process containing the phases that it undergoes between the producer and the consumer in which the ownership of products shift hands, in other words, the ways and processes through which the products flow beginning from production and in which they go through various processes such as processing, storing, parceling, and changing hands is named as a whole marketing channels (Erturk, etc., 2015; Demiryürek, 2016). The distribution channels are important since they enable the product to be at the right time and at the right place. The producers that do business in agricultural sector are businesses that usually possess small and limited marketing capability (Albayrak, 2013). The marketing channels, by becoming a part of the activity, play a role in increasing the effectiveness and make it easy to reach the places outside the local sales places (Eti, 2014). Marketing channels change depending upon product, organization level and competition and trading policies of the country. Producers, brokers, middlemen, merchant brokers, transfer merchants, private firms, institutions in the quality of government, exchange markets, wholesale markets, wholesalers, retailers, cooperatives and production unions operate in the agricultural product markets (Albayrak, 2013). Various marketing systems exist in in agriculture product trade in the world. Marketing of products occur through channels that are direct or that include various brokers (Albayrak, 2009).

Direct marketing in agricultural products is to sell the products to the consumers without brokers, middlemen and wholesalers. Direct marketing is a marketing tool that helps a society's social and economic development and that encourage the connections and relations between the producers and the consumers. In direct marketing systems, the producer takes place as a seller in the market in person. In this system, the producer market directly his or her product to the consumer with such methods as producers' markets, street market, organic product market, selling with own vehicle in the street, on the sides of roads/gardens/fields, electronic trade and open wholesale product sales centers (Albayrak, 2009). In addition, in his or her garden the producer can directly sell the products he /she produces to the industrialist, exporter or retailer as specified in the laws (Canik ve Alparslan, 2010). There are several factors in agricultural products that make direct marketing attractive for consumers. These are to communicate directly with the producer that grow the

crops, desire for buying fresh and high quality good and the desire to support the local producer. In addition to this, the consumers, while getting knowledge about crop growing methods, usage instructions and how to evaluate it, find an opportunity to taste the product. Direct marketing in agricultural products is especially suitable for small and middle scale farmers who do not grow crops in high quantity (Eroğlu Pektaş, 2019).

Direct marketing types; Producers' markets, street markets, organic product markets, selling with own vehicle in the street, seasonal road/garden/field side counters or farm shops, outdoor wholesale product sales centers, organizations in which consumers collect the products themselves (you collect), society supported agricultural initiatives, urban purchase clubs, agricultural tourism initiatives, operations in which they catch the fisheries themselves (you catch), gift basket and sales through post, e-commerce and direct sales to restaurants are the choices that fall into this category (Eroğlu Pektaş, 2019).

The distribution channel structure in which various equity houses or institutions-organizations take place is named as **'marketing channels through brokers'**. Brokers with different qualities, contract based agriculture, producer unions, exporter unions, cooperatives, wholesale markets, exchange markets, street markets, organic product markets, outdoor wholesale centers (Yurdakul ve Koç, 1997; Emeksiz ve ark., 2005) and big retailers take place in this system(Yurdakul, 2007; Albayrak, 2013; Eti, 2014).

Distribution channels are a highly important marketing tool for organic products. Because organic agriculture crops are not much long lasting and consumers prefer to consume these products fresh. Choosing the suitable distribution channels in transferring the organic products to the markets will effect directly to the achievement of marketing activities about these products. The product should be delivered fast after harvesting or should be transferred from producer to consumer with the shortest distribution channel. Organic products are not sold together with other products. The sales of organic products that bear an organic product tag is done either in shops that sell organic products or in a separate place in the shop or should be provided directly from the place where production takes place. Organic agricultural products especially such products as organic milk, yoghurt, fruit, vegetables that that go bad fast should be sent directly to the consumer or to the retailer in a single level distribution plan. With this quality of theirs, organic products take place among the products that can be sold directly (Vural ve Turhan, 2013; Demiryürek, 2016).

The increase in demand which emerged with the increase of the consumer awareness about organic products brought about the search for different distribution channels. Organic product stores are gradually increasing in areas close to settlements of consumer groups with high education and income levels. Organic product stores offer these products under the brand and packaging of the company for sale in charcuterie type stores where only natural and organic products are sold in big cities. Although organic products reach their final sales point in different ways, the marketing models of these products are also different from each other. The most known and common of these models is the producer-wholesaler-retailer-consumer chain. Private retail stores, super/hypermarkets (e.g.: Tesco, Migros, Carrefour, Real, Metro), local public markets, sales transactions carried out directly in the garden of the producer represent the distribution channels in this sector (Kurt, 2006; Eti, 2014). With the increase of information technologies, electronic commerce has also been added to these channels.

On the other hand, sales through brokers consist of organizations that make sales of organic products easy and provide time and place benefits to consumers. Using the experience and facilities of brokers during the marketing of organic products will contribute to the development of organic product market. The fact that the number of buyers and seller of organic products is not large enough causes the wholesale markets which have an important place in the sale of traditional agricultural products to have no important function in the sale of these products. Wholesale activities related to these products are carried out by more large companies. Exporter wholesalers, which are densely located in the Aegean region, play an important role in bringing these to both domestic and international markets.

In this study, there have been examined organic products marketing channels in Turkey and evaluation.

2. DEVELOPMENT OF ORGANIC PRODUCTS MARKETING IN TURKEY

Organic agricultural production in Turkey began in the mid-1980s to meet the demand for organic products from Europe (Merdan, 2018). In the first years, some companies of European origin established organic production projects in Turkey to grow the products they need with contracted farmers and to import the obtained products to their own countries through Turkish exporters (Demiryürek, 2011). In 1985, the first export of organic products from Turkey was carried out from İzmir with only three item products (dried apricots, raisins and dried figs) (Ataseven ve Güneş, 2008; Demir, 2013; Çınar ve Göktaş, 2019). The types of organic products subject to exports have increased continuosly both variety and quantity over the years.

In the first years, the indispensable principles of these organic production activities such as consultancy, inspection and certification were fulfilled entirely by foreign persons and organizations (Demiryürek, 2011; Aydın Eryılmaz, etc., 2015). In the early 1990s, a small number of Turkish experts were trained in these subjects and started to represent foreign companies in Turkey.

The majority of organic products are offered to foreign market and some of these products are consumed directly while some of them are included in the mixture of manufactured products (Hatunoğlu Durmaz, 2010). Produciton project and marketing of products in organic agriculture are carried out in 4 different ways (Hatunoğlu Durmaz, 2010; Öztürk ve İslam, 2014; Yüceboy, 2018; Çakır, 2019):

1. The production project is carried out by a Turkish company and these products are processed, packaged and delivered to the domestic or foreign consumer. There isn't a third company in this process.
2. The production project is carried out by a foreign organization from abroad. The products obtained according to the project are produced by the contracted Turkish manufacturer company according to the project's plan and these products are exported by the project owner firm, processor organization or export company.
3. The products which production project is carried out by a foreign organizations from abroad are produced and processed in the facilities established by the foreign company as a owner or partner in Turkey. It is exported to the project owner company by the processor or exporter company.
4. In a small number of applications, manufacturers certify their products by contacting the control and certification firm directly and offer their products for sale in the free market directly to the consumers.

Initially, the high prices of organic products, low income levels, lack of knowledge about organic products among consumers, lack of marketing practices, limited varieties of fresh organic vegetables in the market restricted the diversification and consumption of organic products in the domestic market.

Organic agricultural production, which started with a focus on the foreign market, has been brougth to the agenda for the domestic market since 2000s with the formation of local demand (Ayla ve Altınbaş, 2017). Until the 1990s, organic products were mostly sold on the farm where they were produced or in the neighborhood markets nearby. Since the late 1990s, in order to meet the domestic demand with the formation of local demand, specialized (boutique) stores that only sell organic products have been established in some districts where largely foreign population is high in large cities (Gök, 2008; Ayla ve Altınbaş, 2017). In these type of stores, natural and/or homemade products are also included to expand the product range and information about organic products is offered to the consumer as an additional service. In the ecological markets, which established in big cities, producers began to market their products directly to the consumer while in supermarkets and hypermarkets began to offer organic products for sale in separate sections. In addition, a large amount of organic products are processed in the food industry. These products are exported of offered to the domestic market. Also, exporter companies offer their own products, products obtained from other companies in Turkey, an imported agricultural and non-agricultural products (aromatic oils, personal care products etc.) for sale in their own organic product stores (Öztürk ve İslam, 2014). Today, organic products are marketed as direct sales through ecological neighborhood markets and open-air shops, stores selling natural products (specialized stores), in separate departments in special outlets, supermarkets and hypermarkets, and as home delivery via e-commerce. In addition, a large amount of organic products have recently started to be used in the food industry. These products processed in the food industry are exported or offered to the domestic market.

In 2005, the number of stores selling organic products reached about 300, alongside supermarkets and special corner in some outlets. In 2006, Turkey's largest organic product store was opened in İstanbul (Rehber, 2011).

Today, organic product are sold in special deparments in supermarkets and hypermarkets as well as in organic product stores (specialized stores) and in producer and district markets. In addition, producers offer their organic products for sale in production areas. However, the amount and variety offered for sale is limited due to the high prices of organic products. There is no major cooperative organization dealing with organic agriculture. There are a few small cooperatives only dealing with hazelnuts (Ataseven ve Güneş, 2008; Rehber, 2011).

There are 809 enterprises operating in organic agriculture in Turkey. Of these enterprises, 158 are only in production, 21 in marketing only, 11 in imports only and 14 in export activities only. The number of enterprises that carry out all production-marketing-import-export activities is 10. By carrying out all the production-marketing-import-export activities, there are 2 enterprises each in Antalya and Şanlıurfa, and one each in Zonguldak, Antakya, Fethiye, Iğdır, Didim and Bayburt (Öztürk ve İslam, 2014).

In recent years, organic products have started to be delivered to the consumer through organic product markets established with the contributions of non-governmental organizations and municipalities. For the first time in our country, %100 organic public market was opend in İstanbul and Antalya (Ataseven ve Güneş, 2008; Kılıç etc., 2014; Şahin, 2019). In 22 locations throughout in the country, organic product markets have been established. Today, 18 organic markets serve, two of which are seasonal (Akyol ve Bayraktar Öktem, 2017; Şahin, 2019). Seasonal organic markets serve only in summer. 3 out of 22 organic product markets have closed in the process (Table 1). These markets are organic product markets established in Zeytinburnu and Eyüp districts of İstanbul and in Mavişehir, İzmir. While the organic product markets in İstanbul were closed due to insufficient number of consumers, the organic product market in Mavişehir was closed due to the very high market area rent of the shopping centre in the second year (Buğday Derneği, 2017; Şahin, 2019).

Table 1 Organic product markets in Turkey

	Place of establishment	Year		Place of establishment	Year
1	İstanbul Şişli	2006	12	Ankara Çayyolu	2011
2	Bursa Nilüfer	2006	13	Konya Meram	2012
3	Ankara Çankaya	2008	14	Balıkesir Burhaniye	2013
4	Samsun Sürmeli Köy	2008	15	Kayseri/Talas	2013
5	İstanbul Kartal	2009	16	İzmir/Balçova	2013
6	İstanbul Beylikdüzü	2010	17	İstanbul/Küçükçekmece	2014
7	İstanbul Kadıköy	2010	18	Kayseri /Kocasinan	2014
8	İstanbul Zeytinburnu	2010	19	İzmit	2016
9	İstanbul Bakırköy	2010	20	Adana	2017
10	İzmir Bostanlı	2010	21	İzmir/Mavişehir	2017
11	Eskişehir Tepebaşı	2010	22	İstanbul/Eyüp	2018

Source: Şahin (2019)

Although it has a small share in sales areas and sales amounts in Turkey, there are also departments where are organic products are offered for sale in supermarkets and hypermarkets. These departments contain organic fresh fruits and vegetables, processed products and organic baby foods that are offered for sale periodically. Examples of these supermarket chains include Tansaş, Carrefour, Migros, Kipa etc. Organic products are also offered for sale on some sites as e-trade on the intertet. On these sites, information about organic products are given, advertised and easily supplied (Öztürk ve İslam, 2014).

In the service sector, there are restaurants that offer menus prepared from organic products. These restaurants serve alongside product sales either on their own or in stores established by private entrepreneurs. These stores both provide information on how to consume organic products and allow consumers to test organic products before purchasing (Marangoz, 2008).

3. DISTRIBUTION CHANNEL MEMBERS IN ORGANIC PRODUCTS

Distribution channel members of organic products:

1. Farmers Association and Cooperatives

The marketing cooperatives that farmers will establish are mainly organizations that sell the products they buy from producers not directly to the end consumer, but to the brokers such as wholesalers, retailers, specialized stores, greengroceries. Thus, the products of the farmer producing organic products are evaluated in the best way and reach the end consumer by going through the most appropriate distribution channel (Marangoz, 2008; Rehber, 2011; Vural ve Turhan, 2013).

2. Wholesalers

Wholesaling refers to the activities of persons or companies that sell goods directly retailers and/or other wholesalers or users but sell insignificant amount to end consumers. Wholesale markets which have an important role in distribution of traditional agricultural products, don't exist for organic products. The reason is that there is small number buyers and sellers/producers. In the marketing and distribution of organic products, mostly big companies carry out wholesale activities. These companies mostly work in foreign markets and market the products they buy from the producer in the country abroad. In our country, companies that buy organic products from producers and market them in foreign markets are generally concentrated in the Aegean region and especially in İzmir (Marangoz, 2008; Vural ve Turhan, 2013).

3. Chain (Supermarkets and Hypermarkets) Stores

The market closest to the consumer is the retail market. The largest group of broker is also in this market. Butchers, grocery stores, greengroceries, supermarkets and hypermarkets are the most important retialers. They often work with a wholesaler because they sell a small amount of products. Some buy products form the producers to reduce the cost of the broker. Retailers have started to include organic products among their product groups since the 1990s and the number and sales of organic products are increasing rapidly within the general product groups. In our country, organic products are sold in local and regional supermarkets as well as large and chain stores like Migros, Tesko-Kipa, CarrefourSA, Real and Metro. Large food stores have an advantage because organic products must be sold packaged and labeled (Marangoz, 2008; Vural ve Turhan, 2013).

4. Producer's Direct Sales

Organic products by their feature are products that can be sold by direct sales method. In the direct marketing method, the products are delivered directly (without broker) to the consumer from the producer. Direct marketing methods such as direct distribution from the farm (farm stores), roadside sales, sales in organic producers' markets are often seen in our country. Apart from that direct marketing takes place in the form of sales from the within the business, e-commerce, home delivery, restaurants etc. Some farmers sell their products without processing them while other prefer to sell them partly by processing (Marangoz, 2008; Eroğlu Pektaş, 2019; Vural ve Turhan, 2013).

5. Ecological (Organic) Markets

Open markets selling organic products are usually public markets where organic products are sold and where producers and consumers can come face-to-face. In our country, especially in big cities, %100 ecological public markets are a good example for this. Fresh products sold without packaging are collected from the garden of the producer the day before the market opens and are sold in bulk to save consumers from the cost of packaging. These products accepted into market with invoices, dispatch notes, producer's certificate or producer receipt. Moreover, the products are weighed both in and out of the market. In this way, both the submitted amounts are checked and the amounts sold by the producer that week are reported to the relevant certification body. The certificate of each product sold is displayed on the counters and consumers are ensured to know where the product is produce and the certification body (Marangoz, 2008; Akgün, 2011; Vural ve Turhan, 2013).

6. Organic Product Stores (Specialized Stores)

In the charcuterie type stores where only natural and organic products are sold in big cities, the company can offer these products for sale with its own brand and packaging. There are also various stores selling only organic products in large housing residential areas. In our country, there are stores where only organic products are sold in big cities such as İstanbul, Ankara, Bursa and İzmir. The number of these stores are increasing day by day. Since consumers who buy and consume organic

products are mostly high in education and income levels, distribution channales that can reach this segment should be used (Marangoz, 2008; Vural ve Turhan, 2013).

7. Public Institutions

As in other areas, one of the biggest buyers of organic products may be public institutions. This is important in terms of both reaching and promotion of organic products to wider audiences and their adoption. On the other hand, the producer are also encouraged since the products are sold. The state may buy organic products espacially for hospitals, kindergartens, orphanages and nursing homes (Marangoz, 2008; Vural ve Turhan, 2013).

8. Other Sales Places

Organic products can also be sold in sales places such as pharmacies, gas stations and greengroceries. In addition, restaurants and hotels that use organic products on their menus are both customers of organic products and brokers who market them after they process (Marangoz, 2008).

4.ORGANIC PRODUCTS MARKETING CHANNELS IN TURKEY

In Figure 1, the main actors that play a role in the marketing channels of organic products and their relationships are shown. Producers of organic products give their certificated products to the marketing channels either directly or through an broker. In a limited amount of product, farmers association and cooperatives are brokers. Organic product markets, outdoor markets, roadside sales, farm stores, e-trade, sales to restaurants and hotels, home delivery sales and direct sales channels to retailers are used as direct sales channels. Certification bodies in the channel either export products through exporters or supply products to the food industry or sell them to retailers. Exporters either operates the products they supply from the producer, certification bodies and exporter associations to the food industry or export them directly and give some of them to retailers. Producers association also offer the products they supply directly from the producer to other marketing channels. Supermarkets, organic product stores, hypermarkets, greengroceries and pharmacies make up the retailers in the marketing channel.

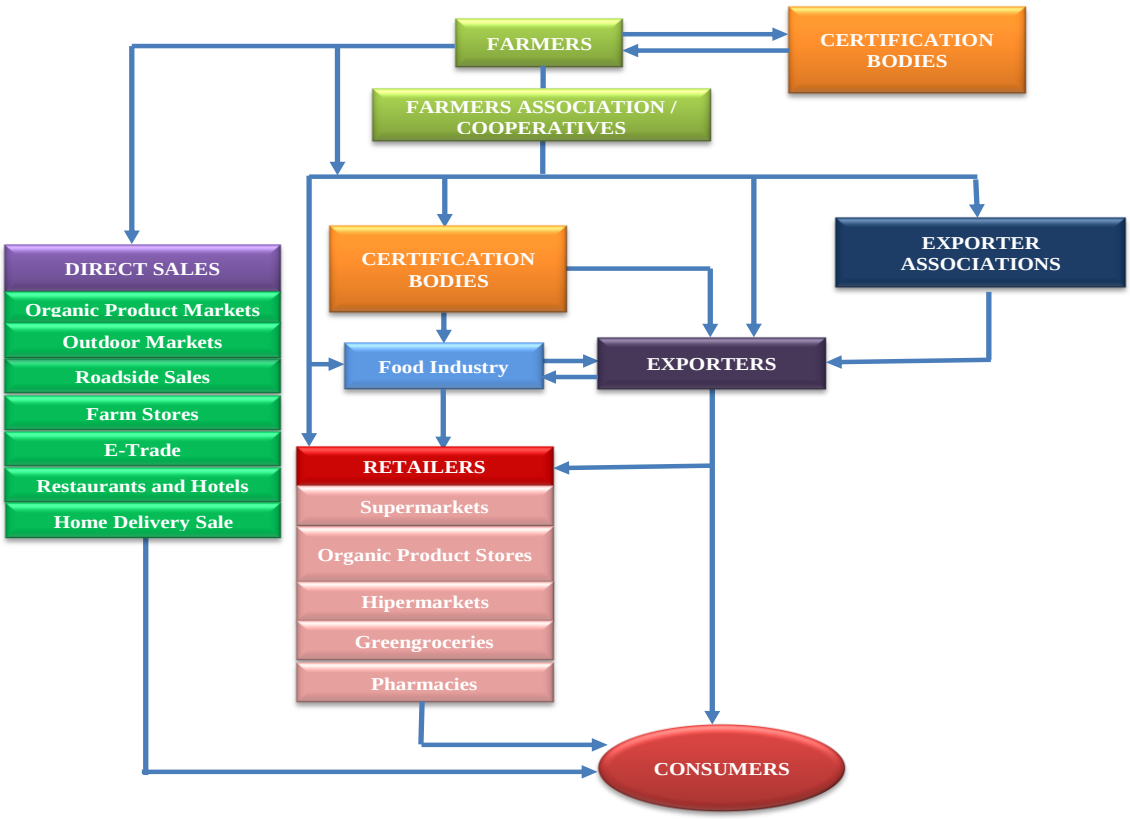

Figure 1 Organic Products Marketing Channels in Turkey

5.CONCLUSION AND SUGGESTIONS

Despite the growing demand of some consumers about organic products and health concerns in recent years, the organic product market in Turkey is still very small and the marketing channels in the domestic market are still in the formation phase. Currently, the vast majority of production is made for the foreign market. The increase in the number of products and producer gives hope for the future. The unique qualities of organic production and products are the biggest constraint of the formation process of the marketing channels. Overcoming this constraint can only be overcome by the high demand of a widespread consumer awareness. The demand to consume healthy products spreading from big cities will allow organic agriculture to grow in domestic market as well as exports. Within the existing marketing channels, the growth potential of direct sales channel with e-commerce applications must be definitely considered.

In order to increase the consumption of organic products, producer, public, private sector and consumer should implement growth-directional policies in cooperation with all stakeholders, without compromising product quality and the quality of sales environment.

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EFFECTS OF DIFFERENT DOSES OF BIOCHAR AND COMPOST APPLICATION ON THE GRAIN YIELD AND GROWTH PARAMETERS OF THE MAIZE CROP

Ayşe ÇETİN[1*], Hamza NEGİŞ[1], Cevdet ŞEKER[1], Osman MÜCEVHER[2]

[1]*Department of Soil Science and Plant Nutrition, University of Selcuk, Konya, Turkey*

[2]*Soil, Water and Deserting Control Research Institute, Konya, Turkey*

*Corresponding author: zmcetinayse@gmail.com

Abstract

Contrary to increasing population in the world, decrease in production areas leads to the problems of hunger and nutrition, which are the main problems of humanity. Together with the efficient and sustainable use of soils, while providing the improvement of problematic soils on the one hand, productivity and quality increases will be provided on the other hand. Besides the increase of organic matter content of soils together with the improvement in soil properties, increases in productivity and quality in crop production are also provided. Different wastes such as farm manure, composted wastes, post-harvest plant residues and biochar can be used for increasing soil organic matter. For this reason, this study was carried out to determine the effects of compost and biochar obtained from the same plant material on the properties of a calcareous and alkaline yield components of the corn plant. The application of 0, 2 and 4 tons da^{-1} of biochar and compost were investigated in this study, which was carried out in line with a randomized block design with three replications in the 14 m^2 sized parcels under field conditions, and the effects of the treatments on plant height, stem diameter, leaf chlorophyll content and grain yield were determined. When the yield values are examined in the highest doses of compost and biochar relative to the control, it was found that yield values increased by 284.2% and 147.4%, respectively and also the effects of the applications on the other measured plant parameters were statistically significant ($p < 0.05$).

Keywords: Organic matter, compost, biochar, corn yield, efficient elements.

1. INTRODUCTION

Agricultural production, which is one of the ubiquitous fundamental of the economy, has an important potential in our country. Agricultural production has an important place in human and animal nutrition, and industries. Soil and seeds form the basis of agricultural production. A fertile soil is an integral whole for sustainable agricultural activity. The physical and chemical properties of the soil must be improved for the plant to develop a healthy crop stands in the soil by the application of agricultural practices. Unsuitable intensive agricultural activities and the use of soils

beyond their capacity endanger the sustainable use of soils, leading to physical degradation in such soils.

The most widely used method to improve the soil physical properties and ensure their sustainability is the addition of organic matter to soils (Bender et al., 1998). It is possible to increase the organic matter content of agricultural soils by applying various organic materials. In addition to improving the physical properties of the soil, organic residues bring nutrients such as N, P, K, Ca, Mg, Cu, and Zn to the soil (Çıtak et al., 2006). Residues from threshed harvest can be applied to the soil again as a result of organic matter sources without causing environmental pollution. The disposal of such organic wastes poses a major financial problem, while their direct application to the soil is inconvenient due to insufficient plant nutrients (Sanchez-Monedero et al., 2019). In recent years, it is very popular to use organic residues by recycling them into soil properties, such as compost and biochar, being transformed into materials that promote plant growth (Atkinson et al., 2010; Vaccari ve ark., 2011). The effects of biochar and compost applications on the improvement of soil quality, carbon sequestration and reduction of greenhouse gases are very important (Agegnehu et al., 2017).

Therefore, in this study, the pruning residues of the spruce tree were transformed into biochar and compost and applied to the soil. Maize (Zea mays L.), which is widely used in human and animal nutrition in many parts of the world was used as a test crop for this study. The effects of different doses of biochar and compost materials on the yield and yield components of the corn plant were determined.

2. MATERIAL AND METHODS

2.1 Experimental Soil

This study was conducted in Karapinar Soil, Water and Combating Desertification Research Institute (37.72 N latitude and 33.55 E longitudes), Konya. The general properties of the soil used in the experiment are given in table 1. The texture class of the trial soil belongs to the sandy clay loam soil according to the USDA soil texture classification, the lime content is very high and has an alkaline properties.

Table 1: General soil properties

Soil properties	Values	References
Sand (%)	60.48	Gee and Bauder (1986)
Silt (%)	13.33	
Clay (%)	26.19	
Texture class	Sandy clay loam	
Organic Matter (%)	1.51	Smith and Weldon (1941)
pH (1:1)	8.59	Kacar (2009)
Lime (%)	72.00	(McLean, 1983)

2.2 Experimental Materials

Spruce tree pruning residues were used in the production of biochar and compost. For compost production, the pruning residues were divided into small pieces and the composting process was made by mixing them with farm manure. Composting process was carried out using the humidity ratio 70% and C / N ratio was 25: 1. Biochar was obtained by charring pruning residues with 550 C ° through slow pyrolysis method. Prior to applying compost and biochar, they were sieved at a 4 mm sieve, then parcels with 3x5 m were designed and also experimental design is given in Table 2.

Table 2: Experimental design

1st Block	**2nd Block**	**3rd Block**
Control	Control	Control
2%- Biochar	2%- Biochar	2%- Biochar
2%- Compost	2%- Compost	2%- Compost
4%- Biochar	4%- Biochar	4%- Biochar
4%- Compost	4%- Compost	4%- Compost

The field experiment involving compost and biochar application was established in May and Pioneer 573-grain corn variety was planted. Plant height, stem diameter and spad measurements were determined during the developmental period (Figure 1). Plant height was measured from the base of the shoot to the tip of the highest leaf using a meter. Plant stem diameter was measured with the help of a caliper. Leaf spad value was measured with a portable spad meter (SPAD-502, Konica-Minolta, Japan). The grain yield was calculated by taking the average of the grains counted from 10 cobs after being dried.

Figure 1: Developmental period in which growth parameters were measured

Figure 2: Period when Spad measurements were measured

3. RESULT AND DISCUSSIONS

Based on the findings of this field study, it was seen that different doses of compost and biochar significantly affected the growth parameters of the maize. Compared with the control, a significant increase of 15 and 34% in plant height at 2 and 4% doses of applied compost was respectively observed (Figure 3). However, there was no statistically significant difference in biochar applications compared to the control (Figure 3). It is known that biochar obtained from plant wastes has less nutrient contents than that produced from animal wastes, but it has been suggested that biochar obtained from plant wastes has a long-term effects within the soil system (Singh et al., 2010; Aslam et al., 2014). The effects of biochar on plant growth was found to be less than that of compost (Manirakiza and Şeker, 2020). It was found that 2 and 4% doses of biochar and compost applications increased stem diameter compared to the control, and the maximum applied doses-4% of the both biochar and compost significantly increased stem diamter by 41% and 60%, respectively (Figure 4) and our results are in line with (Inal et al., 2015). Leaf spad value measured with a portable spad meter experienced a downward trend under biochar applications compared to the control. This is probably due to the sorption effects of biochar and also the resistance of biochar to microbial activities, thereby slowly releasing nutrients (Zimmerman, 2010). Spad value is a value that positively correlates with leaf chlorophyll content. The green hue in plants is directly related to the nitrogen content (Minotta ve Pinzauti, 1996). In compost applications, as the dose increases compared to the control, the spad value increased (Figure 5). Compost applications were the most effective on increasing corn grain yield. Based on to the statistical analysis, the highest grain yield was found in the following order: compost-4% > biochar-4% > compost- 2% > biochar-2% > control (Figure 6). It was seen that compost presented the highest effects over bichar due its high mineralization rate. However, due to the crystalline graphic layer of biochar, the residence time of biochar in the soil is 10-1000 times more than that of other organic materials (Atkinson et al., 2010). By considering the environmental benefits of biochar in sequestering carbon and reducing greenhouse gas emissions, it is highly recommended for sustainable agricultural production (Atkinson et al., 2010; Vaccari et al., 2011; Liang et al., 2014).

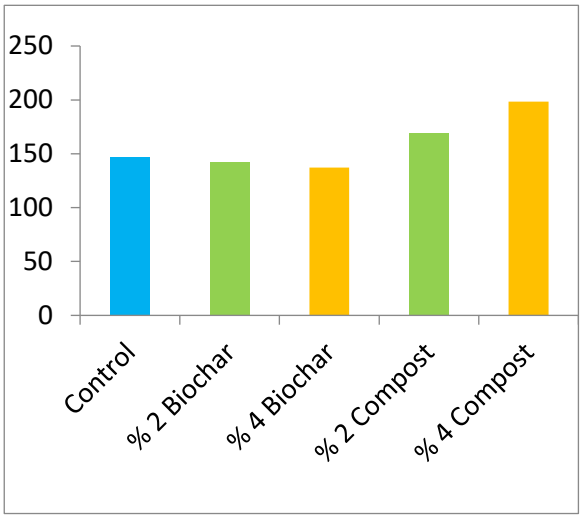

Figure 3. The effects of compost and biochar on plant height (cm).

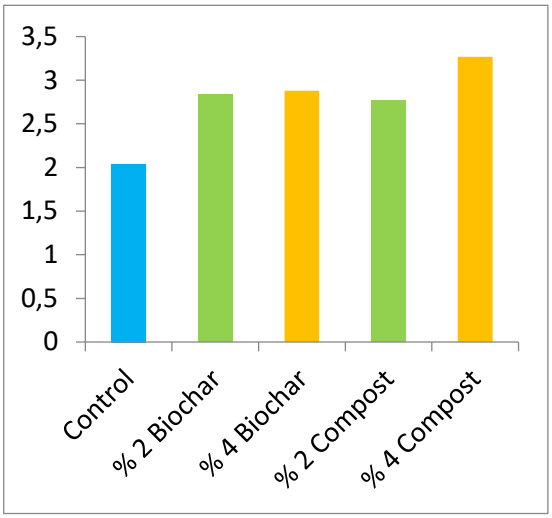

Figure 4. The effects of compost and biochar on stem diameter (mm).

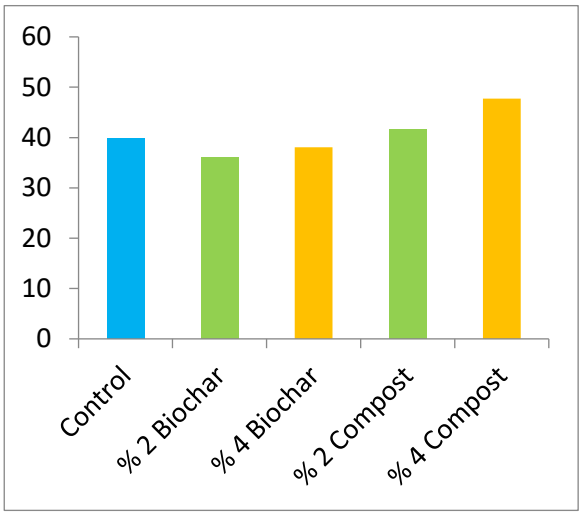

Figure 5. The effects of compost and biochar on the spad values(spad unit).

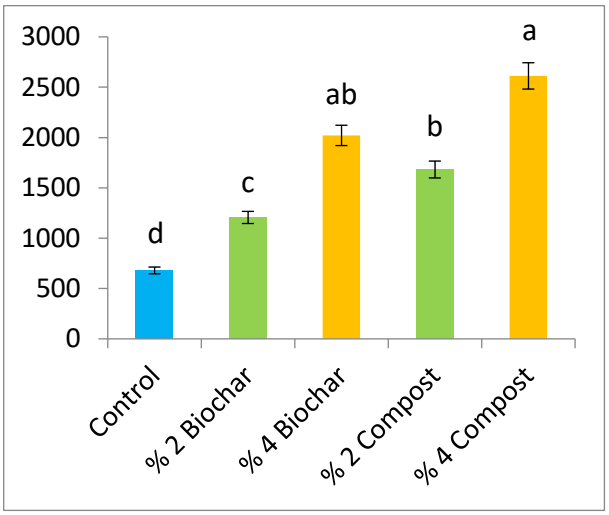

Figure 6. The effect of biochar and compost applications on the grain yield of corn plant(kg da^{-1})

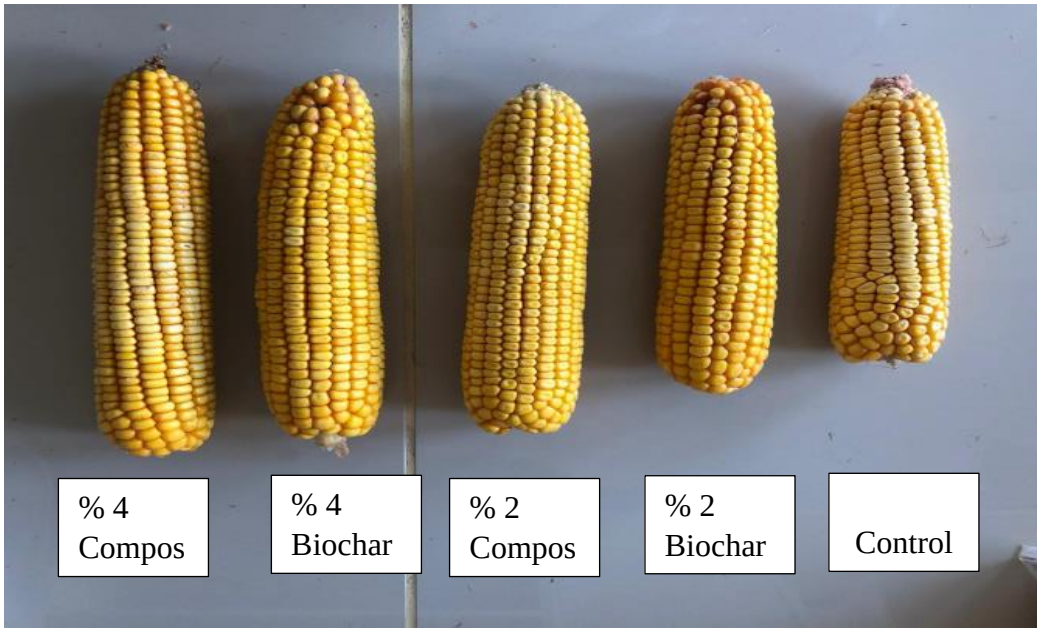

Figure 7. Increase in size of corn cobs versus increasing dose

4. CONCLUSIONS

As a result of the study, the compost and biochar applications showed significant effects on improving crop performance and yield. It was found that the highest applied doses of compost and biochar, respectively increased yield by 284.2% and 147.4%, and also the effects of the applications on other measured plant parameters were statistically significant ($p < 0.05$). Compost has significant effects on crop growth and yield over biochar in short-term as its mineralization rate is higher than that of biochar, however, the effects of biochar could be more than that of compost in the long term. Considering the fact that 1 year of experiment is not enough to contrast the effects of compost and biochar applications on crop performance and yield, long-term study involving compost and biochar application is recommended for conclusive results.

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CHANGES IN SOIL CARBON MINERALIZATION UNDER THE EFFECTS OF FUNGICIDE CYPRODINIL

B. Koçak

Department of Biology, Faculty of Arts and Sciences, Cukurova University, Adana, Turkey

*Corresponding author: bkocak@cu.edu.tr

Abstract

Soil organic carbon mineralization refers to the overall processes by which microorganisms mineralize soil organic C and release it in the form of CO_2. A short term experiment was carried out to ascertain the effects of different recommended doses (RD) of fungicide cyprodinil [0 (Control), 10.7 (RD), 21.4 (RD x2) and 42.9 mg/ kg soil (RD x4)] on soil carbon mineralization using an agricultural soil. Soil was sampled from Research Farm of Faculty of Agriculture in Cukurova University (Adana, Turkey) in June 2018. This soil had no history of cyprodinil usage. After the determination of some soil physical and chemical properties, soils were humidified at 80% of field capacity, mixed with doses of the fungicide tebuconazole and incubated for 42 days at 28°C. CO_2 respiration was measured during the following days of incubation: 1, 3, 6, 9, 12, 16, 23, 30, 37 and 42. Cumulative carbon mineralizations (mg $C(CO_2)$/ 100 g soil) were in the range between 68.56 (Control) and 79.20 (RD x4) while their rates were in between 3.78% (Control) and 4.37% (RD x4) at the end of incubation period. All doses of cyprodinil significantly increased carbon mineralization ($P<0.05$). Stimulations of microbial activity by doses of fungicide cyprodinil were 9.9% for RD, 10.5% for RD x2 and 15.5% for RD x4. It's suggested that microorganisms in this soil may positively mineralize both recommended field dose of fungicide cyprodinil and its higher doses.

Keywords: Fungicide, Aminopyrimidine, Cyprodinil, Soil microbial activity, Soil carbon mineralization

INTRODUCTION

Pesticides are the important chemical compounds that are being used in agricultural systems for protection of crops from pests including weeds, insects etc. Pesticides are usually applied for many times during one crop season and a part of these chemicals always enter to the soil. Many problems including the pollution of the environment have been created by the wide usage of pesticides (Arora and Sahni, 2016). The effects of pesticides on soil microorganisms are depend on physical, chemical and biochemical conditions, in addition to nature and concentration levels of the pesticides (Aurelia, 2009; Sethi et al., 2013). In many studies, it was shown that microorganisms are capable to grow and maintain their lives in the presence of several commercial pesticides. If a soil microorganism can use the pesticide as a carbon and energy source, then catabolism and detoxification metabolism may occur. Most pesticides work by poisoning pests (Arora and Sahni, 2016).In general, a systemic pesticide moves inside a plant following the absorption of plant. This movement is often upward (through xylem) and outward with most fungicides (Shinde et al., 2015)

Cyprodinil was first applied on cereals in France in 1993. This fungicide has been used on cereals, vegetables, fruits, field crops and ornamental plants as foliar application (Waechter et al., 2010). Products contain cyprodinil were marketed in most European countries, in North America and in Japan. Cyprodinil was also used in control of pathogen fungi like *Pseudocercosporella herpotrichoides*, *Erysiphe* spp., *Pyrenophora teres*, *Rhynchosporium secalis*, *Septoria nodorum*, *Botrytis* spp., *Alternaria* spp., *Venturia* spp., and *Monilinia* spp. (Waechter et al., 2010).

Formulations used in foliar applications were as WG (water dispersible molecules) or EC (emulsifiable concentrates) type.

Cyprodinil was identified as a inhibitor of methionine biosynthesis in liquid cultures of *Botrytis cinerea*. It was reported that pathway of cystathionine in filamentous fungi like *Neurospora grassa* and *Aspergillus nidulans* has been established as the the major route of homocysteine and methionine biosynthesis (Yamagata, 1989). In this pathway, cyprodinil targets the cystathionine β-lyase that synthesize cystathionine from homocysteine (Fritz et al., 1997; Masner et al., 1994). Secondary target of cyprodinil was the secretion system of plant cell wall degrading enzymes in pathogenic fungi. It is believed that these enzymes have an important role in the early periods of plant infection and penetration of plant tissues by fungi mycelium was inhibited in the absence of secretion of these enzymes (Milling & Richardson, 1995; Miura et al., 1994).

Soil microbial activities are critical in decomposition of processes (Cernohlavkova et al., 2009). However, intensive applications of chemicals used in agriculture negatively influence on these processes in many soils. Stability and productivity of soil ecosystems depend largely on soil microorganisms and their activity. For this reason, determination of side effects of pesticides on soil microbial communities is very critical for soil health. Carbon mineralization is an important parameter that adopted in international guidelines for ecological risk assessment and standard tests of pesticides and other chemicals (OECD, 2000). After pesticide applications, there were several studies that soil carbon mineralization was increased in field and laboratory experiments (Das & Mukherjee, 2000; Monkiedje et al., 2002). Carbon mineralization (Cmin) is an age-old reliable method for studying microbial activities in soil. Changes in carbon mineralization have also been used as criteria for pesticide toxicity (Torstensson & Stenström, 1986).

The objective of this study was to evaluate the effects of cyprodinil on soil C mineralization. Recommended field dose (as it was written its etiquette, RD) and its 2 (RD x2) and 4 (RD x4) folds of cyprodinil was mixed with an agricultural soil and CO_2 respirations were measured at 28°C for 42 days. It was hypothesized that fungicide cyprodinil would increase soil carbon mineralization.

MATERIALS AND METHODS

Soil Characterization

Soil samples that were not previously exposed to fungicide cyprodinil were collected from the top layer (0-10 cm) in Research Farm of Faculty of Agriculture in Cukurova University in Adana, Turkey (35°18′ E latitude, 37° 01′ N longitude, and 23 m above sea level) in June 2018. Immediately after collection, soil samples were taken to the laboratory in dark plastic bags, homogenized, air-dried at 25°C during 96 h, sieved to 2 mm to remove plant tissue and subjected to physicochemical characterization.

Soil texture was determined with a Bouyoucos hydrometer. Soil pH was measured in mud saturated with distilled water (1:2.5) using a WTW Inolab 720 pH meter. The $CaCO_3$ contents of the soils were estimated with a Scheibler calcimeter. The organic carbon and total nitrogen contents of the samples (%) were determined with the modified Walkley-Black and Kjeldahl methods, respectively (Kacar, 2009). The field capacity (FC) of soils (%) were determined with a vacuum pump with 1/3 atmospheric pressure (Kacar, 2009).

Incubation Experiment

Soil samples (100 g) were placed in 750 ml incubation vessels and mixed with and without fungicide cyprodinil (300 EC) at the recommended field dose and its 2 and 4 folds [0 (Control), 10.7 (RD), 21.4 (RD x2) and 42.9 mg/ kg soil (RD x4)]. The amount used in RD treatment was the recommended field rate for cyprodinil (300 g active ingredient/l) that was written its etiquette with the assumption that the soil weight was 1.4 x 106 g/da at the effective soil depth of 1 mm. Three replicates were used for each treatments and control. Empty vessels were used as blanks. The final moisture contents of both soils were adjusted to 80% of their own field capacity before incubation at 28°C for 42 days. Throughout the incubation period, deionized water was added to the soil to compensate for any water loss. CO_2 derived from microbial activities was absorbed in 10 ml 1 M NaOH solution in bechers, placed in the center of the soils in closed incubation vessels, and then

transferred to a dark incubator. The amount of CO_2 produced was measured by titration with hydrochloric acid in the following days of incubation: 1, 3, 6, 9, 12, 16, 23, 30, 37, 42 (Alef, 1995). Cumulative carbon mineralization (mg $C(CO_2)$/100 g soil) was calculated by summing up all CO_2 measured days until end of incubation period while its rate was calculated by dividing cumulative mineralized C by its soil organic C of control and all applications for 42 days.

Statistical Analysis

Tukey honestly significant difference (HSD) in analysis of variance (ANOVA) was performed to determine the differences between treatments in soil carbon mineralization (Kleinbaum, 1998). All of the tests were performed at the significance level of $P<0.05$. Statistical analysis was carried out using the SPSS v20**.**

RESULTS AND DISCUSSION

Some soil physical and chemical properties of soil sampled from Research Farm of Cukurova University were given in Table 1. Soil was classified as loam and slightly basic. Soil organic carbon and total nitrogen were 1.81 (%) and 0.163 (%), respectively (Table 1). Soil carbon/nitrogen ratio was 11.20 (Table 1).

Table 1. Some physical and chemical properties of soil

Soil Characteristics	
Sand (%)	41,90 ± 0,06
Silt (%)	32,90 ± 0,06
Clay (%)	25,20 ± 0,10
Texture	Loam
Field Capacity (%)	24,52 ± 0,06
pH	7,89 ± 0,03
$CaCO_3$ (%)	41,80 ± 0,84
C (%)	1,81 ± 0,01
N (%)	0,163 ± 0,008
C/N	11,20 ± 0,55

The effects of fungicides on microbial processes and soil microorganisms depend on many factors. Some of major factors include physical, chemical and biological properties (such as organic matter, pH, temperature and humidity) of soil and nature and dose of the fungicides applying and its time (Vyas, 1988; Chen et al., 2001).

Carbon mineralization is an important parameter for determining the side effects of pesticides (Sommerville, 1987; Alef, 1995). Soil carbon mineralizations (mg $C(CO_2)$/100 g soil) were in the range between 3.92 and 10.18 for control, between 4.58 and 10.18 for RD, between 3.66 and 10.99 for RD x2 and between 1.22 and 11.20 for RD x4 (Figs. 1-2). In general, all doses of cyprodinil increased carbon mineralization in whole experiment. Significant differences between control and RD were found on 6.day and 37.day ($P<0.05$) and this data were similar between control and RD x2 (Fig.1 and Fig.2). No significant differences were found between RD and RD x2 except on 42.day. Carbon mineralization under RD x4 dose were significantly higher than control in all measured days except on 12.day and 42.day ($P<0.05$, Figs 1-2).

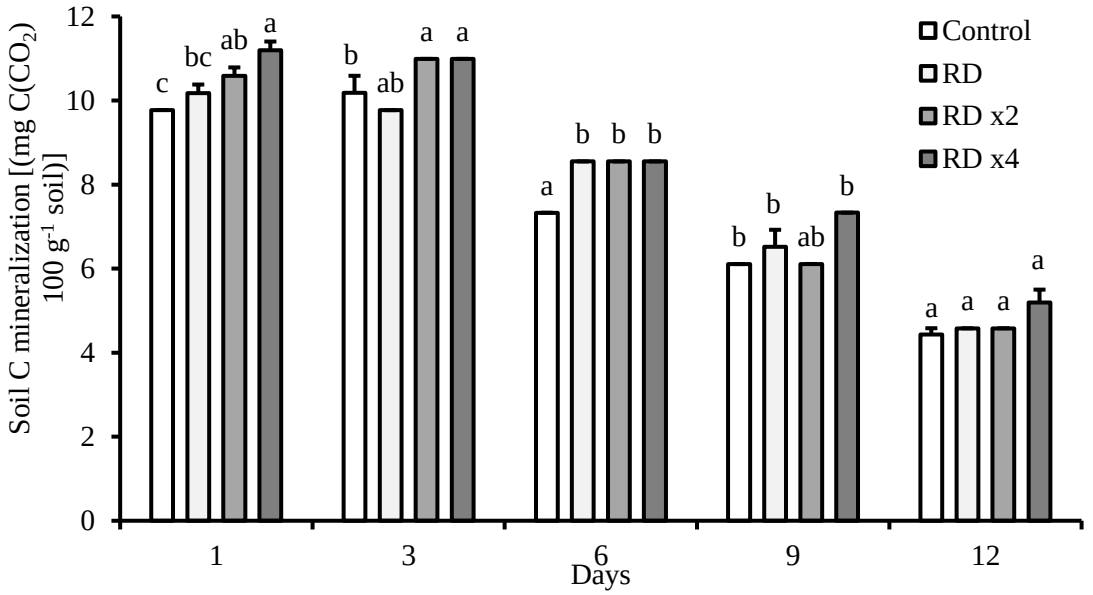

Figure 1. Soil carbon mineralizations between 1.day and 12.day at 28°C [mean± standard error, n=3, a, b and c indicate significant differences between means (P<0.05)]

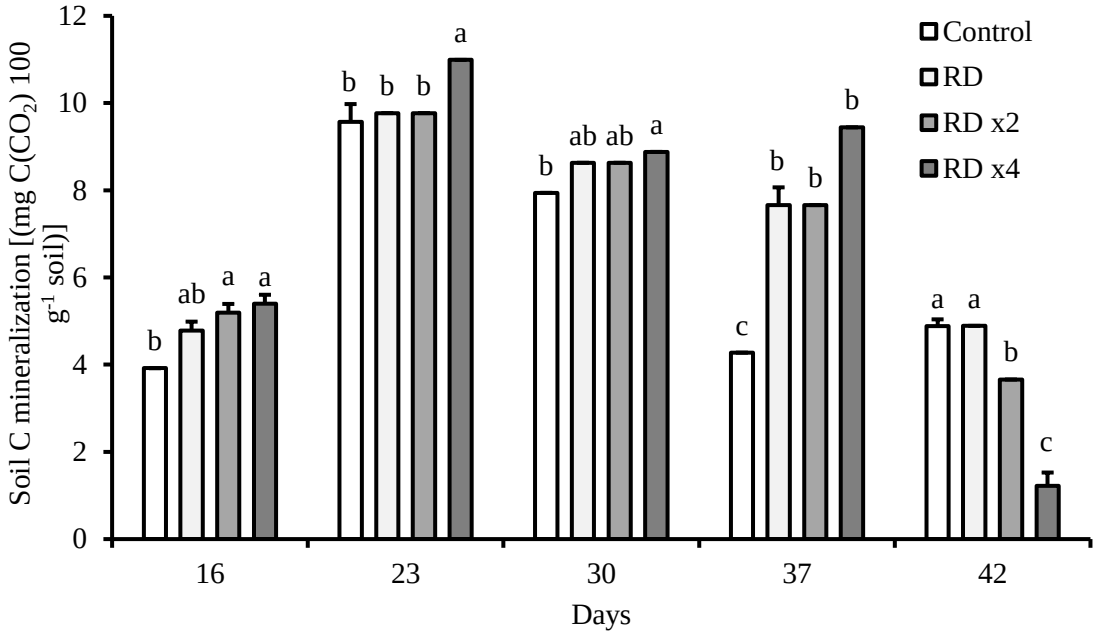

Figure 2. Soil carbon mineralizations between 16.day and 42.day at 28°C [mean± standard error, n=3, a, b and c indicate significant differences between means (P<0.05)]

Liu et al. (2011) compared the half-lives of cyprodinil (50% WG) in soil under field and greenhouse conditions at the dosage of 1,080 g active ingredient ha^{-1} and reported that pesticide cyprodinil degrades faster under greenhouse condition (6.5 days) than field condition (12.5 days) either in soil. Same authors indicated that the temperature and humidity were at almost fixed level (temperature of 25–30°C and humidity of 70–80% according to the experimental record) under the greenhouse condition. These results corralete within our research data. These experiments indicated that cyprodinil may be used as an energy source for soil microorganisms.

The previous studies about cyprodinil were mainly focused on its residues analysis, bound residue formation, photo-degradation in aqueous solution, and biosynthesis of reference standards by microorganisms (Munitz et al., 2013, Dec et al., 1997, Kang et al., 2002, Fenoll et al., 2011,

Chen et al., 2016). Although biodegradation of cyprodinil has been reported by Schocken et al. (Schocken et al., 1997), almost no literature is available about the effects of cyprodinil on soil carbon mineralization. Results of the current study indicated that recommended field dose and its 2 and 4 folds of cyprodinil enhanced ratio of C mineralization in this agricultural soil.

Cumulative carbon mineralizations (mg $C(CO_2)$/100 g soil) were in the range between 68.56 (Control) and 79.20 (RD x4) at the end of incubation period (Fig. 3). All doses of cyprodinil significantly increased soil carbon mineralizations compared to control ($P<0.05$). In contrast, there were found no significant differences between RD and RD x2. Increased percentage of soil carbon mineralizations were 9.9% for RD, 10.5% for RD x2 and 15.5 for RD x4 compared to control (Fig. 3).

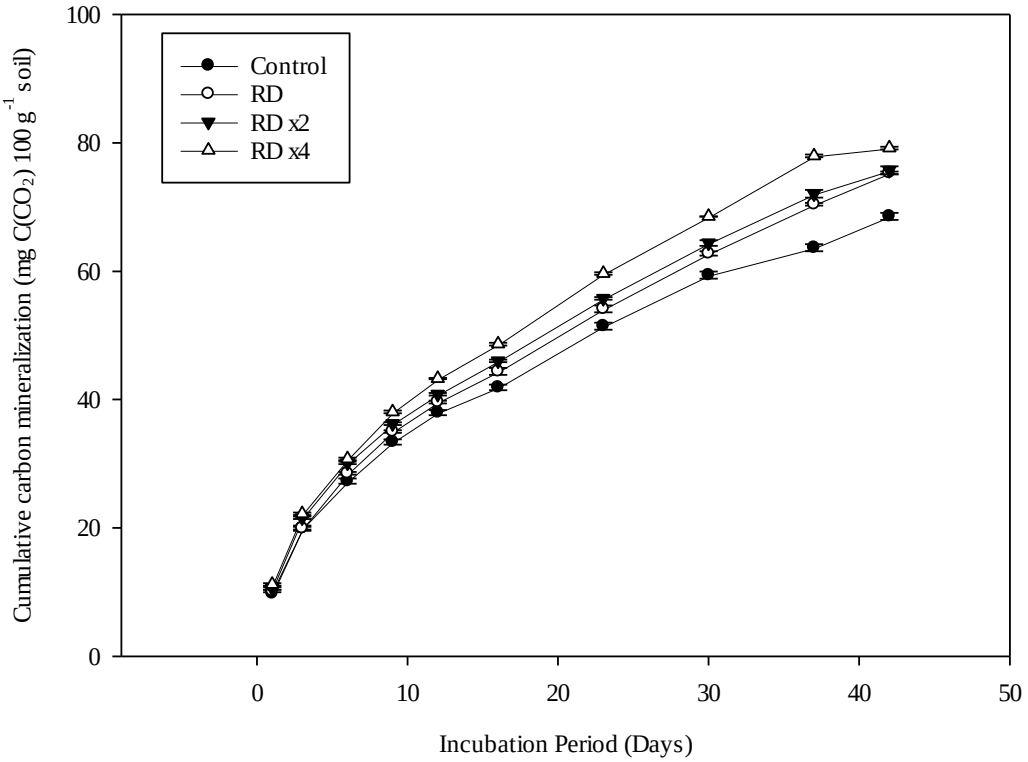

Figure 3. Cumulative carbon mineralizations of control and doses of fungicide cyprodinil at 28°C (mean± standard error, n=3)

Carbon mineralization rates until 30.day, 37.day and 42.day were given in Figure 4. These rates were in between 3.3% (Control) and 3.8% on 30.day, between 3.5 (Control) and 4.3% on 37.day and between 3.8% (Control) and 4.4% (RD x4) (Fig. 4). In all these days, all cyprodinil doses significantly increased the rate of soil carbon mineralization compared to control ($P<0.05$, Fig. 4).

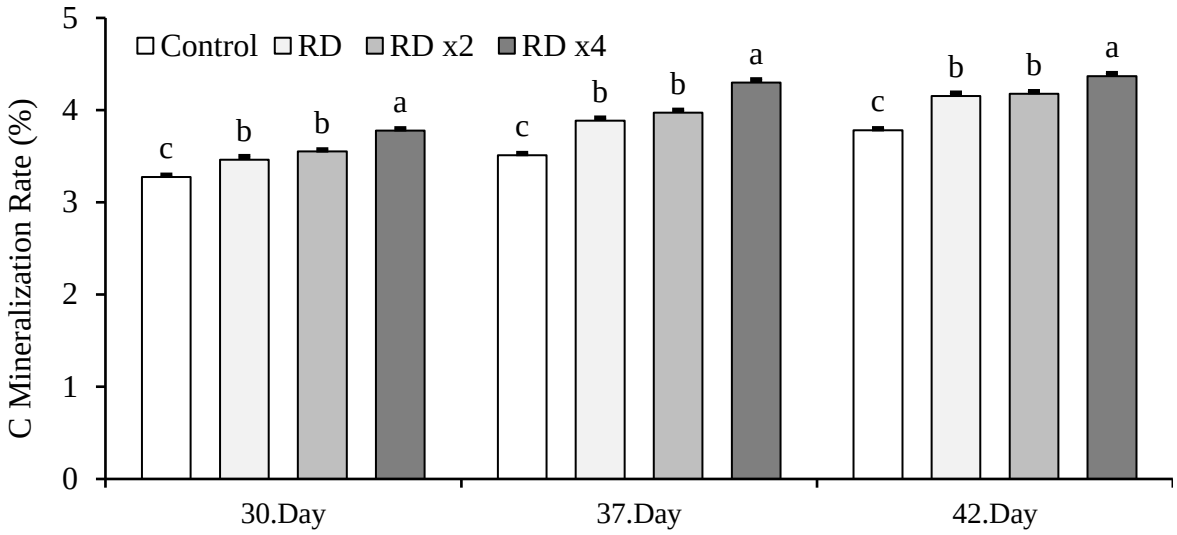

Figure 4. Rate of soil carbon mineralizations (%, mean ± standard error, n=3) of control and doses of fungicide cyprodinil [a, b and c represent significant differences between dosages (P<0.05)]

Application of fungicides for certain purpose on soil can kill or inhibit the target and non-target microorganisms. This event could lead to an immediate inhibition of important reactions such as enzyrne reactions, microbial respiration and mineralization. However, the dead microorganisms or fungicides, might serve as a substrate for the other living microorganisms in the beginning. So, they can be released from competition with fungi or antagonistic inhibition via substances produced by fungi. These effects could lead to a rapid flush of microorganism activity would be likely to increase the rates of mineralization of carbon from organic materials in the soil (Uyanoz et al. 2005). Uyanoz et al. (2005) mixed three fungicides with a silty soil at four concentrations [captan, 0, 100, 200, 400 mg active ingredient (a.i.) kg^{-1}; quintozene 0, 36, 72, 144 mg a.i. kg^{-1} and propamocarb hydrochloride 0, 144, 288, 576 mg a.i. L^{-1}] and found that these fungicides decreased soil respiration primarily during the first eight days, but then it started rising toward the end of the incubation.

CONCLUSIONS

It's concluded that recommended field dose of fungicide cyprodinil (300 EC) significantly increased carbon mineralization in a loamy soil. In addition, there were generally no significant differences between RD and RD x2 doses. Significant increase of rate of carbon mineralization in the loamy soil was highest at the dosage of RD x4 in whole experiment. These results may give a suggestion of reasonable and safe use of the pesticide cyprodinil. However, for further confirmation, effects of high recommended doses of cyprodinil on soil microorganisms should be investigated more comprehensively to eliminate its possible side effects in soil. Therefore, it's suggested that the further researches require the trials with soils having different organic matter, texture and pH and with more fungicides type, dose and incubation period under laboratory, greenhouse and field conditions.

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INITIAL EVALUATION OF THE PRODUCTIVITY AND PHYSICAL PROPERTIES OF A SELECTED KYRGYZ CASHMERE GOAT BREEDING FLOCK

Carol Kerven[1], Joaquin P Mueller[2] , Bruce A McGregor [3], Sabyr Toigonbaev[4]

1. Anthropology Department, University College London (UCL), London, UK and Odessa Centre Ltd., Great Wolford, UK
2. National Institute for Agricultural Technology (INTA), Bariloche 8400, Argentina
3.Institute for Frontier Materials, Deakin University, Geelong, Victoria 3220, Australia
4. Tuvet Cashmere NGO, Tilek Baatyrμ Street 10, Osh, Kyrgyzstan.

Abstract

Cashmere production offers a new source of income for remote farmers in Central Asia where goats have long been raised. Between 2008-2018 we established a selected breeding flock to preserve, assess and improve the economic and genetic potential of cashmere-bearing indigenous goats in Kyrgyzstan. The flock was managed in an enhanced traditional system by a local shepherd in the mountainous region of Osh Province. Significant effects of year, age and the sex of goats affected cashmere weight, while year and age of goat affected cashmere length and year affected cashmere fiber diameter. The best statistical model explained about 60% of the variation in both cashmere weight and length and about 30% of the variation in fiber diameter. No particular measurement year trend could be detected for any trait. Between years, cashmere weight varied between 103-150 g, fiber diameter between 15.8-17.6 μm and length between 32-48 mm. Males produced more cashmere than females with no difference between sex in diameter or length. Cashmere weight was constant between ages 1-4 years before declining progressively from about 144 g to 90 g at age 6 years. Given the harsh winter environment, remote conditions, and limited research resources, data for some years is missing. No genetic trend could be calculated with the information currently available.
Key words: Coat color, Indigenous goats, Fiber diameter, Fiber length, Genetic improvement

INTRODUCTION

Kyrgyzstan is a mainly mountainous country in Central Asia, which was part of the Soviet Union in the 20th century until 1991 (Anderson 2013). Raising livestock, including native goats, has long been the principal economic activity in the rural upland regions (van Veen 1995). Kyrgyz farmers were collectivized into state farms during the Soviet era and several new goat fiber breeds were introduced to some state collective farms (Ajibekov and Almeyev 2008). Following the collapse of the USSR and managed state farms, Kyrgyz farmers now keep goats mainly for home meat consumption and sale to local markets (Kerven and Toigonbaev 2010). The production and sale of cashmere from indigenous goats has not previously been viewed by Kyrgyz farmers as a source of income (Kerven 2011). International cashmere companies from Europe as well as from China have been buying greasy cashmere from farmers in Kyrgyzstan at least since the late 1990s, with almost no recording or surveillance by the Kyrgyz authorities (Kerven et al. 2005). Producing and selling non-perishable and high value products like cashmere offers livestock-keepers in remote locations of Kyrgyzstan a new source of sustainable recurrent income, following the loss of state farm employment in the 1990s (Kerven 2011).

From a genetic and animal production perspective, following goat domestication some 10,000 years before present in Iran (Colli et al 2018; Naderi et al 2008), goats were dispersed eastwards across the Eurasian steppe to Mongolia and northern China (Amills et al. 2017; Zhang et al. 2018). However, there is a dearth of objective information on the potential production and the physical properties of cashmere from the Kyrgyz indigenous goats. The last review of Kyrgyz goats (Ajibekov and Almeyev 2008) was based on data recorded more than two decades earlier in USSR.

There is a great risk that the genetic resources of endemic Kyrgyz goats may disappear due to continued uncontrolled cross-breeding with goats producing mohair-type or cashgora-type fiber (McGregor

2000). Loss of the prospective commercial value of the down-producing Kyrgyz indigenous goat would also be an economic cost for the nation, given the rising interest among buyers from China, and more recently from Europe and USA, in sourcing cashmere from Kyrgyzstan, and the ensuing economic benefit to poorer Kyrgyz villagers.

Given this situation, the first step in conserving the Kyrgyz indigenous goats was to investigate the sources of variation contributing to the production and quality of cashmere produced from Kyrgyz goats raised by farmers (McGregor et al. 2009). The results from 760 goats sampled in five mountainous districts (two different regions) of southern Kyrgyzstan showed that there were farms and cashmere goats in the sampled districts which produce cashmere equal to the finest qualities of commercial cashmere produced in China and Mongolia. The work indicated the scope to increase the production and commercial value of cashmere produced by Kyrgyz goats.

The next step was to preserve and selectively breed these goats. Consequently, the decision was made to create a development flock based on the most promising cashmere goats which had been sampled in that study (McGregor et al. 2009). In the absence of any government-led project, a selected development flock was established in 2008 under private management by a British anthropologist (Kerven) and a Kyrgyz livestock scientist (Toigonbaev). This flock has been maintained privately up to the present day, under the management of a Kyrgyz NGO.

The aim of the selected development flock is to preserve, assess and improve the economic and genetic potential of cashmere-bearing goats raised by farmers in Osh Province in southern Kyrgyzstan. The ultimate objective is to increase incomes for poorer Kyrgyz villagers by breeding selected elite bucks, to be promoted and sold to local farmers. This report provides the first assessment of the cashmere.

MATERIALS AND METHODS

Selection of foundation goats

Goats were selected from two districts (Alai and Chon Alai) in Osh Province with the highest cashmere results out of five districts sampled, having mean fiber diameter (MFD) results of 16 μm or less (McGregor et al. 2009). The first 28 goats were purchased in September 2008 at above-market prices (around $50 USD each) from farmers' flocks in 10 villages (altitude range 1,540 to 3,200 m.a.s.l.). The total sampled population in the five districts had been 958 females and 65 males from 156 flocks (including castrates) (McGregor et al 2009). The purchases were bought from 16 farmers' flocks in 13 villages in which goats had been sampled. These purchases represented 2.5% of the total tested sample of females, purchased from 25% of sampled villages. The average cashmere MFD of goats bought from these 13 villages ranged between 14.4 and 16.0 μm with individual goats having MFD as low as 13.0 μm.

In this first purchasing round no attention was paid to coat color. Coat colors of the 28 goats in the foundation flock were: 13 black (46%), 9 white (32%), and the remainder red, brown or buff colored. In comparison, the frequency of coat colors sampled from farmers' village flocks in these two districts in 2008 was: 40% black, 29% white and the remainder grey, brown, red or buff. In spring 2009 the two original black sire bucks bought in September 2008 were exchanged for two white sire bucks.

Subsequent to the first cashmere sampling of farmers' village flocks in 2008 (McGregor et al. 2009), a second cashmere goat village assessment was undertaken in 2014 for a Swiss-funded rural development project in the same two districts of Alai and Chon Alai of Osh region in which the earlier 2008 cashmere assessment had been carried out. The 2014 study sampled 387 village goats (364 adult females and 23 adult males) in 81 flocks belonging to farmers in 27 villages. The sample was stratified by proportionate allocation using a sampling fraction in each of the strata (districts) proportional to the total official population of goats in these two districts. Between 2-4 flocks were sampled in each village with up to seven goats sampled per flock, depending on the size of the goat population in each sampled village. The average MFD was 17.6 μm, ranging from 15.1-20.8 μm.

The breeding flock had a further influx of goats selected from the results of this second cashmere goat assessment. In autumn 2014, 14 females and 2 bucks with the lowest MFD test results, and mostly white-coated, were purchased and added to the selected flock. At the same time, 20 males and females were culled from selected flock which had MFD test results of over 16.5 μm or had poor body conformation or body growth. The selected newly-purchased goats represented 4% of the sampled village goats from 20% of flocks and 37% of villages sampled in 2014.

Environment descriptions

The foundation flock was first kept in Korul village in Alai district by a shepherd family, but later the flock was moved to Joshulo village in the same district. The altitude of both these villages is around 1,600 m.a.s.l. These mountain villages consist of mixed crop and livestock small-scale farms, and are in the same type of environment as the source villages from which the foundation flock was obtained. The nearest town is Gulcha 40° 19′ N , 73° 26′ E, about 1.5 hours distant from the flock location.

The mountain villages where the flock was kept have cold winters, with snow from late November to early March. The average annual temperature is 8.9 °C. The warmest month is July with an average temperature of 22.3 °C, lows of 12.9 °C and highs of 29.6 °C. The coolest month is January with an average temperature of -7 °C, lows of -11.8 °C and highs of -2.1 °C. The average annual precipitation is 501 mm. The wettest month is May with an average of 90 mm of precipitation and the driest month is September with an average of 16 mm of precipitation. Most days have some sunshine, averaging 8 hours in January and 15 hours in July (Weatherspark 2019).

Management of the selected flock

The management of the selected flock could be described as "upgraded monitored local", in that the basic principles of Kyrgyz mountain livestock husbandry were followed, with the addition of controlled mating, better quality (i.e. more expensive) winter feed, some barn upgrading for insulation and warmth, plus regular supervision and record-keeping by the 2-person flock management team (Toigonbaev and Kerven).

The flock was herded similarly to local livestock farmers' flocks; that is, the goats were grazed on the foothills surrounding villages during spring (March to May), when new vegetation emerges after winter, and grazed there again in autumn (September to November) after village crops were harvested in summer. During June, July and August, the goats together with the shepherd's families' other livestock would be taken to a high mountain pasture area, above 2,000 m.a.s.l. where the shepherd family would stay in a yurt and tend their livestock. This pattern follows the standard Kyrgyz system for livestock management in the mountains (Van Veen 1995; Farrington 2005). However, in the case of the selected flock, the summer mountain pastures where the shepherd's family camped did not receive other villagers with goats, which prevented the risk of random mating of the selected females with unknown bucks. The summer alpine vegetation at the higher altitudes provides optimal nutrition for livestock grazing and browsing (Dörre and Borchardt 2012). Adult females come into estrus by the end of summer and were mated in the field with the selected bucks. After the first snow falls and temperatures drop in late November, the goats were kept inside a barn next to the shepherd family's village home. Kidding took place from late winter (February) to mid-March in the barn. Over winter, the goats received daily rations of purchased hay harvested from local meadows, and a high-protein supplement of maize, barley and sunflower or cotton seed. Routine vaccinations were administered by local veterinarians, and the shepherds were also given anti-parasite medicines to apply on the goats. Not all village goat-owners follow these practices.

Animal and fiber production assessments

At birth, the kids' sex and coat color was recorded and a unique numbered identifier tag was attached to their ears. The dam of each kid was recorded. Raw cashmere production was determined by combing the moulting down fiber in April and weighed by the flock manager, Toigonbaev, on an electronic scale with 5 g gradations. Coat color was subjectively assessed into 6 colors for all kids born live. All non-white males were castrated and culled soon after weaning when they began sexual maturity. Only older, sick, weak and non-white females were culled every year.

Fiber samples were collected from the flock for nine years (2009-2018) and analyzed by several international animal fiber laboratories. Cashmere MFD were determined by testing raw fiber samples using the Optimal Fibre Distribution Analyser (OFDA2000) following international guidelines (Marler and Baxter 2004) using a fiber diameter cut-off of 30 µm for cashmere. Fiber length was measured by graphic technique MNS 4054:2007 on hand dehaired combed samples.

Data editing and statistical analyses

The analyses include data from foundation does, and all subsequent progeny. Four sires in succession were selected on the basis of white coat color and low MFD of below 15 µm at 1 year old. One black sire was initially selected only on the basis of below 15 µm but was replaced in the next breeding year of 2009.

Undertaking pedigree recording and measurements in remote regions with limited resources was challenging. Consequently, records for some of the main traits are missing in some years. A total of 295 animals and 477 records were available, the difference being repeated measurements over time of the same animalRepeated measurements were assumed to be uncorrelated and treated as independent information. Age at measurement was calculated as the difference between measurement year and birthyear. Missing age at measurement was assumed to be 3 years (3 cases out of 295). Animals above 6 years of age (10 cases out of 295) were set to 6 years of age. Overall means and distribution statistics were calculated for fiber traits and additional information on liveweights. Analysis of variance was performed using a mixed linear model (Mixed Procedure of SAS 2008). Least square means were determined for cashmere weight, MFD and length with a model including as fixed effects:

year of measurement (2009-2018); birth_type (single, twin); sex (male, female);
age (1-6); and sire (22, 47, 827, 831, 1214, unknown sire of introduced does).

Probabilities below 5% were considered to be statistically significant. Pearson correlations between traits were calculated using the residuals of the previous model. Sire progeny color frequencies were calculated and tested against chi-square expected values.

RESULTS

Fixed effects on physical properties

Overall measurement statistics are in Table 1 and the results of the analyses of variance in Table 2. The statistical model explained about 60% of the variation in both cashmere weight and length and about 30% of the variation in MFD. For MFD, other unconsidered factors are therefore responsible for most of the observed variation. Year of measurement affected all traits. Cashmere weight was also affected by sex and age, and age also affected cashmere length. Birth_type did not affect any trait. While the significance of sire differences was more important for cashmere weight than for MFD and length, it was still not statistically significant (P = 0.06) (Table 2).

Table 1: Number of records, mean, standard deviation (SD) and ranges of fiber and liveweight characteristics in the breeding flock.

Trait	N	Mean	SD	min	max
Cashmere weight, g	168	125	38	30	274
Mean fiber diameter, µm	250	16.3	1.3	12.8	23.1
Length, mm	109	37.9	10.6	13.1	70.0
Male yearling MFD	18	15.6	1.20	14.0	18.5
Female yearling MFD	37	15.9	1.07	14.3	19.2

Table 2: Statistical significance (probability of F statistic) of fixed effects and variance accounted for by the model (R^2) for cashmere physical properties.

Effect	Cashmere weight	Mean fiber diameter	Length
Info_year	<0.0001	<0.0001	<0.0001
Sex	<0.0001	0.61	0.39
Age	0.0001	0.06	0.02
Sire	0.06	0.09	0.61
Birth_type	0.69	0.65	0.60
R^2	0.57	0.28	0.59

Physical properties of cashmere

The results of physical properties of cashmere (Table 3) have to be considered in relation to effect significance of Table 3. No particular measurement year trend can be detected for any trait. Between years,

cashmere weight varied between 103-150 g, MFD varied between 15.8-17.6 μm and length between 32-48 mm. Males produced more cashmere than females with no difference between sex in diameter or length. Cashmere weight was constant between ages 1-4 years before declining progressively from about 144 g to 90 g at age 6 years. A decline in cashmere length with age may also have occurred. MFD was finest for age 1 year and coarsest for age 6 years but the effect of age was not significant (P = 0.06). Sire 831 produced progeny with the highest cashmere weight and with the finest cashmere. As expected, an unfavorable correlation was found between cashmere length and MFD (r = 0.40, P < 0.0001). Correlations between cashmere weight and MFD were not significant (r = -0.04, P = 0.68). The correlation between cashmere weight and length were slightly positive (r = 0.25, P = 0.06).

Table 3: Least squares means (± Standard Error) of fixed effects on cashmere weight, mean fiber diameter and length.

Effect	**Level**	**Cashmere weight, g**	**Mean fiber diameter, μm**	**Length, mm**
Measurement year	2009	150 ± 11	15.8 ± 0.4	
	2010	127 ± 10	15.6 ± 0.4	48 ± 4
	2012	149 ± 10	16.5 ± 0.3	36 ± 3
	2013		16.9 ± 0.3	
	2014		17.6 ± 0.3	
	2015	103 ± 9	15.9 ± 0.3	
	2016	128 ± 9		
	2017		16.2 ± 0.3	32 ± 2
	2018		16.1 ± 0.6	42 ± 4
Birth type	Single	128 ± 6	16.3 ± 0.2	39 ± 2
	Twin	134 ± 14	16.4 ± 0.4	40 ± 4
Sex	Female	115 ± 7	16.3 ± 0.2	38 ± 2
	Male	147 ± 11	16.4 ± 0.3	40 ± 3
Age	1	141 ± 7	15.8 ± 0.2	41 ± 2
	2	143 ± 9	16.4 ± 0.3	45 ± 3
	3	144 ± 10	16.4 ± 0.3	42 ± 3
	4	146 ± 10	16.4 ± 0.3	33 ± 4
	5	124 ± 11	16.2 ± 0.4	37 ± 4
	6	90 ± 14	16.9 ± 0.4	39 ± 4
Sire	22	129 ± 10	16.2 ± 0.3	43 ± 4
	47	114 ± 11	16.1 ± 0.4	40 ± 5
	827	144 ± 12	16.8 ± 0.4	39 ± 4
	831	143 ± 13	15.7 ± 0.4	38 ± 4
	1214	115 ± 13	16.8 ± 0.4	38 ± 4
	unknown	141 ± 8	16.4 ± 0.3	40 ± 3

Cashmere coat colors

Table 4 provides the color frequency of progeny from a selection of sires used in the flock. Observed color frequencies differed from expected frequencies (Chi-squared significant at $P < 0.0001$) but the results should be taken with caution since more than half the cells have less than 5 counts. For two white bucks (22, 47) about one third of offspring were white. For two white_black bucks (831, 1214) about half of the offspring were white. All of the bucks in Table 4 except buck 831 produced brown, grey and red kids (n = 16). These results indicate a priori a rather complex pattern of coat color inheritance and a long selection process to fix the desired white coat color in the flock.

Table 4. Coat color frequency in progeny of sires (*n*, % of progeny)

Sire tag (own color)	White	White_black	Black	Brown	Grey	Red	Total
22, white (*n*)	18	4	22	6	5	0	55
(%)	33	7	40	11	9	0	100
47, white (*n*)	18	5	15	5	4	3	50
(%)	36	10	30	10	8	6	100
827, white (*n*)	4	2	24	2	0	4	36
(%)	11	6	67	6	0	11	100
831, white_black (*n*)	9	2	5	0	0	0	16
(%)	56	13	31	0	0	0	100
1214, white_black (*n*)	38	4	7	8	6	4	67
(%)	57	6	10	12	9	6	100
Unknown sire (*n*)	21	7	19	3	6	9	65
(%)	32	11	29	5	9	14	100
Total (*n*)	108	24	92	24	21	20	289

DISCUSSION

To fulfill our aim of the breeding flock, the flock has to be genetically superior, improving over years and disseminate its genetic superiority in the region. Economic potential will be improved if traits of economic value are genetically improved in the desired direction. Such traits are basically meat production, cashmere weight and quality, and white color. Meat production can be improved by increasing reproduction rate and liveweights or growth rates. In a harsh winter environment and among poorer farmers, this is a problem since higher prolificacy increases kid mortality and higher liveweights increase feed requirements. Increasing cashmere weight and quality is less dependent on feed supply and are much more heritable. Studies in Iran found heritabilities for liveweights are 0.25-0.32 whereas heritabilities for fleece weight and diameter are 0.42 and 0.49 respectively (Mueller et al. 2015a). In other words, liveweights (and reproduction) are more dependent on environment than fiber traits.

This is particularly true for cashmere MFD which can be improved (reduced) without needing to change the environment. In that sense the selected breeding flock was already established with superior goats. Foundation goats selected in 2008 from the Alai and Chon Alai districts of Osh Province had an MFD which ranged from 14.4 – 16.0 µm while random samples in some of the same villages and in the same year had a clean combed yield MFD of 16.5 µm (McGregor et al. 2009). Similarly, goats added to the breeding flock in 2014 had an overall mean MFD of 15.5 µm while the regional mean MFD was 17.3 µm. These initial selection differentials indicate a promising start. No genetic trend since the establishment of the flock could be calculated with the information currently available although the phenotypic trend is rather erratic, starting with low MFD in the early years, increasing in the period 2013-2014 up to 17.6 µm and declining again afterwards. This result is probably mainly due to environment effects perhaps related to relative improvements in nutrition. Management changes, diseases and feed availability may contribute to such fluctuations as cashmere physical properties do respond to changes in pastoral conditions and nutritional

management (McGregor 1992). Kyrgyzstan's higher altitude pastures experienced decreasing precipitation between 1960-2010, but a slight decrease in inter-annual variability (UNDP 2013). Since the end of the USSR in 1991, village veterinarians lack modern training and supplies to treat diseases, while some winters can be particularly cold.

Continuous improvement in the breeding flock is crucial because eventual customers for bucks from the flock would soon reach an improvement plateau similar to the supplying breeding flock. To continue improving, selection procedures must be efficient. Basically high selection differentials need to be achieved. This requires high numbers of selection candidates, accurate identification of superior animals and replacing inferior bucks with highly selected ones. From our results, variability (measured as standard deviation) of MFD is not high but sufficient to achieve a reasonable genetic improvement. For example, MFD of 1-year old males average 15.6 μm with a range of 14.0 to 18.5 μm (Table 1). Selecting the finest young buck would yield a selection differential of -1.55 μm (14.0-15.6) which mated to average does and assuming a heritability of 0.5 would have progeny averaging -0.4 μm below the previous generation. Consistent recording and selection would reduce MFD in, for example, 10 years from 15.6 to 14.1 μm just by selection. In addition, screening and purchase of additional village breeding stock can further reduce MFD if desired. Other traits of interest such as cashmere weight can also be improved along with reduction in MFD since the genetic correlation between these traits is unfavorable but not very high (Mueller et al. 2015a). In fact phenotypic correlation in the present data set resulted insignificantly different from zero. Cashmere length would be more difficult to improve along with reducing diameter. If sufficient data are available, selection indices could be constructed to maximize economic benefit from selection as were implemented in an Iranian cashmere selection program (Mueller et al. 2015a).

Evaluation of cashmere goats between and within farms in Australia has identified indices which incorporate cashmere staple length, MFD and cashmere weight in order to select on one metric (Butler and McGregor 2014; McGregor and Butler 2015). One serious impediment to cashmere length measurement is the cost and time of laboratory-based methods. Any length measurement which measures cashmere fiber after a dehairing process (which results in a significant reduction of length) provides a confounding of effects, such as variations in actual raw length, fiber strength, MFD or variations in processing (McGregor and Butler 2008). It is suggested that using raw cashmere staple length is a rapid, cheap and effective method of selecting and assessing cashmere production.

Colored cashmere is generally discounted 10-15% compared with the price for white cashmere with similar MFD and fiber length. Thus, producing colored cashmere reduces fleece value but not to a great extent while colored goats may have adaptive advantages in rangeland situations. As the initial selected flock was founded with colored goats, which was reflective of the local village flocks, the results would be expected to be typical of the progress to be obtained in future breeding programs at village level. As mentioned, fixing white coat color in the breeding flock may take time and results of progeny coat color, instead of only own phenotype, may be a more effective selection strategy. For example, the white_black buck 1214 produced proportionally more white progeny and less black progeny than all other white bucks evaluated (Table 4).

A final crucial requirement for the breeding flock to fulfil its aim is the dissemination of bucks in the region. This will occur if bucks offered are attractive to village goat farmers willing to pay at least some of the extra cost involved in producing them. To make an impact in the region the number of such bucks should be high and the benefit in the progeny should be notable. There are several strategies to achieve dissemination at community level (Mueller et al. 2015b). Clearly a substantial expansion of the selected flock would be needed, probably with separate locations in a number of villages throughout the region. This would engage more local farmers and allow the NGO more access to animals for training and selection activities. More rigorous control and improvement of animal nutrition would be essential to improve confidence and reliability in determining genetic progress. More thorough assessment of fleece and bodyweight characteristics would be important to demonstrate the superiority of the selected bucks to local farmers and avoid the likelihood, as experienced in the present investigation, of missing data in some years.

Since 2017 as a result of external support for inputs such as: barn upgrading; improved winter feeding; shepherding costs and management fees, this selection work is being continued by the Kyrgyz NGO Tuvet Cashmere. The flock has been enlarged to 250 selected adult white females and 50 selected adult white males. Interest is growing among Kyrgyz farmers to acquire selected bucks from the NGO, in response to several European and American firms increasingly investing in obtaining high quality Kyrgyz cashmere.

CONCLUSION

Over a 9-year period the productivity of a selected cashmere breeding herd was assessed in the mountainous region of Osh Province in southern Kyrgyzstan. The best statistical model explained about 60% of the variation in both cashmere weight and length and about 30% of the variation in fiber diameter. No particular measurement year trend could be detected for any trait. Males produced more cashmere than females with no difference between sex in diameter or length. Cashmere weight was constant between ages 1-4 years before declining progressively to age 6 years. While selecting superior foundation breeding does was completed, the real challenge was monitoring and selecting superior sires in difficult field conditions.

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MAPPING ANATOLIAN STEPPE REGION AND ECOSYSTEM TYPES BY USING EARTH OBSERVATION AND GIS

E. Aksoy[1], S. Keskin[2], C. Aktuz[2], F. Bozdemir[3], D. Muchoney[1], A.K. Ozbek[2]

[1] Geospatial Unit, NSL, FAO-UN, Rome, Italy
[2] Ministry of Agriculture, Ankara, Turkey
[3]FAO-UN, Ankara, Turkey

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Abstract

Turkey's steppe ecosystems are globally significant and unique environments having very rich flora and fauna composition; and they are extremely vulnerable ecosystems. Although there are some preliminary studies about the steppe region, there was not sufficiently detailed map showing the actual delineation of Anatolian steppe region and the different steppe types. Anatolian Steppe map was produced mainly based on the Earth Observation data interpretation and was produced by analyzing satellite imagery with the help of GIS technologies based on existing data (Forest stand map, surface temperature, aridity/drought index, soil information, elevation, Geological formations, vegetation indices (NDVI, EVI)) and interpretation of other sources. The mapping activity based on convergence of the evidences approach which provided by the cost-effective, scientifically sound and robust mapping techniques with the help of remote sensing technologies and GIS. The signatures of the steppe region were analyzed and the final border of Anatolian steppe region was predicted. The map both reveals the delineated border, including information about the different dynamics of the homogeneous clusters, and also ecosystem types. Moreover, the impacts of land cover changes between 2006 and 2012 and hot-spot analysis that considers several different aspects of the threats and vulnerable areas of region were also analyzed and discussed in this study. Therefore this study should be considered very important key output for the policy makers to build the specific agricultural planning strategies for each of the regions by pointing out the exact locations and to secure integrated management of natural resources in Anatolian steppe.

Keywords: Anatolian Steppe, Remote Sensing, GIS, Mapping, Ecosystem Types

INTRODUCTION

Although steppe ecosystems can provide invaluable ecosystem services to human being, as they

have not been perceived as a natural system with its own economic, social and ecological value, these resources cannot be used in a sustainable and effective means. Turkey's steppe ecosystems are globally significant and unique having very rich flora and fauna composition. Even though it's known that the steppes are one of the most ecologically important systems in Turkey, they are also extremely vulnerable ecosystems.

The Anatolian steppes are part of a larger Palearctic steppe biome that stretches from China to the Mediterranean in more or less fragmented temperate grassland and forests (Wesche et al., 2016). Turkey's steppe ecosystems include pastures, meadows, grasslands and agriculture land. Steppe ecosystems are prevalent in Eastern and Central Anatolia as well as the high mountains of the Aegean and Mediterranean Regions. According to Werger (2012), there are four types of steppe in Turkey: the rare Gramineae steppes; Malacophyll steppes; Tragaganthic steppes; Salty steppe. In central Turkey, patches of grasslands make up the Central Anatolian Steppe ecoregion. On a high plateau surrounded by rugged mountains, the landscape here is dotted with low plants, stunted bushes, and short grasses such as bunchgrass and other tuft-forming grasses. The landscape surrounding this plateau is open and park-like, with grasslands interspersed with scattered trees of juniper, carob, oak, and thorn. The Central Anatolian Steppe encompasses Turkey's largest lake (Tuz Gölü) and its surrounding salt pans, salt lakes, and other wetlands. (WWF report, 2005). At the broad level the steppe ecosystem of Central and Eastern Anatolia are important as areas for biodiversity, with high levels of endemic species (Werger, 2012) in the upland plateaus and mountain areas and basins. The Anatolian Steppes ecosystems may be characterized at differing levels of complexity and as semi-natural and agro-ecosystems which have converted natural ecosystems at global, national and regional levels (Loveland et. al. 2016). Within Turkey the biomes can be sub-divided into semi-natural and anthropogenic biomes (Cureball et. al. (2015) and further divided into ecosystems. The steppe ecosystems range from the mountain steppe, plain steppe, salt steppe of the mixed oak forest and savannah steppes. The Central Anatolian region is classified predominantly as a dry steppe and to the north temperate broadleaf forest biomes (Kurschener and Parolly (2012).

According to the available literature on Anatolian steppe region, different aspects are considered by different articles (vegetation and land use (Senkul&Doga, 2013); flora-fauna (steppe-dependent species (Ambarli et al., 2016) soil type (Aydogdu et al., 2004)). The existing steppe communities have also been mapped by Gokcen et al (2011) on the basis of their moisture status, by lifeform and morphological condition at a broad scale and original vegetation communities (Sekercioglu et al 2011), actually shows the major biomes rather than vegetation cover.

However, there was no common definition for the Anatolian steppe characteristics. Therefore, we described the steppe area and describe the characteristics of Anatolian steppe in this definition

together with the experts and based on the literature survey. According to our definition; the Anatolian steppe cover the secondary step formations resulting from anthropogenic effects with primary step formations in the natural conditions dominated by the Mediterranean type continental climate in the Iran-Turan plant belt. Primary steppe formations are more drought-prone, dry in summer, rest in winter, with herbaceous plants, annual or perennial grains / grains, and in the form of pillows, the main material is the marn-gypsum, which is composed of alkaline and saline soils; and plain steppes are developed between 800-1200 meters in arid areas with an average annual rainfall of less than 300 mm. Secondary steppe formations are mainly composed as a result of anthropogenic effects mainly due to the destruction of the forest less than 10% tree cover of the inner surface of the Anatolia; main geological materials are calcareous, siliceous (serpentine, dazite, andesite, trachyte, basalt); at the forest rainfall zone; having the average annual rainfall between 300-500 mm semi-arid; and having the average annual rainfall between 500 -700 mm semi-arid and semi-temperate areas; High mountain steppes at altitudes above 1200 m. Anatolian steppe ecosystems are mainly agricultural ecosystems (dry and irrigated farming), meadow ecosystems (grassland, pasture, pasture and irrigable meadows) and damaged forests that are outside the forest borders and with less than 10% tree cover.

MATERIAL AND METHODS

Anatolian Steppe map is produced by analyzing satellite imagery with the help of GIS technologies based on existing data and also analyzes and interpretation of other new sources. The mapping activity totally based on convergence of the evidences approach which provided by the cost-effective, scientifically sound and robust mapping techniques with the help of remote sensing technologies and GIS. The signatures of the steppe region that are based on several indicators are analyzed and the final border that delineates the Anatolian steppe region is predicted.

Material

The material that are used in the study was prepared mainly based on the Earth Observation data interpretation and was produced by analyzing satellite imagery with the help of GIS technologies based on existing data, namely forest stand map, surface temperature (night and daytime), annual rainfall, aridity/drought index, soil properties, elevation, geological formations, vegetation indices (NDVI, EVI)) and interpretation of other sources such as soil biomass productivity potential, bio-geographical regions, eco-regions, etc.. There are two kind of data set; primary variables and auxiliary variables, and the detail information about the dataset can be find in the Table 1 (resolution, date and resource).

Table 1. Metadata information of the variables that are used in this study

Variable	Resolution	Date	Resource
Primary Variables			
Aridity Index(P/ETP)	1 km raster; 1km raster; Point data	1970-2000; 1975-2007; 2003-2018	WorldClim2 dataset; Data from Meteorological stations in Turkey; National Geospatial Soil Fertility and Soil Organic Carbon Information System Project, FAO
Forest mask	20 m raster	2015	EEA- Copernicus Product
EVI July-August vegetation reflectance (MODIS 16-days composites and Landsat7 32-days composites)	500 m raster; 30 m raster	2003; 2004-2013 and 2017	Google Earth Engine
NDVI July-August vegetation reflectance (MODIS 16-days composites and Landsat7 32-days composites)	500 m raster; 30 m raster	2011; 2017	Google Earth Engine
Long-term averaged mean annual surface temperature (nighttime and daytime)	1 km raster	2003	SoilGrid250
Annual rainfall	1 km raster	1970-2000; 2003-2018; 1975-2007.	WorldClim2 dataset; Data from Meteorological stations in Turkey; National Soil Organic Carbon Project , FAO
Elevation	50 m raster	2015	National Soil Organic Carbon Project , FAO
Auxiliary Variables			
Soil properties	50 m raster; Polygon	2015 1966-1971; 1982-1984	National Soil Organic Carbon Project , FAO; and; Salinity layer from BTG maps by Sebahattin Keskin (MoAF)
Geological formations	50 m raster	2015	National Soil Organic Carbon Project , FAO
Soil Biomass Productivity Potential (croplands and grasslands)	1 km	2013	ESDAC, JRC, 2016; Original study of Toth et al., 2013
Bio-geographical regions	Polygon	2016	EEA
Eco-regions2017	Polygon	2017	UNBiodivesity Lab, RESOLVE

Methodology

The general methodological approach to identify and characterize the Anatolian steppes can be find in Figure 1 and the main layers that are used in this assessment have already given in the material section. The delineation of the Anatolian steppe border was developed by mainly following below steps;

1. All the layers that were used in the study were prepared for the analysis; raster remote sensing images are downloaded, stored, projected, units are unified, and analyzed. Some of the important applications are;
    a. Up-to-date climatic data (point) coming from the meteorological stations is interpolated and then integrated with the other raster layers.
    b. Aridity index is calculated by using the integrated climatic data in raster format
    c. MODIS and Landsat EVI layers are downloaded for July and August periods for each year from the Google Earth Engine and the final layer is calculated by taking the average of the raster layers
2. Raster layers were simplified by reclassifying into the certain thresholds and ranges as described in the material section
3. All of the layers were overlaid by using Weighted Overlay in ArcGIS
4. The final raster layer obtained by overlaying analysis of the remote sensing images given in the material section were converted to the final border polygon layer.

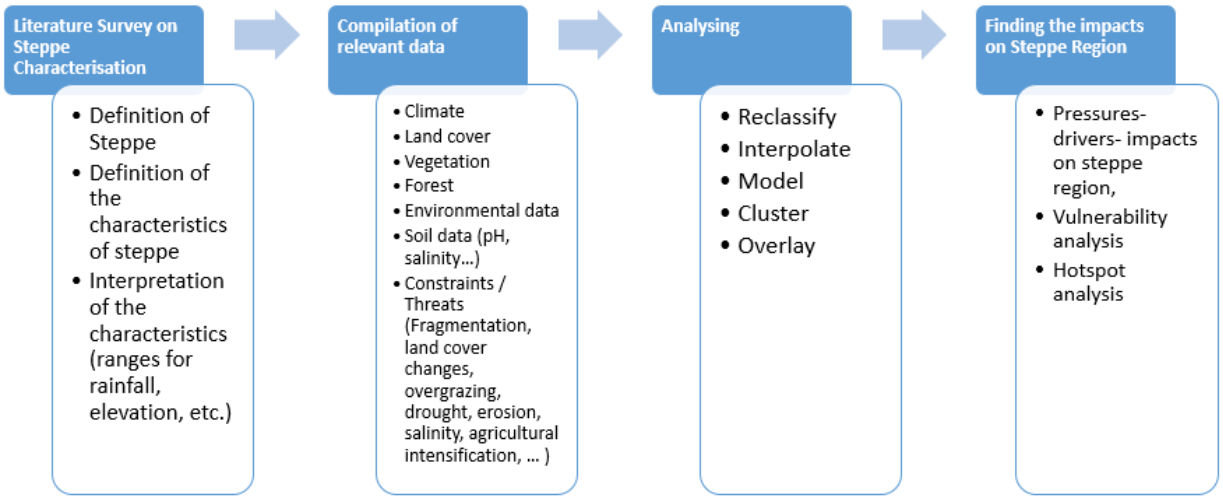

Figure 1. General methodology of Anatolian Steppe Map and Characterization

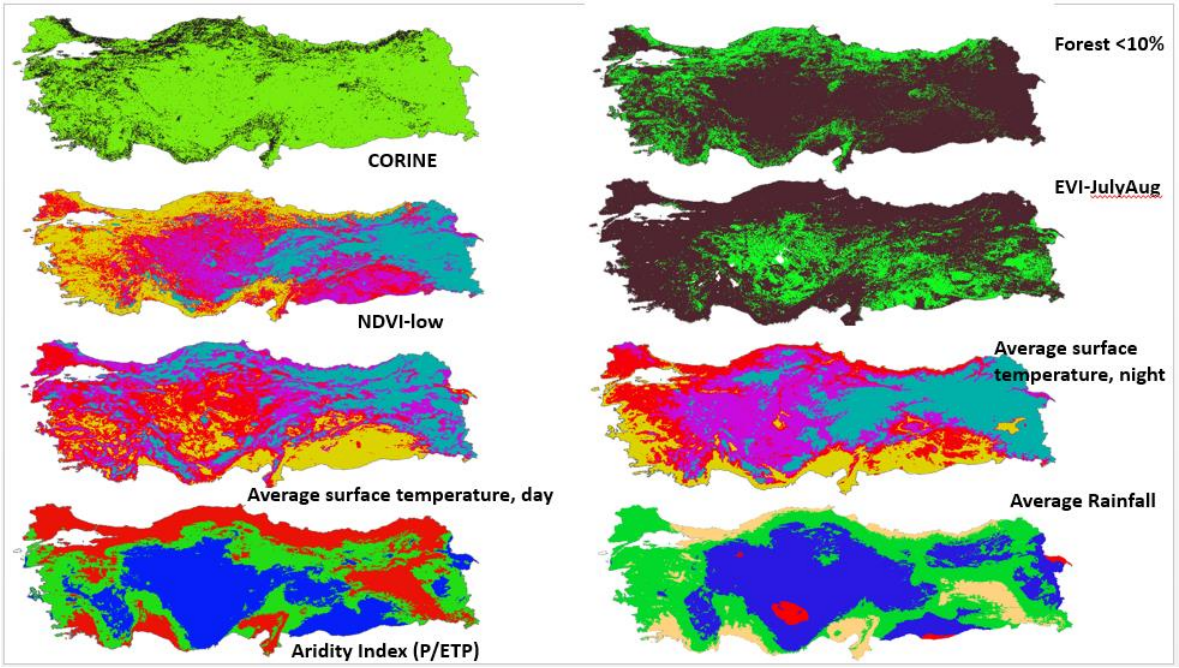

Figure 2. Some of the final layers which are ready to be overlaid

All analysis are performed in the GIS environment by using several tools and extension of the ArcGIS 10.3 software. For downloading the remote sensing images, Google Earth Engine was used.

RESULTS

The areal coverage of Anatolian steppe is found as **32,101,226 hectare** and %72 of the area has 300-500 mm average rainfall (Table 3) but %46 of the area has high soil biomass productivity potential. Moreover, 68% of the area (21.795.338 ha) is found as semi-arid and 30% is dry-subhumid (9.615.921 ha) while %51 of the land is dominated by agriculture and %39 of the land is covered by herbaceous vegetation (pastures, grasslands, moors, sparsely vegetated areas, etc.) according to the CORINE classification.

The Anatolian steppe map itself doesn't include only the information about the delineated border, but also it reveals the information about the different dynamics of the homogeneous clusters. There are 20 different types of combinations, in another word, homogeneous clusters are found and the biggest areal coverages are codes 222 (300-500mm average rainfall; semi-arid; 800-1200m elevation), 223 (300-500mm average rainfall; semi-arid; 1200-5100m elevation) and 233 (300-500mm average rainfall; Dry-subhumid; 1200-5100m elevation) (Table 2)

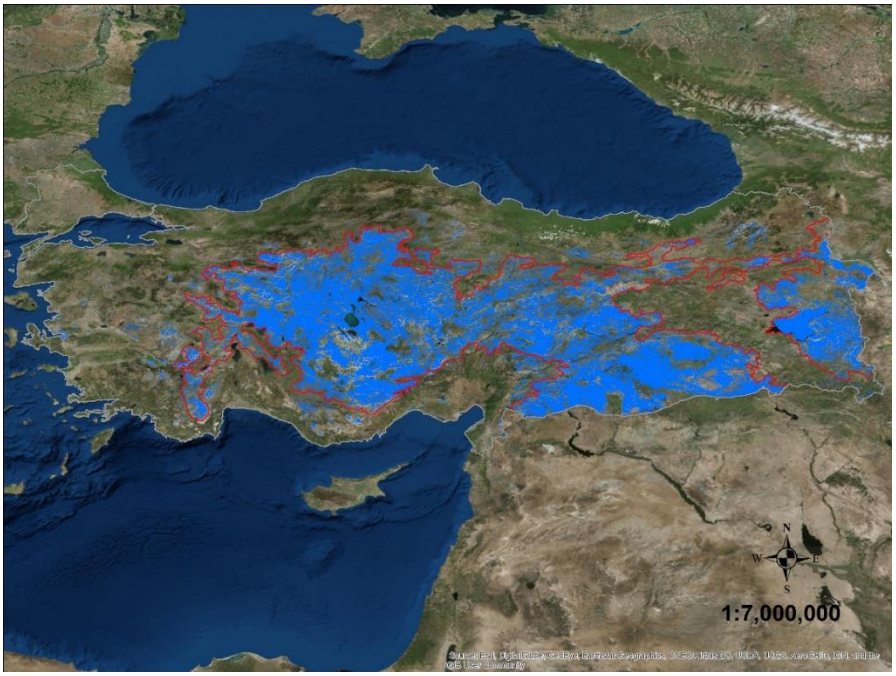

Figure 3. The output of the overlaid raster layers (blue) and the final border (red)

The codes are explained as the combination of the three indicators consecutively; rainfall, climate and elevation. For example; Code 121 has less than 300mm average rainfall, semi-arid region and plain elevation mainly agriculture and grasslands, having salinity and overgrazing problem, but the land has a high soil biomass productivity potential.

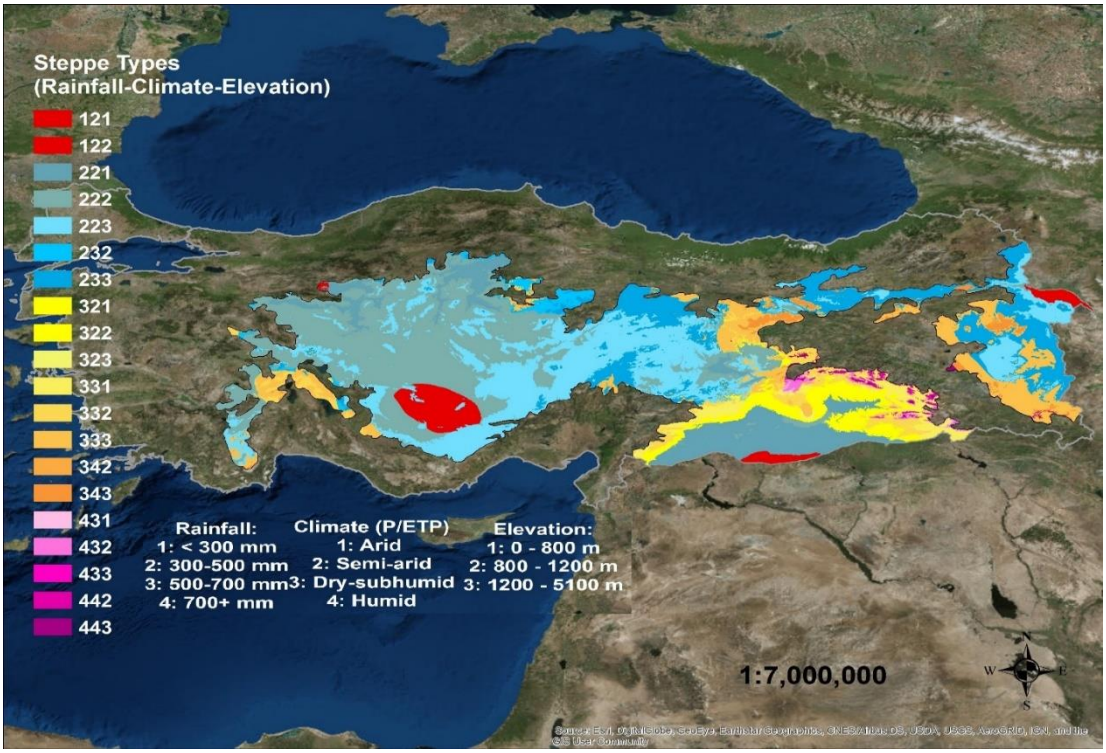

Figure 4. Anatolian steppe type map (3-digit codes integrate the 3 different characteristics consecutively; rainfall, aridity and elevation)

Table 2. Description of the codes in Anatolian steppe map

Code	Areal coverage (ha)	Description of the Codes	Area %
121	212,541	Less than 300mm average rainfall; semi-arid; 0-800m elevation	0.66
122	1,063,903	Less than 300mm average rainfall; semi-arid; 800-1200m elevation	3.31
221	3,176,744	300-500mm average rainfall; semi-arid; 0-800m elevation	9.90
222	8,552,119	300-500mm average rainfall; semi-arid; 800-1200m elevation	26.64
223	7,110,676	300-500mm average rainfall; semi-arid; 1200-5100m elevation	22.15
232	452,595	300-500mm average rainfall; Dry-subhumid; 800-1200m elevation	1.41
233	3,946,846	300-500mm average rainfall; Dry-subhumid; 1200-5100m elevation	12.30
321	853,124	500-700mm average rainfall; semi-arid; 0-800m elevation	2.66
322	755,834	500-700mm average rainfall; semi-arid; 800-1200m elevation	2.35
323	46,362	500-700mm average rainfall; semi-arid; 1200-5100m elevation	0.14
331	791,541	500-700mm average rainfall; Dry-subhumid; 0-800m elevation	2.47
332	1,300,562	500-700mm average rainfall; Dry-subhumid; 800-1200m elevation	4.05
333	2,869,315	500-700mm average rainfall; Dry-subhumid; 1200-5100m elevation	8.94
342	11,423	500-700mm average rainfall; Humid; 800-1200m elevation	0.04
343	509,487	500-700mm average rainfall; Humid; 1200-5100m elevation	1.59
431	25,673	More than 700mm average rainfall; Dry-subhumid; 0-800m elevation	0.08
432	205,982	More than 700mm average rainfall; Dry-subhumid; 800-1200m elevation	0.64
433	9,953	More than 700mm average rainfall; Dry-subhumid; 1200-5100m elevation	0.03
442	116,276	More than 700mm average rainfall; Humid; 800-1200m elevation	0.36
443	90,271	More than 700mm average rainfall; Humid; 1200-5100m elevation	0.28
	32,101,226		

DISCUSSION

With this study, the Anatolian steppe is characterized and the border of it delineated and different steppe types are mapped successfully by using Earth Observation data interpretation and by analyzing satellite imagery with the help of GIS technologies based on existing data (Forest stand map, surface temperature, aridity/drought index, soil information, elevation, Geological formations, vegetation indices (NDVI, EVI)) and interpretation of other sources.

The mapping activity totally based on convergence of the evidences approach which provided by the cost-effective, scientifically sound and robust mapping techniques with the help of remote sensing technologies and GIS. The signatures of the steppe region that are based on several indicators are analyzed and the final border that delineates the Anatolian steppe region is predicted.

The map itself doesn't include only the information about the delineated border, but also it reveals the information about the different dynamics of the homogeneous clusters. Therefore this output should be considered very important key output to build the specific strategies for each of the regions with the exact locations. Additionally, the outputs of this study can be a baseline to monitor the changes in the region.

Importance of the scientifically sound layers, such as aridity index and climate data modelling, are recognized very well in this study because the delineation of the steppe border changes with the changes of climatic patterns since it's highly depend-on climate. The findings are based on the vegetation characteristics derived from the satellite images and climate conditions (aridity index). These two indicators are strongly interrelated each other.

The effects of the human-related activities such as deforestation, overgrazing, land cover changes (agricultural intensification, conversion to croplands, afforestation of bare lands (Ambarli et al., 2016), etc.) on steppe ecosystems should be well analyzed, identified and quantified. Moreover, the all drivers, pressures, impacts and the current conditions of the steppe ecosystem in Turkey should also be well analyzed, identified and quantified. (Vulnerable areas, the most impacted regions).

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DETERMINATION OF CATALASE ACTIVITY IN SALT AFFECTED SOILS

E. Erdel, U. Şimşek and F. Mikailsoy

Igdır University, Igdır, Turkey.

Abstract

Soil salinity and alkalinity is an important problem that causes degradation in soils caused by the effect of climatic, topographic or anthropogenic factors. Approximately 955 million hectares of land in the world were affected by salt and approximately 20 million hectares were out of agriculture. In our country, there are salinity and alkalinity problems in 1.5 million ha area, 74% of these areas have salinity, 25.5% salinity-alkalinity and 0.5% alkalinity. There are salinity and alkalinity problems due to the high ground water in Igdır plain, low rainfall (254.2 mm) and high evaporation (1094.9 mm), and human activities accelerate this process. In the region; saline, alkaline, saline-alkali and boron lands are 36,476 ha. This study was established to determine the catalase enzyme activity in soils affected by different levels of salt. For this purpose, soil samples were taken from 3 different points from 0-30 cm depth, 3 samples from each land with different salinity and alkalinity levels, and analyzes were carried out on these samples. Catalase enzyme activity of soil samples was determined with 3 replicates according to Beck (1971). Results showed that catalase activity was 37.25 mlO_2 $3min^{-1}gr\ soil^{-1}$ in highly saline alkaline soils, 68.23 mlO_2 $3min^{-1}gr\ soil^{-1}$ in alkaline soils, 169.23 mlO_2 $3min^{-1}gr\ soil^{-1}$ in soils without salinity and moderately alkaline. As a result of the experiment, it was determined that soil salinity decreases the catalase activity.

Keywords: Catalase activity, Soil salinity, Soil alkalinity.

TUZDAN ETKİLENMİŞ TOPRAKLARDA KATALAZ AKTİVİTESİNİN BELİRLENMESİ

Özet

Toprak tuzluluğu ve alkaliliği iklimsel, topoğrafik veya antropojenik faktörlerin bir veya birkaçının etkisiyle oluşan, topraklarda degradasyona sebep olan önemli bir problemdir. Dünya üzerinde yaklaşık 955 milyon ha alan tuzdan etkilenmiş ve yaklaşık 20 milyon ha alan tarım dışı kalmıştır. Türkiyede ise 1,5 milyon ha alanda tuzluluk ve alkalilik sorunu bulunmakta, bu alanların % 74'ünde tuzluluk, % 25,5'inde tuzluluk-alkalilik ve % 0,5'inde alkalilik (sodyumlu) görülmektedir. Iğdır Ovası'nda taban suyunun yüksek olması, yağışın düşük (254,2 mm) ve buharlaşmanın fazla olması (1094,9 mm) dolayısıyla tuzluluk ve alkalilik sorunu mevcut olup, insan kaynaklı faaliyetler de bu süreci hızlandırmaktadır. Ovadaki tuzdan etkilenen (tuzlu, alkali, tuzlu-alkali ve borlu) arazilerin miktarı 36.476 ha'dır. Bu çalışmada farklı derecede tuzdan etkilenmiş topraklarda katalaz enzimi aktivitesi belirlenmeye çalışılmıştır. Bu amaçla tuzluluk ve alkalilik derecesi farklı her bir araziden 3 örnek olmak üzere 0-30 cm derinlikten 3 farklı araziden toprak örnekleri alınmış ve analizler bu toprak örenkleri üzerinde yürütülmüştür. Alınan toprak örneklerinin katalaz enzim aktivitesi Beck (1971)'e göre 3 tekerrürlü olarak belirlenmiştir. Analiz sonuçlarına göre katalaz aktivitesi; aşırı tuzlu alkali topraklarda 37,25 mlO_2 3 $min^{-1}gr\ soil^{-1}$, alkali topraklarda 68,23 mlO_2 3 $min^{-1}gr\ soil^{-1}$, tuzsuz ve orta derecede alkalin topraklarda ise 169,23 mlO_2 3 $min^{-1}gr\ soil^{-1}$ olarak belirlenmiştir. Deneme sonucunda toprak tuzluluğunun katalaz aktivitesini azalttığı tespit edilmiştir.

Keywords: Katalaz aktivitesi, Toprak tuzluluğu, Toprak alkaliliği.

1. INTRODUCTION

There are different factors that limits crop production in agricultural lands where agricultural production is intensely made. Soil salinity and alkalinity, mostly occur in arid and semi-arid climates, are among these factors. According to the World Soil Map data, it is reported that there are 954 million ha of salt-affected lands with restricted productivity worldwide (FAO, 1988; Szabolcs 1991).

This type of problem soils have spread over 80.5 million ha in Africa, 50.8 million ha in Europe, 357.3 million ha in Australia, 146.9 million ha in America, and 319.3 million ha in the Asian continent (Sönmez, 2003). Every year 10 million hectares of land in the world are disposed of and become unusable due to the salinity problem (Akgül, 2003). Salinity problems are encountered in 1.7% of the land in our country (1.518.746 ha) and in 3.8% of the agricultural lands (837.405 ha). In other words, these lands are equivalent to 2% of our country's surface area and 5.48% (27.699.003 ha) of the total cultivated land. 74% of the total arid lands are salty, 25.5% saline-alkaline and 0.5% alkaline (sodium) soils (Anonymous 1980).

Iğdır Plain has a surface area of 92,000 ha, which has microclimate characteristics in the Eastern Anatolia region, where agricultural production is intensely carried out (two products per year). There are salinity and alkalinity problems due to the high ground water in the plain, low rainfall (254.2 mm) and high evaporation (1094.9 mm), and human activities accelerate this process. In the region; saline, alkaline, saline-alkali and boron lands are 36,476 ha. More than 1/3 of the total agricultural land in Iğdır plain has lost its productivity by being affected by salt (Özkutlu and İnce, 1999).

Enzymes are complex organic substances that catalyze (increase the speed) chemical reactions of biological events in living plant and animal cells and are synthesized by living cells and are almost protein-based compounds. Enzymes in soils are of plant, animal and microbial origin, and collectively their activities express the metabolic status of soils at a given time. By means of soil enzyme activity, soil biological properties and fertility properties can be determined. Soil enzymes have a close relationship with other biological properties of the soil and play an important role in the mineralization process in the soil.

Catalase, one of the soil enzymes, is a protective enzyme that catalyzes the conversion of hydrogen peroxide into water and oxygen, thus preventing hydrogen peroxide from damaging cellular compounds. Catalytic activity of catalyse enzyme is present in high concentration in all aerobic microorganisms, plant and animal cells (Jones ve Masters, 1976; Nicholls ve ark., 2000).

Physico-chemical properties such as pH, soil moisture, temperature, and organic matter greatly affect the enzyme activities of soils (Aliev etal. 1981;Tabatabai, 1982; Mikayilov, 2018). In this study, different pH and electrical conductivity values were investigated on soil catalase activity and the aim of the study is to determine the effects of salinity and alkalinity on catalase activity in soil.

2. MATERIALS AND METHODS

2.1. Study site

The study was carried out in the research area of Igdır University Agricultural Research and Application Center (Figure 1).

Iğdır has a special microclimate feature due to its low altitude and being surrounded by high mountains in the Eastern Anatolia Region. The altitude of the plain is 850 m and summers are hot and winters are mild. In the region, the annual average rainfall is 254.2 mm and the evaporation is 1094,9 mm. The highest rainfall in the region falls in May and the lowest falls in August (Anonymous 2018).

Some physical and chemical soil properties have indicated in Table 1.

Figure 1. Experiment area and sampling points.

Table 1
Soil properties at the experiment site.

Soil properties	**Results**		
	Soil A	**Soil B**	**Soil C**
Clay, %	38,2	37	35
Silt, %	35,4	34,4	31,4
Sand, %	26,4	28,6	33,6
Texture	Clay Loam	Clay Loam	Clay Loam
Organic matter, %	1,06	1,11	1,34
Bulk density, g cm^{-3}	1,47	1,56	1,16
pH (1:2,5)	9,0	9,09	8,22
Electrical conductivity, dS/m	15,32	2,47	1,2

According to soil electrical conductivity and ph analyses; soil A is saline and strong alkaline, soil B is non saline and strong alkaline and soil C is non saline and moderately alkaline (Table 1).

2.2. Soil sampling and analysis

For soil physical and chemical analysis, disturbed and undisturbed soil samples were taken at the beginning of the research from the depth of 0-30 cm. After taken to the laboratory, the samples were sieved from 2mm sieve without air dried and then stored in the refrigerator at 4 C^o.

Bulk density determined in the undisturbed soil samples and soil texture, organic matter, soil pH, electrical conductivity and catalase activity were determined in disturbed soil samples. Soil texture, soil organic matter, bulk density, electrical conductivity and catalase activity were determined according to Gee and Bauder (1986), Walkley and Black (1934), Blake (1965), Demiralay (1993), Beck (1971) respectively. Soil pH was tested with a soil/water ratio of 1:2.5 using a compound electrode in reference to McLean (1982).

2.3. Data analysis

The data were analyzed using the SPSS statistical software program (SPSS 2008).

RESULTS AND DISCUSSION

3.1. Effects of salinity and alkalinity on soil catalase activity

In the study, catalase activity significantly affected salinity and alkalinity ($p<0,05$). While the catalase activity means of soil C is 169.23 mlO_2 $3min^{-1}gr\ soil^{-1}$, soil A and soil B are 37.25 mlO_2 $3min^{-1}gr\ soil^{-1}$, 68.23 mlO_2 $3min^{-1}gr\ soil^{-1}$, respectively. By the average values of the catalase activity, it was found higher under soil C than soil B and soil A (Figure 2). Between soil A and soil B, catalase activity was higher in soil B. It means that alkaline soils have higher catalase activity than saline-alkaline. Consistent with several prior observations, salinity greatly reduced soil enzyme activity (Liang et al., 2005; Shi et al., 2019). The decrease in catalase activity may be caused by the decrease of microbial activity in saline soils. With increasing soil salinity; osmotic stress limits, microbial growth and activity and the microorganisms tend to dehydrate (Galinski 1995, Oren 1999). Some researchers found that, the small increases in electrical conductivity values higly detrimental effected microbial activity in soils (Rietz and Haynes 2003). The decrease in alkaline soils may be caused by toxicities of Na and other accompanying ions (e.g. Cl^- and $HCO3^-$) along with the very high pH may also inhibit microbial growth (Zahran 1997).

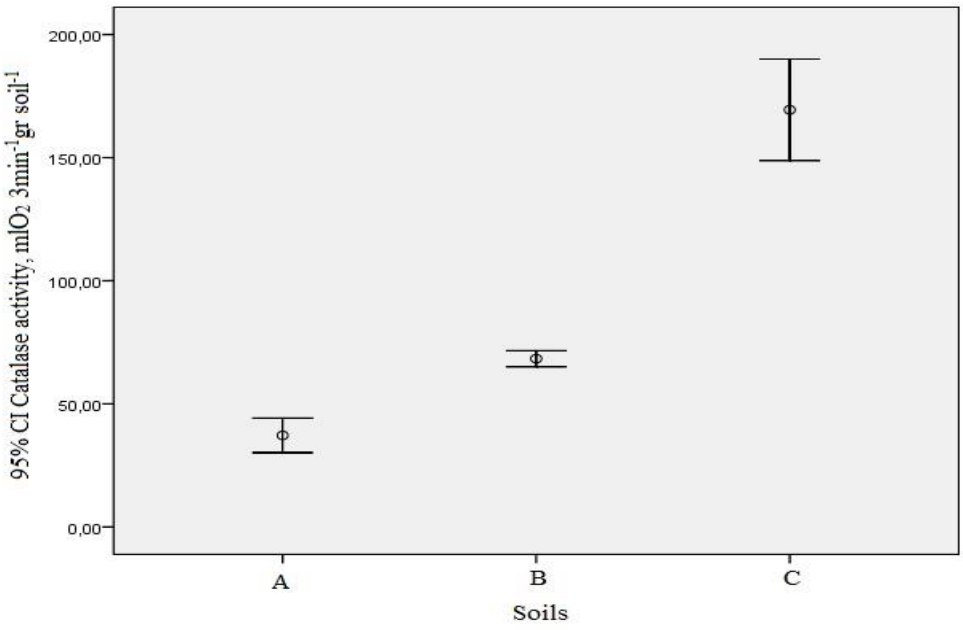

Figure 2. Results of soil catalase activity

CONCLUSION

It is known that soil salinity and alkalinity has many negative effects on soil properties and decreases crop production. In the study, the effect of salinity and alkalinity on catalase enzyme activity in soil was investigated. Results showed that, soil salinity and alkalinity decreased catalase activity and catalase activity in alkaline soils was higher than saline soils.

Adding organic matter which is generally in low amounts especially in arid and semi-arid regions because of high rates of decomposing and is one of the parameters affecting enzyme activity in soils, will cause an increase in enzyme activity in soils besides having positive effects on other soil properties.

Acknowledgements

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In silico CHARACTERIZATION OF SUCROSE SYNTHASE (*SUS*) GENES IN HIGHER PLANT SPECIES

Fırat Kurt *

*Mus Alparslan University, Faculty of Applied Sciences, Department of Plant Production and Technologies, Mus, Turkey

***Corresponding author:** firat.kurt.usa@gmail.com

Abstract

Sucrose synthase (*SUS*) is widely expressed in plants and plays vital roles in plant metabolism and growth. In this study, a total of 50 plant SUS protein sequences were collected from the NCBI protein database and were subjected to homology search, physico-chemical motif, and domain analyses. The domain analysis revealed that sucrose synthase (PF00862) and glycosyl transferase (PF00534) are domain structures in all SUSs. Also, all SUSs are acidic in character and contain a greater number of negatively charged residues (Asp+Glu). Analysis of 10 commonly distributed motifs in the SUSs showed that 6 of 10 motifs are related to sucrose synthase domain, whereas 3 of 10 motifs are associated with glycosyl transferase domain. Predicted N-glycosylation sites showed variations in a species-specific manner, suggesting functional diversities. It was observed that the 3D structure of sucrose synthases domain of *Zea mays*, *Gossypium raimondii*, *Triticum aestivum*, and *Pinus taeda* had the structural divergences. The findings may help for laboratory studies aiming at understanding of SUS genes in plants.

Keywords: Sucrose synthase, SUS, *in silico* analysis, sequence analysis, 3D model.

Introduction

Sucrose synthase (SUS) is an essential enzyme (E.C. 2.4.1.13) in carbohydrate metabolism of plants converting sucrose and uridine diphosphate (UDP) into fructose and UDP-glucose (Kleczkowski et al., 2010). SUS activities are observed in different intracellular structures, including cell membranes (Matic et al., 2004), cytoskeleton (Winter et al., 1998), and tonoplast (Etxeberria and Gonzalez, 2003). Also, SUS plays an important key role in metabolic processes, such as sugar import (Klotz et al., 2003), environmental stress responses (Bieniawska et al., 2007), nitrogen fixation, and arbuscule maturation (Baier et al., 2010). SUS proteins are also reported to be involved in cellulose synthesis by providing UDP-glucose for cell wall thickening and cotton fiber cell development (Nolte et al., 1995; Albrecht et al., 2003).SUS enzymes take part in providing photosynthetic assimilate supplies

necessary for the sink strength of the sink organs such as potato tubers, carrot roots, maize kernels, and pea embryos (Zou et al., 2013).

Many studies indicate that SUS isozymes are encoded by multigene family in the most plant species with at least three *SUS* genes (Zou et al., 2013). *Arabidopsis* and rice include six distinct active *SUS* genes (Barratt et al., 2001; Hirose et al., 2008). At*SUS1* and At*SUS2* are regulated heavily under environmental stresses in *Arabidopsis* (Dejardin et al., 1997). At*SUS5* and At*SUS6*are expressed in almost all plant organs but no report has been made so farfor stressresponses (Baud et al., 2004). A total of five sucrose synthase genes (Sc*SUSy1*, Sc*SUSy2*, Sc*SUSy3*, Sc*SUSy4*, and Sc*SUSy5*) were identified in three *Saccharum* species, including *S. officinarum*, *S. spontanuem*, *S. robustom* (Zhang et al., 2013). In rice, *SUS*1 is generallytranscribed in elongating tissues, whilst*SUS*2 is expressed in germinating seedlings and in seedlings grown under hypoxic conditions. *SUS*3 and *SUS*4 also are predominantly expressed in the caryopsis (Hirose et al., 2008). Three non-allelic *SUS* genes (Cit*SUS1*, Cit*SUSA*, and Cit*SUS2*) were identified in *Citrus unshiu.* Of these genes, CitSUS1 and CitSUSA are reported to be differentially expressed in several tissues of leaf, flower, and fruit (Komatsu et al., 2002). In all plants, the differential expressions of *SUS* genes prove that each SUS isoform diverged into specific functions in different tissues (Chen et al., 2012). In the present study, *in silico* analysis of 50 sucrose synthase (SUS) protein sequences from different higher plant species were performed. The physico-chemical features, homology search, motif analysis, and N-glycosylation siteswere analyzed by using various bioinformatics tools.

Materials and Methods

All the sequences of sucrose synthase (SUS) were retrieved from different plant species on Genbank database (http://www.ncbi.nlm.nih.gov/protein/).The accession numbers of SUS protein sequences are listed in Table 1(Table 1).*Nostoc azollae* (YP_003719961) was selected as outgroup andthe SUSs sequences were retrieved asfasta format for further analyses.The conserved protein motifs were determined by using MEME server (http://meme.sdsc.edu/meme/meme.html) (Bailey et al., 2009).Physico-chemical data (molecular weight, *pI*, and amino acid composition) were generated by ProtParam (Gasteiger et al., 2005).N-glycosylation sites of the SUS proteins were predicted by using the NetNglyc 1.0 (http://www.cbs.dtu.dk/ services/NetNGlyc/) server. The subcellular distribution of SUS proteins were analyzed by using CELLO v.2.5 (subCELlular LOcalization predictor) (Yu et al., 2006) and WoLF PSORT servers (Horton et al., 2007), respectively.

Table 1. Features of SUS protein sequences in higher plant species

Serial no.	Plant Species	Accession no.	Pfam domain	Subcellular prediction by PSORT	Subcellular prediction by CELLO
1	*Alnus glutinosa*	CAA63122	SS, GT	Chloroplast	Cytoplasm
2	*Arabidopsis thaliana*	CAA50317	SS, GT	Cytoplasm	Cytoplasm
3	*Arachis hypogaea var. vulgaris*	AEF56625	SS, GT	Mitochondrion	Cytoplasm
4	*Bambusa oldhamii*	AAL50572	SS, GT	Cytoplasm	Cytoplasm
5	*Beta vulgaris*	AAR19769	SS, GT	Cytoplasm	Cytoplasm
6	*Cichorium intybus*	ABD61653	SS, GT	Cytoplasm	Cytoplasm
7	*Citrus unshiu*	BAA89049	SS, GT	Mitochondrion	Cytoplasm
8	*Coffea arabica*	CAJ32598	SS, GT	Cytoplasm	Cytoplasm
9	*Coffea canephora*	ABI17891	SS, GT	Cytoplasm	Cytoplasm
10	*Craterostigma plantagineum*	CAB38022	SS, GT	Cytoplasm	Cytoplasm
11	*Cucumis sativus*	AEN83999	SS, GT	Cytoplasm	Cytoplasm
12	*Daucus carota*	CAA53081	SS, GT	Cytoplasm	Cytoplasm
13	*Dendrobium officinale*	ADY02961	SS, GT	Mitochondrion	Cytoplasm
14	*Eucalyptus grandis*	ABB53601	SS, GT	Cytoplasm	Cytoplasm
15	*Glycine max*	NP_001237525	SS, GT	Mitochondrion	Cytoplasm
16	*Gossypium barbadense*	ADY68845	SS, GT	Cytoplasm	Cytoplasm
17	*Gossypium herbaceum*	AEV40896	SS, GT	Chloroplast	Cytoplasm
18	*Gossypium herbaceum* subsp. *africanum*	ADY68846	SS, GT	Chloroplast	Cytoplasm
19	*Gossypium hirsutum*	AEV40894	SS, GT	Chloroplast	Cytoplasm
20	*Gossypium raimondii*	AEV40895	SS, GT	Chloroplast	Cytoplasm
21	*Hordeum vulgare supsp. vulgare*	CAA46701	SS, GT	Cytoplasm	Cytoplasm
22	*Ipomoea batatas*	ACL00957	SS, GT	Mitochondrion	Cytoplasm
23	*Jatropha curcas*	AGH29112	SS, GT	Mitochondrion	Cytoplasm
24	*Lilium davidii*	AGW23638	SS, GT	Cytoplasm	Cytoplasm
25	*Litchi chinensis*	AFP23359	SS, GT	Mitochondrion	Cytoplasm
26	*Lolium perenne*	BAE79815	SS, GT	Chloroplast	Cytoplasm
27	*Malus domestica*	AFU56881	SS, GT	Cytoplasm	Cytoplasm
28	*Mangifera indica*	BAM68528	SS, GT	Cytoplasm	Cytoplasm
29	*Manihot esculenta*	ABD96570	SS, GT	Cytoplasm	Cytoplasm
30	*Medicago falcata*	ABP88869	SS, GT	Mitochondrion	Cytoplasm
31	*Medicago sativa*	AAC17867	SS, GT	Cytoplasm	Cytoplasm
32	*Medicago truncatula*	CAB40795	SS, GT	Cytoplasm	Cytoplasm
33	*Musa acuminata*	AEO09338	SS, GT	Cytoplasm	Cytoplasm
34	*Oryza sativa*	CAA46017	SS, GT	Cytoplasm	Cytoplasm
35	*Oxybasis rubra*	CAA57881	SS, GT	Mitochondrion	Cytoplasm
36	*Phaseolus vulgaris*	AAN76498	SS, GT	Cytoplasm	Cytoplasm
37	*Pinus taeda*	ABR15470	SS, GT	Cytoplasm	Cytoplasm
38	*Pisum sativum*	CAA09910	SS, GT	Mitochondrion	Cytoplasm
39	*Populus tomentosa*	AFZ78659	SS, GT	Cytoplasm	Cytoplasm
40	*Populus tremuloides*	AAR03498	SS, GT	Cytoplasm	Cytoplasm
41	*Prunus persica*	AFI57908	SS, GT	Mitochondrion	Cytoplasm
42	*Saccharum officinarum*	AAM68126	SS, GT	Cytoplasm	Cytoplasm
43	*Solanum lycopersicum*	NP_001234655	SS, GT	Cytoplasm	Cytoplasm
44	*Solanum tuberosum*	AAA97572	SS, GT	Mitochondrion	Cytoplasm
45	*Sorghum bicolor*	ACM69042	SS, GT	Cytoplasm	Cytoplasm
46	*Triticum aestivum*	CAA03935	SS, GT	Cytoplasm	Cytoplasm
47	*Triticum urartu*	EMS66266	SS, GT	Cytoplasm	Cytoplasm
48	*Vicia faba*	CAA49428	SS, GT	Mitochondrion	Cytoplasm
49	*Vigna angularis*	BAH56282	SS, GT	Cytoplasm	Cytoplasm
50	*Zea mays*	CAA26229	SS, GT	Cytoplasm	Cytoplasm

SS: sucrose synthase domain (PF00862), GT: glycosyl transferases domain (PF00534)

Model building and evaluation

Four SUS protein sequences were used for homologymodelling of *G. raimondii, Z. mays, T. aestivum,* and *P. taeda.*Homology modelling of SUS proteins were predicted by using Swiss-Pdb Viewer (Guex et al., 2009). After modelling, the quality and validation of the model was evaluated by Rampage Ramachandran plot analysis (http://mordred.bioc.cam.ac.uk) (Lovell et al. 2003).

Results and discussion

Sequence analysis

A total of 50 sucrose synthase (SUS) protein sequences were analyzed by using various bioinformatics tools and physico-chemical data of SUS protein sequences are shown in Table 2. Molecular weights and sequence lengths ofSUSs range from 83.265 to 100.389 kDa and from 727 to 885 amino acids, respectively.The computed *pI* valuesare between 5.63- 6.34 showing thattheyare acidic in character. Also, total number of negatively charged residues (Asp+Glu) are higher than in total number of positively charged residues (Arg+Lys) in all SUS protein sequences. Predicted N-glycosylation sites analysis showed that all SUSs containN-glycosylation sites ranging between 2 and 7.

Asparagine (N)-linked glycosylation is basic post-translational modificationsites serving for covalent attachment of an oligosaccharide onasparagine residues in proteins. N-X-S/T consensus sequence is accepted as a general recognition element (Schwarz and Aebi, 2011). Tonoplast-associated SuSy (sucrose synthase) is phosphorylated in the presence of sucrose, but not plasmalemma-associated SuSy in *Acer pseudoplatanus*(Pozueta-Romero et al., 2004). In N-terminal regulatory domain of AtSUS1, two serine residues play important roles as sites for phosphorylation (Zheng et al., 2011). In maize, serine 15 (S15) is probable phosphorylation sites in SUS1 protein (Huber et al., 1996). Multiple phosphorylation, N-glycosylation and leucine zipper motifs are identified as SUS3 in maize (Carlson et al., 2002). Consecutively, it can be suggested that SUS function and enzymatic activity are regulated heavily in plant metabolic pathways.

SuSy can be soluble or insoluble due to binding to different subcellular structuresin the cell (Pozueta-Romero et al., 2004). SUS enzymes can be associated with the plasma membrane, actin cytoskeleton, amyloplasts, golgi, and tonoplast (Duncan et al., 2006).

Changes in sucrose synthase (SuSy) activity are associated with cellular location and different isoforms (Komatsu et al., 2002; Pozueta-Romero et al., 2004). Subcellular localizations of all SUSs in this study were predicted to be in cytoplasm. Of these proteins, 30 of 50 SUSs were also

predicted to be localized in mitochondrion (13 members), followed by chloroplast (7 members) according to computations on the WoLF PSORT server (Table 1). With parallel to this prediction, the distributions of SUS proteins were determined not only in cytoplasm but also inmitochondrion and chloroplast in the laboratory studies. In this respect, it is reported thatone of maize SUS isoforms SH1 protein was found to have a putative mitochondrial targeting peptide (mTP)(Subbaiah et al., 2006). By and large, some SUS proteins, as indicated in previous studies,seems toplay important roles in mitochondrion and many SUSs may contribute to cytoplasmic sucrose metabolism.

All SUS sequences contain sucrose synthase (PF00862) and glycosyl transferase (PF00534) domains based on Pfam database searches (Table 1). A search of the Pfam database revealed that 126 sequences have the sucrose synthase and glycosyl transferase domain whereas 34 sequences contain only sucrose synthase domain in various organisms (Jayashree et al., 2008). In *Arabidopsis*, the analysis of six At*SUS* genes displayed that sucrose synthase and glycosyl transferase domains are present in all genes (Baud et al., 2004). The sucrose synthase and the glucosyl-transferase domains are accepted as typical signatures of SUS proteins in cotton (Chen et al., 2012).

When all SUS sequences were provided to MEME server, a total of 10 common motifs were observed (Table 3). 6 of 10 motifs were related with sucrose synthase domain, whilst 3 motifs were related to glycosyl transferases group 1 domain.Whereasonly the motif five was not found in *Ipomoea batatas*, all motifs (motif 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10) were detectedin the other plant species. In protein evolution, motifs with short amino acid residues (5-25 amino acids) are being related with biological functions or protein structures (Saito et al., 2007). Conserved sequence regions inproteinsare important for understanding functionally and structurally distinct regions (Sitbon and Pietrokovski, 2007). Overall, the conserved regions in*SUS* genes may shape SUS domain architecture determining catalytic activity andstructural flexibility of SUS proteins in plants.

Table 2. Biochemical characteristics and predicted N-glycosylation sites of SUS protein sequences in higher plants

Source organisms	Number of amino acids	Molecular weight (kDa)	Theoretical *pI*	Total number of negatively charged residues (Asp+Glu)	Total number of positively charged residues (Arg+Lys)	Predicted N-glycosylation sites
Alnus glutinosa	803	91.630	6.34	104	95	141 NASF, 410 NYSD, 469 NHTD, 581 NITG
Arabidopsis thaliana	807	92.924	5.66	120	99	19 NETL, 132 NFTL, 143 NASI, 414 NYSD , 474 NHTD , 587 NLSG
Arachis hypogaea var. vulgaris	806	92.419	5.93	113	95	150 NKSI, 412 NYSD, 471 NHTD , 584 NITG
Bambusa oldhamii	808	92.124	5.98	105	91	98 NVSE, 138 NASF, 409 NYSD , 468 NHTD , 581 NMTG
Beta vulgaris	805	92.227	5.90	112	95	409 NYSD , 468 NHTD, 530 NYTE, 581 NMTG , 735 NISK
Cichorium intybus	806	92.055	5.95	111	93	411 NYSE, 470 NHTD , 584 NLTG
Citrus unshiu	805	92.173	5.90	112	96	141 NASF, 412 NYSD, 471 NHTD, 584 NLTG
Coffea arabica	811	92.818	5.89	110	94	143 NATF, 329 NVTP, 414 NYSD, 473 NHSD, 490 NNTV, 586 NITG
Coffea canephora	806	92.606	6.03	114	99	412 NYSE, 471 NHTD, 584 NLTG
Craterostigma plantagineum	811	92.526	5.90	110	93	143 NASF, 414 NYSD, 473 NNSD, 586 NITG
Cucumis sativus	806	92.627	5.67	116	96	141 NASF, 412 NYSD, 471 NHTD, 584 NITG
Daucus carota	808	92.474	6.21	107	95	414 NYSE, 473 NHTD, 586 NLTG
Dendrobium officinale	807	91.990	5.83	111	90	103 NVSE , 143 NASF, 414 NYSD, 586 NITG
Eucalyptus grandis	805	92.685	6.05	113	98	412 NYSD, 471 NHTD, 499 NFTL, 584 NLTG, 762 NLTA
Glycine max	805	92.243	6.04	111	95	150 NKSI, 412 NYSD, 471 NHTD, 584 NITG
Gossypium barbadense	805	92.643	6.10	113	99	141 NSSF, 327 NITP, 412 NYSD, 471 NHTD, 584 NLTG
Gossypium herbaceum	809	92.073	5.99	109	94	143 NASF, 150 NRSS, 414 NYSD, 586 NMTG
Gossypium herbaceum subsp. africanum	805	92.673	6.17	114	101	141 NSSF, 327 NITP, 412 NYSD, 471 NHTD, 584 NLTG
Gossypium hirsutum	809	91.988	5.99	109	94	143 NASF, 150 NRSS, 414 NYSD
Gossypium raimondii	809	92.218	5.99	110	95	143 NASF, 150 NRSS, 414 NYSD, 586 NMTG
Hordeum vulgare	807	92.211	5.94	108	92	98 NVSE, 138 NASF, 408 NYSD, 467 NHTD, 580 NMTG
Ipomoea batatas	727	83.265	5.63	103	80	471 NHTD, 584 NLTG
Jatropha curcas	805	92.686	6.00	112	96	141 NASF, 412 NYSD, 471 NHSD, 584 NLSG
Lilium davidii	846	96.049	6.02	110	95	12 NHTF, 134 NFTL, 145 NASF, 192 NGTS, 416 NYSD, 588 NITG, 829 NGSV, 843 NGTK
Litchi chinensis	819	93.454	6.01	106	91	143 NATF, 150 NRSS, 414 NYSD, 586 NMTG.

Table 2. (Continued)

Source organisms	Number of amino acids	Molecular weight (kDa)	Theoretical *pI*	Total number of negatively charged residues (Asp+Glu)	Total number of positively charged residues (Arg+Lys)	Predicted N-glycosylation sites
Lolium perenne	885	100.389	6.53	108	102	98 NVSD, 138 NASA, 408 NYSD, 467 NHTD, 580 NMTG
Malus domestica	812	92.891	5.77	110	92	415 NYSD, 587 NMTG
Mangifera indica	800	91.522	6.02	105	93	167 NSSM, 180 NFSE, 407 NYSD, 466 NHTD, 579 NLTG
Manihot esculenta	806	92.783	5.98	114	97	141 NASF, 412 NYSD, 471 NHTD, 584 NLTG
Medicago falcata	804	92.428	6.03	113	98	149 NKSI, 411 NYSD, 470 NHTD, 583 NITG
Medicago sativa	805	92.333	5.85	114	95	150 NKSI, 412 NYSD, 471 NHTD, 584 NITG
Medicago truncatula	805	92.335	5.86	113	95	150 NKSI, 412 NYSD, 471 NHTD, 584 NITG
Musa acuminata	816	92.996	5.94	106	90	102 NISE, 143 NASF, 414 NYSD, 568 NDTK, 586 NLTG
Oryza sativa	808	92.129	5.96	103	88	98 NVSE, 138 NASF, 409 NYSD, 468 NHTD, 581 NMTG, 610 NQSK, 735 NISQ
Oxybasis rubra	803	92.066	5.88	112	95	139 NASF, 409 NYSD, 468 NHTD, 581 NMTG, 729 NPSH.
Phaseolus vulgaris	805	92.024	5.82	110	90	150 NKSI, 412 NYSD, 471 NHTD
Pinus taeda	833	95.273	6.02	112	96	126 NGSV, 143 NASF, 415 NYSD, 587 NMTG, 826 NGTL
Pisum sativum	806	92.502	5.84	114	95	150 NKSI, 412 NYSD, 471 NHTD, 584 NITG
Populus tomentosa	803	92.156	6.00	109	94	410 NYSD, 469 NHTD, 582 NLTG
Populus tremuloides	805	92.523	6.02	111	96	141 NASF, 412 NYSD, 471 NHTD, 584 NLTG
Prunus persica	806	92.605	5.95	113	97	141 NASF, 412 NYSD, 471 NHTD, 584 NITG
Saccharum officinarum	822	91.723	5.77	105	88	98 NVSE, 138 NASF, 409 NYSD, 468 NHTD, 581 NMTG
Solanum lycopersicum	805	92.446	5.90	114	95	412 NYSE, 471 NHTD, 584 NLTG
Solanum tuberosum	805	92.577	5.98	113	97	124 NGTS, 412 NYSE, 471 NHTD, 584 NLTG
Sorghum bicolor	802	91.712	5.82	104	88	98 NVSE, 138 NASF, 409 NYSD, 468 NHTD, 581 NMTG
Triticum aestivum	815	92.608	6.17	101	88	106 NVSE, 129 NGSI, 146 NASF, 417 NYSD, 588 NMTG
Triticum urartu	815	92.639	5.85	104	85	106 NVSE, 145 NASF, 416 NYSD, 588 NLTG, 617 NPSK
Vicia faba	806	92.521	5.78	115	95	150 NKSI, 412 NYSD, 471 NHTD, 584 NITG
Vigna angularis	805	92.093	6.02	110	94	150 NKSI, 412 NYSD, 471 NHTD, 584 NITG
Zea mays	802	91.732	5.96	104	90	98 NVSE, 138 NASF, 409 NYSD, 468 NHTD, 581 NMTG

Table 3. Ten different motifs commonly observed in sucrose synthase protein sequences

Motifnumber	Width Sequence	Protein sequences	Pfam Domain
1	50	YHFSCQFTADLIAMNHTDFIITSTFQEIAGSKDTVGQYESHTAFTLPGLY	Sucrose synthase
2	41	AFGLTVVEAMTCGLPTFATCHGGPAEIIVHGKSGFHIDPYH	Glycosyl transferases
3 3	50	APDPCTLETFLGRIPMVFNVVILSPHGYFAQDNVLGYPDTGGQVVYILDQ	Sucrose synthase
4	50	EMKKMYSLIETYNLNGQFRWISSQMNRVRNGELYRYICDTKGAFVQPAFY	Glycosyl transferases
5	50	DFFEKCKADPSHWDKISQGGLQRIYEKYTWQIYSQRLMTLTGVYGFWKHV	Not found
6	50	FPRPTMSKSIGNGVQFLNRHLSAKMFHDKESMHPLLNFLRAHCYKGKTMM	Sucrose synthase
7	31	EMQGKPDLIIGNYSDGNIVASLLAHKLGVTQ	Sucrose synthase
8	41	VRALENEMLHRIKQQGLDITPRILIVTRLLPDAVGTTCGQR	Glycosyl transferases
9	50	HICVLKDRNKPIIFTMARLDRVKNMTGLVEWYGKNAKLRELVNLVVVAGD	Sucrose synthase
10	50	QEAIVLPPWVALAVRPRPGVWEYIRVNVHALVVEELQVSEYLHFKEELVD	Sucrose synthase

Three-dimensional model of SUS proteins

Proteins consist of domains with distinct structure, function and/or evolutionary history. Domain rearrangements and sequence differentiation are very important to understand the development of new functions of proteins (Bjorklund et al., 2005). Proteins' three-dimensional structuresare more conserved than protein sequences or functions (Kinch and Grishin, 2002). For domain modelling, four divergent SUS proteins were selected by including two monocots (*Z. mays* and *T. aestivum*) and two dicots (*G. raimondii*and *P. taeda*) (Figure 1A, B, C, and D). It was observed that 3D structures of these proteins (monocots and dicots species)contained some structural divergences. SUS isoforms play important roles in both cytosolic and membrane-associated sucrose degradation but their vital effect is observed in isoform-specific functional roles (Duncan et al., 2006). These structural divergences may be explained by isoform-specific functional roles of SUSs in sucrose metabolism.

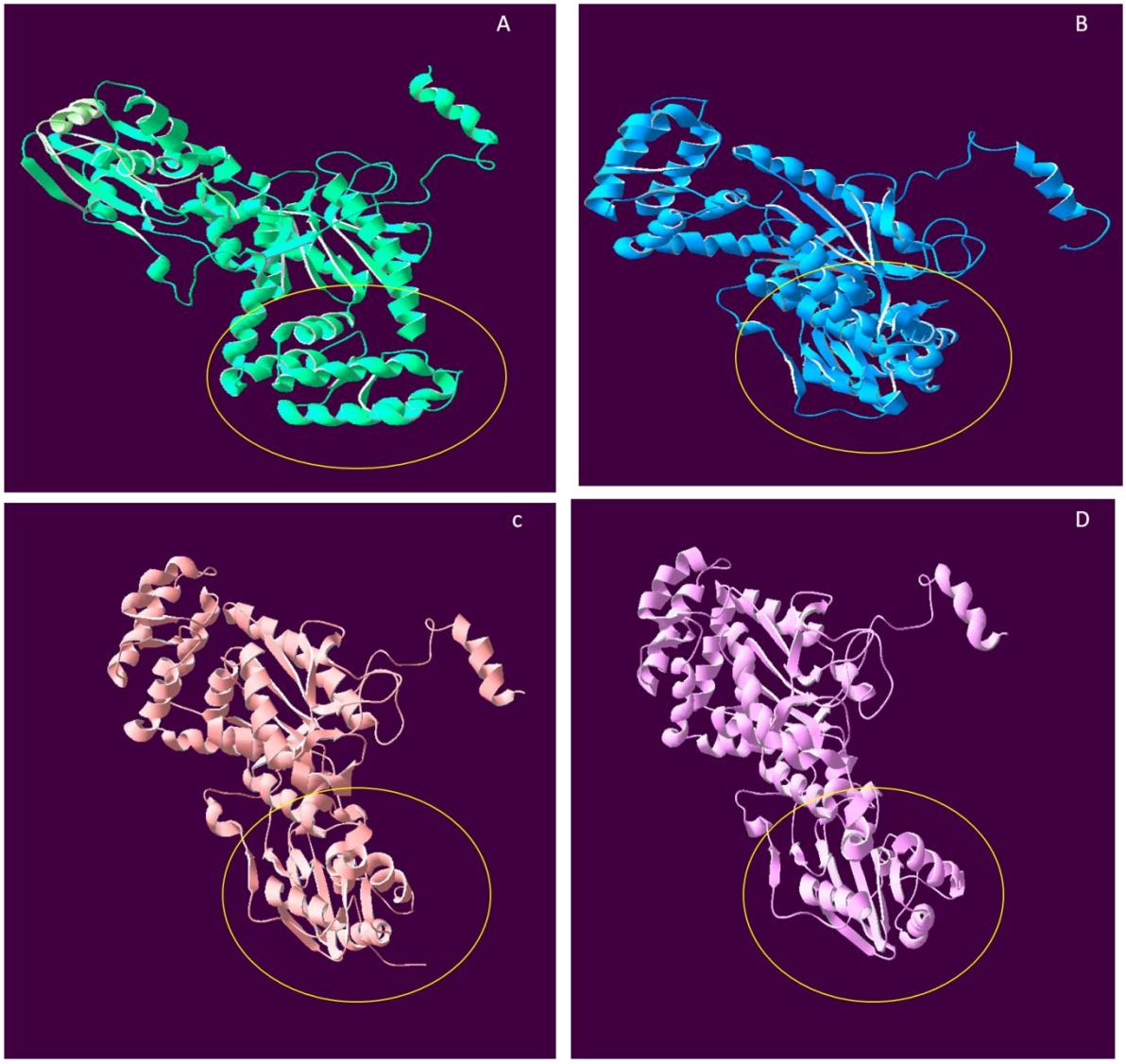

Figure 1. Predicted 3D structureof sucrose synthase domain of*G. raimondii* (A),*Z. mays* (B), *T. aestivum* (C), and *P. taeda* (D). The yellow circles show structural divergences in SUS domains.

The stereo-chemical qualities of the modelled proteins were evaluated by RAMPAGE server. According to Ramachandran plot,2.4%, 2.2%, 3.4%, and 3.2% were in allowed region, and 97.1%, 96.2%, 95.6%, and 95.9% in favored regionin G. *raimondii* (A), *Z. mays* (B), *T. aestivum* (C), and *P. taeda* (D),respectively. Only 0.5%, 1.5%, 1%, and 0.8% residues werefound in outlier region, indicating the predicted 3D protein models were reliable and good quality.

Conclusion

In conclusion, *in silico* characterization of plant sucrose synthases has revealed the sequence similarity along with similar physico-chemical properties and conserved motif structures. The findings may help for laboratory studies aiming at understanding of SUS genes in plants.

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PHYSIOLOGICAL AND VEGETATIVE DEVELOPMENT RESPONSES OF GRAPEVINE ROOTSTOCK SAPLINGS TO GRAPE POMACE, SPENT MUSHROOM COMPOST AND FARMYARD MANURE APPLICATIONS

A. SABIR[1], Y. GAYRETLI[2], S. A. A. ABDULHADI[2]

[1] Horticulture Department, Agriculture Faculty, Selcuk University, Konya, Turkey
[2]Graduate School of Natural and Applied Science, Selcuk University, Konya, Turkey

ABSTRACT

Agricultural production has been pressurized by multiple environmental stress factors aggravated by climatic extremes. Precision agricultural techniques have therefore gained particular prominence to maintain the food demand of global population with sustainable principles. Grape pomace as juice process residue, spent mushroom compost, farmyard manure and control (no supplement) were tested on the physiological and vegetative development saplings of 41 B, 44-53 M and Rupestris du Lot rootstocks. The general growth medium was obtained with the equal mixture of vineyard soil and sand. Four different growth media were obtained by supplementing the each substance in 25% solid volume, while the control group has not received any of them. The rooted cuttings of each rootstock were transplanted into the plastic pots filled with the mixture of the growth media.Spent mushroom compost resulted in the highest shoot length in 41 B and Rupestris du Lot rootstock saplings. Certain physiological activities of the rootstocks were also affected by the applications, indicating the significance of growth media in nursery practices. The uses of spent mushroom compost and fermented pomace have been recommended to use in nursery production to harden the grapevine saplings against the stress factors for a sustainable viticulture.
Keywords: Grapevine nursery, sustainable viticulture, cultural practices, sapling hardening.

INTRODUCTION

In recent years, the use of high-yielding crop cultivars, synthetic fertilizers and pesticides in combination with mechanization have remarkably increased worldwide agricultural production. However, the overuse of agrochemicals has caused the eutrophication
and contamination of agricultural soil and water. Organic farming and/or sustainable agriculture have been proposed as essential strategies to reconcile food production, biodiversity conservation and environmental sustainability. Agricultural soil amendment practices are vital for the success of sustainable food production and for the functioning of agroecosystems in general. The soils around the Konya Closed Basin has been characterized by having low water retention, low levels of organic matter and nutrient availability which correspond to inceptisol soils with low organic matter contents and high pH. The use of organic amendments has been strongly recommended as the concept of integrated nutrient management to improve plant and soil quality.

The grape pomace is an abundant by-product (solid organic waste) composed of the remaining cluster stalks, berry skins and seeds representing around 25% of the total grape weight used in the juice process depending on the variety and process (Oliveira and Duarte, 2016). The material is characterized by C:N ratio ranges from 40 to 45:1 and pH ranges from 3 to 6, low electrical conductivity, and high organic matter content and organic forms of micro and macro-nutrients, which are mineralized through time (García-Lomillo and Gonzalez-San José,2017; Salgado et al. 2019). Therefore, the products generated by the composting of grape pomace can have a great positive impact in response toapplied quality organic amendments in the same grape

crops, considering the necessity to improve the inceptisol soil quality. Therefore, recent attention has been focused on the effective use of grape pomace as a secondary byproduct of grape process for the production of organic fertilizer through the composting.Similarly spent mushroom compost, remaining from the mushroom production, is a bulky waste product and a type of slow-release organic plant fertilizer. After pasteurization process to reduce hygiene problems, it is an ideal soil enrichment substance with its nutrients.

The objective of this study was to evaluate the effects of farmyard manure, spent mushroom compost and grape pomace on growth medium pH and plant development in grapevine rootstocks (41 B, 44-53 M and Rupestris du Lot). Spent mushroom compost and grape pomace, as good organic materials for soil amendment, were evaluated for their effects on grapevine growth in comparison to both untreated control and farmyard manure commonly applied by farmers.

MATERIALS AND METHODS

The present study was performed at the Research and ImplementationGlasshouse (38°01.814 N, 032°30.546E, and 1158m altitude) and laboratories of Selcuk University Agriculture Faculty Horticulture Department.

Experimental Description

Experimental plants consisted of three worldwide grapevine rootstocks originating from different genetic background; 41 B (*Vitis vinifera* x *V. berlandieri*), 44-53 M (*V. riparia* x *V. rupestris*) and Rupestris du Lot (*V. rupestris*).Four different growth media were prepared to compare for their effects on plant development.

For this purpose, farmyard manure, spent mushroom compost and grape pomace were supplemented into the growth medium used in the pots. Before their uses, the substances were kept for one year to let them proper composting and decreasing the salinity level. Such maintenance would also reduce the risk of possible NH4-N toxic effectof fresh compost. The main growth medium was prepared with equal mixture of vineyard soil and sand. Each of the organic substances in 25% solid volume was added into the growth medium, while none of them was used for the control medium. The cuttings of each rootstock genotypes were rooted in perlite medium for three months in controlled glasshouse. At the beginning of the vegetation period, the rooted cuttings with equal development about ten cm shoot were transplanted into plastic pots.The plants were placed in east-westoriented rows in controlled glasshouse with the spaces 25×50cm. The single shoot per plant was tied withthread to wires 2.2 m above the ground to let plants grow on a perpendicularposition to ensure equally benefiting from the sunlight. Thevines received the same cultivation conditions and were dripirrigated using one line for per plant row, single emitter per vine. Irrigation amount and intervals were regulated according to daily climatic conditions.

Measurements and Analyses

For pH quantification, soil samples in the middle of growth period were collected from the root zone of the pots. The pH of each growth medium was measured in de-ionized water electrometrically (pH meter, Seven Easy, Switzerland) on a 1:5 (w/v) dry soil:water suspension after2 h stirring using a glass membrane electrode at 25 °C(Richards 1954).

To investigate the physiological response of the plants to organic substances, leaf temperature (T_{leaf}) and stomatal conductance (gs) investigations were carried out in the middle of the vegetation. T_{leaf} and gs were recorded at around 10 a. m. (Sabir and Yazar 2015) using a portable porometer (SC-1 Leaf Porometer). Measurements were performed on a total of nine south-facing, sun-exposed mature but not senescence leaves born at thetop 5th to the 7th nodes per treatments (Stavrinides et al.2010).

Leaf chlorophyll density (SPAD meter value mean, expressed asSPAD units) of 3rd and 4th nodes of each shoot was estimatedby SPAD readings using a portable chlorophyllmeter (SPAD-502; Konica Minolta Sensing, Inc., Japan).

Leaf (node) number per shoot, leafarea (LA, cm^2), leaf fresh mass (FM, g) and leaf dry mass (DM, g) were determined on fully expanded leaves of of each treatment (Tramontini et al. 2013). Two groups of mature leaves, consistingof nine leaves per treatment, were collected from themid-shoot area of each plant (OIV 1997). The first group was scanned to determine single LA using Win Folia computer software program, while the second was immediatelyweighed to determine FM. After weighing, they dried to the constant weight to record dry mass (DM).

At the end of the summer, shoot length was measured with a sensitivity of 1 mm. Shoot diameter was measured by digital calipers at 1 cm above the second node.

Statistical Analysis

Numerical data were subjected to statistical analysis usinga factorial design. Each treatment was designed withthree replicates consisting of nine plants. As the rootstockshave different physiological response to environmentalfactors, the mean values of parameters were compared separately for each rootstock separately using the least significant difference (LSD) test. Statistical tests were performed at $P < 0.05$ using SPSS 13.0 for Windows (SPSS Inc., Chicago, IL, USA).

RESULTS AND DISCUSSION

All the organic matters supplied into the soil significantly decreased the pH (Fig. 1). The highest decrease was obtained from grape pomace (7.3) application in comparison to the control soil (7.7). Farmyard manure (7.5) and spent mushroom compost (7.6) were also effective on decreasing the soil pH. The microbial activity in cultivated soil is more efficient around the neutral pH (Rousk and Baath, 2011). Therefore, the organic substances used in the study would also improve the biological feature of the growth medium with the highest benefit of pomace.

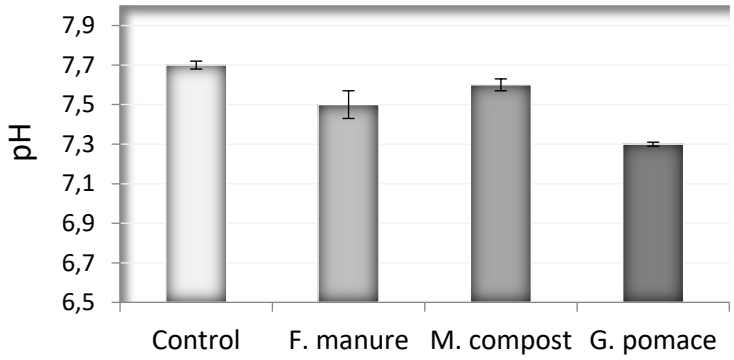

Figure 1. Changes in soil pH in response to organic matter supplementation growth medium.

Shoot length is one of the reliable parameters indicating the degree of plant vegetative development. Shoot growths of the rootstocks displayed significant differences in response to organic matter applications (Fig. 2). In 41 B, all of the applications resulted in significant increases in shoot length, ranging from 96.8 cm (control) to 122.0 cm (grape pomace). In 44-53 M rootstock, pomace application (195.5 cm) also led to significant increase in shoot growth although other substances did not affect the shoot elongation. Pomace addition into the soil provided 17% increase in shoot development in this rootstock. On the other hand, the spent mushroom compost was the only effective substance in Rupestris du Lot rootstock with 13% growth enhancement. The grape

pomace is an abundant by-product consisting of the remaining berry skins, seeds and cluster stalksrepresenting around 25% of the total grape weight used in the must process (Oliveira and Duarte, 2016). Themoisture after pressing is around 20-30% w/w, and the material ischaracterized by C:N ratio ranges from 40 to 45:1, low electrical conductivity, and high organic substance content and organic micro and macro-nutrients, which aremineralized through time (García-Lomillo and Gonzalez-San Jose, 2017).Therefore, the plant nutrients generated by the presence of grape pomace in growth medium could have a great positive impact on shoot development of the grapevine rootstocks.

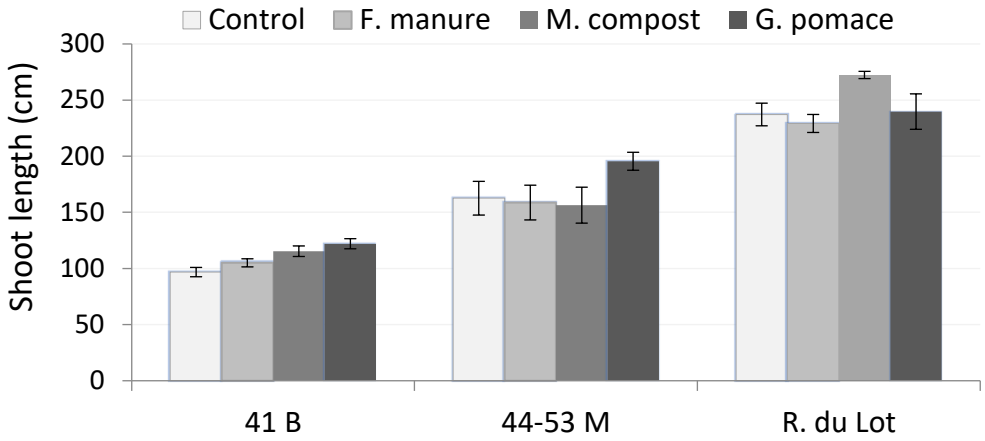

Figure 2. Changes in shoot length of the rootstocks in response to organic matter supplementation into the growth medium.

The gs was also affected by organic matters used in the growth medium (Fig. 3). In general, farmyard manure tended to decrease the gs. In Rupestris du Lot, the effect of spent mushroom compost on gs was obvious. In plants stomatal regulation is a complex physiology involving feedback controls which interact with a wide range of environmental stimuli (Zweifel et al. 2007), and the plant responses to various stimuli are integrated into a system of regulation of stomatal conductance for harvesting as much carbon as possible. Mushroom compost may have affected the stomatal behavior through the amending the growth medium physical features including water holding capacity. Water deficit, due to limitations of soil available water, usually impacts on leaf gs.

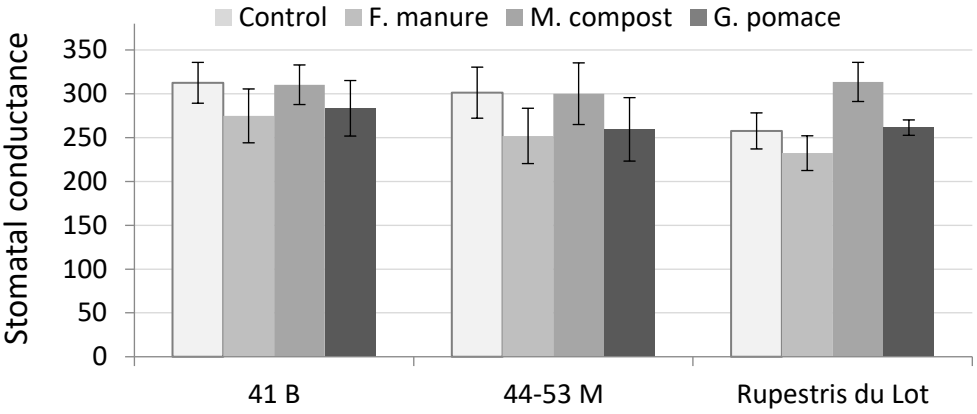

Figure 3. Changes in stomatal conductance of the rootstocks in response to organic matter supplementation into the growth medium.

As depicted in Fig. 4, T_{leaf} did not show significant difference in response to organic matter supplementation into the growth media across the rootstocks.

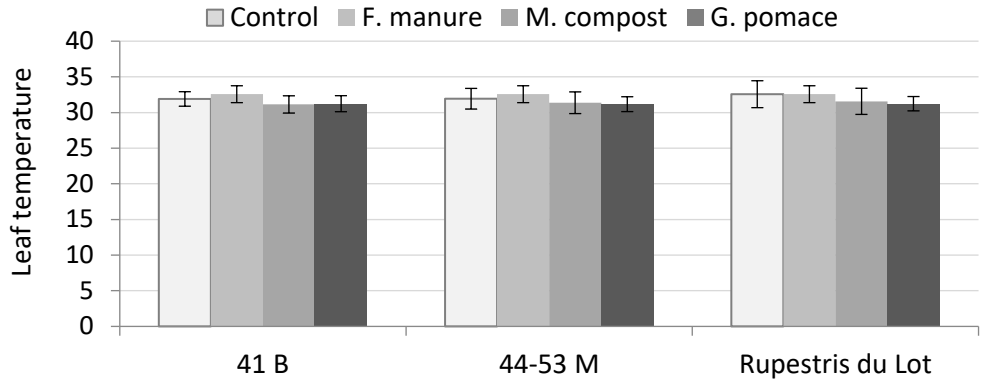

Figure 4. Changes in leaf temperature of the rootstocks in response to organic matter supplementation into the growth medium.

Leaf chlorophyll content, estimated as SPAD readings, showed differences between the applications (Fig. 5). Grape pomace application resulted in the highest chlorophyll content in leaves, although the only significant affect was found in Rupestris du Lot when compared with control.

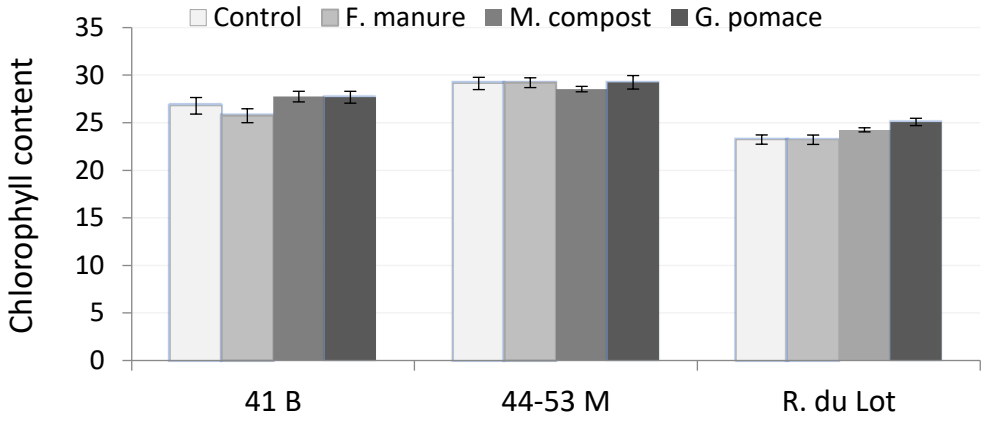

Figure 5. Changes in leaf chlorophyll content of the rootstocks in response to organic matter supplementation into the growth medium.

Leaf area displayed a wide variation in response to organic matter applications (Fig. 6). Grape pomace applied let to higher leaf area than untreated control grapes across the grapevine rootstocks.The elevation in the leaf surface area may provide better rates of photosynthesis, which were based on a large photosynthetic area and high levels of photosynthetic pigments (Dineshkumar et al., 2018).

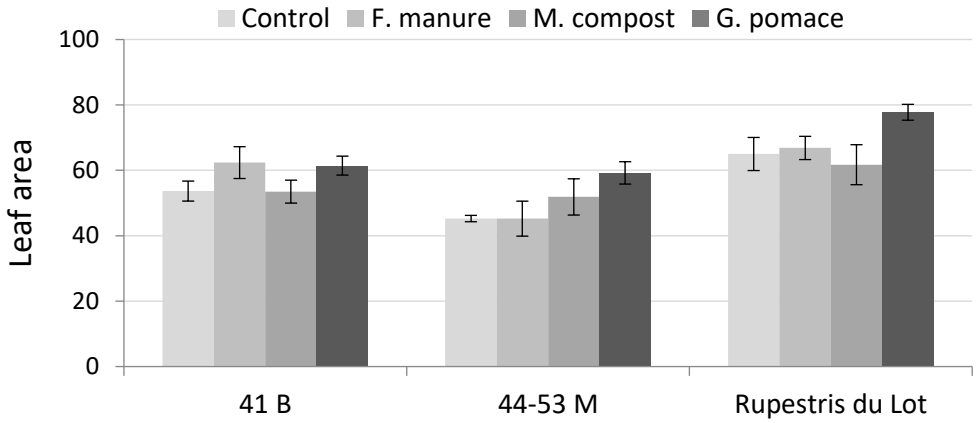

Figure 6. Changes in leaf area of the rootstocks in response to organic matter supplementation into the growth medium.

Similar to leaf area findings, the highest leaf fresh and dry mass values were obtained from the pomace application (Table 2). Spent mushroom compost also let to remarkable increases in leaf mass. Improvements in vegetative development of tomato plants were also reposted by Sönmez (2017) who investigated the effects of spent mushroom compost utilization with the mixture of different growing media on the seedling quality.

Table 1. Changes in leaf fresh and dry masses of the rootstocks in response to organic matter supplementation into the growth medium.

Rootstocks	Treatment	Leaf fresh mass (g)	Leaf fresh mass (g)
41 B	Control	1.28±0.19ab	0.34±0.02 b
	F.manure	1.24±0.04 b	0.31±0.02 b
	M. compost	1.48±0.06 a	0.38±0.03 a
	G. pomace	1.51±0.09 a	0.39±0.02 a
44-53 M	Control	1.12±0.13 c	0.28±0.04bc
	F. manure	1.04±0.04 c	0.24±0.01 c
	M. compost	1.30±0.05 b	0.35±0.06ab
	G. pomace	1.69±0.09 a	0.43±0.05 a
Rupestris du Lot	Control	1.58±0.12b	0.39±0.05b
	F. manure	1.76±0.07b	0.49±0.04b
	M. compost	2.01±0.13a	0.39±0.06a
	G. pomace	2.08±0.08a	0.51±0.03a
Means of triplicate measurements are presented with standard deviations. Data with different letters are significantly different ($P<0.05$)			

CONCLUSION

Multiple environmental stress factors accompanying with climate changes should be managed through the use of precision techniques in agriculture to sustain the global food demand. Organic residues have great potential for sustainable agricultural production. Grape pomace, spent mushroom compost, farmyard manure were tested on the physiological and vegetative development of grapevine rootstocks cultivated in equal mixture of vineyard soil and sand media in pots. All of

the organic substance, added with 25% solid volume, decreased the pH of the growth medium with the highest effect of pomace. Shoot length and leaf development features such as chlorophyll content, area and mass were considerably enhanced by pomace application. Spent mushroom compost also let to remarkable enhances in several growth parameters in comparison to control. Therefore, the uses of spent mushroom compost and fermented pomace could be recommended to add into the nursery growth medium to harden the grapevine saplings against the stress factors for a sustainable viticulture.

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BICARBONATE INDUCED CALCIUM STRESS IMPAIRS THE PHYSIOLOGY OF GRAFTED AND NONGRAFTED 'PRIMA' GRAPEVINES IN NURSERY

Y. GAYRETLI[1], S.A.A. ABDULHADI[1], A. SABIR[2]

[1]Graduate School of Natural and Applied Science, Selcuk University, Konya, Turkey

[2] Horticulture Department, Agriculture Faculty, Selcuk University, Konya, Turkey

ABSTRACT

Calcareous soil conditions frequently cause significant decreases in agricultural productivity worldwide. Therefore, investigations on the physiological responses of grapevine genotypes to calcium stress would yield invaluable knowledge to recover growth imbalances in nursery. This study was conducted on the evaluation bicarbonate ($NaHCO_3$) induced calcium stress on the physiology of grafted or nongrafted 'Prima' grapevines in nursery. One year old saplings cultivated individually in plastic pots under glasshouse condition were subjected to two different doses (50 and 100 mL per plant) of 1 N$NaHCO_3$ solution. The application of $NaHCO_3$ solutions was replicated three times to understand the detrimental effect of calcium stress on grapevine physiology. Findings revealed remarkable negative effects of calcium stress on grapevine physiology depending of the doses and the use of rootstock.

Keywords: Rootstock use, chlorosis, vine physiology, calcium stress, soil pH.

INTRODUCTION

Environmental stress factors as drought, salinity, and temperature extremes reduce the yield and quality of horticultural plants across the world. Thus, the studies on developing sustainable methods to alleviate the adverse effects of such stress factors should be performed with priority. Under stress conditions, agricultural production should also be enhanced in order to sustain the food necessities of rapidly growing world population. To supply the food demands of increasing population, protected cultivation has gained particular significance to protect plans and commodities against u multiple stress factors. Though, the majority of crops in protected cultivation are grown in soil, there has been an increasing interest in the use of soilless culture techniques to reduce soil-specific problems (Gayretli et al., 2019). However, experimental studies on the impacts of macro- and micro-element deficiencies on grapvines are still inadequate to match necessity of clear knowledge to sort out the problems regarding to vineyard nutrition applications under stress conditions.

Roughly 30% of total land area of the world is calcareous soils resulting from high calcium carbonate content and alkalinity (Sánchez-Rodríguez et al. 2014). The bioavailability of certain micronutrients in these soils is low because the high pH limits the solubility of the nutrients. Particularly, the restrictive effect of high pH on grapevine nutrient acquisition physiology also causes lime stress in vineyards worldwide. Hence, nutrient deficiency in plants is a worldwide trouble that impact many crops cultivated in calcareous soils. Many cultivated perennial plants, including some *Vitis* spp., shows low degree of lime tolerance. It has been well-known that high bicarbonate degrees in the soil induce iron chlorosis and increase soil pH.

Iron chlorosis, in calcareous soils and water deficit are prevalent environmental stresses in the Mediterranean Region. Therefore, in this region, they engender critical economic losses in grapevine production. Within non-irrigated vineyards, local differentness in soil conditions, such as

texture, pH or active limestone content, can generate a wide variability in vine-to-vine water and/or iron status, influencing yield and grape composition (Martín et al., 2007; Li et al., 2017).

While there are many literature data on growth and development of vine, we still do not have enough knowledge with regard to lime-induced chlorosis because lime-induced chlorosis is a sophisticated phenomenon. Lime-induced chlorosis impacts major annual crops and perennial plants growing on calcareous soils. Many woody crop plants such as grapevine are traditionally grown with scion varieties grafted onto rootstocks. The selection of an appropriate rootstock is essential to be managed the growth and yield of the scion. After European vineyards were destroyed by the phylloxera in the second half of the 19th century, the use of rootstocks obtained a new dimension.

Vitis vinifera L. itself shows symptoms of iron (Fe) deficiency when grafted on some lime-susceptible American rootstocks, which have been made use of following phylloxera invasion at the end of 19th century in European viticulture. Breeding efforts made to obtain lime-tolerant rootstocks included successfully crossing between wild grape species, and some chlorosis-resistant genotypes are now available for the grape growers of the many calcareous areas worldwide (Bavaresco et al. 2003). Despite the fact that knowledge about the interactive relations among the cultivar, the rootstock, and nutrient content in grapevines is decreased, many studies have indicated that rootstocks vary in their effect on the nutrient levels in the grafted cultivar (Nikolaou et al., 2000; Garcia et al., 2001; Bavaresco et al., 2003; Fisarakis et al., 2004; Robinson, 2005).

Lime-tolerant grapevine rootstocks possess some specific physiological mechanisms to come through chlorosis when grown on lime soils, consisting of improvement of root Fe uptake (Fregoni, 1980; Pouget, 1980) the root response mechanisms to Fe deficiency of grapevine are referred as “Strategy I” (Nicolic et al. 2000;Varanini and Maggioni 1982). The growth rate of sink tissues and organs such as the roots, shoot apex, fruits, and storage organs can be restricted by procuration of photosynthates from the source leaves or by a limited capacity of the sink to benefit from the photosynthates (Marschner 1995). Studies on grapevines grown on calcareous soil indicated that the high content and reactivity of high calcium carbonate in soil adversely affected the leaf mineral content (Bavaresco and Poni 2003) and led to important chlorosis (Sabir et al. 2010), deriving from disturbed Fe metabolism due to elevated pH in rhizosphere. To mitigate negative impacts of high pH are progressively adopted soil and foliar fertilizations to various crops.

The soil stress response of plants involves chemical signals originating in the root system that are carried to the foliage in the transpiration stream where they induce stomatal closure. Stomatal conductance (gs) is responsive to changes in the hydraulic conductance of the soil to leaf pathway. Under environmental stress conditions, stomata operate to enhance photosynthesis on the one hand, while avoiding dehydration induced damage on the other. Therefore stomatal regulation plays essential role in plants to cope with environmental constrains. In the present study, certain physiological responses, such as stomatal conductance, leaf temperature and chlorophyll content, of grafted and nongrafted ‘Prima’ grapevines to bicarbonate application to growth medium were investigated.

MATERIALS AND METHODS

Study description

The experiment was carried out in the research and implementation glasshouse of Selcuk University (Konya, Turkey) in 2020. The experimental layout was a two factors randomized complete block design with two plant materials [own-rooted ‘Prima’ plants and grafted plants (‘Prima’/41 B)] and three treatments (non-treated control, 50 and 100 mL 1 N $NaHCO_3$solution per plant. Each treatment has three replications consisted of three healthy plants. For the study, two

years old healthy vines were chosen according to homogeneity in vegetative development. The experimental vines were individually grown in cylinder pots (approx. 8 L in solid volume) containing sterile peat and perlite mixture in equal volume. The vines were pruned to leave only the single main shoot per plant and cultivated in a controlled glasshouse under ambient light and temperature. Night and day temperatures inside the experimental area were 18 ± 5 and 35 ± 6 °C respectively (Data logger, Ebro EBI 20 TH1). The vines were watered daily with equal amount of tap water (0.4 to 1.0 L per pot depending on weather conditions) to maintain the moisture at approximately 60-70% water holding capacity of the cultivation medium. The same annual amount of was applied to the vines during the vegetation period. The shoots were tied with thread to the wires 2.2 m above the pots to let plants grow on a perpendicular position to ensure equally benefiting from the sunlight (Sabir 2013).

Measurements and Analyses

Early responses of grapevines were investigated through certain physiological reactions such as leaf temperature (T_{leaf}) and stomatal conductance (gs). Investigations were carried out with daily monitoring after each application during three consecutive days. T_{leaf} and gs were recorded at around 10 a. m. with a portable porometer (SC-1 Leaf Porometer) on each plant (Sabir and Yazar 2015), using sun-exposed mature leaves born at the top 5th to the 7th nodes per treatments (Stavrinides et al. 2010).

Investigations on other leaf characteristics such as chlorophyll content, surface area, fresh mass and dry mass were performed one month after the last bicarbonate application when the shoots elongation was approaching cessation. Leaf chlorophyll content was estimated with SPAD meter (SPAD-502; Konica Minolta Sensing, Inc., Japan) readings of 3rd and 4th nodes of each shoot. Leaf (node) number per shoot, leaf area (LA, cm^2), leaf fresh mass (FM, g) and leaf dry mass (DM, g) analyses were performed on fully expanded leaves of representative grapevines of each treatment (Tramontini et al. 2013). Three groups of mature leaves, consisting of nine leaves per treatment, were collected from the mid-shoot area of each plant (OIV 1997). The first group was scanned to determine single LA using Win Folia computer software program (Régent Instruments, Quebec, Canada), while the second was immediately weighed to determine FM.

Statistical Analysis

Data were subjected to statistical analysis using a factorial design. Each treatment was designed with three replicates consisting of a total of nine plants (pots). Mean values of parameters were compared separately for grafted and nongrafted vines separately using the least significant difference (LSD) test. Statistical tests were performed at $P < 0.05$ using SPSS 13.0 for Windows (SPSS Inc., Chicago, IL, USA).

RESULTS AND DISCUSSION

pH and EC values of the experimental growth medium underwent a significant gradual increases during the study (Fig. 1). The initial pH value of the medium was 7.6 and displayed significant increase in response to $NaHCO_3$ application depending on the solution concentration. The pH values ranged from 7.8 to 8.5 at the end of the study. Similar increases in EC values were also detected as influenced by different doses of $NaHCO_3$ solution.

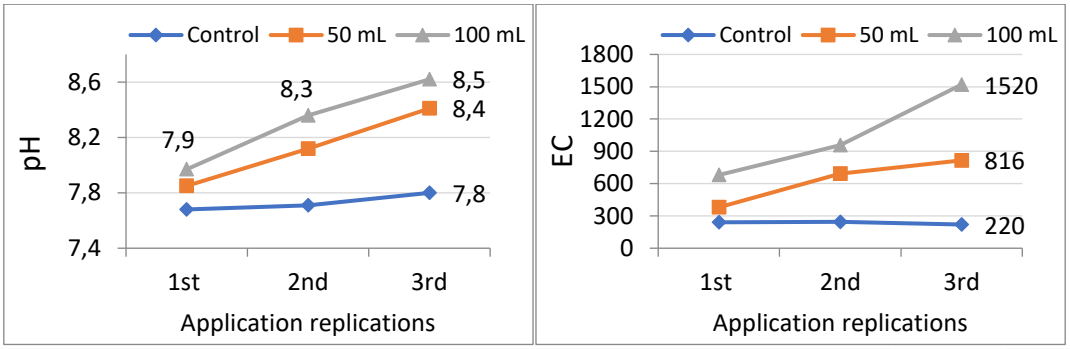

Figure 1. Variation in pH and EC values of growth medium as influenced by $NaHCO_3$ applications.

T_{leaf} responses of grapevines were quite similar after the first and second $NaHCO_3$ applications (Fig. 2). Therefore, the investigations after the third application were used to compare the effects of $NaHCO_3$ applications on temperatures of the mature leaves. As can be seen in Fig. 2, 100 mL $NaHCO_3$ applications resulted in obvious decrease in T_{leaf}. The changes in T_{leaf} were statistically insignificant for the vines grafted on 41 B rootstock. However, T_{leaf} underwent significant decrease after the 2nd treatment in own rooted grapevines, depending on the doses. T_{leaf} may be precursor for early detection of plant response to environmental adversities (Acosta-Motos et al. 2016) although it may not completely determine the stress tolerance capacity of plant (Sabir and Yazar 2015). After the third application, T_{leaf} values of both grafted and nongrafted grapevines were higher than 30 °C exceeding the values for optimum photosynthesis (25–30°C) for grapevines.

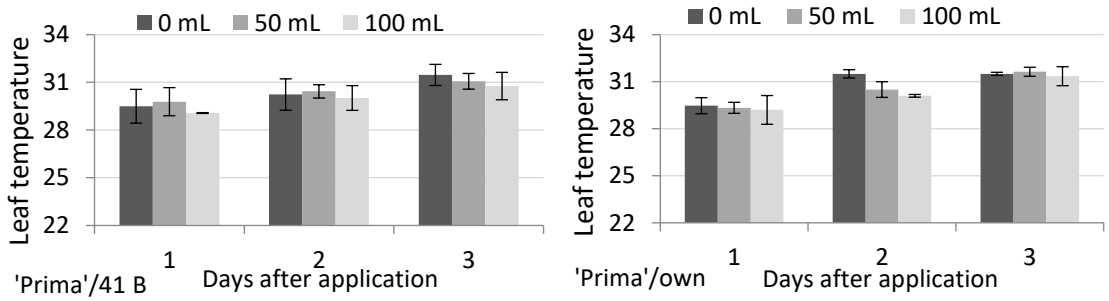

Figure 2. Variation in leaf temperature of grafted and nongrafted 'Prima' grapevines as influenced by $NaHCO_3$ applications.

Stomatal gas exchange was investigated with three consecutive days following each $NaHCO_3$ applications. The gs immediately decreased just after the 1st$NaHCO_3$ application at higher dose as depicted in Fig. 3. In grafted vines, 50 mL $NaHCO_3$ applications was ineffective on gs, while the 100 mL dose led to significant decrease for both three days. Responses of the own rooted vines were quite different from the grafted vines in that the lower dose (50 mL) was also effective on the gs after the second and third days of the first $NaHCO_3$ application. Stomatal conductance is a physiological process related to transpiration efficiency of plants (Johnson et al. 2009). $NaHCO_3$ application negatively affected the transpiration efficiency of grapevines with greater effects on nongrafted 'Prima' vines.

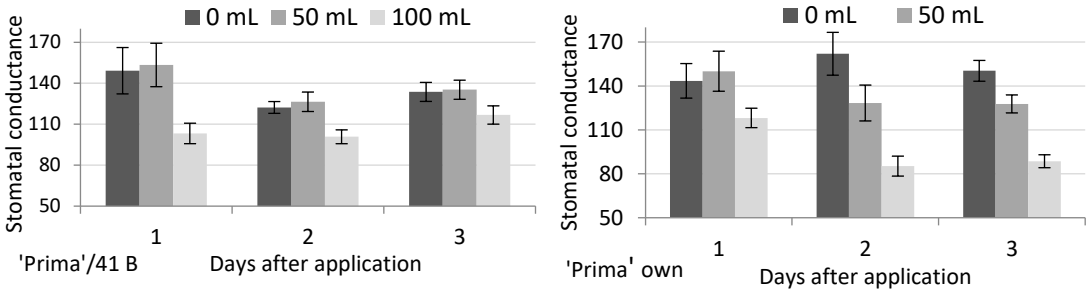

Figure 3. Variation in stomatal conductance of grafted and nongrafted 'Prima' grapevines as influenced by the first $NaHCO_3$ applications.

The gs values after the 2nd $NaHCO_3$ application also displayed significant variations depending on the dose and grafting (Fig. 4). In grafted vines, 100 mL $NaHCO_3$ application significantly decreased the gs although 50 mL did not result in remarkable change in gs. In own rooted vines, dose depended decrease was detected following the $NaHCO_3$ applications. It should be underlined that the gs values of the vines of 100 mL application at 3rd day were not as far below as those of the first and second days. This may indicate the adaptive strategies of the grapevines during the prolonged period.

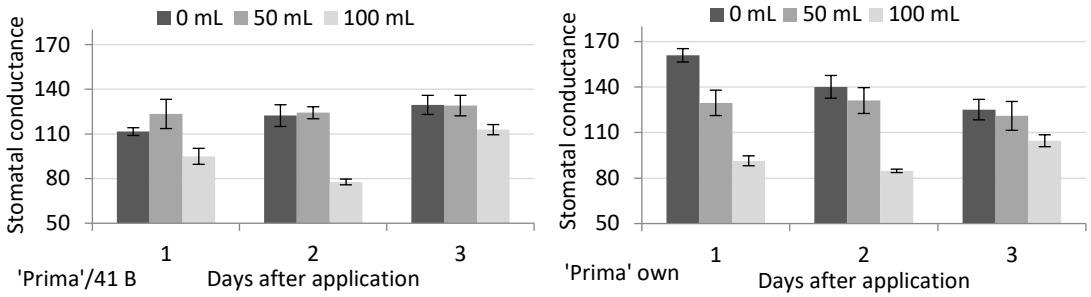

Figure 4. Variation in stomatal conductance of grafted and nongrafted 'Prima' grapevines as influenced by the second $NaHCO_3$ applications.

After the 3rd $NaHCO_3$ application, dose depended decrease in gs observed in both grafted and nongrafted vines (Fig. 5). But the negative effect magnitude of 100 mL NaHCO3 application in grafted vines was not as high as those of nongrafted vines. This may be due to the high tolerance feature of 41 B rootstock to high pH condition.

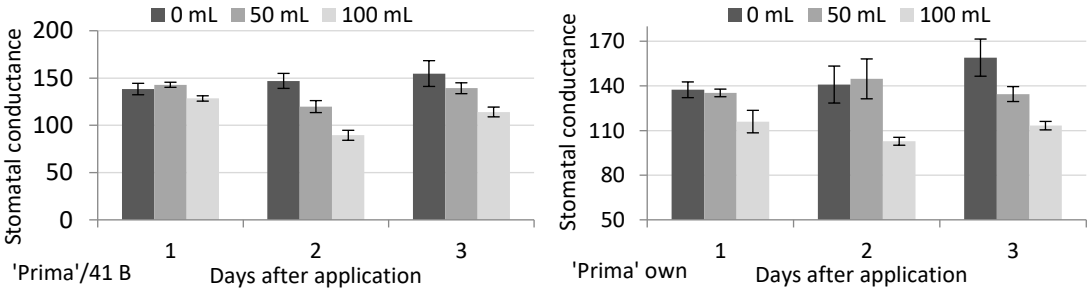

Figure 5. Variation in stomatal conductance of grafted and nongrafted 'Prima' grapevines as influenced by the third $NaHCO_3$ applications.

As illustrated in Fig. 6, leaf chlorophyll contents determined after the third application decreased in response to the gradual increase in pH due to $NaHCO_3$ application. High pH value in the soil restricts the availability of certain nutrients among which the Fe deficiency is widespread across the world (Bertamini and Nedunchezhian, 2005). Decrease in the leaf chlorophyll concentration is accompanied by the increase in pH level. In a previous study, high calcium carbonate in cultivation medium resulted in considerable chlorosis emerging from disturbed Fe metabolism due to elevated pH in rhizosphere (Sabir et al. 2010).

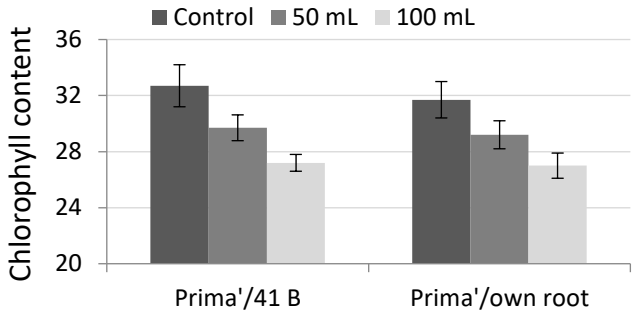

Figure 6. Variation in leaf chlorophyll content of grafted and nongrafted 'Prima' grapevines as influenced by first $NaHCO_3$ applications.

CONCLUSION

Experimental knowledge on the physiological responses of grapevine to calcium stress would aid the growers to recover growth imbalances in nursery. $NaHCO_3$ induced high pH in growth mediumadversely affected the physiology of grafted or nongrafted 'Prima' grapevines in nursery, depending on doses (50 and 100 mL 1 N $NaHCO_3$ solution per plant). Decrease in stomatal conductance was more apparent than those of leaf temperature, indicating the sensitivity of gas exchange of stomatal aperture. In certain cases, physiological constrains were slighter in grafted vines than nongrafted ones. This proves the convenience of the use of 41 B rootstock for calcareous conditions.

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ESTIMATION OF WHEAT WATER FOOTPRINT BASED ON CRU AND AgMERRA GRIDDED DATASETS

Faraz GORGIN PAVEH[1]*, Hadi RAMEZANI ETEDALI[2], Parisa KAKVAND[1]

[1]:TEHRAN UNIVERSITY
[2]:IMAM KHOMEINI INTERNATIONAL UNIVERSITY
Corresponding author: Gorgin.faraz@gmail.com

Abstract

There is always a huge lack of data in space and time scale, especially when there is no synoptic station near a specified location. In this paper, the 30 years data from two datasets, CRU and AgMERRA, were used to estimate wheat's water footprint. Wheat is the main cereal of the Qazvin Plain, the largest plain in the Salt Lake basin. The AquaCrop model was used to estimate the water footprint (WF) parameters. Then, the synoptic station in the province evaluated data. According to the results, the CRU dataset was much more efficient than the AgMERRA dataset. The amount of R2, RMSE, NRMSE, and ME in estimating the blue WF were 0.414, 94.93, 22.3%, and 171.51 with the CRU dataset, and 0.326, 189.66, 38.43%, and 402.66 with the AgMERRA dataset, respectively. These results were 0.463, 94.93, 22.32%, and 171.51 to estimate the green WF with the CRU dataset, while the same index was 0.253, 145.23, 34.35%, and 243.6 with the AgMERRA dataset, respectively. According to the results, using the CRU dataset to estimate the blue and the green WF of wheat in the Qazvin province is suggested. This study suggests more studies on datasets in estimating the WF of crops.

Keywords: Wheat, CRU, AgMERRA, Dataset, AquaCrop.

1. Introduction

The lack of data in space and time scale is always a challenge to agricultural managers worldwide. The number and the accuracy of synoptic stations may not be acceptable in some places. The accurate estimate in weather parameters can reduce water usage and increase agriculture production. It also helps water resources managers to more efficient using lands.

As satellites and remote sensing techniques progress, a wide range of projects can be done locally, regionally, nationally, and globally. Agricultural and natural resource management, flood degradation, drought, climate change, soil and air pollution, crop's water requirement, etc. are examples in which satellite data can be used. These devices also take less time and cost, and they can be very effective.

Hoekstra (2003) introduced the concept of 'water footprint' (WF), which is an indicator of the allocation of freshwater resources to different sections of the production of the process (Ababaei and Ramezani Etedali, 2014, 2017). This term facilitates water resources management, especially in water-scarce areas. This concept has been adopted in numerous studies (e.g., Ramezani Etedali et al., (2019) and Ababaei and Ramezani Etedali, (2016); Bazrafshan et al., (2020); Mojtabavi et al., (2018); and Nazari et al., (2020)).

Estimating the water requirement of crops, yield and other crop parameters can be done by simulation models. But each model have several issues such as the highly requirement of input data and the information about the crop growth of specified locations. FAO developed AquaCrop in 2009 to address these limitations.

AquaCrop is a multi-crop model that simulates the water-limited yield of the herbaceous crop under different biophysical and management conditions and provides a good balance between robustness, simplicity, and output accuracy, which can be used for a large number of crops (Raes et al., 2009; Steduto et al., 2009).

The lack of data is an undeniable issue that so many regions are dealing with it. On the other hand, there are so many datasets worldwide, which suggest free data in vast quantities. But their accuracy in estimating the weather and climate parameters, are not specified enough. In this paper, the accuracy of two datasets is used to estimate the water footprint of wheat in Iran's provinces, the Qazvin Province. The AquaCrop model was used to convert weather variables to water footprint parameters.

2. Materials and Methods

2.1. Study Area

The Qazvin province, which is located between 48 45' – 50 50' E and 35 37'-36 45' N has an area of 15 821 km^2. In the Salt Lake basin, the largest plain is the Qazvin Plain. This plain has the largest cultivation area of various crops of all plains. The location of the province in the country is presented in Figure 1.

Figure 1 The location of the Qazvin Province in Iran.

The climate of the Qazvin province is arid to semi-arid with relatively warm summers and cold winters with 14 C mean annual temperature and 300 mm precipitation. The main irrigated crops in this plain are wheat, barley, corn, maize, alfalfa, tomato and canola. According to Agricultural Jihad Ministry (2015) 144000 ha of land under cultivation is dedicated to wheat, which leads to 315000 ton production per year.

2.2. Water Footprint

The water footprint (WF) is consisted of two elements, the blue WF and the green WF. The volume of the water which is used in the production of crops, and is known as net water requirement, is called the blue WF. The green WF is related to the effective rainfall which is stored in the soil and supplies crop water demand (Hoekstra and Chapagin, 2008; Hoekstra et al., 2009). These two elements can be determined by the following equations:

$$WF_{Blue} = \frac{(ET_c - P_e) \times 10}{\gamma}$$

$$WF_{Green} = \frac{P_e \times 10}{\gamma}$$

Which WF_{Blue} and WF_{Green} are the blue WF and the green WF, respectively, in $m^3\ t^{-1}$, P_e is the total effective rainfall during the crop-growing season (mm), ET_c is the crop evapotranspiration (mm), and γ is the crop yield ($t\ ha^{-1}$). In this model, the ET_c calculated by the FAO Penman-Montieth method by the CROPWAT model (Allen et al., 1998), and the meteorological data from the Qazvin synoptic station (Table 1), and the P_e values were calculated by the United States Department of Agriculture (USDA).

Table 1 Water footprint components for irrigated and rainfed wheat.

Crop	Yield ($kg\ h^{-1}$)	Water use (mm)		WF ($m^3\ t^{-1}$)		
		ET_c	P_{eff}	Green	Blue	Total
Irrigated Wheat	3939	475	303	769	437	1206
Rainfed Wheat	805	-	303	376	-	376

2.3. Datasets

In this paper, data from the 30 years of two datasets were used to estimate the WF parameters. These two datasets are CRU and AgMERRA.

The CRU TS dataset which was developed by the UK's Natural Environment Research Council (NERC) and the US Department of Energy, is one the reliable and popular available gridded datasets. This dataset contains data on ten weather variables from over 5000 individual weather stations which interpolated into 0.5° × 0.5° grid cells. This gridded time-series dataset covers the period 1901-2019, and its coverage include all land areas.

The AgMERRA and AgCFSR climate forcing datasets were created as an element of the Agricultural Model Intercomparison and Improvement Project (AgMIP), which provide consistent, daily time series over the period of 1980-2010. These two datasets cover global variables that require for agricultural models. Data interpolated into 0.25°×0.25° grids. In this study, data from only AgMERRA dataset were used.

2.4. AquaCrop

The AquaCrop model, version5, is used in this study to compute the actual evapotranspiration. This model was introduced by the FAO (Raes et al., 2012). The AquaCrop model simulates yield and biomass in relation to the water available to plants, which were introduced by Doorenbos and Kassam empirical relation (1979). The model estimates the values of water productivity index (transpiration), and the yield of the crop in a daily time step through separation transpiration and evaporation from evapotranspiration, and the amount of biomass produced by the harvest index (Steduto et al., 2009). It also uses green cover on the ground instead of the leaf surface index. In this model, the growth rate index does have great importance, and it examines the productivity index, instead of the ratio of the relative decrease in performance.

3. Results and Discussion

3.1. The CRU dataset results

The amount of indexes and the proposed model for the CRU dataset for both the blue and the green WF are presented in Table 2. According to Table 2, the R^2 for the blue WF is 0.414, while the RMSE is 131.03, and the NRMSE is 26.55 %. The ME in this model is 249.03. Also, for the green WF, the amount of R^2 is 0.463, while the RMSE is 94.93, and the NRMSE is 22.32 %. In this model, the ME is 171.51. At this table, y in the proposed model, represent the CRU dataset and x represent the synoptic station, and according to the table, a linear relation is proposed.

Table 2 The proposed model, R, RMSE, NRMSE and ME of the CRU dataset and the synoptic station for the blue WF and the green WF.

The WF component	The proposed model	R^2	RMSE ($m^3 t^{-1}$)	NRMSE (%)	ME ($m^3 t^{-1}$)
Blue WF	y = 0.4399x + 356.42	0.414	131.03	26.55	249.03
Green WF	y = 0.5676x + 112.22	0.463	94.93	22.32	171.51

According to the results, the proposed model for the green WF is more efficient than the blue WF.

3.2. The AgMERRA dataset results

Similarly, the amount of indexes and the proposed model for the AgMERRA dataset for both blue and the green WF are presented. According to this table, the R^2 for the blue WF is 0.326, while the RMSE is 189.66, and the NRMSE is 38.43 %. The ME in this model is 402.66. Also, for the green WF, the amount of R^2 is 0.253, while the RMSE is 145.23, and the NRMSE is 34.35 %. In this model, the ME is 243.6. The proposed model is also a linear regression between the CRU data and the synoptic data.

Table 3 The proposed model, R, RMSE, NRMSE and ME of the AgMERRA dataset and the synoptic station for the blue WF and the green WF

The WF component	The proposed model	R^2	RMSE ($m^3 t^{-1}$)	NRMSE (%)	ME ($m^3 t^{-1}$)
Blue WF	y = 0.318x + 182.91	0.326	189.663	38.432	402.66
Green WF	y = 0.4059x + 128.95	0.253	145.23	34.35	243.6

According to the table, the AgMERRA is more efficient for the green WF than the blue WF.

4. Conclusion

In this study, two datasets, the CRU, and the AgMERRA datasets, were used to estimate the blue and the green WF for wheat in Iran's provinces, the Qazvin Province. These data were used as input data in the AquaCrop model to calculate the WF parameters. Then data were evaluated by the nearest synoptic station. Results indicate that the CRU dataset is much more efficient in estimating the WF than the AgMERRA dataset. The amount of R^2, RMSE, NRMSE, and ME in estimating the blue WF were 0.414, 94.93, 22.3%, and 171.51 with CRU dataset, and 0.326, 189.66, 38.43%, and 402.66 with AgMERRA dataset, respectively. These results were 0.463, 94.93, 22.32%, and 171.51 for estimating the green WF with the CRU dataset, while the same index were 0.253, 145.23, 34.35%, and 243.6 with the AgMERRA dataset, respectively. Datasets can be a good alternative to synoptic stations, especially in places far from synoptic stations. More studies on them may find a good relationship between them.

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ESTIMATION OF MAIZE WATER FOOTPRINT BASED ON GPCC AND AgCFSR GRIDDED DATASETS

Parisa KAKVAND[1], Hadi RAMEZANI ETEDALI[2], Faraz GORGIN PAVEH[1]*

[1]:TEHRAN UNIVERSITY
[2]:IMAM KHOMEINI INTERNATIONAL UNIVERSITY

*Corresponding author: Gorgin.faraz@gmail.com

Abstract

Because of the huge lack of data in space and time scale, especially in places far from synoptic stations, datasets can be good alternatives. In this study, the GPCC and the AgCFSR datasets were used to estimate the water footprint (WF) of maize in the Qazvin Plain, Iran. The 30 years of data from datasets were used as input for the AquaCrop model. The model calculated the WF parameters. Then the closest synoptic station in the province was used to evaluate data. Results showed the ability and efficiency of both datasets. The GPCC dataset was more efficient in estimating the WF than the AgCFSR dataset. Results showed that the GPCC dataset is more efficient in estimating the green WF, but the AgCFSR is better in estimating the blue WF. According to the results, datasets are efficient in estimating the WF of maize in the province. With more studies, the best dataset in estimating the WF of each crop in other places can be found.

Keywords: Maize, AquaCrop, AgCFSR, GPCC, Dataset.

1. Introduction

The lack of data in space and time scale may be a great challenge to water resources managers. The number of synoptic stations and their accuracy may not always be acceptable, especially in some regions there are no close synoptic stations. By the accurate estimation of weather and climate parameters, land use plan can be more efficient.

On the other hand, satellites and subsequently, remote sensing techniques, provide a wide range of locally, regionally, nationally, and globally data, with the minimum time and price. These data can be used in many fields such as agricultural and natural resource management, flood degradation, drought, climate change, soil, and air pollution.

The first time, the concept of 'water footprint' (WF) was introduced by Hoekstra (2003) as an indicator of the allocation of freshwater resources to different sections of the production of a process (Ababaei and Ramezani Etedali, 2014, 2017). Water resources management, especially in water-scarce areas, can be facilitated. Many studies was focused on this concept (e.g., Ramezani Etedali et al., (2019) and Ababaei and Ramezani Etedali, (2016); Bazrafshan et al., (2020); Mojtabavi et al., (2018); and Nazari et al., (2020)).

Simulations models have been developed in recent years, especially in estimating the water requirement of crops, yield, and other crop parameters. Despite huge progress on them, they have several issues, such as the high requirement of input data and the information about the crop growth of each crop's specified locations. In 2009, AquaCrop developed by FAO, which addressed these limitations. This model is a multi-crop model that simulates the water-limited yield of the herbaceous crop under different biophysical and

management conditions, which provides a good balance between robustness, simplicity, and output accuracy, which can be used for a large number of crops (Raes et al., 2009; Steduto et al., 2009).

As mentioned, many regions are facing several issues of lack of data. Using worldwide datasets that suggest free data and simulation models can be an effective solution to this issue. In this research, two datasets were used to estimate the WF of maize in the Qazvin Province, Iran. Results were evaluated by the synoptic station in the province. Data from datasets and the synoptic station were used to calculate the WF's parameters.

2. Materials and Methods

2.1. Study Area

The Qazvin province, with 15 821 km^2 area, is located between 48 45' – 50 50' E and 35 37-36 45' N. The Qazvin Plain, is located in this province, which is the largest plain in the Salt Lake basin, with the largest cultivation area of various crops (Figure 1).

The climate of this province is arid to semi-arid. It has relatively warm summers and cold winters with 14 C and 300 mm mean annual temperature and precipitation, respectively. In the Qazvin Plain, wheat, barley, corn, maize, alfalfa, tomato, and canola are the main irrigated crops. Maize is responsible for 42% of the production in the plain (Agricultural Jihad Ministry, 2015).

Figure 2 The Qazvin Province in Iran.

2.2. Water Footprint

The concept of WF is consists of two elements, which are the blue WF and the green WF. The blue WF is the volume of the water, which is used in the production of crops. It is also known as the net water requirement. The effective rainfall which is stored in the soil and supplies crop water demand is the green WF demand (Hoekstra and Chapagin, 2008; Hoekstra et al., 2009). These two elements are determined as below:

$$WF_{Blue} = \frac{(ET_c - P_e) \times 10}{\gamma}$$

$$WF_{Green} = \frac{P_e \times 10}{\gamma}$$

which WF_{Blue} is the blue WF ($m^3\ t^{-1}$), and WF_{Green} is the green WF ($m^3\ t^{-1}$), P_e is the total effective rainfall during the crop-growing season (mm), ET_c is the crop evapotranspiration (mm), and γ is the crop yield (t ha^{-1}). The ET_c is calculated by the CROPWAT model and the FAO Penman-Montieth method (Allen et al., 1998), and the meteorological data from the Qazvin synoptic station, as Table 1. Finally, the P_e values were calculated by the United States Department of Agriculture (USDA).

Table 4 Water footprint components for irrigated maize.

Crop	Yield (kg h^{-1})	Water use (mm)		WF ($m^3\ t^{-1}$)		
		ET_c	P_{eff}	Green	Blue	Total
Maize	55594	695	29	5	120	125

2.3. Datasets

For estimating the WF parameters, two datasets, GPCC, and AgCFSR, were used in this paper.

The GPCC, which is short of Global Precipitation Climatology Center is operated by DWD under the World Meteorological Organization (WMO). This dataset provides global precipitation analyses to monitor and research the earth's climate, at monthly and daily precipitation datasets. The GPCC products are available in 1.0° x 1.0° and 2.5° x 2.5° (only monthly) latitude by longitude spatial resolutions. It is composed of observed monthly totals from more than 80000 stations worldwide.

The AgCFSR and AgMERRA climate forcing datasets were created as an element of the Agricultural Model Intercomparison and Improvement Project (AgMIP), which provide consistent, daily time series from 1980 to 2010. These two datasets cover global variables that require agricultural models. Data interpolated into 0.25°×0.25° grids. In this paper, data from only AgCFSR dataset were used.

2.4. AquaCrop

In this study, the AquaCrop model, version 5 were used. This model, which was introduced by the FAO (Raes et al., 2012), simulates yield and biomass to the water available to plants, introduced by Doorenbos and Kassam empirical relation (1979). According to Steduto et al. (2009), the AquaCrop model estimates the values of water productivity index, which is the transpiration, the yield of the crop in a daily time step through separation transpiration and evaporation from evapotranspiration, and the amount of biomass produced by the harvest index. Also, the green cover on the ground is used instead of the leaf surface index. Finally, the growth rate index has great importance, and the model examines the productivity index, instead of the ratio of the relative decrease in performance.

3. Results and Discussion

3.1. The GPCC dataset results

The green WF and the blue WF of maize estimated by the synoptic station and the GPCC dataset from 1980 to 2009 are demonstrated in Figure 2 and Figure 3, respectively. According to the figures, the estimates are close together, and in most years, the GPCC dataset underestimates the green and the blue WF. Also, RMSE for the blue and the green WF are 43/05 and 18/22, respectively, with 101/54 and 47/05 ME, respectively. According to the results, the GPCC dataset is more efficient in estimating the green WF than the blue WF.

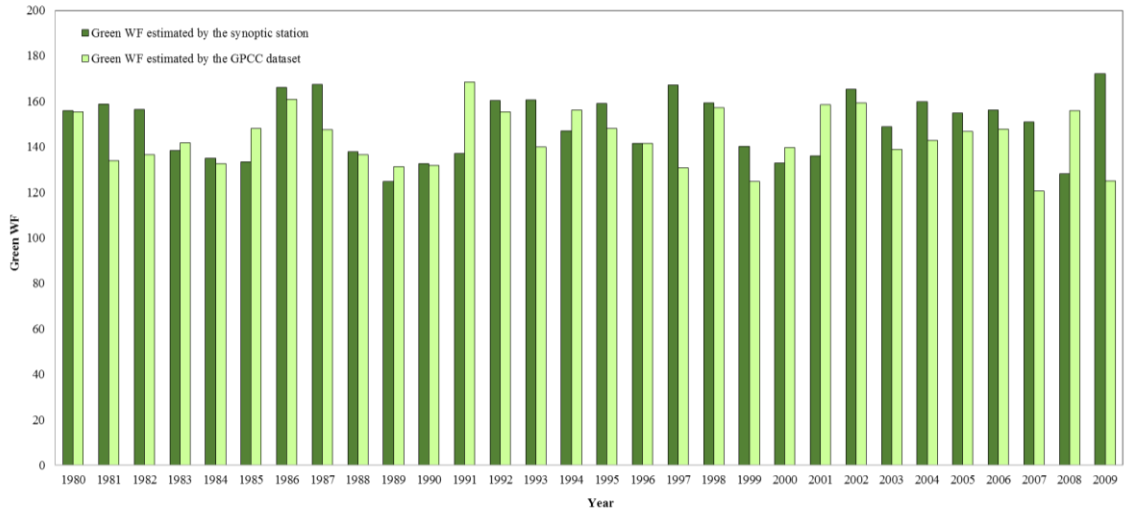

Figure 3 The Green WF of maize estimated by the synoptic station and the GPCC dataset

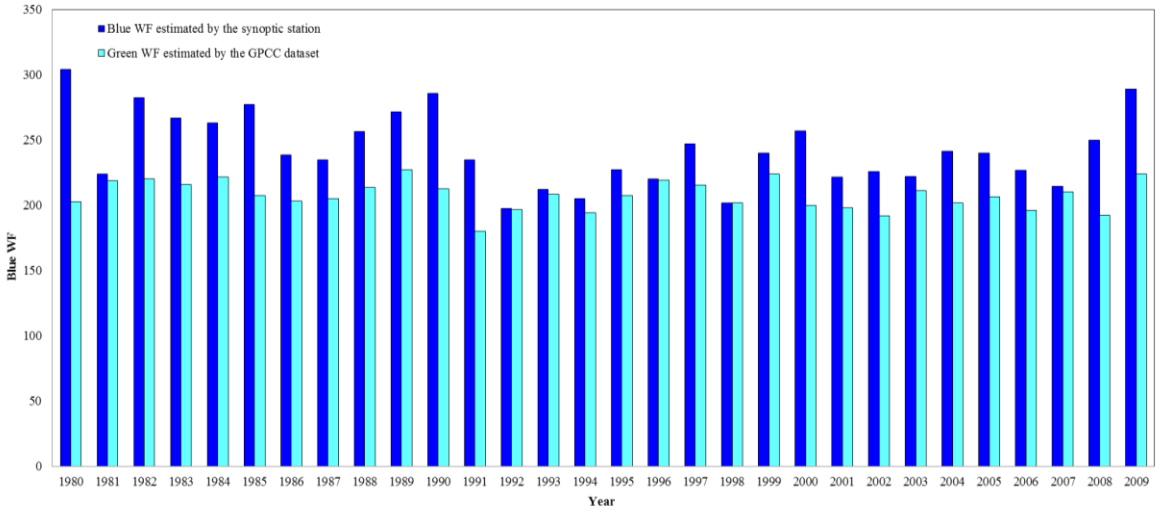

Figure 4 The Blue WF of maize estimated by the synoptic station and the GPCC dataset

3.2. The AgCFSR dataset results

Similarly, the green WF and the blue WF of maize estimated by the synoptic station and the AgCFSR dataset from 1980 to 2009 are demonstrated in Figure 4 and Figure 5. According to the figures, in most years, the AgCFSR dataset underestimates the green and the blue WF. Also, RMSE for the blue and the green WF are 39/72 and 120/31, respectively, with 82/72 and 167/05 ME, respectively. According to the results, the AgCFSR is more efficient in estimating the blue WF than the green WF.

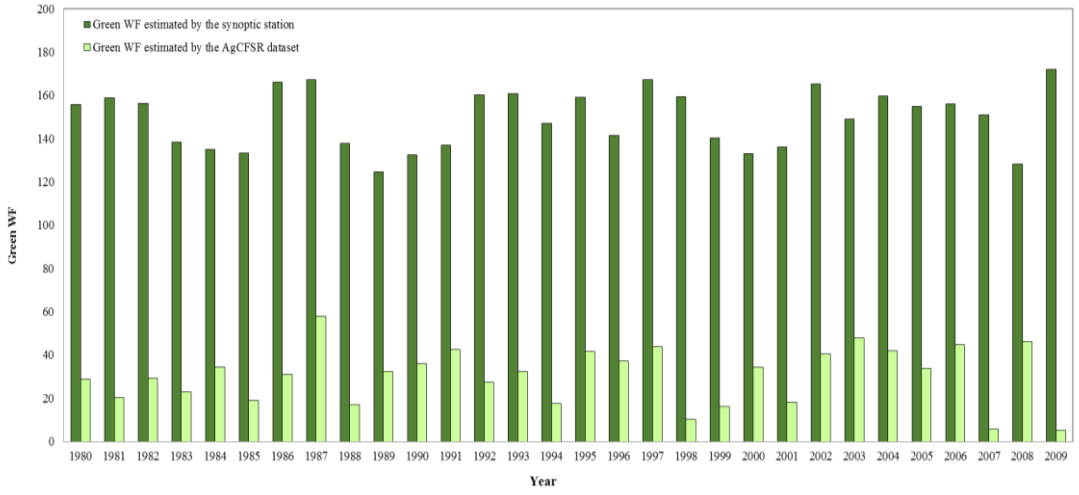

Figure 5 The Green WF of maize estimated by the synoptic station and the AgCFSR dataset

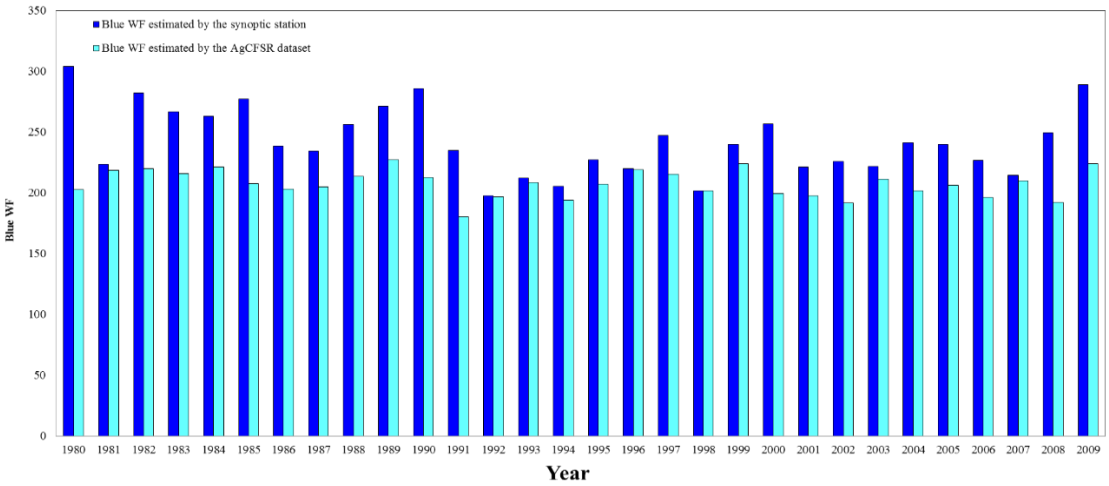

Figure 6 The Blue WF of maize estimated by the synoptic station and the AgCFSR dataset

4. Conclusion

In this study, two datasets, the GPCC, and the AgCFSR datasets were used to estimate the blue and the green WF for maize in one of Iran's provinces, the Qazvin Province. First, data from the closest synoptic station and the GPCC dataset, and the AgCFSR datasets were used as input data in the AquaCrop model. Then the WF parameters were calculated from the AquaCrop model. Results showed that the GPCC dataset

was more efficient in estimating the green WF than the blue WF. But the AgCFSR is more efficient in estimating the blue WF than the green WF. In total, the GPCC is more efficient than the AgCFSR dataset in estimating the WF. This study suggests using datasets instead of synoptic stations. However, more studies are needed to evaluate their ability to estimate the WF parameters.

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CONJUGATED LINOLEIC ACID IN MEAT AND MEAT PRODUCTS AND ITS EFFECTS ON HEALTH

İlkay Çelik[1]*, Cemalettin Sarıçoban[1], Kübra Ünal[1]

[1]Selcuk University, Agriculture Faculty, Department of Food Engineering, Konya, Turkey

*** Corresponding author:** ilky.clk.26@gmail.com

ABSTRACT

Conjugated linoleic acid (CLA) is a term used for the mixture of positional and geometric isomers of linoleic acid (C18:2), an essential omega-6 fatty acid, containing double bonds in the *cis*-9 and *cis*-12 arrangement. The double bonds contained in the CLA are found in the form of *cis* or *trans*. CLA has 28 different isomers, but only biological properties of *cis*9-*trans*11 and *trans*10-*cis*12 isomers have been determined. The main source of CLA is milk and meat products. Cooking time-method, storage and fermentation process do not cause to any changes, while the level of CLA in meat varies with various factors such as season, type of animal, diet, age, individual physiological characteristics and environmental conditions. Meats from ruminant have more CLA amount than meats from non-ruminant. In several studies, it has been determined that CLA has quite significant and positive effects on human health. It has been stated that CLA has antioxidative impact and positive effect on the immune system. It was reported that it protects against various diseases such as obesity, diabetes, cardiovascular diseases and some types of cancer as well as increases muscle development. In this review, the structure of CLA, its presence in meat and meat products, and the effects of its consumption on human health will be discussed.

Keywords: Conjugated linoleic acid, essential fatty acid, meat, ruminant, health

1.INTRODUCTION

Conjugated linoleic acid (CLA) isomers are functional lipids obtained from ruminant animals and whose substantial effects on the body have been determined in studies on humans and animals (Güney et al., 2020). CLA is a term used for 28 different positional and geometric isomers of linoleic acid (*c*9, *c*12) with 18 carbon atom, an essential ω-6 fatty acid. Double bonds are located at 7,9; 8,10; 9,11; 10,12 or 11,13 positions and in different *cis*-*trans* configurations (*cis*/*cis*; *trans*/*trans*; *cis*/*trans* or *trans*/*cis*) in the carbon chain (Demirok and Kolsarıcı, 2010).

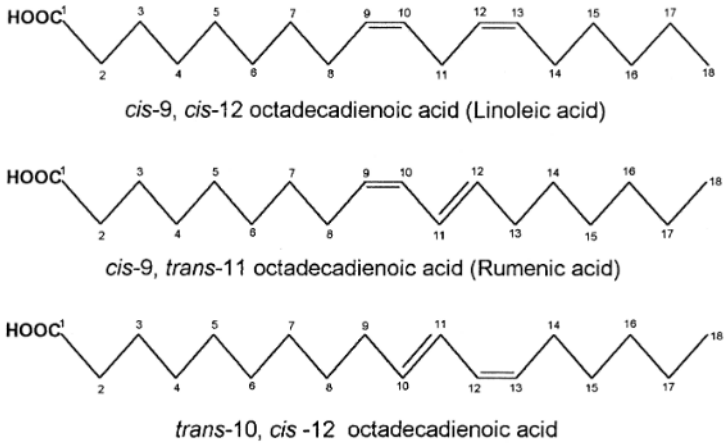

Figure 1. Graphical representation linoleic acid and its most biologically active isomers (Bessa et al., 2000)

The double bonds of the CLA can be found in *cis* or *trans* form. The presence of one of these bonds in *trans* form indicates that this compound is biologically active (Çelebi and Kaya, 2008). Among the conjugated linoleic acid isomers, *cis*-9, *trans*-11 and *trans*-10, *cis*-12 isomers are known to have biological activity (Pariza et al., 2001) and they constitute 80-90% and 3-5% of the total CLA, respectively (Kocatürk et al., 2019). *cis*-9, *trans*-11 octadecadienoic acid is the predominant natural isomer in humans and animals. The term 'rumenic acid' was suggested as the common name for this isomer. Rumenic acid is considered the most biologically active CLA isomer because it has the ability to incorporated with phospholipids in the membrane (Bessa et al., 2000).

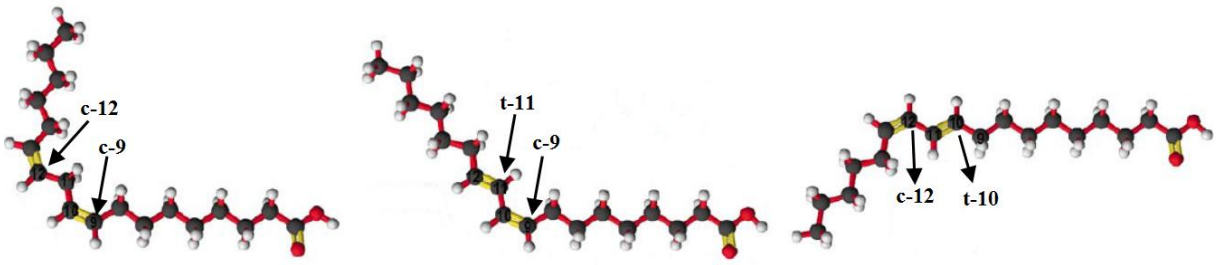

Figure 2. Structures of linoleic acid and its two CLA isomers; linoleic acid (*cis*-9, *cis*-12 octadecadienoic acid) (left); *cis*-9, *trans*-11 CLA (middle); *trans*-10, *cis*-12 CLA (right) (Choi, 2009; Çelik, 2006)

2.BIOSYNTHESIS OF CONJUGATED LINOLEIC ACID

CLA isomers are intermediates formed during the biohydrogenation of polyunsaturated fatty acids (PUFA) such as linoleic and linolenic to stearic acid (C18:0) by *Butyrivibrio fibrosolvens* bacteria in the rumen (Çelebi and Kaya, 2008). The linoleate *c*12, *t*11 isomerase enzyme, which this bacterium has, carries the double bond at the 12th carbon atom of linoleic acid to the 11th carbon

atom and converts the *c*/*c* configuration to the *c*/*t* configuration. At this stage, the *c*9, *t*11 isomer is synthesized as an intermediate product and some of it is transported to the tissues. (Demirok and Kolsarıcı, 2010). Isomers that are not transported to tissues are reduced by the CLA reductase enzyme to form *trans*-vaccenic acid (t11-octadecenoic acid C18: 1). Some of this compound is transported to the tissues. The non-transportable *trans*-vaccenic acid is hydrogenated by another rumen bacteria to form stearic acid. Also α-linolenic, γ-linolenic and oleic acid are converted first to *trans*-vaccenic acid and then to stearic acid in the rumen of ruminants. The *c*-9, *t*-11 isomer is not synthesized from these fatty acids as an intermediate product (Demirok and Kolsarıcı, 2010). In the second metabolic pathway, the synthesis of CLA isomers occurs in adipose tissues and the mammary gland (Çelebi and Kaya, 2008; Demirok and Kolsarıcı, 2010). The part that does not undergo rumen biohydrogenation is absorbed from the intestines and transforms into conjugated octadecadienoic (C18: 2, *c*-9, *t*-11) acid through the Δ^9-desaturase enzyme in the tissues (Çelebi and Kaya, 2008; Wang and Jones, 2004). The adipose tissue and mammary gland of ruminants have considerable Δ^9-desaturase activity (Griinari et al., 2000).

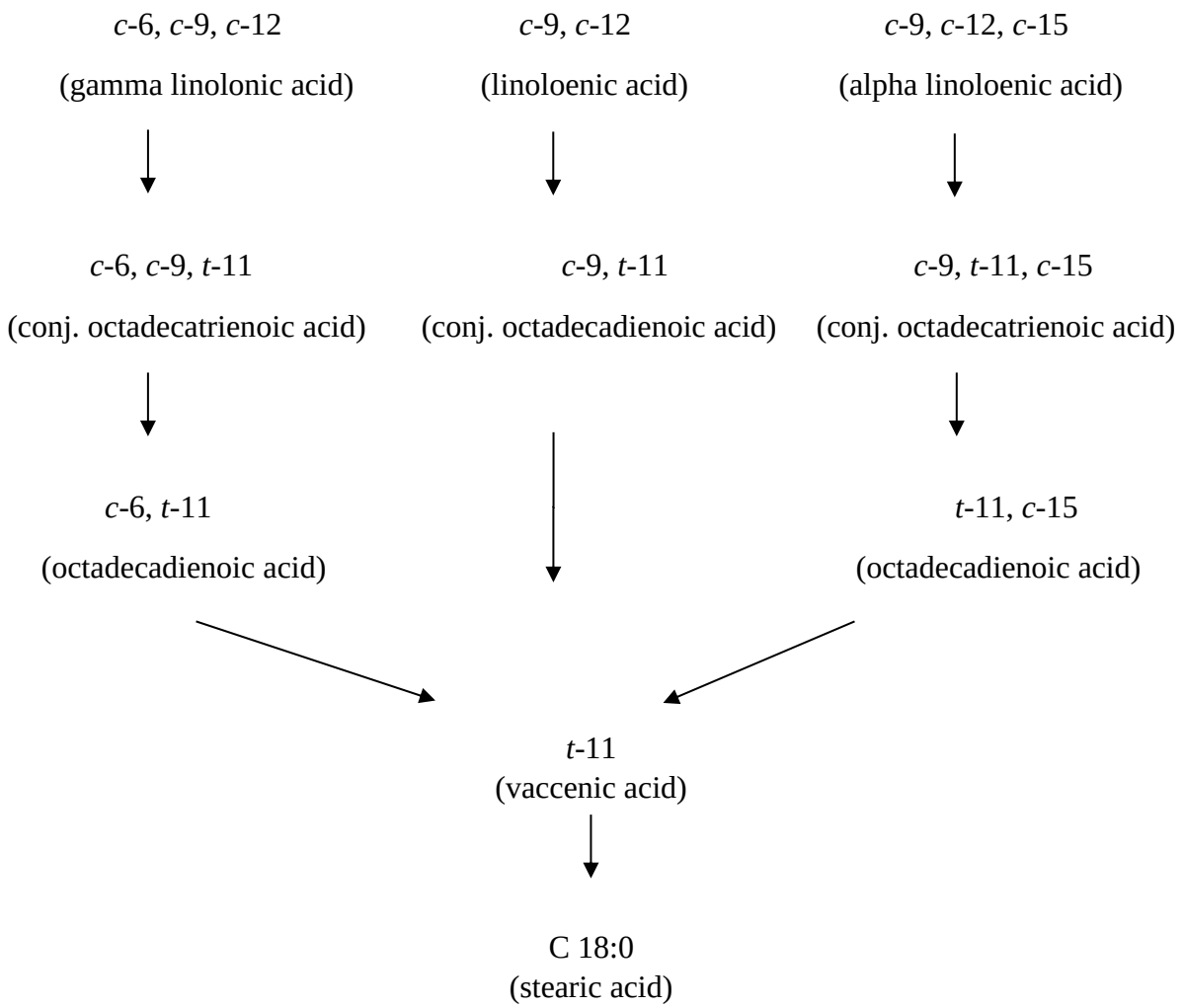

Figure 3. Predominant pathway of biohydrogenation of unsaturated C18 fatty acids (Aydin, 2005)

3.CLA CONCENTRATIONS IN FOODS

CLA is naturally found in limited amounts in many foods but cannot be synthesized in the human body (Çelebi and Kaya, 2008). The main food source of CLA for humans is ruminant meats (lamb, beef etc.) and dairy products such as milk and cheese. The main CLA isomer in natural foods is *cis*-9, *trans*-11 (*c*9*t*11) (Wang and Jones, 2004). The concentration of CLA in dairy products varies depending on the concentration of CLA in unprocessed milk. CLA concentration of slaughtered meat is quite high compared to poultry and fish. The level of CLA in ruminants is much higher than in non-ruminants (Çelik, 2006). The highest CLA amounts were found in lambs. It has been determined that the CLA content of seafood and poultry, except for turkey, is low (Gnadig et al., 2003). The amounts of CLA obtained from meat and dairy products vary between 2.9 and 5.6 mg per gram of fat, while these amounts are around 0.6 and 0.9 mg in egg and chicken meat, respectively (Çelebi and Kaya, 2008).

Table 1. CLA contents of various foods, g/100 g of total fatty acids (Gnadig et al., 2003)

	CLA content
Butter	0.63-2.02
Milk	0.46-1.78
Beef	0.67-0.99
Lamb	1.62-2.02
Fish	0.04-0.28
Yoghurt	0.43-1.12
Cheese	0.50-1.70
Pork	0.15
Turkey	0.96
Plant oils	not determined

Table 2. CLA content in meat products (in mg/g fatty acid methyl ester) (Schmidet al., 2006)

Meat product	CLA content
Salami	4.2
Knackwurst	3.7
Black pudding	3.0
Mortadella	2.9
Wiener	1.5-3.6
Liver sausage	3.3
Cooked ham	2.7
Beef frank	3.3
Turkey frank	1.6
Beef smoked sausage	3.8
Smoked bacon	0.8-2.6
Smoked bratwurst	2.4
Smoked German sausage for spreading	4.4
Smoked ham	2.9
Smoked turkey	2.4
Minced meat	3.5
Corned beef	6.6
Potted meat	3.0

4.BIOLOGICAL EFFECTS OF CONJUGATED LINOLEIC ACID

Although there are various data in the literature about the daily consumption of CLA in order to show its beneficial effects on humans, many researchers recommend that the daily consumption should be at least 3 g (Güney et al., 2020). Interest in CLA started with the discovery that CLA has anticarcinogenic and antimutagenic effect in cooked beef in 1979 (Çelik, 2006). In addition to these effects, the effect of reducing fat accumulation in the body, reducing the risk of arteriosclerosis, antidiabetic effects, strengthening effects of the immune function, increasing bone mineralization has been explored and has taken attention with its use in functional food production recently (Çelik, 2006; Khanal and Olson, 2004; Rainer and Heiss, 2004). It is known that the *c*9-*t*11 and *t*10-*c*12 isomers of CLA have different and similar metabolic effects. It is stated that the *c*9-*t*11 isomer induces growth, while the *t*10-*c*12 isomer is effective in changing body composition. It is also reported that these two isomers have an anticarcinogenic effect (Yılmaz and Şanlıer, 2017). In various studies, it has been determined that CLA has an anticarcinogenic effect at various stages of cancer development (Rainer and Heiss, 2004). There is no precise information about CLA's mechanism of preventing cancer formation. However, there are some hypotheses regarding this issue. One of them is that antioxidants have an anticarcinogenic effect by preventing the formation of some carcinogenic compounds such as nitrous compounds. CLA has been reported to reduce the amount of residual nitrite thanks to its antioxidant properties and prevent cancer formation (Hah et al., 2006). Many studies in animals have revealed that CLA can reduce fat accumulation and increase lean body mass (Wildman, 2002). CLA has the effect of reducing body fat, especially abdominal fat, chaniging serum total lipids and reducing whole body glucose uptake in the human body (Huang et al., 2008). In animal studies, CLA has also been found to increase growth efficiency ve lean body mass, reduce body fat, and prevent diabetes (Mulvihill, 2001). Conjugated linoleic acid has also been found to have antiatherosclerotic properties as well as antidiabetic properties in animal studies. (Dhiman et al., 2005).

5.FACTORS AFFECTING CLA CONTENT OF MEAT AND MEAT PRODUCTS

CLA content in beef is influenced by a various of factors such as seasonal variations, animal genetics and production practices (Ma et al., 1999). Differences in the CLA content between different animal tissues, between animals of different breeds or upbringing, or between individual animals of the same breed are reported. Raes et al., (2004) reported that higher CLA concentrations in muscles are generally associated with a higher intramuscular fat content. The diet is the most important factor because of providing the substrates for the CLA formation. Pasture feeding led to significantly higher CLA concentrations. Using oilseeds to the diet has been seen to be an efficient method to increase the CLA content in the muscle lipids. Sunflower seed, linseed and safflower seed increased the CLA content of lambs (Schmid et al., 2006). In another study, extruded full-fat soybeans were also shown to increase the CLA content in muscle fatty acids of crossbred Angus steers (Madron et al., 2002). Priolo et al., (2003) found that chickpeas to replace soybean meal and corn in the diet of lambs also resulted in higher CLA concentrations in the longissimus dorsi muscle. Feeding vegetable oils and fish oil supplements are another way to increase CLA content (Schmid et al., 2006). Except these factors, cooking and storing does not negatively affect the CLA concentration of the meat and meat products. In ground beef patties cooked with frying, baking,

broiling or microwaving, CLA concentrations did not show large differences. Shantha et al., (1994) reported that cooking methods did not cause any major changes in the CLA. Maranesi et al. (2005) indicated that both broiling and microwave cooking did not alter total CLA in in lamb rib-loins. There are limited number of studies about cooking and storage on CLA formation. The number of studies needs to be increased.

6. CONCLUSION

Conjugated linoleic acid (CLA) is used for positional and geometric isomers of linoleic acid. Meat and meat products are important foods for CLA. Especially meats obtained from ruminants are quite rich in terms of CLA amount compared to those obtained from non-ruminants. Several studies show that CLA has beneficial effects on health such as antioxidative, antidiabetes, anticarcinogenic impact. For this reason, with the use of CLA in meat and meat products, it is thought that both healthy and quality products will be obtained.

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THE APPLICATION AREAS OF NANOTECHNOLOGY IN FOOD INDUSTRY

İlkay Çelik[1]*, Hatice Sena Olcay[2], Eda Alagöz[1], Alime Yaldiz Cabi[1], Cemalettin Sarıçoban[1]

[1]Selcuk University, Agriculture Faculty, Department of Food Engineering, Konya, Turkey
[2]Istanbul Aydın University, Engineering Faculty, Department of Food Engineering, Istanbul, Turkey

* Corresponding author: ilky.clk.26@gmail.com

ABSTRACT

The term 'nanotechnology' comes from the term 'nanometer', which is one billionth of a meter. Nanotechnology is a field of science and technology that deals with the production, characterization and modification of atomic, molecular or colloidal level of materials. New products can be developed by applying nanotechnology in many fields such as food, medicine, biotechnology, agriculture, pharmacology, electronics, defense, textile, machinery and construction industries. In the food industry, nanotechnology has applications in many areas such as the development of nutrient-enriched foods, preservation, packaging, reduction of agricultural inputs, new product development, increasing food safety, and the development of nano-additives and nanosensors. The nanoparticles produced by nanotechnology applications provide the desired properties to foods such as texture and aroma. Food packaging is the most applied area of nanotechnology and its applications in this area are gradually increasing. Food safety and shelf life can be secured by developing active and intelligent packaging systems instead of traditional packaging systems. With nanosensors and intelligent packaging, indication of spoilage occurring in foods can be determined in advance. Although the applications of nanotechnology in foods are becoming crucial all over the world, there is no definite information about its effects on human health. This situation causes consumers to be cautious about nanotechnology applications. In this review, nanotechnology and its usage areas
in food industry are discussed.

Keywords: Nanotechnology, food industry, food safety, intelligent packaging system, nanosensor

1.INTRODUCTION

It is known that the word ‘nano’ is derived from the Greek word ‘dwarf’ (Momin et al., 2013). A nanometer is one billionth of a meter. Generally, word of nano mentions a size scale between 1 to 100 nm (Mousavi and Rezaei, 2011).
Nanotechnology is a branch of science and technology that involves the characterization and production of structures or materials that have at least one dimension that is smaller than 100 nm in length. When particle size of the material reduces below 100 nm, material demonstrates different physical and chemical properties from macroscale materials constituted of the same substance (Duncan, 2011).

Nanotechnology can apply in many fields such as food, medicine, biotechnology, agriculture, pharmacology, electronics, defense, textile, machinery and construction industries. Nanotechnology applications have recently started in the food field compared to other fields.

However, studies in the food sector are of great importance for the future, such as the production of new functional food products (Dağ, 2014). Nanotechnology in the food industry is a rapidly developing field with various applications in food analysis, food processing and food packaging (Patel et al., 2018).
In this review, application areas of nanotechnology in food industry such as development of functional products, transport of bioactive substances, improving food safety, some packaging systems were discussed. Also, potential adverse effects of nanotechnology were mentioned.

2.NANOTECHNOLOGY IN THE FOOD INDUSTRY

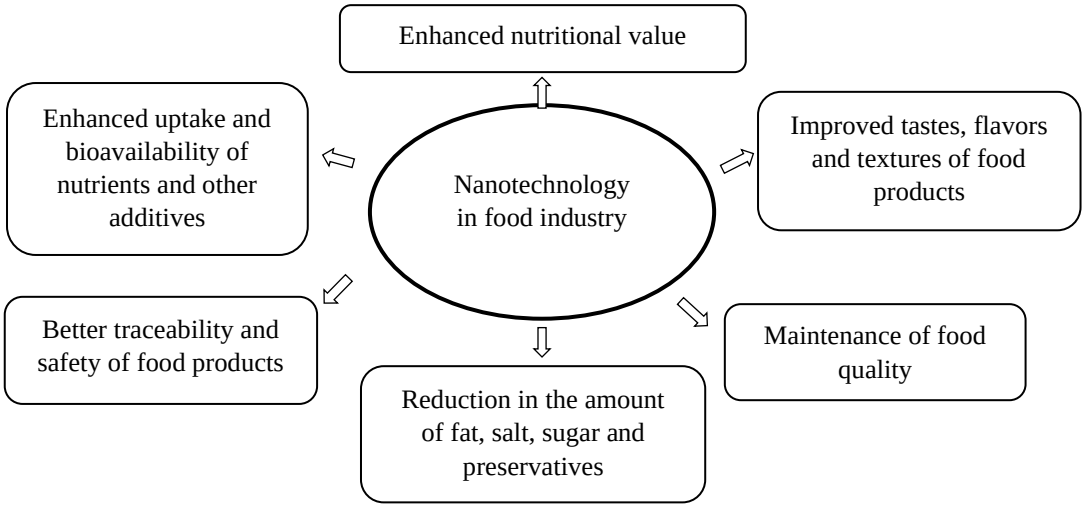

Figure 1. Benefits of nanotechnology applications in the food industry (Lamabam and Thangjam, 2018)

The term nanofood expresses the foods that have been raised, manufactured, processed or packaged using nanotechnology techniques (Momin et al., 2013). Nanotechnology has been successfully applied directly into food or packaged food products for food fortification (vitamins, minerals, essential oils and antioxidants), food quality and food safety (detection of toxic metabolites or foodborne pathogens), sensory improvement (enhancement of flavor or color), extension of shelf life and production of antimicrobial food packaging. In fact, there is very limited information on nanoscience applications in the food sector and scarce research has been performed, however the results of the studies are promising. (Patel et al., 2018).

Nanotechnology applications in the food field can be grouped under four topic titles (Tarhan et al., 2010):
-Food processing and development of functional products
-Transport and controlled release of bioactive substances and nutraceuticals
-Detection of pathogens and improving food safety
-Development of packaging systems.

Food processing and development of functional products

A main focus of nanotechnology applications in food is the development of nanostructured food ingredients and also delivery systems for supplements and nutrients (Chaudhry et al., 2008). The principles of nanoscience are to develop encapsulation systems that improve the stability of food and also protect sensitive bioactive substances from the environment and prevent undesirable

interactions during food processing and prevent food quality degradation during storage (Sanguansri and Augustin, 2006). Nanotechnology enables antioxidants, nutrients and proteins to reach specific parts of the body and cells more effectively and efficiently, thereby increasing efficacy and bioavailability. Therefore, nanotechnology makes possible the enrichment of food products and the development of new products (İlyasoğlu and El, 2010).

Emulsions are heterogeneous systems in which at least two unmixable liquids are suspended in droplets inside each other. These systems consist of two phases, hydrophilic and lipophilic. These phases are called the continuous and dispersed phase of the emulsion. The continuous phase carries the dispersed phase as droplets. The droplet size in nanoemulsions varies between 20 to 200 nm. Nanoemulsions exhibit different physical properties than those of microscale emulsions. For instance, microscale emulsions often have a white appearance because they cause a strong multiple scatter of visible light. Structures in nanoemulsions are smaller than visible wavelengths, so nanoemulsions appear optically transparent (İlyasoğlu and El, 2010).

Nanoemulsions have more potential advantages than conventional emulsions for special applications in food and beverage products. One of the most important advantages of nanoemulsions is that they can be incorporated into clear or slightly turbid products without changing their visual appearance. Nanoemulsions also generally have better stability against particle aggregation and gravitational segregation. Oil-in-water nanoemulsions consisting of oil droplets dispersed in an aqueous phase have the greatest potential for application in commercial products. (McClements and Rao, 2011).

Nanoemulsions are not thermodynamically stable by contrast with microemulsions, However, they can have high kinetic stability thanks to have small droplet size that makes them stable against sedimentation or creaming (Velikov and Pelan, 2008). Nanoemulsions are an important system developed for the transport of bioactive products by preventing sedimentation and creaming thanks to nano-droplets that make them appear transparent (Saka and Gülel, 2015).

Nanoemulsions are often used as delivery systems to encapsulate lipophilic components, such as carotenoids, oil-soluble vitamins, ω-3 oils and phytosterols (McClements and Rao, 2011). Nanoemulsions increase the accessibility of substrates for surfactants such as lipase. Nanoemulsions increase the bioavailability of oils and digestion of fat soluble nutrients by nanocapsulation as well as they improve product appearance (Saka and Gülel, 2015).

The bioavailability of nanoemulsified forms of coenzyme Q10 (CoQ10), which has very low bioavailability, increases significantly (Saka and Gülel,2015).

Transport and controlled release of bioactive substances and nutraceuticals

The controlled- release process of bioactive compounds is divided into 3 categories: wet (liquid) process, drying / coating and solid process. wet (liquid) phase processing used for water-based systems, organic solvents and hot melt systems. In the drying process, pressure is applied to the suspension containing the active ingredient and it is atomized and dried by spray drying method to create a "mist" in the drying chamber. Some of the other drying methods are centrifugal atomizers and extruders (Garti, 2008).

The use of nanocapsules as a carrier for nutrients such as essential oils, proteins, antioxidants, minerals and vitamins, and their release in the appropriate part of the body by protecting them from adverse environmental conditions, and thus increasing their bioavailability can be achieved (Dağ, 2014). With the nanoparticles produced through nanotechnology applications, the desired texture and aroma can be given to the food. Thanks to the edible film, antimicrobial packaging, biodegradable materials, the safety and shelf life of foods can be secured. With intelligent packages and nanosensors, indication of spoilage in foods can be detected in advance (Çelik and Tümer, 2016; Saka and Gülel, 2015).

Hydrophilic substances become fat-soluble and lipophilic substances become water-soluble because of nanotechnology, so some functional components such as carotenoids, phytosterols and antioxidants disperse within water or juices and develop bioavailability of nanoparticles (Chau et al., 2007).

When vitamin E, which is quite beneficial for health, is added to fruit juices, it causes turbidity in the beverage and negatively affects the appearance. This problem has been overcome by the design of vitamin E nanoparticles (Chen and Wagner, 2004).

The bioavailability of carotenoids is quite low. Because of their high hydrophobicity, carotenoids are insoluble in aqueous systems and therefore have a poor uptake in the body. Micro and nanodispersions have been developed to improve their water dispersibility, coloring strength potential and also increase their bioavailability. Because of their high bioavailability, they have attained interest as delivery systems for bioactive substances such as carotenoids, polyunsaturated fatty acids, phytostetol and lipophilic vitamins (Ribeiro et al., 2008).

In studies in the food sector, it is aimed to increase the quality of the products, shorten the fermentation period and protect against chemicals by using encapsulated enzymes (Saka and Gülel, 2015).

Detection of pathogens and improving food safety

The one of main applications of nanotechnology in food engineering is food nanosensors (Lamabam and Thangjam, 2018). During food processing, nano-based sensors are used to track products and detect pathogens or chemical contaminants that cause food spoilage. For this purpose, simple, recyclable, low cost and highly sensitive carbon nanotube based biosensors that do not require labels have been developed (Saka and Gülel, 2015).

QDs, CNTs, gold nanostructures and other active nanostructures have been used in the development of nano biyo-sensors for the detection of contaminants and microorganisims for food safety (Lamabam and Thangjam, 2018).

Nanosensors are placed directly into the packaging material, where they detect metabolites released during food spoilage in a short time and provide information about whether the food is safe to consume or not. The working principle of the portable, low-cost and non-specialized nanosensors is to place a specific protein of the microorganism (bacteria), which is characterized as a bioagent, on a chip and the target microorganism in the food sample binds to
this protein (Uyarcan et al., 2019).

Development of packaging systems

Packaging has an important place in meeting the food industry and consumer needs. Consumers expectations from food packaging have increased in parallel with technological developments. Therefore, in recent years, researchers have developed new technologies to increase the functional properties of packages. Nanotechnology has also found use among these new technologies (Karagoz and Demirdoven, 2017).

Packaging designs have been made using nanomaterials and nanocomposites in food packaging (Uyarcan et al., 2019). Nanomaterials are divided into three categories: nanoparticles, nanofibers and nanoplates (Mihindukulasuriya and Lim, 2014). Nanoparticles consist of equi-sized particles of different shapes such as nanogranules, nanocrystals, nanospheres and nanoclusters (Ntim and Noonan, 2017). Nanoparticles stand out with their mechanical, optical and antimicrobial properties as well as important barrier properties. Silver nanoparticles and nanoclay constitute the majority of nanotechnological packages in the market (Bumbudsanpharoke et al., 2015). Nanofibers are nanomaterials of nanometric thickness and width but of micro or millimeter length, examples of which are nanotubes, nanorods and nanowires. Nanoplates are disc, sheet or plate-like materials with only one dimension nanometric and the other two dimensions quite large (Ntim and Noonan,

2017). Today, these nanomaterials are used in food packaging to preserve the freshness of the packaged food and to extend its shelf life (Bumbudsanpharoke et al., 2015).

Nanomaterials are combined with various materials to create larger particle size nanocomposites. These nanocomposites with high surface:volume ratio have superior physicochemical properties such as solubility, optical and transmittance (Bajpai et al., 2018; Kalita and Baruah, 2019). Nanocomposites can be used as an alternative to existing polymer and polymer alloys. Nanocomposites used in food packaging are expected to be resistant to various stresses during processing, distribution and storage (Bajpai, 2019). Active, smart and biodegradable packaging designs are realized with nanocomposites. Active nanomaterials with antimicrobial, oxygen scavenging properties in nanocomposite active packaging; nanocomposite devices such as nanosensors, time-temperature indicators in nanocomposite smart packaging; current studies are carried out using nanocomposite biopolymers obtained as a result of combination with polysaccharide, protein and lipid-based biopolymers in biodegradable nanocomposite packaging (Uyarcan et al., 2019).

Since nanotechnology is a very new technology in the food packaging industry, there is a need for both the development of packaging designs and the detection of migration from

packaging to food (Uyarcan et al., 2019).

3.POTENTIAL ADVERSE EFFECTS OF NANOTECHNOLOGY APPLICATIONS ON THE HEALTH

It is quite difficult to predict the long-term effect of any technology such as nanotechnology (Moraru et al., 2009). Although the potential benefits of foods produced by nanotechnology are highlighted, there is no knowledge of the safety of these products. Therefore, there are concerns about its effects on health. Recently, some researchers have carried out studies on the toxic effects of nanotechnology on biological systems and determined some potential effects. Nanomaterials such as silver, zinc-oxide, and magnesium integrated into packaging materials can contaminate foodstuffs by direct contact, and when these products are consumed, they can pose a risk to human health. It has been stated that nanoparticles may have harmful effects on human health, but there are many uncertainties in this regard. The large surface areas of nanoparticles enable the binding and transport of toxic chemical pollutants. It is stated that because of the ability of nanoparticles to penetrate into cells, toxic substances can also spread inside the body and cause disorders in the cell and defense mechanism. It is also stated that inhalation of nanosized substances can also cause lung diseases (Dağ, 2014).

More studies should be performed on the applications of nanotechnology in food processing, packaging, regulation, nanotoxicity and risk-benefit analysis in order to overcome information gaps, maintain the development of the nano food industry and avoid unpredictable
health hazards (Chau et al., 2007).

4.CONCLUSION

Nanotechnology can be applied in many fields and is considered as the most important technological application of our age. The applications of this technology in the food industry provide many benefits such as developing new products, increasing the nutritional value of foods, detecting pathogens, using smart packaging instead of traditional packaging methods, encapsulating some functional ingredients and adding in beverages and increasing bioavailability. Food safety can also be guaranteed with these applications. However, there is not enough scientific data on the risks of consuming foods enriched with nanoparticles, and this situation causes concerns for consumers. For this reason, it is thought that the researches can be increased and these concerns can be overcome by scientific regulations.

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IN-OVO FEEDING WITH PROPOLIS EXTRACT IN POULTRY

Kalbiye KONANÇ[1*], Ergin OZTURK[2]

[1]Ordu University, Ulubey Vocational School, Department of Veterinary, 52850, Ordu, Turkey
[2]Ondokuz Mayis University, Faculty of Agriculture, Department of Animal Science, 55139, Samsun, Turkey
*Corresponding author: kalbiye-serdaroglu@hotmail.com

ABSTRACT

Live vaccination applications requires both costly and labor-intensive work. For this reason, research continues on both easier and more reliable methods that can reduce the workforce to minimum. In addition, vaccines can minimize the need for vaccination by improving immune systems of animals in the embryonal period. In this context, the in-ovo injection system was launched in 1985 as new application. In-ovo injection, which was previously developed as a vaccination system, has recently been continuing with in-ovo feeding studies aimed at feeding the embryo. During the embryonic period, the feeding of the creature inside the egg (in-ovo) is carried out in order to prevent the deficiency of the nutrients that creatures need at hatching. During the period when the chicks of the embryonic period take the amniotic fluid orally, the additional nutrient injection can accelerate the enteric development and increase the digestion capacity and digestion of the food. During the embryonic period, isotonic fluid and nutrients are injected in-ovo into the amniotic fluid, allowing the embryo to ingest the nutrients supplied to the amniotic fluid before hatching. Chicks can be fed in-ovo before hatching, so they can develop earlier than desired. In addition to its use in vaccination, it has also been used in last 10 years to improve the immune systems of poultry and increase their performance values with the in-ovo injection system. In this article, the usability of special growth factors and immune supportive nutrients such as propolis in poultry production with in-ovo injection system was discussed.

Keywords: Embryonic feeding, In-ovo injection, Poultry, Immune system, Digestive capacity, Special growth factors

IN-OVO FEEDING

All the nutrients required for normal embryonic growth and development should be present in the egg. The nutritional source is primarily from the mother's ration and this starts with the consumption of well-prepared rations. The accumulation of nutrients in eggs depends on greater

storage efficiency (Hossain et al., 1998). It is estimated that low brooding efficiency and poor chick quality in young broiler breeders are generally due to malnutrition. For fast growing commercial lines such as broilers, chick quality is important in terms of their weight in slaughter. For a profitable business, the quality of the chicks coming and feeding the animals with balanced rations should be a priority.

It has been reported that feeding chicks in solid, liquid or semi-solid form immediately after hatching will have a positive effect on live weight and carcass yield at slaughter age.(Noy and Sklan, 1999). In the late stages of hatching, the growth of chicks depends on the nutrients remaining in the egg yolk. Late delivery of feed and water to chicks has resulted in death and slow development over 5%, and a decrease in resistance to diseases and slowing muscle development (Uni and Ferket, 2004; Ferket, 2006). When feed consumption begins immediately after hatching, nutrients from the feed complement the nutrients provided from the egg. In-ovo feeding, that is, feeding the creature inside the egg during the embryonic period is carried out in order to prevent the deficiency of the nutrients that creatures need at the hatch of the egg. It has been reported that in the embryonic period chicks take the amniotic fluid orally, the additional nutrient injection will accelerate the enteric development, increase the digestion capacity and the digestion of food. It has also been reported that with in-ovo feeding, chicks can develop earlier than desired immediately after hatching (Ferket, 2006).

The in-ovo injection system is realized by opening the shell with a thin injector into the air gap on the egg shell. Success in in-ovo injection depends on the embryo period, the injection time and the injection site (Moosanezhad et al., 2011; Salahi et al., 2011, Kop Bozbay et al., 2016). The effects of vaccines or therapeutic agents to be applied to various regions can increase or limit the response of the embryo depending on the region. With the in-ovo method, many advantages can be obtained such as feeding the embryo, the rate of feed utilization, post-hatching deaths and diseases, immunity against enteric antigens, disorders in the skeletal system, increasing the yield of breast meat by increasing muscle development, and improving the immune system by reducing many factors that suppress the growth of broilers. It has also been reported that it can reduce production costs (Ferket, 2006).

WHY PROPOLIS?

Propolis is a bee product that has antimicrobial, anti-inflammatory, hepatoprotective, anti-oxidative effects as well as biologically enhancing the immune system by stimulating the immune

system. Propolis is rich in biochemical compounds. It has been found to contain more than 300 compounds, including phenolic acid, terpenes, cinnamic acid, caffeic acid, many esters and flavonoids (Bankova vd, 2000).

Generally, ethanol is the best solvent for propolis preparation, and other solvents such as ethyl ether, water, methanol, acetone, dichloromethane and chloroform may be used for extraction and identification of propolis compounds (Szliszka et al., 2013).

In terms of immune system, flavonoids in propolis increase natural killer activities against recurrent tumor cells (Sforcin et al., 2002), regulate in vitro and in vivo nitric oxide and hydrogen peroxide production by peritoneal macrophages (Orsi et al., 2000) and increase fungicidal activities of these cells (Murad et al., 2002) were observed.

Due to these effects of propolis and the flavonoids it contains, it has managed to be among the subjects that have been extensively researched in recent years. (Banskota et al., 2001, Wagh, 2013).

BEE PRODUCTS USED IN-OVO FEEDING

Bakhshayesh, 2016 planned to investigate the effects of injection of propolis extract and zinc oxide nanoparticles on the broiler breeder eggs on embryonic development, growth performance, hatchability, weight broiler hatching eggs and hatched safety.

The results of this experiment showed that infusion solution into the amniotic tested on 15.5 incubation on hatchability, hatching chicks in egg weight, feed intake, immune system, feed conversion, daily gain and carcass traits were significantly affected. But there was no significant difference on the weight of hatching chicks.

In-ovo injection of propolis water extract

Aygun (2016) determines the effects of in-ovo injection of a propolis water extract on hatchability, embryonic mortality, starter live performance, and livability of Japanese quails. Hatchability and embryonic mortality in the 2% propolis and 3% propolis treatment groups were significantly lower compared with the control group, but no significant differences were observed between the 1% propolis and control groups. There were no significant bodyweight gain, feed intake, feed conversion ratio, or livability differences among treatments.

In-ovo propolis ethanol extract

Two trials were conducted by Kop Bozbay et al. (2016) in order to evaluate the effects of in-ovo propolis injection and injection site on hatchability, hatching weight and viability in two different slowly growing broiler lines. As a result, in this study in which propolis extract was

applied in-ovo to the air sac on the 18th day of incubation, they reported that the propolis extract injection increased the hatching rate, but decreased the hatching weight.

In-ovo polen extract

Coşkun et al. (2014) stated that injection of pollen extract to broiler breeder eggs on the 16th day of incubation increased the chick weight ratio. At the end of the study, when the incubation ability is controlled; 89.1%, 82.3% and 73.1% values were recorded for the negative control and pollen extract injected groups, respectively. While there was no statistically significant difference in hatching between the control and pollen extract-injected groups, hatching was decreased in the negative control group ($P < 0.05$). After hatching, chick weight / first egg weight was 70.1%, 71.1%, and 73.5% in the control group, negative control and pollen extract injected groups, respectively. It was determined that the injection of pollen extract into the egg amnion statistically increased chick weight / initial egg weight compared to the control and negative control groups ($P < 0.05$). At the end of the study, it was concluded that pollen extracts can be used as feed ingredients to obtain heavier chicks after hatching, but different extraction methods or different pollen extracts should be investigated.

In-ovo oil-extracted propolis

The purpose of their studies were to determine the effects of in-ovo injection of oil-extracted propolis on the growth performance and immune status of broiler chicks (Ross 308) after hatching. The results showed that propolis extract injected into eggs at day 15 of incubation did not show effect on hatchability, body weight and weight of the hatched chicks hatched egg weight ($p>0.05$). In-ovo injection levels of oil-extracted propolis were no significant on feed intake, body weight, average daily gain and feed conversion ratio in total rearing periods among treatments (Bakhshayesh and et al., 2017).

In-ovo injection of honey

Memon et al., (2019) evaluated the effect of honey administration in pre- and post-hatch sessions on the immunity and intestinal microflora of growing broilers. It was shown that the pre-hatch honey administration significantly ($P < 0.05$) improved feed intake, final body weight, relative weight of spleen and anti-NDV antibody titer.

Post-hatch honey supplementation (in drinking water) significantly ($P < 0.05$) increased feed intake, FCR, final body weight, anti-NDV titer, relative weight of spleen and *Lactobacilli* count, while decreased ($P < 0.05$) the counts of *Escherichia coli* and *Salmonella* on day 21. The interaction

of both the pre- and post-hatch honey administrations also significantly affected ($P < 0.05$) performance and immunity parameters, as well as the intestinal microflora.

So, in ovo and post-hatch administration of honey had positive impacts on performance, immune organ indices, gut microbiota and anti-NDV titer in growing broiler chickens.

In-ovo Royal Jelly

The influence of in ovo royal jelly (RJ) injection on hatching, growth and blood parameters in two chicken strains (Dokki-4 and El-Salam as example for different strains) was evaluated on the seventh day of incubation. Injection with 0.5 mL RJ/egg significantly ($p < 0.05$) improved chicken body weight and daily weight gain compared to the control treatment. RJ injection decreased blood lipid profile parameters and the numbers of monocytes and eosinophils and increased total protein, globulin, haemoglobin (Hb) and lymphocyte levels compared to the control treatment. The Dokki-4 strain was superior to the El-Salam strain for the tested parameters and injection with 0.5 mL RJ/egg produced the best hatching parameters, growth performance and health-related traits. RJ in ovo injection was much more effective in the Dokki-4 strain than in the El-Salam strain, which supported the hypothesis of the study that varying the chicken strain could alter the response to the in ovo injection with RJ (Ayman et al., 2019).

Moghaddam et al. (2013), who used royal jelly in-ovo on the 7th day of incubation to investigate chick body and organ weights and gonadotropin levels, reported that the hatching weight, heart and liver weight and FSH and LH levels increased compared to the control group.

Again, according to the results of the in-ovo royal jelly application on the 7th day by Jafari Ahangari et al. (2013), the body weight, feed consumption and feed conversion rate determined on the 21st day were found to be higher than the control group.

CONCLUSIONS

In-ovo and post-hatch administration of bee products had a positive impact on performance, immune organ indices and anti-Newcastle disease virus antibody titer in growing broilers.

Moreover, some bee products administration positively influenced the population of gut microbiota in growing animals. Nonetheless, further studies are needed to examine the effect of different doses of bee products on gut microbiota and immunity in immunologically challenged broilers.

Also injection into the different sites of eggs and different incubation days, elicited significant positive effects on hatching parameters, growth performance, blood chemistry, haematology and immunological parameters.

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USE OF PROPOLIS AS A DIGESTIVE SYSTEM REGULATOR IN POULTRY

Kalbiye KONANÇ[1*], Ergin OZTURK[2]

[1]Ordu University, Ulubey Vocational School, Department of Veterinary, 52850, Ordu, Turkey

[2]Ondokuz Mayis University, Faculty of Agriculture, Department of Animal Science, 55139, Samsun, Turkey

*Corresponding author: kalbiye-serdaroglu@hotmail.com

ABSTRACT

Intestinal microflora is one of the most important factors affecting performance in poultry. Increasing the rate of conversion of feed to meat by keeping the disease factor microorganisms in general microflora relatively low and keeping the immunity levels of animals. It is essential to know the types and amounts of microorganisms present in order to know the effect of plants and plant extracts on the digestive system. Medicinal and aromatic plants, both remove pathogenic microflora in monogastric and increase the concentration of microorganisms that will assist in the digestion and absorption of nutrients. In particular, birds are more susceptible to pathogenic microorganisms such as *Escherichia coli*, *Salmonella* spp. Microorganisms in the digestive system of poultry live symbiotically with the host and are very important for the host's nutrition, metabolism and immunity. Propolis, as a resinous, natural and strong adhesive substance, is collected by honey bees from buds, tree and plant leaves and used to protect the hive from natural events such as rain or to prevent bacterial invasion of the hive. The most important active components of propolis are aromatic acids, phenolic compounds and especially flavonoids (flavones, flavonols and flavones) and phenolic acids. Flavones and flavonoids are the components that give to propolis; antifungal, antiviral and antibacterial properties. Another mechanism is to prevent bacterial growth by destroying the bacterial cell, especially the cytoplasm, cell membrane and cell wall. In this article, the possibilities of using propolis as a digestive system regulator in poultry were evaluated.

Keywords: Flavonoids, Phenolic acid, Antibacterial, Poultry, Intestinal microflora

INTRODUCTION

The presence of infections that cause the integrity of the poultry digestive system in the ration or diseases experienced in the early period may result in impaired micro-absorption of nutrients. Poultry diets are generally based on the need of healthy animals under ideal management. Therefore, in order to protect the health of the poultry and to strengthen the immune system, especially in the presence of epidemic diseases, there is a need to support poultry diets in terms of both macro and micronutrient values.

Intestinal microflora is one of the most important factors affecting performance in poultry, especially broiler chickens. Increasing the rate of conversion of feed to meat is vital for the profitability of the poultry sector, as the disease factor microorganisms are proportionally less in the general microflora and the immunity levels of the animals are kept high for the increase in performance in poultry.

Plant extracts, which have been frequently emphasized in poultry feeding in recent years, are traditionally used in the treatment of diseases and are an alternative to prohibited antibiotics. Studies on the benefits of plant extracts and the use of viable alternatives in the future are ongoing. With the addition of propolis to poultry rations, it is aimed to reduce the risk of developing diseases by improving the immune systems of animals, reducing excess losses when infectious diseases are observed in the herd and spending on drug treatments. Thanks to the flavonoids it contains, propolis positively supports the intestinal microflora and plays an active role in the immune system.

PROPOLIS

Propolis is a bee product; that is sticky, aromatic and pungent odor, non-soluble in water and hard and brittle below 15 ºC, soft and flexible at 65 ºC, melting at 80-105 ºC, varying from black to yellow depending on the source. Its composition slightly varies between regions and among seasons as a result of flora variation, propolis is generally composed of 50% resin and balsams, 30% wax, 10% essential and aromatic oils, 5% pollen grains and other substances (Gómez-Caravaca et al., 2006).

Propolis is collected from buds, tree and plant leaves by honey bees as a resinous, natural and strong adhesive substance and mixed with substances such as pollen with enzymes secreted by bees. It is used to protect the hive from natural events such as rain or to prevent bacterial invasion of the hive (Benkovic et al., 2007). It has also been reported to have a wide range of biological activities. It has been reported that propolis, which has different pharmacological properties, is used as an antimicrobial and anti-inflammatory, and also improves its hepatoprotective, anti-oxidative effects and biologically stimulating the immune system (Bankova, 2000). Propolis is very rich in biochemical components and more than 300 compounds have been identified, including phenolic acid, terpenes, cinnamic acid, kaffeic acid, many esters and flavonoids (Bankova et al., 2000).

Pinosembrin, an active ingredient in propolis; antimicrobial and antifungal, galangin; antiviral and antioxidant, caffeic acid and caemferol; antifungal, antiviral, antimicrobial, antioxidant, anticarcinogenic, antihepatotoxic and immunostimulant, quercetin; antifungal, antiviral,

antimicrobial and anticarcinogenic, chrysin; antifungal, antimicrobial, anticarcinogenic and antihepatotoxic and fisetin and apigenin components; They show antiviral, anticarcinogenic and antioxidant effects (Banskota et al., 2001).

INTESTINAL MICROFLORA

Infectious diseases, particularly enteric diseases, constitute a major problem for commercial poultry farmers mainly because of the associated production losses, increased mortality rates and subsequent contamination of poultry products intended for human consumption. Therefore, the manipulation of gut microbiota and immunity of poultry chickens using feed additives has been known as an important strategy for improving the growth performance and reducing losses caused by diseases (Kamboh et al., 2016). In addition, a growing concern related to anti-microbial resistance of pathogens isolated from humans and food animals, together with the ban of the use of antibiotics as feed additives, have enhanced the focus of research on natural alternatives for the production of food animals (Raheema et al., 2016).

Feeding probiotics in post-hatch period helps to maintain a beneficial intestinal microflora, augments the host's immune system, and results in a healthy gastrointestinal environment with an enhanced gut function and feed conversion that results in improved weight gain and performance of birds (Vilà et al., 2009; Mountzouris et al., 2010). Subsequent to banning of use of antibiotics as growth promoters in poultry nutrition, numerous studies turned to finding of alternative solutions, i.e. other, natural substances, which would have positive effect on chicken growth and feed conversion. The most often additives evaluated in poultry nutrition were probiotics, prebiotics, antioxidants, acidifiers and enzymes (Perić et al., 2009).

The gut microflora provided a natural barrier against the harmful bacteria, which subsequently prevented the growth of exogenous and pathogenic bacteria, as well as produced bacteriocins and other substances that augmented the immune system, thus increased the helpful microorganisms in the intestine (Tannock and Savage, 1974). Memon et al., 2019 has reported, the in-ovo administration of honey acted as a prebiotic that served as feed for the endogenous probiotics, hence suppressed the growth of exogenous pathogenic microbes. Kumar et al. (2008) resaerched that, the antimicrobial property of propolis collected from Gujarat by agar diffusion method against *Staphylococcus aureus*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Candida albicans,* and *Asparagus nigar*. Ethanolic extracts of sample (conc. 200 mg/mL) showed high antibacterial activity against Gram-positive, that is, *Bacillus subtilis*, but least activity against

Gram-negative bacteria (*P. aeruginosa* and *E. coli*). The yeast *C. albicans* showed the moderate zone of inhibition whereas *A. niger* did not show any activity. However, the least was in the 40% methanolic extracts. Selvan et al. (2011) collected propolis from different places in Bangalore, they observed that bee propolis in combination with chlorhexidine possesses high antimicrobial activity against *Streptococcus mutans*.

Propolis extract has been studied in vitro as well as pathogenic microorganisms that can be found in poultry microflora including; *Escherichia coli, Salmonella spp., Enterobacter cloaca, Klebsiella pneumoniae, Pseudomonas aeruginosa, Staphylococcus aureus, Staphylococcus epidermis, Bacillus cereus, Bacillus subtilis, Micrococcus luteus, Enterecoccus faecalis* and *Enterecoccus faecium*. Data from studies concerning antibacterial properties of propolis support the fact that propolis is active mainly against Gram-positive bacteria in and shows lower activity against the Gram-negative ones at small quantity or is inactive at all.

The focus of alternative strategies has been to prevent proliferation of pathogenic bacteria and modulation of indigenous bacteria so that the health, immune status and performance are improved. Gut microflora has significant effects on host nutrition, health, and growth performance (Kročko et al., 2012) by interacting with nutrient utilization and the development of gut system of the host. This interaction is very complex and, depending on the can have either positive or negative effects on the health and growth of the chickens. For example, when pathogens attach to the mucosa, gut integrity and function are severely affected and immune system threatened (Neish et al., 2002). Gut microflora is a nutritional responsibility in fast-growing broiler chickens (Dibner and Richards, 2005; Lan et al., 2005) since an active microflora component may have an increased energy requirement for maintenance and a reduced efficiency of nutrient utilization.

ALTERNATIVE FOR THE IMPROVING OF THE BROILER CHICKEN HEALTH

One alternative for the improving of the broiler chicken health and performance may be incorporation of propolis and bee pollen into broiler diets (Kročko et al., 2012). It was found that occurrence of both beneficial and pathogen microorganisms in gastrointestinal tract of broiler chickens was affected by nutrition with propolis and bee pollen supplement. The bacteria colonization pattern in gastrointestinal tract of broiler chickens can be affected also by combination of nutrition supplements and pH value which can provide the advantage to some bacteria and influenced their competitiveness.

Mahmoud et al. (2014) and Abdel-Mohsein et al. (2014) clarified that supplementation of propolis (100, 250, 500 or 750 mg/kg diet) had a significant stimulating effect on the numbers of *Lactobacillus* spp. and *Bifidobacteria* spp. in the broiler gut under both recommended temperature and chronic heat stress conditions. Conversely, dietary supplementation of propolis at 1000 mg/kg diet (Tekeli et al., 2010) or 400 or 800 mg/kg diet (Kročko et al., 2012) in broilers was reported not to influence the numbers of intestinal lactic acid bacteria. Supplementation of propolis has not been shown to affect caecal numbers of total *Coliforms*, *E. coli* and *Enterococcus* spp. in chickens (Tekeli et al., 2010; Mahmoud et al., 2014). On the contrary, Abdel-Mohsein et al. (2014) reported that diets mixed with propolis (250, 500 or 750mg/kg diet) significantly reduced total anaerobes and coliform bacteria within the gut of broilers reared under heat stress.

CONCLUSIONS

Previous studies have indicated that the effects of propolis on poultry performance, health and welfare are affected by multiple factors, such as its type and dosage, active component levels, feeding duration and physiological factors (i.e. age, weight and/or breed) and animal species.

The available literature, and its varying results with propolis suggests its efficiency is affected by trial conditions (stressed or unstressed and the types of stressors). However, the positive findings for propolis on performance and health of poultry support its stated biological functions as an antioxidant, antibacterial, immunostimulant and growth promoter; and indicate that the use of propolis as a natural feed additive is promising.

Plant extracts, which have been frequently emphasized in poultry feeding in recent years, are traditionally used in the treatment of diseases and are an alternative to prohibited antibiotics. Studies on the benefits of plant extracts and the use of viable alternatives in the future are ongoing. With the addition of propolis to poultry diets, it should be aimed to reduce the risk of developing diseases by improving the immune systems of the animals, reducing the excess losses when infectious diseases are observed in the herd and the expenses for drug treatments.

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THROUGH A PARTNERSHIP TO SAFETY OF VALUABLES

Murataliev Bolot Anarbekovich, Mamatov Nurlan Elebesovich, Karabaev Aibek Nurudinovich

Murataliev Bolot Anarbekovich, Head of Project ” Kyrgyz taigan".
Kyrgyz Republic, e-mail: pfr_bam11@yahoo.com

Mamatov Nurlan Elebesovich, Department of animal science, Faculty of Agriculture, Kyrgyz-Turkish University of Manas, doctor of Agricultural Sciences .
Kyrgyz Republic, e-mail: nurmamatov1965@mail.ru

Karabaev Aibek Nurudinovich, Ph. D agriculture sciences, NGO “Central Asian Partnership”, Kyrgyz Republic. e-mail: aibekusa@mail.ru

There are many cases when individual animals occupy a special place among the national values of the peoples of the world, especially neutered and raised to a high level, as the pride of the entire nation. In many countries, there are cases when some animal proudly points to the eyes and sanctifies it. For example: in Kazakhstan – the snow leopard, Spain – the heat in Thailand – the elephant in India – tiger in Turkey – kangal in the UK – a lion, Australian kangaroo, Finland – deer in Germany – bear, Italy – wolf, Hungary – dog breed mosquitoes in the United Arab Emirates – poultry, in Azerbaijan is the Karabakh horse, in Bolivia, llama, Albania – eagle, in Algeria –a view of a Fox named the Fennec Fox.b.

The Kyrgyz people highly appreciated the Taigan dog breed and have preserved it to this day. We can say that this animal with its critical, special properties and currently obtains respect among the peoples of other countries, finds its fans and finds its place under the name "Kyrgyz taigan". It is one of the symbols of the Kyrgyz people. It has good qualities such as laughter, intelligence, dexterity, courage, and spice. The breed of this dog, mentioned in the epic Manas, is also found in oral and cultural sources about the Kyrgyz. For thousands of years, the taigan dog has accompanied Kyrgyz heroes, hunters, and manaps. Taigan-a special animal, it needs freedom, it was used in hunting, military campaigns, was given as a gift with honor and respect.

The famous scientist-biologist L. p. Sabaneyev considered the turning of the tip of the dog's tail as a sign that it was included in the number of domestic animals. Previously, he gave evidence of 3400 thousand years before our era, found in the Egyptian pyramids. [1]

In the Kyrgyz Republic, since 2018, a number of works have been carried out within the framework of the “Kyrgyz taigan” project.

For wide dissemination of information at the international level with the Association of heads of state bodies, public organizations, educational institutions, practices engaged in scouting www.kgtaigan.com implemented, books are published in English, French, Russian, and Kyrgyz through mass media (mass media). Cooperation in this direction with scientific institutions, universities, and foreign partners gives good results. Thus, at the Kyrgyz-Turkish University "Manas" with the participation of scientists, specialists working in the field of archaeology, entography, anthropology and Ethnology, scientific work has begun to determine the genotype of the taigan.

In 2019, measures were taken to determine the number of Taigans on the territory of our country. As a result, it was found that 2316 Taigans are officially registered in the country, and if clarified, their number may be even greater. This situation suggests that there is enough genetic material in our country to ensure the purity of the taigan.

The number of Taigans in Kyrgyzstan as of June 2019.

№	Regions	Number of Taigans
1	Naryn	801
2	Ysyk-Kol	433
3	Talas	386
4	Chuy – Bishkek	372
5	Jalal-Abad	242
6	Osh	66
7	Batken	16
	Total	**2316**

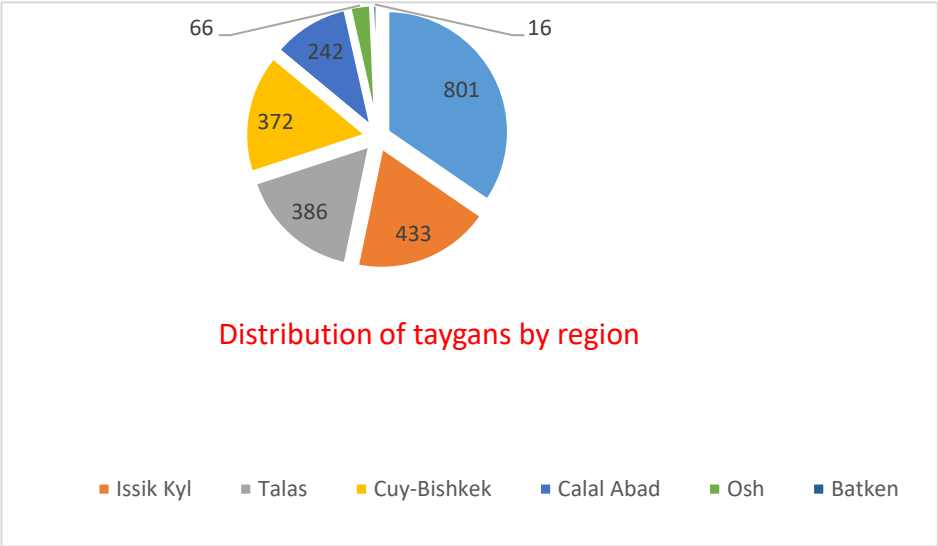
Meeting with the population of the Naryn region of the Kyrgyz Republic.

Head of the Department of the Administration of the President of the Kyrgyz Republic K. Bazarbayev during familiarization with the situation of the Taigans.

Results of the «Kyrgyz taigan» project currently being implemented in the Kyrgyz Republic:

- In 2019, a count was conducted to determine the number of Taigans in the country;
- Within the framework of the project, samples of aviaries for catching Taigans were created;
- 2019 August 29, 2019 in the framework of conservation of cultural heritage values of the Kyrgyz people in terms of the request of the Kyrgyz Taigan in 2019-2020 plan of works approved by the Government of the Kyrgyz Republic and carries out the appropriate actions.
- 2019 on October 11, the Public Association "KYRGYZ TAIGAN CLUB" was established and registered. A unified database of dog breeds began to form under the club. This organization is responsible for resolving issues related to the split, and favorable conditions are created in the Republic for uniform work.

Diagram distribution of taigans by region.



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HISTORICAL INFORMATION REMAINING ON THE STONE

Kubatbek Tabaldiev, Taalaybek Abdiev, Mamatov Nurlan Elebesovich, Aibek Karabaev

Kubatbek Tabaldiev, Ph.D, Kyrgyz-Turkish Manas University Professor, Archaeologist, Kyrgyz Republic

Taalaybek Abdiev, Ph.D, Kyrgyz-Turkish Manas University, Associate Professor, Turkologist Kyrgyz Republic

Mamatov Nurlan Elebesovich, Department of animal science, Faculte of agriculture, Kyrgyz-Turkish University of Manas, doctor of agricultural Sciences. Kyrgyz Republic.e-mail: nurlan.mamatov@manas.edu.kg nurlan.mamatov19645@mail.ru

4, Aibek Karabaev, Ph. D agriculture sciences, Mercy Corps Kyrgyzstan, SIBELIUs project officer

Abstract: The good side of the Son of Man's hunting is that he is interested in dog and bird hunting. Or it has been noted that hunters were photographed in Bronze Age paintings. Hunting with eagles is mentioned in pictures drawn on stones 2000-2500 years ago, starting from the Early Iron Age. Hunting with a dog may have originated in the Middle Stone Age. As a result of old research, people began to protect their dogs in the Middle Stone Age 12-7 years BC. According to the latest information, the human dog is known to have been bred nearly 30,000 years before the Upper Stone Age. According to medieval pictures, dog and bird hunting turned into games like fun. The hunting of Kagan and heads of state is said in written sources. In general, the images of hunters riding horses and hunting with birds were taken by different researchers. At that time, it was found not only in beautiful statues, objects and shades made of bronze, but also in shadows. For thousands of years, the dog has interfered with the spiritual life and traditions of the human race in its duty to protect our lives next to old hunters. Sometimes they buried him next to the body of the deceased. According to other world beliefs, the dog is responsible for protection. Now there are reports of more than 50 dead and buried dogs in the highlands of Eurasia.

Keywords: Mankind, dog, bird hunting, kagan

One aspect of hunting involves hunting dogs and birds. Bronze Age paintings depict foot hunters. Harpy hunt with a bird on a stone paintings after the Early Iron Age , namely, 2000-2500, from the year-ago period to pull nity started. The earliest dog hunting dates back to the Middle Stone Age. According to ancient studies, humans used the dog in the Middle Stone Age - BC. Began to adopt in 12-7 thousand years. Concluding endowments, human dog, stone age, almost 30 years ago to get started to be aware tightly.

According to medieval paintings, dogfighting and bird-watching became a form of entertainment. The hunting of Kakans and leaders is also described in written sources. In general, the involvement of hunters on horseback and birds has become a multi-faceted interpretation. He points to the surface of the stone, bronze and impunity bottles of beauty products, the grass here.

For thousands of years, the dog has been involved in the spiritual life and customs of mankind, guarding the livelihoods of ancient hunters. Sometimes it's late line laid down. According to the beliefs of the "other world", the dog must have performed the function of guarding a corpse. Now Euroasia is over the strip of menstruation and mountain steppes over 50 late buried dog with information on the narrow.

Kyrgyzstan archaeologist Chan Slade Abetekov from Chuy belonging to the Bronze age in the cemetery watched the dog in normal condition and hospitalized 1973 found. According to the excavation, the deceased was placed in the excavated grave, covered and covered with three dogs. According to the photos, the dogs have long bodies and long legs.

In 1991, we are in the eastern part of the ram, the five-Tash Courtyard Stock century VII-IX on a monumental archaeological research information. A soldier's body was dug "favorite pick " head tilted east, is located. After covering the grave with flat rocks, the horse was buried with his horse and equipment at the entrance. Then the dog was put to bed while the soil was being filled. Bones of shepherd dogs, preposition, "he is the world as a" driver capable of laying watched Isa cushy.

Every burial tradition is an attempt to treat the body of the deceased with respect, to provide him with the necessary things as he was alive, and to create conditions for a peaceful coffin . Efforts to "create the necessary conditions for the deceased" are diverse. They are invented in different environments and then become a permanent folk tradition.

What are the archaeological excavations of the information found in the sample analysis, the dog is dead and put in a cool burying habits are not widespread. It is seldom buried together when it is adapted to the personality of the deceased during his lifetime. Probably because of the friendly relationship between the dog during his lifetime, the service given to the dog's owner.

Because dog bones are so rare, it is difficult to identify their offspring. And if involved in the only on-line , is not easy. Most of the images of the dog on the rock are associated with hunting scenes. The dog was photographed chasing mountain goats, argali-kuljas, or fleeing in front of them. Often scenes of archers shooting deer fleeing are complemented by pictures of dogs.

The tradition of hunting photography continues from one epoch to another . It's just that their weapons have changed . From the Bronze Age to the late Middle Ages, bows were hunted, and later rifles were used.

Running mountain goats are depicted on a rocky outcrop in Kochkor's Kyrgyzbai-Bulu. At the top of the stone is a man holding a short-handled ax. Next to it, the image of a dog with long legs, bones, skinny, tall, long neck, short white slave, and short tail is carefully drawn . The long, short-stemmed Bronze Age ax and the dark black color of the painting are probably Bronze Age paintings.

Long-tailed dogs are depicted in lines drawn from the Early Iron Age and the Saka period. Some taygans comet. The legs are not always drawn long . Judging by the pictures, the slippery dogs that went hunting were different. Dogs' ears are sometimes pointed. It was not possible to permanently depict the image of a leopard with long, slender ears or a feather hanging down from its back . In the pictures, the dog's tail is raised like a slide.

A medieval painting was found in Kok-Sai, Kochkor district. Unfortunately, the image has not been fully preserved. The large-scale paintings painted here in the same way are accompanied by runic inscriptions belonging to the Turkic peoples, including the Kyrgyz . Therefore, this greyhounds shots feasibility believe that part of the VIII century. At the same time, their h d p involved in the gang, as usual. The two slippery mountain goats in the picture are chasing each other. At first glance, it seems that one large and one small animal is demanding another small animal (rabbit, fox?).

We can say that this breed of dogs was called taigan in Turkic languages, including Kyrgyz, because in the 11th century dictionary of our ancestor Mahmud Kashgari " Divan Lugat at- Turk" there is a word and even a proverb with this word. The heart of taigan fox does not love – fox does not love without running (*Ancient Turkish dictionary* 1969: 528). It is well known that today this proverb is found in our language in the form of "Dogs do not like foxes." In addition, the presence of children's games such as "fox - taigan", "fox does not bite", "fox chase", "fox drag" (Yudahin 1965: 874; Mukambaev 2007 : 849) proves that the Kyrgyz people have been hunting with taiga since ancient times. In addition to the word “taigan” in Kyrgyz, “tazy” is sometimes used: “ tazy T aygan. Becoming Tazy with a golden crow (Manas SO) (Explanatory Dictionary of the Kyrgyz Language 2010: 439).

The word taigan is also found in place names . For example, the Crimean Peninsula, a long, Cani was. Later, during the Soviet era, the village was renamed Ozernoye. In 1938, a large reservoir was built near the village and was called the Taigan Reservoir. This water reservoir of topsoil in 2012, titled "Cani" within the safari park was built, mainly cultivates the lions, tigers, zoo as

a tourist services to the visitors. Where and how the word "slippery" is used deserves a separate investigation.

Archaeologists excavating the Jaltyrak-Tash monument in Talas have copied a picture of a two-winged dog drawn on a stone with a thin, sharp weapon. Let us consider the beliefs in this regarArchaeologist DV Cheremisin , who has studied the rock paintings , says: “The Turkic-speaking peoples believed that there was a fantastic dog named Kumai. The animal that was bitten by his teeth did not survive. According to the legend written by the ethnographer of the XX century AA Divaev, the Kazakhs laid eggs on the shoulders of birds or mazars . According to information from a Kazakh hunter , a dog-spotted goose? E. Spangenberg wrote that a dog born from an egg is called a greyhound. They gave birth to a fast dog named Kumai. Kumai brought the man who found such a dog to his well-being. "Yt-kus has a place in Yakut folklore . "

D.V. Cheremisin collected similar examples from the folklore of Kyrgyz, Khakass, Bashkir and other Turkic -speaking peoples . In a fairy tale written by a great Khakas scientist NF Katanov, he went to a place where a species of duck called turpan lived and found an egg in a cave. From that egg a dog named "Kubai-kus" was born. When he is taken out to hunt, he takes home animals, birds, deer, deer, and deer. Local mountain and lake owners, fearing the extinction of the animals, lured Kubai-Kus into a trap and chained him to the lake. In the folklore of the Turkic-speaking Balkar people, an animal in the form of a dog-bird is called Samir. The eagle prints two eggs. When the egg hatches, she eats it herself if she does not have time to take the puppies. If saved, the bird will turn into a dog. In their story, Jelmaus, the coyote finds a puppy in a fish caught on the seabed. Samyr means muskrat (water rat) in Turkish. ID Suusamyr of our aquatic ondatr d may be associated with a soap or a dog.

In the Kyrgyz language, the word kumai has two meanings:

- “ Kumai I snow vulture, Kumai.
- Kumai II sandy; sandy loam, sand; The surrounding gray sandstone is a brain-boiling desert folk. around there will be gray sand, there will be a desert with unbearable heat ”

(Yudahin 1965) .

According to Professor Imel Moldobaev, who has studied Kyrgyz epics in connection with history and ethnography, Kumayyk is Manas's dog. Kumayyk is born of a bird with an eagle's head and a lion's body. It lays its eggs on deserts and roads. Up to three days after birth, the person who finds it will return with an animal species (will take any animal). But if a person can't find it, he becomes a bird. The person who finds it must not sleep for seven days, otherwise he will disappear (Moldobaev, 1989: 41).

It is the image of an animal born from a bird depicted with immeasurable artistry from Jaltyrak-Tash in Talas. In the study of petroglyphs, or in the study of ethnography and folklore, if the data

coincide in the above way, the study will be more beautiful and the meaning will be somewhat resolved.

Until now, there has been no in-depth scientific research on slipping. A fundamental, multi-volume work on the Kazakh taiga and the Kyrgyz taiga is being written by Evgenia Shishkina, a well-known Russian dog trainer and now a French citizen. This book provides some very interesting historical information. During her research, she visited the petroglyphs near the village of Ornok on the shores of Lake Issyk-Kul and identified valuable information about the historical development of dogs.

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THE EFFECTS OF DIFFERENT SOLID GROWING MEDIA ON ONION FRESH LEAF YIELDS IN SOILLESS CULTURE

H. CAN[1], M.PAKSOY[*,1,2], C. SADRİDİN UULU[1]

[1]: Department of Field Crop and Horticulture, Faculty of Agriculture, Kyrgyz-Turkish Manas University, Bishkek/ Kyrgyzstan

[2]: Department of Horticulture, Faculty of Agriculture, Selcuk University, Konya/Turkey

[*]: Corresponding author: paksoy42@hotmail.com

Abstract

Nowadays, soilless culture is a common agricultural method in many countries, and in some developed countries, the great part of the agricultural land is used as a greenhouse and for soilless cultivation. Peat and perlite are two of the most common solid growing media used in soilless cultivation for growing various horticultural plants including onion. In the trial, perlite, a kind of volcanic glass, organic peat and a mixture of these two at a ratio of one to one were used as growing media. The study was carried out in laboratory conditions in Bishkek/Kyrgyzstan in 2019. In the laboratory of Kyrgyz-Turkish Manas University Agriculture Faculty, three replications according to a completely randomized block design were used in the experiment. Onion bulbs with 2-4 cm diameters were used as the experimental material. In the experiment, the stem diameter, leaf number, leaf length, leaf width and leaf weight parameters were recorded to determine to the yield of onion leaves. According to the results, the highest onion fresh leaf yield was obtained from the peat-perlite mixture, whereas the lowest onion fresh leaf yield was obtained from the peat medium. The best results in terms of leaf number and leaf length were also obtained from the peat-perlite mixture.

Keywords: Onion, soilless culture, growing media, leaf yield

Introduction

Soilless culture is defined as a growing method without using soil as a rooting medium where the inorganic nutrients absorbed by the roots are provided with irrigation water (El-Kazzaz and El-Kazzaz 2017). Soilless systems are a significant alternative against normal cultivation methods which have problems that may arise during soil processing in the soil (salinization)/water (drought) (Olympios and Choukr-Allah 1999). Soilless culture is generally carried out in 3 different ways. These are hydroponic systems, solid cultures and aeroponic systems. While plants may be grown in open or enclosed environments in solid growing medias, in solid cultures, various substrates (perlite, vermiculite, coconut shell) are used for fixating plants as long as these are characterized by water and air retention capacity and easy drainage (Atzori et al. 2019). Soilless growing has several superior aspects in comparison to classical cultivation. These advantages mainly include that it minimizes water loss (can achieve up to 30% savings in comparison to soil

culture), prevents salinization in the root area, provides maximum yield, reduces transpiration, uses mineral nutrients effectively, and most importantly, provides sufficient nutrients such as vitamins, minerals and diet fibers in foods for human consumption (Barbosa-Cánovas 2003). Another issue that makes soilless culture significant and increasingly a necessity is that, although the human population today is increasing (expected to reach 9.7 billion in 2050), the amount of agricultural land per person is constantly decreasing (while there as 0.21 hectares of land per capita in Europe in 2015, this is expected to decrease 1.5 or 2 times) (Gruda 2019). Hussain et al. (2014) reported that vegetables such as *Fragaria ananassa* (strawberry), *Lactuca sativa* (lettuce), *Lycopersicon esculentum* (tomato), *Phaseolus vul*garis (green beans), *Beta vulgaris* (beet), *Cucumis sativus* (cucumber), *Cucumis melo* (melon) and *Allium cepa* (onion) can be commercially produced in soilless culture.

Growth media, "substrates" or "plant substrates" provide a root environment that is initially freed from plant pathogens and provides sufficient oxygen, water and nutrient supply (Savvas and Gruda 2018). As substrates, rock wool, perlite, volcanic rocks, tuff, clay pebbles, vermiculite, zeolite, pumice, sand and synthetic materials may be used directly or in combination with other materials as a growth medium. Among all organic substrates, peat is the most frequently used organic solid substrate in horticultural plant production, and it is preferred due to its low cost, low nutrient content, excellent chemical, biological and physical properties, low pH content, high air gap presence and drainage properties, lightness and a unique water retention capacity that is free from pests and diseases (Gruda et al. 2017; Savvas and Gruda 2018). While having such good and unique properties, organic and inorganic solid substrates are still an active area of study in soilless culture. This is because, for achieving stable production in soilless culture, a growth medium suitable for sowing, transplanting and planting should be used, and this rhizosphere environment should be kept in a suitable state throughout the growing period. Only then the aforementioned high yield and quality product could be achieved. In this study, as mentioned above, onion which has commercial importance horticultural crop and commercially produced by soilless culture was selected, and the leaf yields of onions in different growth media were assessed in laboratory conditions.

Materials and methods

Experimental information

The properties of the media that were used in the trial may be summarized as follows. Perlite, which is an inorganic growth medium, is a white, light growth medium that is obtained by processing ground, sieved material at 1100°C. It was selected because, due to its porous structure, it allows ventilation of the growth environment, regulates drainage, does not carry diseases, does not create a problem about salinity or alkalinity as it contains little to no soluble ions, is neutral (pH=6.5-7.5) and has low thermal conductivity, which minimizes damages in the plant from daily temperature changes.

Peat is generally obtained by accumulation of the residues left by plants growing in swamps in anaerobic conditions in the form of aggregates. Many firms trade it in packages with varying dimensions. It was selected because it is one of the media with the highest water retention capacity.

This study was carried out in 2020 at the department of Field crop and horticulture laboratory of Kyrgyz-Turkish Manas University. Throughout the growing period, it was observed that the room temperature in the laboratory conditions was 18-22°C during the day and 15-18°C at night. In the trial, three different growth media were used. This study was completed in growth media including peat, perlite and a 1:1 mixture of peat and perlite.

The trial was established with 3 replications based on the random blocks trial design, and 18 onions were planted into 9 pots in each plot on 25 February 2020. Planting was performed by filling the medium up to a height of 15 cm, placing 2 onions and covering with the medium up to a height of 5 cm. Plant nutrition was achieved by manual irrigation, and drainage was provided from holes under the pots. The nutrient solution started to be given to the onions after planting. The onions were given the nutrient solution for 3 days and water for 1 day. The nutrient solution included the elements given in Table 1, each pot was given 50 ml of the nutrient solution per day, and the acidity of the nutrient solution (pH 6-7) was not intervened with. The onions were harvested on 19 March 2020.

Table 1. Elements in the nutrient solution and their concentrations (Kahraman 2014)

Element	N	P	K	Ca	Mg	S	Fe	Mn
ppm	193	64	242	182	37	55	4	1.23

Measurements

In this study where onions were grown with the method of soilless culture, stem diameter, number of leaves, leaf length, leaf width and green weight measurements were made.

Stem diameter (mm): Measurement was made with a digital compass from right above the level the developed onion stems emerged out of the media.

Number of leaves: It is the number of parts obtained by counting the total number of leaves coming out of one onion.

Leaf length (cm): Measurement was made with a rule from the bottom to the top of the leaves coming out of the onion.

Leaf width (mm): Widthwise measurement of the leaves coming out of the onion.

Green onion weight (g): Measurement of the weight of cut onion leaves with an electronic scale.

Statistical analyses

The results obtained in the study were analyzed with the SPSS 22 package software using ANOVA and Tukey's Post Hoc tests.

Results and discussion

There were significant differences in the stem diameters among the growth media (peat, perlite, peat+perlite) ($p<0.05$) (Table 2). The stem diameter varied in the range of 6.16-9.09 mm with a mean value of 7.54 mm in the peat group. It varied in the range of 5.12-9.32 mm with a mean value of 6.95 mm in the perlite group. It varied in the range of 5.53-11.39 mm with a mean value of 8.13 mm in the group with the peat+perlite mixture. The highest value and the highest mean value of stem diameter (11.39 mm) was found in the peat+perlite mixture medium. Kahraman (2014) determined in their study that there was no significant difference in onion stem diameters based on the growth media.

There were significant differences in the leaf lengths among the growth media (peat, perlite and peat+perlite) ($p<0.05$) (Table 2). The leaf length varied in the range of 15-42 cm with a mean value of 26.55 cm in the peat group. It varied in the range of 19-46.2 cm with a mean value of 31.12

cm in the perlite group. It varied in the range of 20-52 cm with a mean value of 34.88 cm in the group with the peat+perlite mixture. In our trial, it was found that the leaf length was different in all three media. The highest leaf length and the highest mean leaf length (52 cm) was observed in the peat+perlite mixture medium. In their soilless culture study, Rodriguez-Delfin et al. (2005) reported the leaf length of onions as 32.8 cm. In another soilless culture study, Kahraman (2014) reported the lowest leaf length value in zeolite as 27.66 cm and the highest value in coconut fiber as 34.80 cm. In our study, the leaf lengths obtained from the peat+perlite mixture were higher than those reported by Rodriguez-Delfin et al. (2005) and highly similar to those reported by Kahraman (2014) on coconut fiber.

Table 2. Results of Tukey's test on onion measurements in the growth media

Media	Leaf length (cm)	Stem diameter (mm)	Number of leaves	Leaf width (cm)	Leaf weight (g)
Peat	26.55^{b}	7.54^{ab}	5.27^{b}	0.72^{ns}	6.57^{c}
Perlite	31.12^{ab}	6.95^{b}	7.89^{a}	0.79^{ns}	8.84^{b}
Peat+perlite	34.88^{a}	8.13^{a}	8.22^{a}	0.83^{ns}	12.57^{a}
Significance	*	*	*	ns	*

* statistical significance level of 5%, ns statistically not significant

There were significant differences in the leaf numbers among the growth media (peat, perlite and peat+perlite) ($p<0.05$) (Table 2). The number of leaves varied in the range of 3-9 with a mean value of 5.27 in the peat group. It varied in the range of 5-14 with a mean value of 7.89 in the perlite group. It varied in the range of 5-16 with a mean value of 8.22 in the group with the peat+perlite mixture. In the trial, there were differences among the media in terms of the numbers of leaves. As a result of the Tukey's test that was conducted, the best mean values were obtained in the perlite and peat+perlite media. Kahraman (2014) reported the number of leaves to vary in the range of 3.23-3.90, while Rodriguez-Delfin et al. (2005) stated this range as 6.7-8.2. In terms of the numbers of leaves, our study was highly similar to that of Rodriguez-Delfin et al. (2005). Another reason for the differences in leaf numbers may be the differences in the growth condition, cultivar, growth medium and nutrient solution of onion used in different studies.

There was no significant differences in the leaf widths among the growth media. Kahraman (2014) also found no significant difference in the leaf width values among the treatments in their study conducted with perlite, coconut fiber and zeolite.

There were significant differences in the leaf weights among the growth media (peat, perlite and peat+perlite) ($p<0.05$) (Table 2). The leaf weight varied in the range of 3-9 g with a mean value of 6.57 g in the peat group. It varied in the range of 4.03-17.03 g with a mean value of 8.84 g in the perlite group. It varied in the range of 6.2-24 g with a mean value of 12.57 g in the group with the peat+perlite mixture.

With the study they conducted on different species, Giroux et al. (1999) demonstrated that increasing the amount of perlite in peat led to an increase in root development. In their study conducted on strawberries, Hesami et al. (2012) determined that peat and perlite mixtures at various ratios increased vitamin C and soluble substance contents. In addition to these studies, Londra et al. (2018) found that increasing the ratio of perlite in mixtures resulted in reduced water retention capacity and an increase in wide pores.

Conclusion

Considering all these data, in our study, the peat+perlite mixture showed the best performance, and the results were similar to those reported in previous studies. As a mixture of perlite and peat at a ratio of 1:1 was used in this study, the reduction in the water retention capacity reported by Londra et al. (2018) was not observed in this study. Keeping this issue in mind, it is seen that, in order to determine the ideal growth medium, it is needed to try organic and inorganic media mixed at different ratios and to determine the mixture providing the best results based on the plant to be produced.

The best growth medium for our study was determined as the peat+perlite mixture mixed at a ratio of 1:1.

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INVESTIGATION ON THE GROWTH POSSIBILITIES OF SOME PLANT SPROUTS

H. CAN[1], M. PAKSOY[*,1,2]

[1]: Department of Field Crop and Horticulture, Faculty of Agriculture, Kyrgyz-Turkish Manas University, Bishkek/ Kyrgyzstan

[2]: Department of Horticulture, Faculty of Agriculture, Selcuk University, Konya/Turkey

[*]: Corresponding author: paksoy42@hotmail.com

Abstract

Today, as with sufficient consumption of food, food consumption with healthy ingredients containing nutrient content has become a very significant part of diets for human beings. These foods contain plenty of the vitamins, minerals, amino acids, proteins, low amount of carbohydrates, high amount of dietary fiber, total phenolic content, aglycone, isoflavones, saponin, glycosides and antioxidants whose health benefits have been proven by many studies. It has been supported by many studies that the aforementioned health content of sprouts obtained from germination of seeds is high, and sprouts are now widely consumed in countries such as Far Eastern countries, some European countries and the USA. These edible sprouts could be obtained by germination of a diversity of seeds like soybean, alfalfa, broccoli, radishes, kale, watercress, peas, cereals, mustards, adzuki bean and mung bean. The aim of this study is to determine the major yield-related properties of sprouts such as soybean, mung bean, chickpea and wheat by measuring the length, fresh and dry weights of sprouts. For this purpose, seeds of soybean, mung bean, chickpea and wheat were germinated in sterile laboratory conditions in three replications. The height (cm), fresh weight (g) and dry weight (g) measurements were taken from at least 50 sprouts from each replication, and the sprouts with the highest dry matter content were determined by comparing the results to each other. The results are presented in the full text.

Keywords: Plant sprout, soybean, mung bean, chickpea, wheat, germination

Introduction

The increased health-related sensitivities of consumers in recent years have led them to substantially change their consumption tendencies. The emergence of various health problems by the use of many additive substances to increase the shelf life of foods and improve their sensory qualities has led this tendency to change towards natural foods. As a result of this tendency, the popularity of functional foods has increased, and this popularity has shown a very fast growth.

Nowadays, at least as much as consuming sufficient food, consumption of foods that contain bioactive compounds that carry importance in terms of health has gained considerable importance. Among these functionally rich foods, there are sprouts produced out of various seeds. Sprouts are plant parts that are produced out of seeds by germination or from other plant organs, and they are generally plants or plant parts that are nutritional or used as a supplementation to food contents in diets which are produced by using simple cultivation methods within short growth cycles from usually cereals, crucifers and legumes (Świeca and Gawlik-Dziki 2015). The reasons for selecting and consuming especially crucifers as sprouts include that, in addition to compounds with antioxidant properties at high concentrations (e.g., carotenoids, vitamin C and

folates), they contain isothiocyanates that facilitate xenobiotic biotransformation and indoles that are glucosinolate precursors (Cartea and Velasco 2008; Baenas et al. 2012). In terms of nutrient content, sprouts have more bioactive substance content than seeds from which they are produced. This is because, during germination, catabolizing and degrading main macronutrient substances lead to a reduction in undigested contents (Gan et al. 2017). Sprouts are not just limited to vegetables of crucifers and legumes, but they are produced from various species such as canola, peppergrass, rocket, mustard, onion, leek, sunflower and clover. Although sprouts are usually prevalently consumed in Far Eastern Asian countries, they are becoming widespread in other parts of the world, as well (Peñas et al. 2009).

While the natural bioactive contents of sprouts are high, these contents may be increased even further by producers through manipulation. Some stress agents are used to increase bioactive contents. These stress agents consist of chemicals like some plant hormones, sucrose, sodium chloride and amino acids. These agents activate the defense mechanism of the sprout by inducing stress on it and increase its bioactive contents (Guo et al. 2014; Baenas et al. 2016). For these reasons, studies on sprout production and increasing the bioactive contents of sprouts are highly widespread today. Especially sprouts that are added to diet lists are a plant group whose significance is increasingly higher in the entire world in terms of their healthy contents. For the aforementioned reasons, their practical and mass production is highly important. The purpose of this study is to reveal the production potential of sprouts under different conditions. The main objective of the study includes proving that sprouts could be produced under practically every condition in addition to purchasing this group of food that is highly significant in terms of health. This study was carried out at the department of field crop and horticulture Laboratory of the Faculty of Agriculture at Kyrgyz-Turkish Manas University.

Materials and Methods

Germination procedures

The study was carried out at the department of field crop and horticulture laboratory of the Faculty of Agriculture at Kyrgyz-Turkish Manas University. As the plant material, species that are frequently used in plant sprout production were selected. In the study, seeds of soybean, mung bean, chickpea and wheat were germinated. The seeds were selected generally from among local cultivar that had not been chemically treated produced in Kyrgyzstan.

The seeds that were used in the trial were germinated by being subjected to surface cleaning by being left in a 6% sodium hypochlorite (NaClO) solution for 30 minutes before sowing. The trial was organized to include 3 replications. A sufficient number of seeds was placed into each germination container, the seeds were washed with distilled water 3-4 times after leaving them for 30 minutes, and they were than kept in distilled water for wetting for 24 hours. Afterwards, the seeds were taken into a plant growth chamber on suitable detectable wire grids in sterilized plastic food containers. Germinations were facilitated at cabin conditions of a temperature of 24±1 °C and a relative humidity of approximately 60-70%. The seeds were germinated in the dark for 7 days. In this process, the water needs of the seeds were met once every day.

Measurements on sprouts

Sprout height (cm): After 7 days from seed sowing, the heights of the sprouts were measured by a ruler from the root tip to the tip of the cotyledon leaves of the plant and are shown as cm.

Sprout fresh weight (g): As a result of germination, the fresh weights of the sprouts were measured with a precision scale from the tip of the root to the tip of the cotyledon leaves.

Sprout dry weight (g): The sprouts whose fresh weights were measured were separately packed, they were dried in a drying chamber until they reached constant weight, and their weights were measured.

Results and discussion

As a result of the conducted study, the germination results, heights, fresh weights and dry weights of the mung bean, soybean, chickpea and wheat sprouts are shown respectively in Tables 1, 2, 3 and 4. Table 1 shows that the heights of the sprouts of mung bean varied in the range of 6.673-6.754 cm, and their mean height was 6.724. Their fresh weights varied in the range of 0.268-0.292 g, while their mean weight was 0.277 g. For the dry weights, the range was 0.044-0.058 g, and the mean value was 0.049 g. Ebert et al. (2017) determined that the sprout weights of mung bean (dry weight corresponding to 100 g of fresh weight) varied in the range of 9.72-14.37 g. They also determined that the sprouts contained 7.13-8.53 mg Ca, 0.36-0.81 mg Fe, 0.49-0.67 mg Zn and 17.61-23.33 vitamin C. As our study showed similarities to the lower limit value of weight in their study, it is highly likely that the mineral and vitamin data would show similarity to their lower limit values. The reason for this difference between these two studies may be due to the seeds, germination conditions and harvest time. In another study, Zhou et al. (2018) monitored various procedures on mung bean through different time intervals. Among the properties they followed, they reported the mean fresh weight of 0.2 g and sprout height of approximately 8 cm. Our results were similar to their study in terms of the weight values.

Table 1. Results on mung bean sprouts

Plant	Replication	Height (cm)	Fresh Weight (g)	Dry Weight (g)
Mung Bean	1	6.673 ± 0.66	0.272 ± 0.4	0.044 ± 0.1
	2	6.754 ± 1.21	0.268 ± 0.4	0.046 ± 0.1
	3	6.704 ± 0.92	0.292 ± 0.5	0.058 ± 0.1
	Mean	6.724	0.277	0.049

Table 2 shows that the heights of the sprouts of soybean varied in the range of 8.454-9.000 cm, and their mean height was 8.689 cm. Their fresh weights varied in the range of 0.431-0.453 g, while their mean weight was 0.445 g. For the dry weights, the range was 0.107-0.108 g, and the mean value was 0.107 g. Ebert et al. (2017) also studied soybeans to make a comparison to mung beans. In their study, they reported the dry weights of 100 sprouts to vary in the range of 16.37-28.15 g. Additionally, in the sprouts with these dry weights, they determined Ca as 46-76.7 mg, Fe as 1.43-2.22 mg, Zn as 1.04-1.58 mg and vitamin C as 8.67-14.67. In our study, the 100 g fresh weight equivalent dry weight of the soybean sprouts was calculated as 24.82 g. The fact that this was within the limits reported by their study is an indication that the sprouts in our study would most probably have similar mineral and vitamin contents. Yang et al. (2019) reported on soybean sprouts harvested on the same day as our study that the heights varied in the range of 5.63-7.78 cm, and the fresh weights varied in the range of 0.44-0.54 g. The data obtained in our study showed a strong similarity to theirs.

Table 2. Results on soybean sprouts

Plant	Replication	Height (cm)	Fresh Weight (g)	Dry Weight (g)
Soybean	1	8.454 ± 4.1	0.431± 0.04	0.107 ± 0.01
	2	8.615 ± 4.3	0.453 ± 0.05	0.107 ± 0.01
	3	9.000 ± 4.6	0.452 ± 0.04	0.108 ± 0.01
	Mean	8.689	0.445	0.107

Table 3 shows that the heights of the sprouts of chickpea varied in the range of 7.216-7.616 cm, and their mean height was 7.466 cm. Their fresh weights varied in the range of 0.190-0.191 g, while their mean weight was 0.190 g. For the dry weights, the range was 0.020-0.022 g, and the mean value was 0.021 g. Arora et al. (2019) reported that, under different germination conditions, the weights of chickpea sprouts

varied in the range of 0.125-0.211 g. The fresh weight we determined in this study was similar to those in the literature. In another study on chickpea sprouts, Sreenivasan (2020) reported that the heights varied in the range of 7.24-8.34 cm, while the fresh weights were in the range of 0.104-0.165 g. While the results of our study on height were similar, our fresh weight findings were higher than those reported in their study.

Table 3. Results on chickpea sprouts

Plant	Replication	Height (cm)	Fresh Weight (g)	Dry Weight (g)
Chickpea	1	7.566 ± 1.77	0.190 ± 0.03	0.022 ± 0.001
	2	7.616 ± 1.06	0.191 ± 0.03	0.021 ± 0.001
	3	7.216 ± 1.16	0.190 ± 0.04	0.020 ± 0.001
	Mean	7.466	0.190	0.021

Table 4 shows that the heights of the sprouts of wheat varied in the range of 13.650-13.780 cm, and their mean height was 13.710 cm. Their fresh weights varied in the range of 0.092-0.099 g, while their mean weight was 0.095 g. For the dry weights, the range was 0.012-0.013 g, and the mean value was 0.013 g. In their studies, Wang et al. (2020) stated that the heights of wheat sprouts in the control groups were about 13 cm, and the fresh to dry weight ratio in the control groups was approximately 6. In our study, the mean height of the wheat sprouts was 13.71 cm, whereas the mean fresh to dry weight ratio was determined as 7.3. It is considered that such results were obtained because of the fact that the wheat sprouts in our study were harvested 1-2 days later.

Table 4. Results on wheat sprouts

Plant	Replication	Height (cm)	Fresh Weight (g)	Dry Weight (g)
Wheat	1	13.720 ± 1.29	0.099 ± 0.01	0.012 ± 0.002
	2	13.780 ± 1.66	0.092 ± 0.01	0.013 ± 0.002
	3	13.650 ± 1.52	0.095 ± 0.03	0.013 ± 0.003
	Mean	13.710	0.095	0.013

Table 5. ANOVA results among sprouts

Plant	Height (cm)	Fresh Weight (g)	Dry Weight (g)
Soybean	8.689*	0.445*	0.107*
Mung Bean	6.724*	0.277*	0.049*
Chickpea	7.466*	0.190*	0.021*
Wheat	13.71*	0.095*	0.013*

* 0.05 degree of statistical significance

The prevalent sprout types grown in the scope of our study were observed to show similarities in many respects to previous studies. This comparison showed that they were at the same standard as international studies. Table 5 presents the results of the ANOVA conducted among the examined properties. As a result of the ANOVA, statistically significant differences were observed among the height, fresh weight and dry weight properties of the sprouts. As the species were different, it is natural that there were statistically significant differences. The finding that there were no statistically significant differences among the replications also showed that the results were consistent.

Conclusion

With the study, the practical applicability of sprout production was tested, and based on the obtained results, it was shown that these sprouts could have similar contents to those in previous studies. According to the ANOVA conducted among the fresh weights, there were significant differences ($p<0.05$). The highest fresh weight was in the soybean sprouts, while others could be listed in descending order as the mung bean, chickpea and wheat sprouts. According to the ANOVA conducted among the dry weights, there were significant differences ($p<0.05$). The highest dry weight was in the soybean sprouts, while others could be listed in descending order as the mung bean, chickpea and wheat sprouts. As a result of our study, the highest dry matter content was obtained in the soybean sprouts. In a sense, this situation means these were the sprouts with the highest mineral and bioactive contents. With this study, it was shown that sprouts could be easily grown in different environments, their health-promoting contents could be increased with practices like eustress, and they could be easily integrated into consumption as diet. Today, it is as highly important to consume foods with high bioactive and mineral contents as consuming sufficient food. With this study, it was shown that these foods with high beneficial nutrient contents could be easily grown in various environments.

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EFFECTS OF MEDETOMIDINE/KETAMINE ANESTHESIA AND THEIRS REVERSAL BY ATIPAMEZOLE ON ECHOCARDIOGRAPHIC VALUES IN CATS

M. Kibar[1*]

[1]Hunting and Wild Life Medicine Programme, Artvin Vocational School, Artvin University, Artvin, Turkey. muratkibartr@yahoo.com

Abstract

In order to improve the quality of results of an investigation on cardiac morphology and function in cats undergoing anesthesia, the aim of this study was to clarify, investigate, and visualize in vivo the short-term echocardigraphic effects of medetomidine/ketamine (MED-KET) anesthesia regime and their reversal (atipamezole) in cats undergoing ovariohysterctomy. A randomized, single-blinded study was conducted. Ten sexually intact female cats (weiging between 2.2 and 3.6 kg, and between 0.5 and 5.5 yrs of age) referred for ovariohysterectomy procedure. Electrocardiogram, non-invasive blood pressure, respiratory rate, heart rate, pulse oximetry, and rectal temperature were monitored throughout the anesthesia. The group showed declines in left ventricular diameter (LVD%) and left ventricular ejection fraction (EF) after anesthesia induction (T0 vs. T1, all, $p < 0.05$); nevertheles, the reduction and starting pattern of LVD% and left ventricular EF presented important intergroup distiction. In conclusion, echocardiographic values effected significantly after anesthesia with MED-KET; and atipamezole can be useful for return to baseline values quickly and safely in cats after abdominal surgery such as ovariohysterectomy.

Keywords: Echocardiography, Anesthesia, Atipamezole, Cat

INTRODUCTION

Anesthesia is often needed during the medical management of animals for both experimental models and therapeutic procedures. The reaction of the cardiovascular system to anesthetics can be various different, based on dosing, the experimental model and agent selection (Fabian 1964; Gross, 2009; Wessler et al., 2011). Mostly used maintenance and induction anesthesia procedures involve agents that are known to effect the parasympathetic and sympathetic nervous systems, contractile properties of the myocardium, and vascular tone (Oguchi et al., 1995; Kunts et al., 1999; Wessler et al., 2011).

Medetomidine has got potent muscle relaxing properties. Its half-life is one hour. It is a sedative analgesic too. It is a extremely specific α-2 adrenergic agonist. Medetomidine induces

sedation and primary hypertension later increased intravenous administraion, after produced to bradycardia and a reduce in blood pressure to ordinary or lightly below ordinary grades. These impacts are guessed for by a centrally lightly reducee in sympathetic grade and peripherally slightly vasoconstriction and rise in baroreceptor and vagal capacity. Medetomidine decreases the quantity of noradrenaline slip and its change in the nervous system (Bienert et al., 2012; Grundmanova etal., 2016). Medetomidine is often utilized to immobilising for non-surgical procedures to animals, as a premedication before general anaesthesia or such as radiography or oral inspection.

Ketamine, a derivative of phencyclidine and cyclohexamine, is a N-methyl-D-aspartate antagonist that is often applied to start anesthesia in dogs. It acts on the limbic, reticular activating, and thalamocortical systems (Anandmay et al., 2016). Restricted models present to show the various cardiovascular impacts of ketamine which contained rised cardiac output, vascular resistance, and heart rate.

Anesthesia with the combination of medetomidine/ketamine (MED-KET), which can be antagonized by atipamezole, has been described as a useful anesthetic technique for animals (Virtanen, 1989; Talukder et al., 2009; Baumgartner et al., 2010). Obvious benefits of these drug combinations relate to the competitive reversibility by atipamezole for all components, which leads to an improvement to control anesthetic depth, a shorter recovery phase and less occurence of hypothermia (Astner, 1998; Henke et al., 2005; Baumgartner et al., 2010a).

Ultrasound imaging technologies can be applied for the scanning of direct vascular impacts of anesthetics (Baumgartner et al., 2008; Riha et al., 2012; Baumgartner et al., 2010b). Anesthetic drugs are well-known to utilize different impacts on various data of the cardiovascular system (e.g., blood pressure, ventricular contractility and heart rate), and in most patients, there is a visible dose-response correlation (Smith, 2009).

Late informations evaluating prospective studies have noticed more intraoperatively morbidity and mortality corporated with anaesthesia in dogs and cats (Dyson and Maxie, 1998) checked with humans (Lunn and Mushin, 1982). Consequently, there has been wide study into the impacts of various anaesthetic agents on dog cardiovascular function and their additive to intraoperatively deaths.

Normal values of cardiac morphology and function have been published for cats (Allen, 1982). However, papers about cardiac function and morphology in cats with anesthesia regimes is lacking. The manufacture of deep cardiovascular impacts has been a stable finding in past researches. Nevertheless, there is small information about the direct cardiovascular impacts of MED-KET

anesthesia regime in cats. The hypothesis of this study is that echocardiographic values and cardiac morpholgy are affected by medetomidine/ketamine anesthesia.

For improve the quality of results of an research on cardiac function and morphology in cats undergoing anesthesia, the aim of this study was to investigate, visualize, and clarify in vivo the short-term echocardiographic impacts of MED-KET anaesthesia regime and their reversal (atipamezole) in cats undergoing ovariohysterctomy.

MATERIALS AND METHODS

Animals and anesthesia

A randomized, single-blinded study was conducted. Ten sexually intact female cats (weiging between 2.2 and 3.6 kg, and between 0.5 and 5.5 yrs of age) referred for ovariohysterectomy procedure by their owners at regular intervals over 2 months were contained in the study. Holders were inquired to fast cats from 24.00 hr to the morning of the operation, but water was adlibitum. The study protocol was addmitted by the local ethics committee (approval number: 2014-12).

The cats were haphazardly included ten cats in each group (T0, baseline). Cats were anesthesied using a combine with medetomidine 80 μg kg^{-1} IM (Tomidine, Provet, Turkey) and ketamine hydrochloride 2 mg kg^{-1} IM (Alfamin, Egevet, Turkey) in group (T1: after 10 min premedication). Electrocardiogram, respiratory rate, non-invasive blood pressure, heart rate, rectal temperature, and pulse oximetry were monitored (Guoteng Co Ltd, China) throughout the anesthesia (T2: after 15 min starting operation; T3: after last suture). At the end of the ovariohysterectomy procedure, anesthesia regime was reversed using atipamezole 200 μg kg^{-1}, IM (Reversal, Provet, Turkey; T4: after 10 min reversed). Cats were not entubated during anesthesia. They were not received additional O_2.

Echocardiography

Each cat was shaved in preparation for ultrasonographic measurements. Ultrasonographic measurements of the 2-dimensional (2-D) guided M-mode echocardiography were directed with the cats placed in right lateral recumbency. For echocardiography, a 7.0 MHz microconvex transducer was used. The transducer was utilized together with an ultrasonographic system (SIUI, S. Korea). Echocardiographic values of the heart were evaluated to research changes of cardiac datas. The heart was initially viewed in the 2-D mode in the right parasternal short-axis plane. From this scane, an M-mode indicator was placed at the level of the papillary muscles and interventricular septum by perpendicular to the posterior wall of the left ventricle. Chamber measurements were detected by the M-mode tracings. The left ventricular end-systolic diameter (LVSD) was determined at the

point of peak upward deflection of the posterior wall, the posterior wall thickness was measured at end-systole. Echocardiographic investigation measured fractional shortening (FS), left ventricular diameter % (LVD%), and ejection fraction (EF) which was calculated by the echocardiograph's soft-ware of ultrasonographic machine. Measurements were carried out at T0, T1, T3, and T4 time points (except T2).

M-mode echocardiographic and 2-D systolic function values were assessed before induction of anesthesia and then at T0, T1, T3, and T4 time points (except T2). The same investigator, who was not informed of the cats' group assignment, performed all of the echocardiographies. The echocardiographic values were related to effects of anesthetic regimes. These values were calculated for each time point except in T2 (after 15 min starting operation) time point. Each animal's datas was included in the statistical evaluation. No patient was withdrawn from the study.

Animals breathed spontaneously during anesthesia. Monitoring of respiration rate, heart rate, mean arterial pressure, peripheral arterial oxygen saturation, and body temperature was monitored using a patient monitor (Guoteng Co Ltd, China) at T0, T1, T2, T3, and T4 time points (data not shown). Clinical datas, including respiration rate, mean arterial pressure, heart rate, body temperature, and peripheral arterial oxygen saturation were recorded concurrently with the ultrasonographic examination except at T2.

Ovariohysterectomy was carried out in cats after T1. Every surgeries were did by the same ginecolog together with veterinary students. No other anesthetic or analgesic drug was applied during the operation. Carprofen 4 mg/kg IV (Rimadyl, New Jersey, USA) was applied to all cats for analgesia after T4 time point. All cats were discharged 24 hours after the operation.

Mean ± SE values were used to estimate the values of all datas. Statistical analysis was performed using nonparametric tests since the sample size was small and the datas were not normally distributed. Statistical significance was establish a probability value of $p < 0.05$ with an assumption of equal variance and two-sided confidence interval. The statistical analyses were start using SPSS Version 22.0. SPSS Inc., IBM Company, 233 S. Wacker Drive, Chicago, Illinois 60606.

RESULTS

All baseline monitoring values were within the expected reference ranges for anesthetized cats (Table 1). The serial systolic functional changes in MED-KET group are showed in Table 2. Within the MED-KET group, the end systolic volume increased significantly after medetomidine and ketamine injection. There is a statistically significant difference between times ($p = 0.006$). There

was a statistically significant difference at T1 and T3 versus at baseline (T1, T3 vs. T0; p = 0.0287 & p = 0.018, repectively); though values were not significanly different from baseline by T4 (T0, T1 vs.T4 p = 0.128 and p = 0.075, respectively). The left ventricular EF declined importantly from T0 at T1 and T3 (p = 0.028 & p = 0.018, repectively), and started values at T4 (p = 0.091). Although the left ventricular EF decreased momentarily, the quartile value was within acceptable systolic function [T1: 69.2 (64.2-83.6), T3: 69.0 (56.0-79.8)].

The serial M-mode echocardiographic changes in MED-KET group are determined (data not shown). Within the MED-KET group, the LVIDd increased significantly after medetomidine and ketamine injection. There was a statistically significant difference between times (p = 0.049). There was a statistically significant difference between T3 versus T0 (T3 vs. T0, p = 0.028); though this recovered at T4 with no statistically significant difference (T0, T1 vs.T4 p = 0,176 and p = 0,128, respectively).

The internal diameter of left ventricular at end-systole (LVIDs) increased importantly from starting value at T1 and T3 (p = 0.028 & p = 0.018, repectively), and return to initial value by T4 (p = 0,128). There was a statistically significant difference in T1 and T3 versus T4 (T1, T3 vs. T4 p = 0,028, p = 0,018, respectively), but no statistically significant difference in T0 versus T4 (p = 0,128).

The interventricular septum thickness at end-systole (IVSs) increased significantly after medetomidine and ketamine injection. There was a statistically significant difference in T4 versus T0 (T4 vs. T0, p = 0.043)

DISCUSSION

In conclusion, echocardiographic values effected significantly after anesthesia with MED-KET; and atipamezole can be useful for return to baseline values quickly and safely in cats after abdominal surgery such as ovariohysterectomy.

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Table 1. Animal data and baseline (T0) physiological variables for both groups (Mean ± SE).

Patient variable	**MED-KET group**
BW (kg)	2,55±0,13
BCS	2.67±0.21
Age (years)	1,00±0,30
Baseline HR (beats/min)	162,00±58,00
Baseline RR (breaths/min)	12,00±1,00
Baseline BP (mmHg)	117,50±10,50
Baseline SPO_2 (mmHg)	94,00±1,15

BCS: body condition score; BP: blood pressure; BW: body weight; HR: heart rate; RR: respiration rate; SPO_2: Oxygen saturation.

Table 2. The serial systolic functional changes in MED-KET group.

	Group	T0	T1	T3	T4
IVS%	MED-KET	33,05±5,25	36,10±6,41	35,76±4,69	40,55 ±3,21
LVPW%	MED-KET	75,69±10,73	43,14± 6,70	63,35±6,66	54,80±17,25
LVD%	MED-KET	55,63±4,46	36,27±2,69	36,44±2,41	41,90±5,34
EDV	MED-KET	3,09±0,49	13,29±8,9	5,39±0,41	3,79 ±0,40
ESV	MED-KET	0,43±0,15	2,82±1,36*	1,73±0,23*	0,88±0,14
SV	MED-KET	2,67±0,38	10,46±7,55	3,62 ±0,29	2,90±0,52
EF	MED-KET	87,36±3,18	69,23±2,60*	69,05±3,05*	73,33±5,39
CO	MED-KET	0,57±0,07	1,71± 1,35	0,48 ±0,08	0,50±0,15

CO: cardiac output; EDV: end diastolic volume; EDS: end systolic volume; EF: ejection fraction; IVS%: interventricular septum fractional thickness %; LVD%: left ventricular thickness %; LVPW%: left ventricular posterior wall thickness %; SV: stroke volume *$p < 0.05$: vs. T0 within the group, †$p < 0.05$: T1 vs. T4 within the group.

EFFECTS OF MEDETOMIDINE/KETAMINE ANESTHESIA AND THEIR REVERSAL BY ATIPAMEZOLE ON OCULAR PARAMETERS AND MONITORED ANESTHESIA CARE IN CATS

M. Kibar[1]
[1]Hunting and Wild Life Medicine Programme, Artvin Vocational School, Artvin University, Artvin, Turkey.
muratkibartr@yahoo.com

Abstract

The aim of this study was to research the summary impact of the general anesthetic drug ketamine and premedication agent xylazine, and their reversal by atipamezole, on feline ocular parameters such as intraocular pressure, horizontal pupillar diameter, and Schirmer tear test and monitored anesthesia care values. A randomized, single-blinded study was conducted. Ten sexually intact female cats (weiging between 2.2 and 3.6 kg, and 0.5 to 5.5 yrs of age) referred for ovariohysterectmy procedure by owner at regular intervals over 4 months were included in the study. The cats were included to one group with ten cats in group (T0, baseline). The cats were anesthesied using a combine with medetomidine 80 µg kg-1 IM and ketamine hydrochloride 2 mg kg^{-1} IM in group (T1: after 10 min premedication). At the end of the ovariohysterectomy procedure anesthesia regimes were reversed by using atipamezole 200 µg/kg intramuscularly. Monitoring of respiration rate, heart rate, mean arterial pressure, peripheral arterial oxygen saturation, and body temperature were conducted using a patient monitor at T0, T1, T2, T3, and T4 time points. The animals showed declines in intraocular pressure and increases in horizontal pupil diameter after anesthesia induction (T0 vs. T1, all, $p < 0.05$); however, the chencing and recovery pattern of intraocular pressure and horizontal pupil diameter showed significant intergroup difference. In conclusion, mederomidine/ketamine is effective in attenuating the intraocular pressure, increasing the horizontal pupil diameter, and chance monitored anesthesia care response in the general anesthesia.

Keywords: Anesthesia, Atipamezole, Cat, Ocular

INTRODUCTION

Anaesthetic drugs and endotracheal intubation have vitally significant effects on the cardiovascular

and pulmonary systems. At the same time, they cause sudden increases in intraocular pressure. This leads to severe complications occurring in surgical interventions performed on patients, in particular, those with ocular trauma or glaucoma (Zimmerman et al., 1996; Batista et al., 2000; Perk et al., 2002; Hofmeister et al., 2006; Hofmeister et al., 2009; Güzel et al., 2013).

Increasing intraocular pressure (IOP) in ophthalmic surgery has always been problematic for the surgeon and it is necessary to prevent the elevation of IOP and control IOP before, during and after the surgery (Miller, 2005; Banga et al., 2015). Anesthesia for a patient with a penetrating eye injury and a full stomach is a challenge to the anesthesiologist. In these cases the aim of anesthesia is rapid sequence induction without increasing IOP. The anesthesiologist must weigh the risk of aspiration against the risk of blindness in the injured eye that could result from elevated IOP and extrusion of ocular contents (Banga et al., 2015).

Monitored anesthesia care (MACr) has been utilized to ensure relief from anxiety, sedation, minimal memory loss, and comfort throughout diagnostic or therapeutic applications with analgesia and sedation (Cunningham and Barry, 1986; Gelatt et al., 2007; Karabağlı et al., 2014). Respiratory decrease is associated with the most significant case injuries in MACr (Cunningham and Barry, 1986; Gelatt et al., 1977). The goal of MACr is the management of anesthesia and maintenance of optimal cardiac functions without intense respiratory down and airway obstruction. The ability to quickly modulate the depth of anesthesia when needed is also a significant aspect of MACr. Several narcotics, analgesics and sedatives are utilized to obtain these aims while minimizing side effects (Karabağlı et al., 2014).

Anesthesia with the combination of medetomidine/ketamine (MED-KET), which can be antagonized by atipamezole, has been described as a useful anesthetic technique for animals (Badrinath et al., 1986; Bruniges et al., 2016). Obvious benefits of these drug combinations are related to the competitive reversibility by atipamezole for all components, which leads to improved control of anesthetic depth, a shorter recovery phase and lower occurence of hypothermia (Hofmeister et al., 2006; Bruniges et al., 2016).

While there has been extensive research on some general anesthesia and premedication agent pharmacodynamics and pharmacokinetics, information on their impact on MACr and ocular parameters, such as IOP, horizontal pupil diameter (HPD), and Schirmer's tear test (STT) in animals and particularly cats, are few, deficient and rather contentious (Karabağlı et al., 2014; Bruniges et al., 2016). To our knowledge, no articles have focused on the impact of medetomidine/ketamine anesthesia on ocular parameters and MACr values in cats. The aim of this study was to research the summary impact of the general anesthetic drug ketamine and premedication agent medetomidine,

and their reversal by atipamezole, on feline ocular parameters such as IOP, HPD, and STT and MACr values.

MATERIALS AND METHODS

The experimental procedure was authorized by the local ethics committee (approval number: 2014-12). A randomized, single-blinded study was conducted. Ten sexually intact female cats (weiging between 2.2 and 3.6 kg, and 0.5 to 5.5 yrs of age) referred for ovariohysterectmy (OVH) procedure by owner at regular intervals over 2 months were included in the study.

The cats were included with ten cats in each group (T0, baseline). Carprofen 4 mg/kg IV (Rimadyl, USA) was applied to all cats for analgesia. The cats were anesthesied using a combine with medetomidine 80 μg kg^{-1} IM (Tomidine, Provet, Turkey) and ketamine hydrochloride 2 mg kg^{-1} IM (Alfamin, Egevet, Turkey) in group (T1: after 10 min premedication). Electrocardiogram, oscillometric mean arterial blood pressure (MAP), respiratory rate (RR), heart rate (HR), hemoglobin oxygen saturation (SpO_2), and rectal body temperature (BT) were monitored by multiparameter monitor (Guoteng; China) with 5 min intervals throughout the anesthesia (T2: after 15 min starting operation; T3: after last suture). At the end of the OVH procedure anesthesia regime was reversed by using atipamezole 200 μg/kg (Reversal; Provet) (T4: after 10 min reversed) intramuscularly.

Animals breathed spontaneously during anesthesia and were not entubated in order to avoide a heightened effect on the IOP. Monitoring of heart rate, RR, MAP, SpO_2, and BT was conducted using a patient monitor at T0, T1, T2, T3, and T4 time points. Clinical datas, including RR, HR, MAP, SpO_2, and BT were recorded concurrently.

Ocular parameters were measured at T0, T1, T2, T3, and T4 time points. All ocular measurements were performed with the cat with the care taken not to occlude the jugular veins or place pressure on the globe while retracting the eyelids. The cats were in dorsal recumbency in T3 time point, and in lateral recumbency at other time points. One researcher who was blind to the anaesthetic drug, performed all IOP controls using a rebound tonometry (TonoVet; Tiolat). Intraocular pressure was evaluated on the center of the cornea in accordance with the instruction manual of each tonometer. The tonometer was factory-calibrated before the study and calibrated each day before data collection. Three readings were obtained in the right eye at each measurement time. The mean of the three readings was recorded. No local anesthetic drop was used before IOP measurement. PS was measured with a caliper by horizontally at the same time points. Schirmer

tear test I was performed using commercial Schirmer strips placed in the lower fornix for 1 min.

Ovariohysterectomy was carried out in cats after T1 time point. All surgeries were performed by the same ginecolog with assisstance from veterinary students. All cats were discharged 24 hours after the operation.

Mean ± SE values were used to estimate the values of all datas. Statistical analysis was performed using nonparametric tests since the sample size was small and the datas were not normally distributed. In order to test whether the effects of the drug differed from the median values, the Friedman test was used to analyze the variables between the two groups. Comparisons between the groups were made employing the Mann-Whitney U test, and differences between measurements were taken over time using the Wilcoxon test. Statistical significance was set at a probability value of $P < 0.05$ with a two-sided confidence interval and assumption of equal variance. The statistical analyses were run using SPSS Version 22.0. SPSS Inc., IBM Company, 233 S. Wacker Drive, Chicago, Illinois 60606.

RESULTS

No statistically significant differences were observed between the treatment groups with regard to body weight (BW), body condition score (BCS), age and baseline measurements of HR, RR, SpO_2, and BT. All of baseline monitoring values were within the expected reference ranges for anesthetized cats (Table 1).

The serial monitorized data changes in MED-KET and XYZ-KET group are noted (data not shown). Within the MED-KET group, the HR decreased significantly after medetomidine and ketamine injection. There is a statistically significant difference between times ($p = 0.005$). There was a statistically significant difference at T1, T2 and T3 versus at T0 (T1, T2, T3 vs. T0, $p = 0.005$, $p = 0.014$ and $p = 0.005$, respectively); though values were not significanly different from baseline by T4 (T0 vs. T4, $p = 0.508$). Even though the HR reduced temporarily, the quartile range was within normal values [T1:103.80 (60.00-148.00), T2: 124.41 (67.00-200.00), T3: 113.50 (68.00-175.00)].

The serial intraocular parameter changes in MED-KET group are compared in Table 2. Within the MED-KET group, the STT reduced significantly after medetomidine and ketamine injection. There is a statistically significant difference between times ($p = 0.000$). There was a statistically significant difference at T1, T2 and T3 versus at T0 (T1, T2, T3 vs. T0, $p = 0.005$, $p = 0.005$ and $p = 0.007$, respectively); though values were not significanly different from baseline by

T4 (T0 vs. T4, p = 0.233). Even though the STT decreased temporarily, the quartile range was within normal values [T1: 5.50 (2.00-15.00), T2:4.20 (3.00-13.00), T3:4.40 (2.00-8.00)].

DISCUSSION

In conclusion, XYZ-KET is more effective than MED-KET in attenuating the IOP, increasing the HPD, and chance the MACr response in general anesthesia. This temporary reduction in IOP could likely be helpful in eye operations especially in animals with high IOP values. Additionally, dilated HPD could possibly aid in the avoidace of anretior sinechia during corneal surgery. Future investigations may focus on the impact of other premedicant or induction agents on the IOP, HPD, and MAC to confirm our results for medetomidine and xylazine, and on evaluating the effects on the IOP, HPD, and MACr of different doses of medetomidine or xylazine.

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Table 1. Animal data and baseline (T0) physiological variables for both groups, Mean (±SE)

Patient variable	**MED-KET group**
BW (kg)	2.66±0.13
BCS	2.78±0.15
Age (years)	1.43±0.20
Baseline HR (beats/min)	173.82±13.40
Baseline RR (breaths/min)	11.56±0.54
Baseline SPO_2 (%)	91.20±0.75
Baseline BT (C)	38.77±0.14

BW: body weight, BCS: body condition score, HR: heart rate, RR: respiratory rate, SpO_2: hemoglobin oxygen saturation, and BT: rectal body temperature, NS ($p>0.05$).

Table 2. The serial intraocular parameter changes in MED-KET and XYZ-KET group.

	Group	T0	T1	T2	T3	T4	p-within group
IOP	MED-KET	24.52±2.85	22.60±2.88	20.90±2.16	23.60±1.79	23.20±2.45	0.762
PS	MED-KET	6.60±0.40	7.10± 0.57	7.10±0.38	6.90±0.43	7.40±0.40	0.034
STT	MED-KET	12.84±1.59	5.50±1.23*,‡	4.20±0.59*,‡	4.40±0.56*,‡	10.00±1.67	0.325

*, $p < 0.05$: vs. T0 within the group, †, $p < 0.05$: vs. T1 within the group, ‡, $p < 0.05$: vs. T4 within the group, IOP: Intraocular pressure, PS: pupil size, STT: Schirmer tear test.

USE OF MICROBIAL STIMULANTS TO REDUCE THE NEGATIVE IMPACT OF DROUGHT IN SUSTAINABLE VEGETABLE PRODUCTION

Musa Seymen[a,*]

a: Selcuk University, Horticulture Department of Agriculture Faculty, Konya/Turkey

*Corresponding author: mseymen@selcuk.edu.tr

Abstract

Drought is one of the most important abiotic stress factors that limit agricultural production in many regions of the world, especially in arid and semi-arid areas. As a result of global climate change, many regions are faced with water scarcity in the world, and accordingly, 45% of agricultural areas have drought stress. Therefore, for the economical use of available water, determination of plant water consumption, growing drought-tolerant plants, using microbial biostimulants that reduce the impact of drought by different mechanisms, etc. are important approaches. It is well known, AMFs and PGPRs living in the rhizosphere are known as microbial stimulants (MS). MSs interacts with plant roots to assist in plant nutrient uptake and decomposition of organic substances from the soil, as well as promote plant development and also helps suppress the phytopathogens. Some MS practices that contribute significantly to plant development are known to tolerate abiotic stress conditions and reduce yield losses. In this review, the effects of environmentally friendly MS applications on vegetable crops and its use in reducing drought stress have been revealed through current studies.

Keywords: Abiotic stress, Bio-stimulants, Drought stress, Microbe, Vegetable,

1. Introduction

Vegetables, which have an important role in human nutrition and whose 50 different types are evaluated economically, are a part of a healthy life. Approximately 1 094 343 707 tons of vegetables are produced annually in the world, and approximately 50% of this production is provided by China (FAO, 2018). Vegetables with the most economic value are mainly tomato, pepper, cucumber, eggplant, melon, watermelon, and onion.

The world population is increasing day by day, and it is inevitable to open new agricultural areas or to increase the productivity per unit area to feed this population. Opening new agricultural areas in the world is limited by natural resources and ecology. Therefore, efforts to increase efficiency per unit area are more desirable. In line with this goal, producers have started to use more intensive chemical fertilizers and pesticides in agricultural cultivation (Kaymak, 2019). On the other hand, it has been a production method where more chemical wastes and medicines are used in greenhouse and open field conditions to increase efficiency in vegetable production (Seymen et al., 2019a). Pesticides and fertilizers used day by day caused the deterioration of the soil structure, as well as the ecological balance and human health.

On the other hand, day by day, besides intensive and wrong agricultural practices, ecological factors, drought, salinity, heavy metal toxicity, alkalinity, and flood have increased the negative effects of abiotic stress factors. Drought, which is one of the abiotic stress factors, is an important factor that negatively affects plant growth and productivity. The decrease in water resources with the effect of global warming in the world increased the negative effect of drought (Rijsberman,

2006). It has been determined that drought stress has negative effects on plant growth in approximately 45% of the world's agricultural areas (Asraf and Foolad, 2007). Water scarcity is a global problem where 1/3 of the world population is affected and it has become a progressive problem with the increasing use of water in areas such as population growth, urbanization, industry, and agriculture. If this increase is not put to a stop, it is thought that 2/3 of the world population will suffer from water scarcity in 2025 (UN Water, 2014). Therefore, different applications are developed to avoid the negative effects of drought. At the beginning of these practices, determination of drought-tolerant genotypes (Seymen et al., 2019b), investigation of the effects of different plant species on plant growth and yield under limited irrigation conditions (Yavuz et al., 2015; Jiménez-Arias et al., 2019; Seymen 2021), grafting of commercial varieties onto drought-tolerant rootstocks (Yavuz et al., 2020) and inoculation of beneficial microbial stimulants (Enebe and Babalola, 2018; Igiehon et al., 2019; Hefzy et al., 2020). Microbial stimulants are important applications in terms of ensuring sustainability in agriculture and protecting human health.

AMFs and PGPRs that generally live in the rhizosphere are known as microbial stimulants (MS) (Calvo et al., 2014; Mishra et al., 2016). Microbial stimulants are biological applications that increase plant nutrients from the soil, protect soil fertility, and contribute positively to plant growth. In the studies conducted, MSs applied to the soil contributed to the soil ecosystem and showed that the microbial population in the rhizosphere developed qualitatively and quantitatively (Fiorentino et al., 2018; Rouphael and Colla, 2018). Besides, MSs encourage plant development by increasing the decomposition of organic matter and nutrient uptake in the soil and additionally suppress the negative effect of phytopathogens (Nihorimbere et al., 2011; Mishra et al., 2016). On the other hand, it has been demonstrated in many studies that MSs tolerate abiotic stress conditions and reduces yield losses (Calvo et al., 2014; Ipek et al., 2019; Selvakumar et al., 2008; Wang et al., 2012a; Yıldırım et al., 2006).

In this review, it is aimed to reveal the use and effects of microbial stimulants (PGPRs and AMFs), which are an environmentally friendly application agent within the framework of sustainable agricultural production, under drought stress conditions that have significant constraints in the cultivation of vegetable species that have an important place in human nutrition.

2. Microbial stimulants and drought stress in the vegetable production

Global climate change has started to show its negative effects day by day. Today, the most important factors that cause climate change are fossil fuels, wrong land use, lack of protection of forests, and increased industry, and the increasing greenhouse gas negatively affects the atmosphere (Altuntaş and Kutsal, 2018). Global warming occurs as a result of the increase in the average temperature of the atmosphere. As a result of global warming, the surface temperature increases and affects plant growth negatively. Although the total amount of precipitation is at the same level, the lack of effective rainfall during the vegetation period of the plant negatively impairs the plant development and yield and the plant is exposed to drought stress.

Especially drought stress is an important factor that negatively affects agricultural productivity and limited plant growth in arid and semi-arid regions (Seymen et al., 2016; Yavuz et al., 2015a; Yavuz et al., 2015b; Seymen et al., 2019a; Yavuz et al., 2020). Ethylene released from plant tissue in arid conditions can restrict plant growth, inhibit photosynthesis, and alter chlorophyll content. Some chemicals such as amino ethoxy vinyl glycine (AVG), cobalt ion (Co2 +), and silver ion (Ag +) can be applied to reduce the ethylene level and protect against stress. However, these chemicals are not preferred because they are both expensive and adversely affect human health (Mckeon et al., 1995). Also, such chemicals are not recommended because they have permanent effects on the soil and will cause environmental pollution and other stress factors in the future. Environmentally-friendly production techniques and practices should be developed as an alternative method to ensure sustainability in agriculture. Although plants have developed some special mechanisms to combat such stress conditions, it is known that some beneficial microorganisms in

the root regions play an important role in reducing the stress intensity (Nadeem et al., 2014). The use of PGPR and AMF is an important issue in sustainable agriculture to avoid the negative impact of drought stress (El-Meihy, 2016; Wang et al., 2012a).

It is possible to explain the mechanisms developed by PGPRs against abiotic stress factors; 1- It produces some phytohormones such as ABA, GA, and IAA, 2- ACC reduces the ethylene level in the roots with deaminase, 3- It creates systemic resistance with bacterial compounds, 4- Increases bacterial exopolysaccharides (Kim et al., 2013; Timmusk et al., 2014; Yang et al., 2009). ACC has a significant influence on ethylene regulation, a plant hormone, resulting in modified plant growth and development. Bacterial strains containing ACC deaminase can eliminate adverse effects caused by stress and mediated by ethylene. It has been reported that some bacterial strains such as *Bacillus, Azospirillum, Burkholderia, Enterobacter, Agrobacterium, Rhizobium, Methylobacterium, Alcaligenes, Pseudomonas, Variorhizobium, Ralstonia,* and *Rhodococcus* release ACC deaminase and have positive effects under stress conditions (Altuntaş and Kutsal, 2018).

AMFs consists of three families, *Glomaceae, Gigasporaceae, and Acaulosporaceae. Mycorrhizae* form hyphae in the roots of plants, helping the plants to form more roots and obtain better plant nutrients from the soil. For this reason, AMFs reduce yield losses by providing plant growth more tolerant to drought with better nutrition in the soil. AMFs interact with some cations and play a role in dissolving insoluble phosphate ions in the soil (Kloepper and Schroth, 1978). AMFs provide a better rhizosphere by secreting enzymes and organic matter. On the other hand, it makes important contributions to the intake of micronutrients.

Due to the decrease in water resources used in agriculture day by day, it is difficult to meet the irrigation water needed in vegetable agriculture. Therefore, it is among the issues that are tried to reduce the negative impact of drought in vegetable agriculture. PGPR applications in vegetable species and drought protection of plants are among his research topics. When the studies were examined, *V. paradoxus* applied to tomato increased the root dry weight and chlorophyll content. On the other hand, it caused a decrease in the content of oxidative damage to lipids, osmolyte accumulation, root hydraulic conductivity, net photosynthetic capacity, and proline content and it was explained that it had positive effects against drought. As a result of the application of *Citrobacter freundi*-J118 bacteria, K + accumulation, RWC, and fruit yield were increased in tomato, while Na + uptake and electrolyte leakage decreased. Similarly, *Bacillus cereus* AR156 and *A. brasilense* bacteria applied to tomatoes showed positive results in arid conditions. In pepper, it has been stated that *Bacillus licheniformis* K11 bacteria produce Auxin and ACC deaminase and are important bacteria in arid conditions. *Achromobacter piechaudii* ARV8 bacteria strain applied in tomatoes and peppers under arid conditions made positive contributions on dry and wet weights by reducing ethylene production. Bacterial strains of *Pseudomonas putida* SAB10 and *Pseudomonas palleroniana* SAW21 applied under drought stress conditions in eggplant caused increases in plant height, above-ground and underground dry weights. Again in eggplant, the bacterial strain *Rhizobium* strain applied in arid conditions provided increased fruit yields, higher leaf relative water content, higher consumptive use of water. In pumpkin, *Azotobacter chroococcum* ML1, *Bacillus circulans* ML2, *Bacillus megaterium* ML3, and *Pseudomonas fluorescence* ML4 bacteria strains showed significant increases in enzymes activities, IAA, GA3, osmoregulators, growth characteristics, and yield compounds. In cabbage, *Bacillus megaterium* TV6D, *Bacillus megaterium* TV-20E, *Peanibacillus polymyxa* KIN-37, and combination of *Bacillus megaterium* TV-6D + *Pantoea agglomerans* RK-92 + *Brevibacillus choshiensis* TV-53D bacteria strains in arid conditions, hormone enzyme production, and decreased electrolyte leakage. In onion, *Agrobacterium rubi, Pseudomonas putida, Pseudomonas fluorescens, Pantoea agglomerans, Bacillus subtilis, Bacillus megaterium* bacteria made significant contributions to enzyme levels in arid conditions. *Bacillus megaterium* TV-3D, *Bacillus megaterium* TV-91C, *Pantoea agglomerans* RK-92, and *Bacillus megaterium* KBA-10 bacterial strains applied under arid conditions in broccoli made significant contributions to seedling length, stem diameter, leaf area, leaf area, leaf dry matter,

and mineral element content. In a study on cucumber, *Bacillus cereus* AR156, *Bacillus subtilis* SM21, and *Serratia* sp. While XY21 bacteria strains decreased MDA content and relative electrical conductivity, leaf proline content, the root recovery intension, and SOD activity showed significant increases (Table 1).

Table 1. Effects of PGPRs applied in drought stress conditions on some vegetable species

Species	PGPR	Result	Reference
Tomato	*V. paradoxus*	Shoot dry weight and chlorophyll content were increased. Oxidative damage to lipids, osmolyte accumulation, root hydraulic conductivity, net photosynthetic capacity, and proline content was decreased	Calvo-Polanco et al., 2016
Tomato	Citrobacter freundii – J118	K+ accumulation, RWC, and fruit yield were increased. Na+ uptake and electrolyte leakage were decreased	Ullah et al., 2016
Tomato	*Bacillus cereus AR156*	The relative water content of leaves, recovery intension of roots, chlorophyll a, chlorophyll b, total chlorophyll, SOD, CAT, and POD were increased	Wang et al., 2012b
Tomato	*A. brasilense*	Nitric oxide as a signaling molecule in IAAinduced pathway which enhanced lateral root and root hair development	Creus et al., 2005
Pepper	*Bacillus licheniformis* K11	Auxin and ACC deaminase producing	Lim and Kim, 2013
Tomato and Pepper	*Achromobacter piechaudii* ARV8	Reduced ethylene production and increased fresh and dry weight	Mayak et al., 2004
Eggplant	*Pseudomonas putida* SAB10 *Pseudomonas palleroniana* SAW21	Plant height, shoot dry weight and root dry weight were increased	Fathalla and Sabry, 2020
Eggplant	*Rhizobium strain*	Increased fruit yields, higher leaf relative water content, higher consumptive use of water	Wakchaure et al., 2020
Squash	*Azotobacter chroococcum* ML1, *Bacillus circulans* ML2, *Bacillus megaterium* ML3 and *Pseudomonas fluorescence* ML4	Enzymes activities, IAA, GA3, osmoregulatory compounds, growth characteristics, and yield were increased	El-Meihy, 2016
Cabbage	*Bacillus megaterium* TV6D, *Bacillus megaterium* TV-20E, *Peanibacillus polymyxa* KIN-37, and combination of *Bacillus megaterium* TV-6D +*Pantoea agglomerans* RK-92+*Brevibacillus choshiensis* TV-53D)	accumulating antioxidant enzymes, osmolytes, hormone production, and decreased electrolyte leakage	Samancioglu et al., 2016
Garlic	*Agrobacterium rubi, Pseudomonas putida, Pseudomonas fluorescens, Pantoea agglomerans, Bacillus subtilis, Bacillus megaterium*	important changes in the plant enzyme levels	Saharan and Nehra, 2011
Broccoli	*Bacillus megaterium* TV-3D, *Bacillus megaterium* TV-91C, *Pantoea agglomerans* RK-92 and *Bacillus megaterium* KBA-10	seedling length, stem diameter, leaf area, leaf dry matter, and mineral element content were increased	Ruiz-Lozano and Aroca, 2010
Cucumber	*Bacillus cereus* AR156, *Bacillus subtilis* SM21, and *Serratia* sp. XY21	MDA content and relative electrical conductivity were decreased Leaf proline content, the root recovery intension, and SOD activity were increased	Wang et al., 2012

Table 2. The effects of AMFs applied under drought stress conditions on some vegetable species

Species	AMF	Result	Reference
Tomato	*R. irregularis*	Shoot dry weight and chlorophyll content were increased. Oxidative damage to lipids, osmolyte accumulation, root hydraulic conductivity, net photosynthetic capacity, and proline content was decreased	Wang et al., 2016
Tomato and bell pepper	*Rhizophagus intraradices*, *Rhizophagus fasciculatum*	Biomass, root length, shoot length, and chlorophyll content were increased. Accumulation of proline was decreased	Tallapragada et al., 2016
Tomato	*Funneliformis mosseae* BEG12	Increased leaf area, root weight or length, plant transpiration	Bitterlich et al., 2018
Pepper	*Glomus fasciculatum* and *Glomus spp.*	Leaf water potential, relative water, content stomal conductance, transpiration, and plant biomass were enhanced	Davies et al., 2002
Pepper	*Glomus fasciculatum* (AMFG), a fungal species consortium from the forest "Los Tuxtla" in Mexico (AMFT), a fungal species consortium from the Sonorian desert in Mexico (AMFD)	AMFT and AMFD increased fresh weights AMFG increased color intensity and chlorophyll NAMF increased carotenoid content	Mena-Violante et al., 2006
Pepper	*Glomus coronatum* and *C. annuum* var. VNR-145	Increased shoot biomass and root biomass, absorption of water from roots, and membrane integrity	Krishna et al., 2018
Lettuce	*Glomus mosseae, G. fasciculatum Glomus coronatum, G. intraradices, G. claroideum, G. mosseae*	Shoot biomass and N were decreased	Tobar et al., 1994
Lettuce	a mixture of *G. intraradices* and *G. mosseae*	Improved the accumulation of antioxidant compounds, mainly carotenoids and anthocyanins, and to a lesser extent chlorophylls and phenolics, in leaves	Baslam and Goicoechea, 2012
Watermelon	*Glomus mosseae*	Increased water use efficiency, leaf water content, and leaf osmotic potential.	Ortas et al., 2011
Cabbage	*Glomus occultum*	Increased yield and quality	Auge, 2001
Muskmelon	*Glomus mosseae*	Increased K/Na ratio	Turrini et al., 2005
Melon	*Glomus mosseae*	Increased water use efficiency, leaf water content, and leaf osmotic potential.	Sannazzaro et al., 2006

At the same time, AMF applications have an important place in vegetable agriculture to avoid the negative effects of drought. Researchers have reported that different mycorrhiza breeds have different effects on vegetable species and their effectiveness should be determined in arid conditions. *R. irregularis* shoot dry weight and chlorophyll content applied in tomatoes in dry conditions increased, while oxidative damage to lipids, osmolyte accumulation, root hydraulic activity, net photosynthetic capacity, and proline content decreased. In another tomato study, *Funneliformis mosseae* BEG12 application revealed increases in the rate of leaf area, root weight or length, plant transpiration under arid conditions. *Rhizophagus intraradices* and *Rhizophagus fasciculatum* applied to two important species such as tomato and pepper increased the biomass, root length, shoot length, and chlorophyll content in dry conditions, while the accumulation of proline decreased. In pepper, *Glomus fasciculatum* and *Glomus spp*. Its applications have been reported to increase leaf water potential, relative water content, stomal conductance, transpiration, and plant biomass in arid conditions. *Glomus fasciculatum* (AMFG) applied to pepper, a fungal

species consortium from the forest “Los Tuxtla” in Mexico (AMFT), a fungal species consortium from the Sonorian desert in Mexico (AMFD), *Glomus coronatum* and *C. annuum* var. VNR-145 applications have shown positive results in arid conditions. In a study conducted on lettuce, applications of *Glomus mosseae, G. fasciculatum Glomus coronatum, G. intraradices, G. claroideum, G. mosseae* reduced shoot biomass and N uptake in arid conditions. The application of the mixture of *G. intraradices* and *G. mosseae* in lettuce in dry conditions improved the accumulation of antioxidant compounds, mainly carotenoids and anthocyanins, and to a lesser extent chlorophylls and phenolics, in leaves. *Glomus mosseae* application in watermelon in arid conditions revealed an increase in water use efficiency, leaf water content, and leaf osmotic potential. *Glomus occultum* application has made positive contributions to yield and quality in cabbage under drought conditions. *Glomus mosseae* applications in muskmelon showed an increase in the K / Na ratio. It has been reported that *Glomus mosseae* applied in arid conditions have increased water use efficiency, leaf water content, and leaf osmotic potential in melon (Table 2).

3. Conclusion

As a result of the decrease in water resources used in agriculture, the negative effects of drought in vegetable cultivation are increasing regularly. Previous studies have shown that the application of microbial stimulants to avoid the negative effects of drought is not only environmentally friendly but also increases the efficiency of water use. In addition to increasing the intake of plant nutrients, these practices help plants avoid drought by providing changes in enzymes and physio-biochemicals in the plant. Since vegetable cultivation is an agricultural production pattern with labor-intense, the use of microbial stimulants becomes important in terms of sustainability. In light of the studies conducted, new microbial stimulants need to be diagnosed to increase drought tolerance. On the other hand, the relationships of the stimulants obtained with vegetable species and varieties should be examined. Besides, it is necessary to examine the works that are usually practiced as potting work in the open field and greenhouse conditions and to demonstrate their effectiveness. Despite the rapid limitation of water resources, stimulants with demonstrated effectiveness take a long time to commercialize. Studies on the transformation of commercial preparations should be focused on this subject.

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SECTOR THAT DETERMINES THE MARKET VALUE OF FOODS: COLD STORAGES

Mustafa AYDINLI

Necmettin Erbakan University, Konya, Turkey

m.aydinli@caglayansogutma.com

ABSTRACT

Most of food in the world cannot be consumed immediately after production. Keeping food stable in an environment of suitable temperature and humidity is of great importance, especially in terms of protecting sensitive foods such as meat, milk, fish and frozen foods and keeping them intact. Failure to create an ideal food environment causes microbial growth and disrupts the physiological and chemical structures of food. Therefore, food must be stored in appropriate conditions. Cold storage is the process of preserving a product by creating conditions that preserve its market value and quality. Cold storage aims to generate a high income from the product. The overwhelming majority of cold storages operating in our country are deprived of the technological capabilities that engineering technologies provide. The most obvious reason for this is unsuitable selection of a refrigeration system suitable for food storage conditions. This study will explain basic storage information and provide information on the parameters needed to design a refrigeration system suitable for food storage.

Keywords: Cold Storage, Food Storage, Refrigeration Technology, Cold Storage Management.

INTRODUCE

The world population is constantly increasing and the demand for food is increasing day by day. Improper practices during the post-harvest processing and storage of food cause negative consequences in terms of continuous access to food and food safety. Cold storage rooms, in which the food is stored under conditions to protect its physical properties and quality, are of great importance. In the products that do not provide the storage conditions specific to the product to be stored during the cold storage process, and the products stored in the warehouses where the temperature and especially the ideal humidity environment required by the product are not created, it will be inevitable to experience a serious loss of quality and consequently loss of added value. In this study, the importance of cooling system design according to the product is emphasized.

STORAGE OF FOOD

The process of storing food at the desired temperature and relative humidity conditions without losing its physical properties in the process from production to delivery to the consumer is called cold storage.

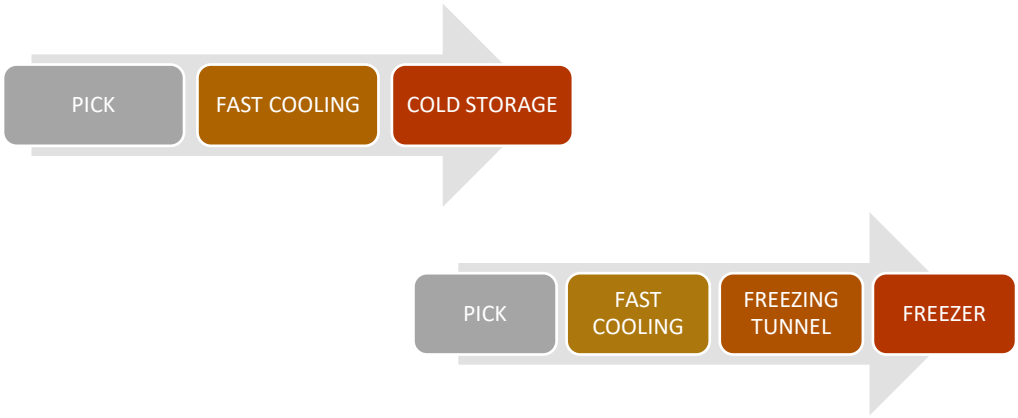

Figure 1 Cooling Process

During the cooling process, harvested fruits are quickly pre-cooled. After the rapid cooling process, the product temperatures are reduced from the field temperature to the appropriate temperature for long-term preservation and taken to normal storage rooms. In the food processing process, the products that pass the pre-cooling stage are taken to the shock chambers and subjected to the shock process. Frozen foods are taken to long-term frozen storage rooms and stored.

MODERN FRUIT AND VEGETABLE STORAGE

Today, foods are processed and preserved in modern processing and storage facilities. Cold storage is one of the most important elements that keep the cold chain efficient and uninterrupted. With the development of cooling technology, cold storage rooms are built to meet the industrial capacity of 1000-10,000 tons.

COOLING SYSTEMS

Today, cooling systems can be produced in refrigerant types such as freon, ammonia, CO2, depending on the country and conditions in which they are used. It can be designed as split or central cooling systems according to the project where the cooling system will be used. Cooling systems used in different fluid types are described below.

Freon Systems

Freon cooling systems Hydrofluorocarbons - HFC are the most used systems in the market, which are evaluated in the freon category. During the storage of food, cooling can be provided to

capacities between 1 kW and 450 kW. The auxiliary equipment supply of Freon systems is also easy. They are easy to malfunction and maintenance systems. It is designed and used as split and central systems. Its disadvantage compared to other refrigerants is that it has a negative effect on the environment and has a low cooling coefficient.

NH3 Ammonia Systems

Ammonia refrigeration systems are used in large-scale businesses where food is processed and stored. Ammonia systems offer solutions in terms of high energy efficiency and rapid cooling technique up to very low temperatures. Ammonia has been used in the field of industrial refrigeration for years. Low regime ammonia systems developed in today's refrigeration technology have helped to address safety concerns. Propane and carbon dioxide are preferred for industrial storage applications, which are increasing in popularity for cascade systems that also use carbon dioxide and ammonia.

CO2 Carbon-dioxide Cooling Systems

R744 (CO2) has been replaced by halocarbon refrigerants due to the decrease in the cooling effect coefficient and high operating pressures due to heat rejection around or above the critical point. Due to the negative effects of halocarbon refrigerants on the environment, it has begun to be used again as alternative, natural refrigerant. Thanks to the current machine and heat exchanger technology and system control elements, R744 (CO2) has reached competitive levels in terms of efficiency, especially in northern countries and in southern countries with subcritical cascade cycle.

DETERMINATION OF COOLING CAPACITY IN COLD STORAGES AND SELECTION OF EVAPORATOR (COOLER)

The choice of cooler is critical in the design phase of cold storages. Failure to provide a suitable humidity environment in the cold storage will dry the room, and there will be waste losses in the product. For this reason, it is important to choose the cooler in the appropriate ΔT (Delta T) range. ΔT (Delta T) is defined as the difference between the temperature of the air entering the evaporator and the evaporation temperature inside the evaporator. In Figure 1, relative humidity values corresponding to delta t variations are shown. In cold rooms where 90% relative humidity is desired, a cooler should be selected in delta t = 5 conditions. Especially in red meat, apple and pomegranate rooms, 85-90% humidity will be required, so a cooler selection will be required for these rooms at delta t = 5 conditions.

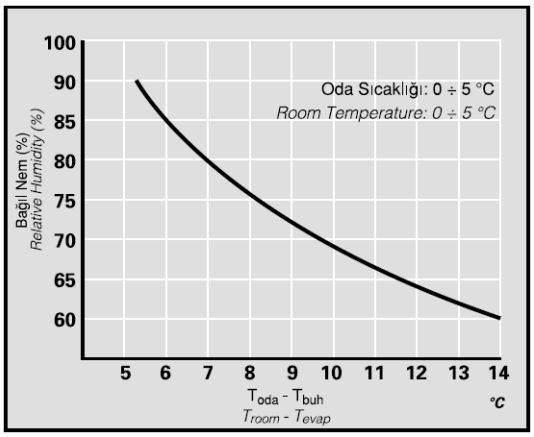

Figure 2 Temperature Difference Between Room Temperature And Evaporation Temperature. (Friterm)

DETERMINATION OF COOLING CAPACITY IN COLD STORAGES

If we want to keep the product to be stored for a long time without losing value; Quickly pre-cooling the product should be the primary rule. It is not possible to keep the product stored in rooms where the cooling system is not selected correctly and for a long time. Especially for freshly stored products, determination of cooling capacities and accurate calculation of storage heat loads are of great importance.

While calculating the heat load; The cooling capacity calculation is made by including the heat conduction load that may come from the cold room wall, floor and roof, the heat load caused by the heat exchange of the product entering the room, and the heat loads that may occur during product breathing into the total heat load calculation. Cooling load calculation is explained in the following titles.

Transmission Calculation

Q = I x S x (It – Ot) x h / 1000

Q = kWh / day cooling l.
I = İnsulation value (W / m2.K)
S = Wall, roof and floor surface area (m2)
It =Internal temperature (° C)
Ot=Outside temperature (° C)
h=Number of hours in a day
1000= W - > kW

Walls and Roof

$$Q = I \times S \times (It - Ot) \times h / 1000$$

Floor

Q = I x S x (It - Ot) x h /1000

Calculation of Product Change Coefficient

In addition to the products cooled in the cold room, the following formula is used in calculating the change coefficient resulting from the entry of the high temperature product into the warehouse.

$$Q = m \times Sp \times (It - Ct) / 3600$$

Q = kWh / day
Sp = Specific heat (kJ/kg.°C)
m = Product mass (kg)
It = Input tempreture (°C)
Ct= Cold room tempreture (°C)
3600 = kJ -> kWh

The cooling load must be calculated separately for fast cooling.

Product Respiration Coefficient Calculation

Product breathing changes depending on time and temperature. The following formula is used to calculate the respiratory coefficient.

$$Q = m \times resp / 3600$$

Q = kWh / day
m = Product amound (kg)
resp = Product respiratory temperature (kJ / kg)
3600 = kJ -> kWh

In order to calculate the total cooling load, after calculating the conduction, product storage and respiratory temperatures, in addition to these calculations, the total cooling load should be calculated by including the lighting fixtures in the room, the heat given by the evaporator fans and the heat dissipation of the working people. The result should be reached by adding 10 -15% as a safety factor to the total cooling load that results.

CONTROLLED ATMOSPHERE STORAGE

In controlled atmosphere storage technology, which is one of the methods applied to prevent the loss of quality that may occur during the storage of food, all the necessary conditions for the cooling process are provided, as well as the oxygen level of the ambient atmosphere in specially insulated and sealed storages from 21% to 5% to 0.1% (ULO) levels, and the CO2 level is increased to levels between 1% and 5%. The remainder is complemented by N2. This slows the breathing rate of the product and increases the marketing time. In addition, moisture loss is prevented by controlling the ethylene level in the room.

Figure 3 CA Storage Technologies (Van Amerongen)

ENERGY EFFICIENCY IN COOLING SYSTEMS

The selection of auxiliary equipment used when designing cooling machines is of great importance in saving energy. By using double speed fans in cold storage, both product waste is reduced and energy savings are achieved. We mentioned in Figure 2 that the waste in the product can be reduced by reducing the temperature difference between room temperature and evaporation temperature during long cold storage periods of the chilled products. During this process, energy savings will be achieved throughout the system. By reducing the Delta T difference, the compressors will be provided to operate at higher evaporation temperatures, so C.O.P. increases and energy savings are achieved. Figure 4 shows the distribution of energy consumption over time between the two systems.

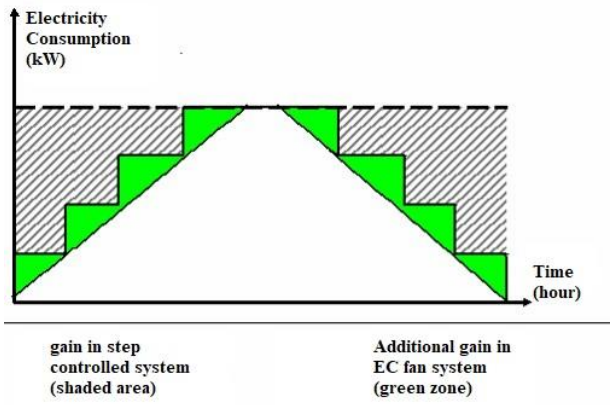

Figure 4 Energy Efficiency for Cooling Systems (Friterm)

CONCLUSION

Considering all the above, it is correct to say that; The important thing in the construction of a cold room is not to isolate the room and cool it, but to ensure that the product to be stored is stored in the room without causing any quality loss by providing the storage conditions required in the room. In other words, it is important to design a cooling system specific to the product to be stored. While doing this, designing a cooling system that will consume the least energy should be the primary

goal. The way to get high returns from the product is to preserve it without compromising its quality. Since the products stored in poorly designed cold rooms will lose quality, it will not be possible to create the desired economic added value.

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HOW CAN WE USE COMPUTER AND SOFTWARE TECHNOLOGY TO ANALYZE AND DEVELOP AGRICULTURAL MACHINERY DESIGN?

M. Ucgul[1]

[1] University of South Australia, STEM, SA 5000, Australia

Abstract

Soil constraints limit crop productivity. In order to overcome soil constraints a wide range of agricultural machines are used. Selection of a suitable agricultural machinery is a challenging job as the performance of each machinery is difficult to evaluate. The performance of the agricultural machineries is generally evaluated through time and resource intensive field works which can only be undertaken at certain times of the year. Similarly, development of new agricultural machineries to increase agricultural production is also based on field experiments. If the interaction between soil and agricultural machinery can be simulated using computer and software technology (a) the performance agricultural machineries can be evaluated (b) more effective agricultural machineries can be designed without performing field tests. In this paper a useful methodology, which includes using of 3D scanner and discrete element method (DEM) to evaluate and design agricultural machinery, has been suggested. The aim is to help and offer a new perspective to the academics working on agricultural machinery and agricultural machinery manufacturers for agricultural machinery design.

Keywords: Computer simulation, discrete element method (DEM), 3D scanner, agricultural machinery

Introduction

The population of the world has increased dramatically, but the required land and water resources to produce a sufficient amount of food are limited. The reducing per capita availability of arable land pushes farmers to increase their productivity (Gajri et al., 2002). Using a of a suitable agricultural machinery has a vital role on improving agricultural production. Energy currently plays a key role in agricultural machinery systems as diesel fuel is currently the main energy source agricultural tractors (Aybek et al., 2011). In order to improve the efficiency of the agricultural machineries and reduce energy use, the evaluation and design of the agricultural machineries must be improved. Tillage, which is defined as the physical manipulation of the agricultural soil, is an extremely vital part of crop production. The cultivation of agricultural soils has been achieved by manipulating the soil using tractor-drawn implements. Kushwaha and Zhang (1998) pointed out that the energy used for tillage is almost half of the total energy used in crop production. So, optimum tool configuration must be determined, and more efficient tillage tools must be designed to achieve energy efficiency and hence economic crop production.

The performance of the agricultural machineries is generally evaluated using empirical methods (i.e. field experiments and soil bin tests). Although empirical methods give practical information, physical testing of the agricultural machineries is expensive and time consuming. Additionally, physical tests can only be undertaken at certain times of the year. The extrapolation of the results to all field conditions is also most uncertain (Raji, 1999). In order to, overcome the shortcomings of the empirical methods, analytical and numerical methods are also used.

Analytical methods have received much attention over the last 50 years from many researchers (i.e. Godwin et al., 2007). Although the results of the analytical modelling approach are

still valid to some extent, analytical models are not able to fully simulate a real system in a complete way due to the fact that almost all of the proposed analytical models used simplifying assumptions. The disadvantages of using analytical methods are that (1) the structure of the agricultural materials is not homogenous, so developing of just one governing equation to calculate the whole process is not realistic, and due to their quasi-static or dynamic condition assumptions, the analytical models only examine forces but not the movement of the agricultural product.

With the rapid development of the computer technology, numerical methods have also been implemented to overcome the shortcomings of the empirical an analytical method. Two types of numerical methods, namely, continuum approach and dis-continuum approach have been used to simulate agricultural machineries. Commonly used continuum methods are Finite Element Modelling (FEM) and Computational Fluid Dynamics (CFD). The FEM is used for finding approximate solutions of partial differential and integral equations. Particulate materials with continuous bonding between particles, can be considered as continua and can be successfully analysed using FEM. FEM is in particularly useful when analysing the stress and force distribution over an agricultural tool. The main limitations of the FEM are the difficulties when setting up the boundary conditions and computation time. Automatic recognising of the new contacts is also not possible with FEM (Raji, 1999). On the other hand with the CFD method, governing laws of fluid dynamics are solved by using partial differential equations in a geometric domain divided into small volumes, commonly known as a mesh. The flow patterns can be successfully simulated using CFD. However, its use is limited when modelling tillage equipment. All of the CFD simulations have been conducted considering the soil as a single continuous phase incompressible medium; hence the change in the soil structure cannot be predicted precisely. Also, the rheological properties of soil have not been measured for different soil physical conditions and soil types. Generally, it can be said that although there are some advantages of the continuum numerical methods, the assumption of continuity is not always valid. Hence, the change in the soil structure and soil translocation cannot be predicted accurately by using continuum numerical methods (Asaf et al., 2007).

To overcome the shortcomings of the continuum numerical methods for modelling the mechanical behaviour of agricultural materials, discrete element method (DEM), which is a dis-continuum numerical method can be used. DEM is based on the contact between two particles. Interactions between the particles are calculated by using contact models governed by physical laws. After calculating all the forces acting upon a particle, position and orientation of the particle is then calculated by integrating Newton's second law of motion. Agricultural materials (i.e. soil, nuts, fertilizers) can be considered as granular. Thus, DEM can be used to model the bulk behaviour of agricultural materials. Recent studies have shown that DEM can be in particularly helpful for modelling soil-tool interaction (Saunders et al, 2021; Barr et al ,2020).

The major constraint in using DEM in agricultural systems is the massive number of contact points within the bulk system which affects the computation time and memory (Raji, 1999). Due to the lack of suitable computer technology, DEM was not been able to be used as an effective method in the past. However, with the rapid development of the microchip and processor technology; the appropriate computer technology is now becoming available to allow the use of DEM for designing and evaluating of agricultural machineries.

Besides the modelling of the agricultural product, obtaining of the CAD model of the agricultural tool to be modelled is also important. Generally, agricultural machinery manufacturers do not provide the CAD models of the tools. Therefore, an accurate modelling of the agricultural material and agricultural tool can be challenging. However, with the use of 3D scanner technology, CAD model of the agricultural tool can be easily obtained (by scanning the tool) and effective modelling and evaluation of agricultural machinery can be achieved.

In this study, the method of DEM has been introduced and a detailed explanation of how it should be used in agricultural machinery design and evaluation, along with 3D scanners, has been described. The main objective of the study is to help and offer a new perspective to the (i) academics working on agricultural machinery and (ii) agricultural machinery manufacturers.

Materials and Methods

Due to computational limitation, particle sizes used in DEM simulations are generally specified larger than that of the real size. Additionally, spherical particles are generally preferred due to their computational simplicities (as the use of complex shapes causes an increase in the number of contacts and hence the computation time).

In order to start calculations in a DEM algorithm, firstly, the contacts between the particles must be detected. If the distance between the centres of two spheres is less than the sum of their radii, two spheres can be taken as in contact. After detecting the contact, relative velocity is calculated at inter-particle contacts in terms of a given time increment. Then the overlap between the two spheres is found by calculating the relative displacement between the spheres. To do so, the relative velocity equations need to be integrated with respect to the time step. A suitable integration time step must be chosen to make the system computationally stable. After determining the relative overlap, the contact forces between the particles are computed by using a suitable contact law. After the total moment acting upon the particles is computed, the new position and velocity of the particles are calculated by integrating the linear and rotational acceleration of the particles. The flowchart of the calculation s DEM process is given in Figure 1.

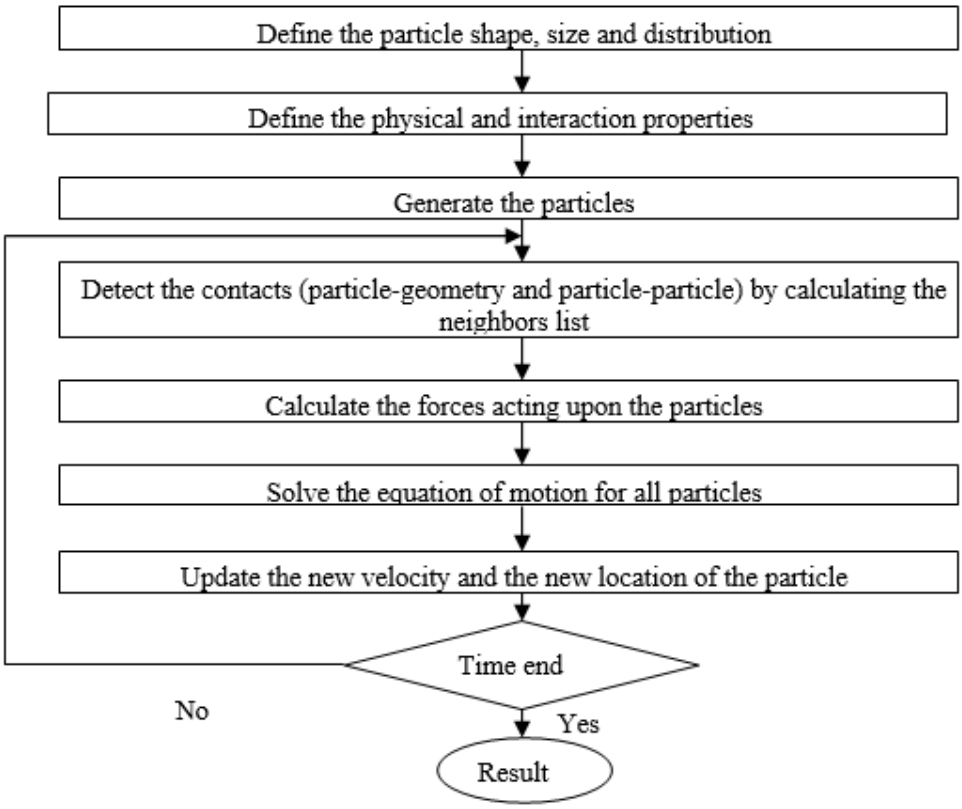


Figure 1. Flowchart of the calculating process in DEM adopted from Shmulevich (2010)

There are different contact models used to calculate the interaction between agricultural materials. For soil tillage applications, hysteretic spring contact model integrated with a linear cohesion is suggested (Fielke et al., 2013) while for other applications Hertz-Mindlin contact model is preferred. If there are bonds between the particles (i.e. fibre or organic matter) then a parallel bond contact model is used.

In order to carry out a realistic simulation, the shape of the DEM particle should be as close as possible to the shape of the real particle. As the spherical particles are preferred due to their computational advantage, clump particles, using multiple spheres, are used to create a realistic shape of the particles (Figure 2).

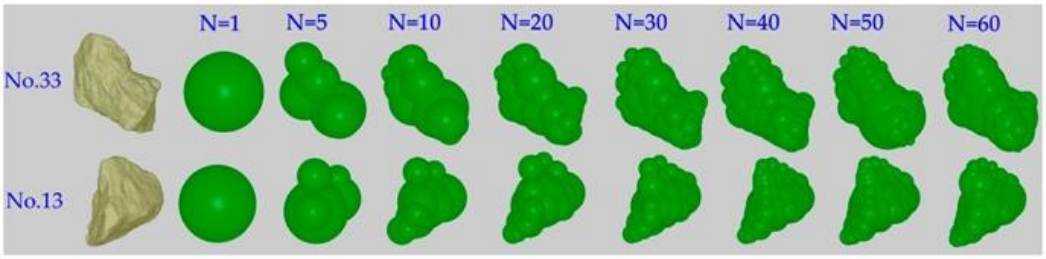


Figure 2. Particle shape generation using clump particles (Li et al., 2017)

Using of greater particle sizes and different particle shapes also require calibrating DEM particles so that DEM particles behave like actual agricultural material. Calibration process can be carried out using geo-technical tests. However, at least 2 different tests should be performed for accurate calibration one of which is for determining soil movement and the other one is for force calibration. For the simplicity, angle of repose and cone penetration tests are generally preferred.

The angle of repose (AOR) for granular materials is defined as the steepest angle of the slope of material pile at rest, measured relative to the horizontal plane (Li et al., 2020) (Figure 3a and 3b). The DEM parameters required to run the simulations can be determined by performing an angle of repose test matching the simulation results to test results (Figure 3c). Similarly, force results obtained using a cone penetration test, can also be used to calibrate the DEM parameters (Figure 4a and 4b).

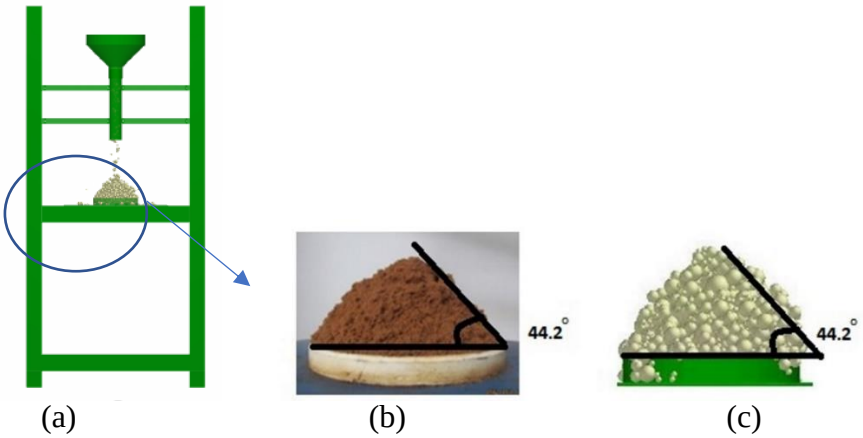


Figure 3. (a) Angle of repose test; (b) measured angle of repose; (c) DEM simulated angle of repose

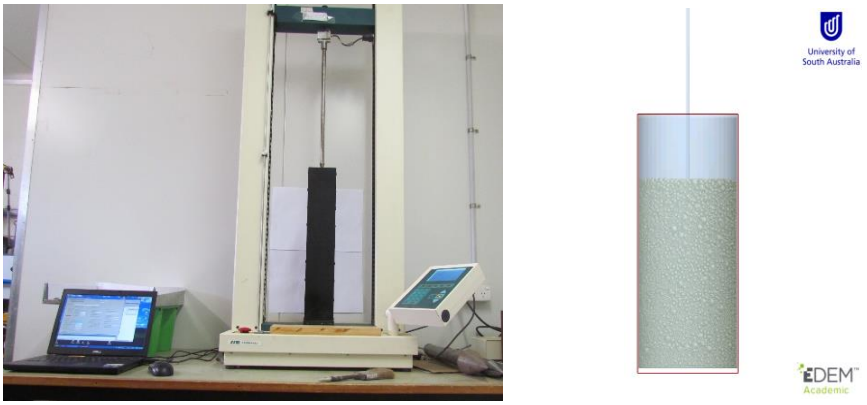


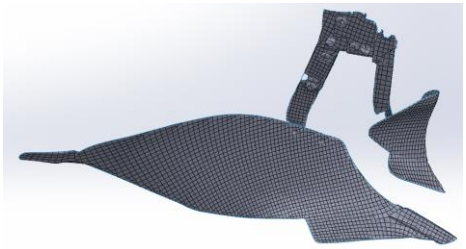
Figure 4. (a) Cone penetration test; (b) DEM simulated cone penetration test

In order to determine the most suitable DEM parameters or to optimize the design process the statistical method of design of experiment (DOE) can be used. Response surface methodology (RSM) is generally preferred in combination with a box-Behnken design to analyse and optimise the effect of DEM input parameters.

In order to run an accurate simulation obtaining of the CAD model of the geometry is essential. Although the best way to obtain the CAD model is to request it from the manufacturer, manufacturers generally do not provide CAD models due to IP concerns. A 3D scanner can be used to scan and obtain the CAD model of an agricultural tool. The accuracy of the 3D scanning process is influenced by many factors such as the quality of the 3D scanner, the available computational power and lighting. Better scanning of the geometry allows to carry out more accurate simulations. Scanned parts can also be modified in CAD software for further modification.

(a)

(b)



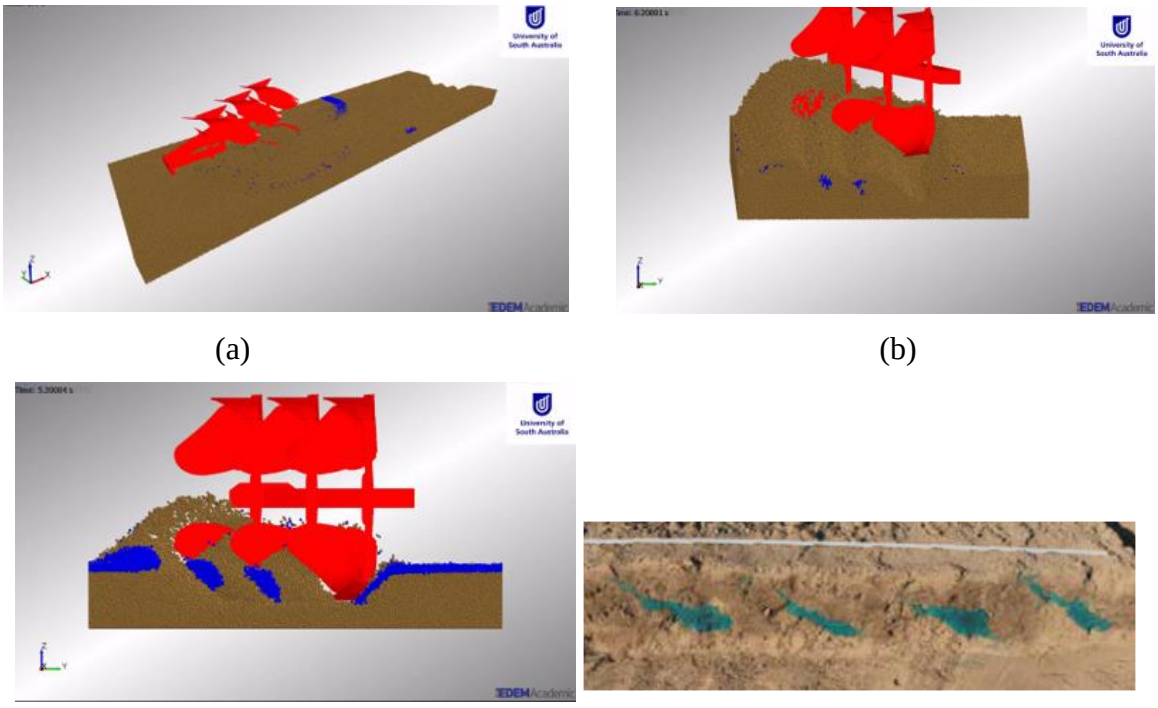
(c)

Figure 5. (a) 3D canner; (b) Mouldboard plough; (c) 3D scanned mouldboard plough

In DEM, in order to carry out a simulation, firstly the shape and size of the particles are determined. Then, the DEM properties of the particles determined through the calibration process, are entered to the software. After the agricultural tool scanned using a 3D scanner (and modified using 3D modelling software) is imported, particle factories that generate the particles in the simulation are created. Finally, simulation time is entered, and simulations are started. In this study some of the agricultural tools modelled using DEM has been presented.

Results and Discussion

DEM simulation of soil-mouldboard plough interaction has been presented in Figure 6. In the simulation, topsoil burial performance of a three-furrow mouldboard plough was modelled. The colour of a small strip of topsoil was changed into blue and the final location of this strip then investigated. The DEM results were compared to the test results available in the Farmax Magazine (2019). Results showed that the soil burial predicted using DEM is similar to the test results. By using the same geometry, the effect of moulboard skimmer on topsoil burial was also investigated using DEM (Figure 7). The comparison of the topsoil burial results with and without skimmer attachment showed that using of skimmer improved topsoil burial which also aligns with the field observations.



(a) (b)

(c) (d)

Figure 6. (a) Isometric view of DEM simulation of soil-moudlboard plough interaction (b) Rear view of DEM simulation of soil-moudlboard plough interaction; (c) DEM predicted cross sectional view; (d) Test results of cross-sectional view (from Farmax Magazine, 2019)

In Figure 7, results of a test and a DEM simulation carried out to predict wear on tillage tools (used for cultivation process) is given. In the simulation, the interaction between soil and tillage tool (Figure 7a) was simulated. The same tool was also physically tested in an outside soil bin (Figure 7b). The 3D scanned tool after the testing (Figure 7c) and DEM predicted wear results (Figure 7d) show a fair agreement.

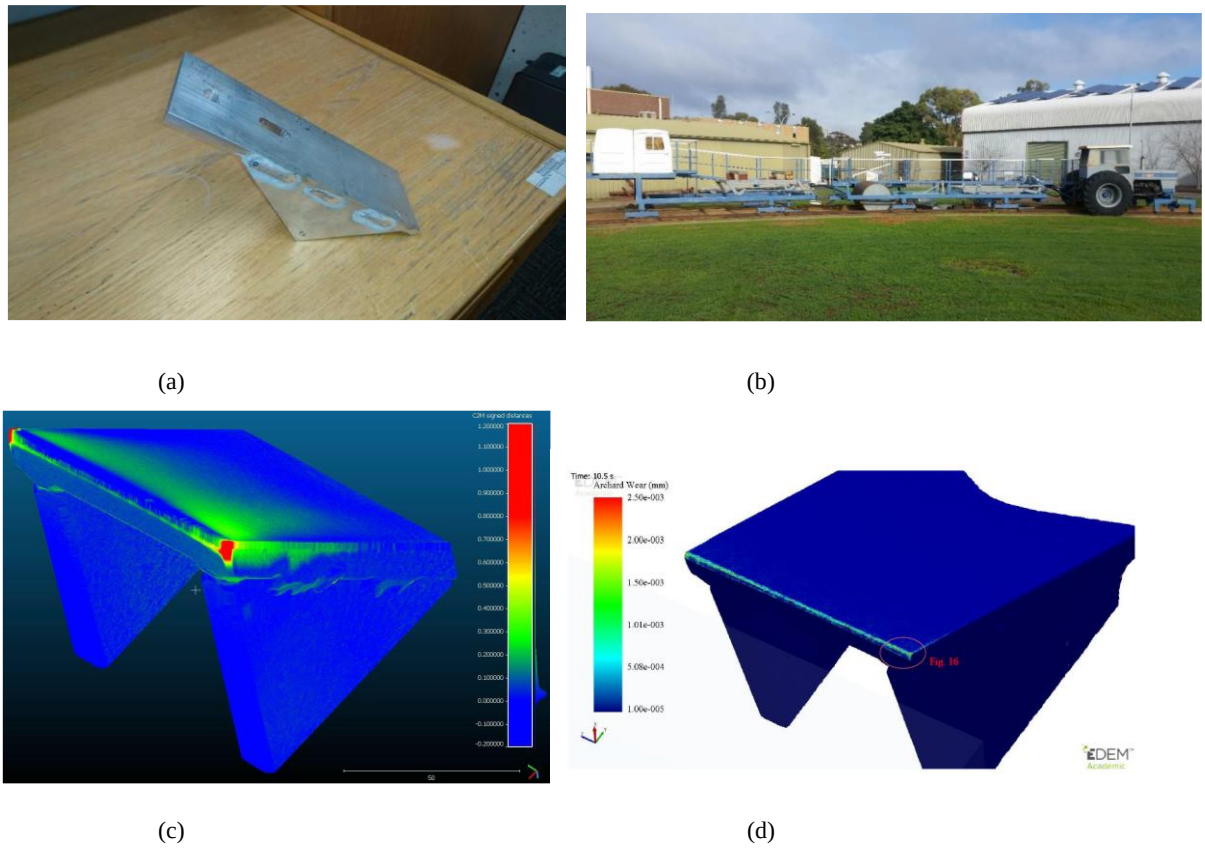


Figure 7. (a) Tool tested; (b) Outside soil bin test; (c) 3D scan of the tool after the test; (d) DEM predicted wear (Seeliger, 2019)

Another study conducted to show the effect of soil type on the performance of a disc opener showed that DEM can predict tillage forces and demonstrate soil stickiness under different tool and operation conditions (Figure 8).

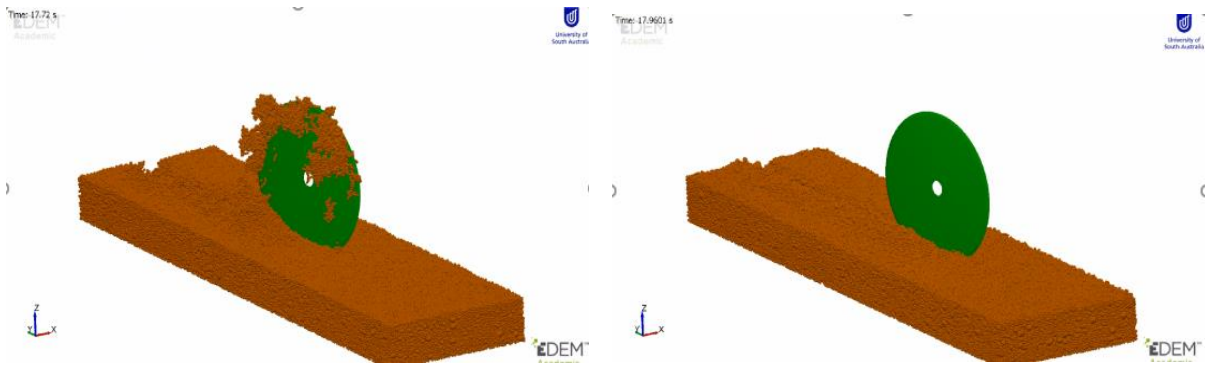


Figure 8. Soil-disc opener interaction in (a) sticky-cohesive soil and (b) non-cohesive soil

Conclusion

Due to the nature of the agricultural materials, modelling and evaluation of the agricultural machineries are challenging and generally rely on empirical methods. In this study, a methodology, which includes using of 3D scanner and discrete element method (DEM), was suggested to evaluate the performance of agricultural systems. It is suggested from the results that using DEM and 3D scanners can be very useful to improve the design of agricultural machinery systems. Future work will focus on using suggested method (a) for more complex systems (i.e. Fluidised bed simulation using DEM-CFD coupling) and (b) to other areas of agricultural machinery (i.e. food systems and silos)

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DETERMINATION OF ADAPTATION ABILITIES OF SOME APRICOT VARIETIES IN BISHKEK ECOLOGICAL CONDITIONS

M. Ilgın[1.2], N. Alimova[1]

1: Kyrgyzstan-Turkey Manas University, Faculty of Agriculture, Department of Horticulture, Bishkek / Kyrgyzstan
2: Kahramanmaraş Sütçü İmam University, Faculty of Agriculture, Department of Horticulture Kahramanmaraş/Turkey, muruvvet.ilgin@manas.edu.kg

Abstract
This study was conducted in 2019 in apricot parcel, which was established in the Field of Research and Application, the Faculty of Agriculture of Kyrgyzstan-Turkey Manas University. Phenological observations and pomological analyzes were performed on 4 apricot varieties which are Medovıy, Korolevskiy, Issyk-Kulsky and Krasnoşekiy, and the results obtained were evaluated. Within the scope of the thesis, phenological criteria such as bud swelling, first blooming, full blooming, fruit setting and fruit ripening and pomological values such as fruit weight, width, lenght, height, seed weight, width, lenght, fruit top color, ground color and fruit flesh color, kernel weight, width, length and taste, and water-soluble dry matter (brix) amount were recorded in the parcel with apricot varieties. When the phenological observations made in apricot varieties were evaluated in general, in Medovıy, Korolevskiy, Isık-kulskiy and Krasnoşekiy varieties, bud swelling between March 12-15, beginning of blooming between March 16-17, full blooming on March 25, fruit set between April 3-4 and fruit ripening between June 26 - July 17 were recorded. When the pomological analysis of the varieties included in this study was evaluated, the largest fruits in terms of fruit weight were the Isık-kulskiy variety with 34,0 g. While the Krasnoşekiy variety had the most intense red top color, the Isık-kulskiy variety attracted attention with its completely hairless peel. The kernels of all varieties were determined as sweet, and the water-soluble dry matter values were between 22,0-17,9%.

Keywords: Apricot, phenology, pomology, Kyrgyzstan

INTRODUCTION

Apricot fruit species is geographically distributed in many parts of the world and its fruits are consumed gladly, it is a type of fruit belonging to the Prunoideae subfamily of the Rosaceae family (Özbek, 1978; Layne et al., 1996; Guerriero et al., 2001). It is included in the Prunus genus. There are 4 subgenus in the Prunus genus. Apricot is found in the Prunuphora subgenus. The type name of the apricot that is cultivated is *Prunus armeniaca* L.

It is accepted that the homeland of the apricot is the northern and northeastern mountainous areas of China, the Tiyan-Shan and Altai Mountains in the Hinjiang region, Central Asia and Manchuria, and that its gene centers are China, Central Asia and the Near East. It is estimated that the history of apricot goes back to 3000 BC in China. Vavilov, known for his studies on the genetic resources of plants, stated that there are forests consisting of wild apricot trees in Turkistan and that they differ from the cultural varieties only by the small size of their fruits and seeds. Vavilov stated that the Near East Gene Center is the secondary center for the culture forms of apricots. This researcher drew attention to the relationship between the wild forms of apricot and the old culture

forms with the mountains (Vavilov, 1951). Apricots are best grown in mountainous areas where the summers are hot and dry, the winters are long and cold and the continental climate prevails.

Apricot is a type of fruit that is grown economically in the world. Despite the large number of apricot species and varieties grown in different climatic conditions, world fresh apricot production is still very low.

It is noteworthy that apricot, which is in high demand in the world, is a good source of income, and its planting areas have increased in recent years. According to FAO records, the world apricot production areas and production amounts increase and decrease over the years. The most important factor affecting apricot cultivation is the climate factor, and the most important of this factor is the late spring frosts. Due to the late spring frosts, there are fluctuations in worldwide apricot production over the years. In 2018, Turkey took the first place with a production value of 750,000 tons in an area of 125,756 ha, and it was followed by Uzbekistan, Iran, Algeria and Italy according to the order of production quantity. As of 2018, 3,838,523 tons of fresh apricots were produced on 548,730 ha area around the world (Anonymous 2020).

Uzbekistan took palce on the top among the neighbors of Kyrgyzstan in apricot production with an area of 38,694 ha and a production amount of 493,842 tons. China with 76,193 tons of production and Tajikistan with 31,980 tons followed this country. Kyrgyzstan, which ranks 4th in terms of area and production amount, produced 25,702 tons of apricots on 7,855 ha area.

An important part of the apricots produced in the world are consumed as edible. However, since the harvest period is short and fresh apricots deteriorate quickly, apricots are mostly dried or processed. Approximately 10-15% of the fresh apricots grown in the world are used as dried.

Fruit types can adapt to different ecological conditions. Especially in countries and regions with similar ecologies, conducting adaptation studies is one of the priority research topics. This situation is even more important for apricot. In fact, apricot, which has serious problems in terms of ecological adaptation capability among fruit species, has limited number of varieties that can fully adapt to all ecologies, and varieties that fit all ecologies must be determined by adaptation studies.

In this study, it was aimed to determine some characteristics of 4 apricot varieties in Kyrgyzstan Bishkek ecological conditions.

MATERIAL AND METHOD

Material

This study was carried out in 2019 in the Research and Application Area of the Faculty of Agriculture of Kyrgyzstan-Turkey Manas University. Medovıy, Krasnosekiy, Korolevskiy and Issyk-kulskiy apricot trees in the research and application garden were used as plant material in the research. The trial garden was established with planting intervals of 5x4 meters.

The city of Bishkek is in the Çüy district and at the foot of the Kyrgyz Ala-Too mountain range and is 760 km above sea level. It is located in the southeast of Kyrgyzstan between 37' 36' north latitude and 36' 56' east longitude. Bishkek has the southern position in the continental zone of the temperate area according to the climatic conditions. The monthly sunshine duration is 322 hours in July and 126 hours in December. The climate of Bishkek shows continental climate features.

In the garden where the research is conducted, irrigation was done with a drip irrigation system. Technical and cultural processes such as fertilization, disease and pest control were carried out regularly. The garden soil was sandy, clayey and loamy.

Method

Phenological observations

Phenological observations such as bud swelling, first blooming, full blooming, fruit setting, fruit ripening dates, harvest dates were made on the apricot types found in the experiment under the field conditions.

Bud Swelling: It was recorded as the date when the flower buds swelled.

First Blooming: It was recorded as the date when approximately 5% of flower buds opened.

Full Blooming: It was recorded as the date when approximately 70-80% of flower buds opened.

Fruit Setting: The date when fertilization was completed and the ovary began to bulge was taken into account.

Fruit Ripening: It was recorded as the date on which the cheeks and the ground of the fruits became colorful, that is, they were ripened.

Pomological observations

Measurements were made on 20 randomly picked apricot fruits representing each variety from fruit samples brought to the laboratory, and their measurement values were recorded.

Fruit Weight (g) : The weights of 20 fruits were determined with a digital scale with a sensitivity of 0,01 g and averaged.

Fruit width and length, height (mm): The width and length values of the fruits were determined with the help of a digital caliper.

Seed weight (g): 20 seeds were weighed and averaged with digital scales with a sensitivity of 0,01 g.

Seed width and length (mm): The width and length values of the fruit seed were determined with the help of digital caliper.

Color of fruit peel and flesh: The colors of fruits taken from all varieties were determined. Color measurement was made with the Konica Minolta CR-400-branded colorimeter. Measurements were given in form of L, a, b. Color measurements were determined by measuring L (100: white, 0: black), a (+: red, - green), b (+: yellow, -: blue) values according to CIE 31 standard.

Kernel weight (g), width, length (mm) and kernel taste: After the seeds were separated from the hard shell, their weights were determined by weighing on a sensitive scale, their width and length were measured with the help of a caliper and their sensory tastes were determined as sweet or bitter.

Water-Slouble Dry Matter (Brix) (%) : In order to measure the water-soluble dry matter amount of the fruits, some fruit taken from each repetition was put in cheesecloth and squeezed and the fruit juice was extracted. Taking enough of the obtained homogeneous juice, readings were made in digital refractometer and the values were recorded as %.

RESULTS AND DISCUSSION

Phenological observations

The first budding, beginning of blooming, full blooming, fruit setting and fruit ripening dates of the varieties used in the experiment were given in Table 1. As can be seen from the chart, the first budding happened on March 12, 2019 in Krasnoşekiy and Isık-Kulskiy varieties, and these two varieties were followed by Medoviy and Korolevskiy varieties which budded on March 15.

Table 1. 2019 phenological observations of the apricot varieties used in the experiment.

Varieties	First blooming	Beginning of blooming	Full blooming	Fruit setting	Date of fruit ripening
Medovıy	March 15	March 17	March 25	April 03	July 16
Krasnoşekiy	March 12	March 16	March 25	April 04	July 16
Korolevskiy	March 15	March 17	March 25	April 03	June 26
Issık-kulskiy	March 12	March 16	March 25	April 04	July 17

The first beginning of blooming was detected in Krasnoşekiy and Issyk-kulskiy varieties. The full blooming period for all varieties was determined as March 25.

It was determined that the first fruit setting among the varieties occurred on April 3 in Medoviy and Korolevskiy varieties and April 4 in Krasnoşekiy and Issyk-kulskiy varieties (Table 1).

When the first ripening dates of the varieties used in the experiment in 2019 were compared, the Korolevskiy variety was the first to ripen their fruits on June 26. Medoviy and Krasnoşekiy ripened their fruits on July 16, and Isık-Kulskiy on July 17.

Phenological parameters, which are considered as an indicator of biological development stages of plants, are very important in determining the behavior of varieties as well. Phenological stages of fruit trees such as full blooming, fruit maturity and leaf fall show quite distinct differences according to years and the ecological conditions (Crandal and Daubeny, 1990; Ağaoğlu et al., 1995; Vachun, 2003). Accordingly, according to the data obtained in the two-year study on 13 types and 4 varieties in Malatya province of Turkey, it was determined that there were variations between genotypes in the phenological stages in the range of about 8-10 days (Asma et al., 2007). However, other researchers stated that there might be a difference of almost two months between these phases (Szalay et al., 2010).

The time from the beginning of blooming to the fruit ripening period of the varieties we conducted the experiment was approximately 2.5-3 months depending on the varieties.

Pomological Analysis

The pomological characteristics of the fruits belonging the varieties cultivated in 2019 were given in Table 2-5.

Fruit weight (g)

While the average fruit weight of the apricot varieties included in the study was obtained from the Isık-kulskiy variety with the highest 34,0 g, the lowest value was obtained from the fruits of the Medovıy variety with 15,6 g (Table 2; Figure 1).

Bahar and Son (2016) measured the fruit weight of the Tyrinthe variety between 46,29 g and 55,67 g in their study between 2007 and 2012, and they measured it between 40,75 g and 45,37 g in the fruits of the Ninfa variety. Son (2018) measured the fruit weight of some varieties as Alyanak 43,02 g, Aurora 39,68 g, Bebeco 55,51 g, Ninfa 42,84 g, Priana 37,7 g, and Tyrinthe 52,28 g. Ruiz and Egea (2008) reported that fruit weights were between 80-95 g in their study on 5 varieties in Spain. Khadivi-Khub and Khalili (2017) determined the fruit weights between 33,01 g and 66,01 g.

Considering all these studies, it was determined that the apricot varieties grown in Bishkek conditions were medium-sized. The size criterion may vary according to the climatic conditions and maintenance conditions as well as the variety feature.

Fruit Width, Length and Height (mm)

As a result of the analysis, it was seen that the fruit sizes were parallel to the average fruit weight in general. In the measurements, the highest fruit width, fruit length and fruit height were

obtained from the fruits belonging to Isık-kulskiy with 36,4 mm, 38,6 mm and 37,6 mm, respectively, and the second highest values were obtained from Korolevskiy fruits with 35,2 mm, 34,8 mm and 34,2 mm, respectively. The lowest values were measured in Krasnoşekiy variety with 27,4 mm, 29,3 mm and 27,3 mm (Table 2; Figure 11).

Table 2. Fruit weight, fruit width, length and height values of apricot varieties in 2019

Varieties	Fruit weight (g)	Fruit width (mm)	Fruit length (mm)	Fruit height (mm)
Medoviy	15,6	30,9	30,2	29,3
Korolevskiy	28,0	35,2	34,8	34,2
Isık-kulskiy	34,0	36,4	38,6	37,6
Krasnoşekiy	23,6	27,4	29,3	27,3

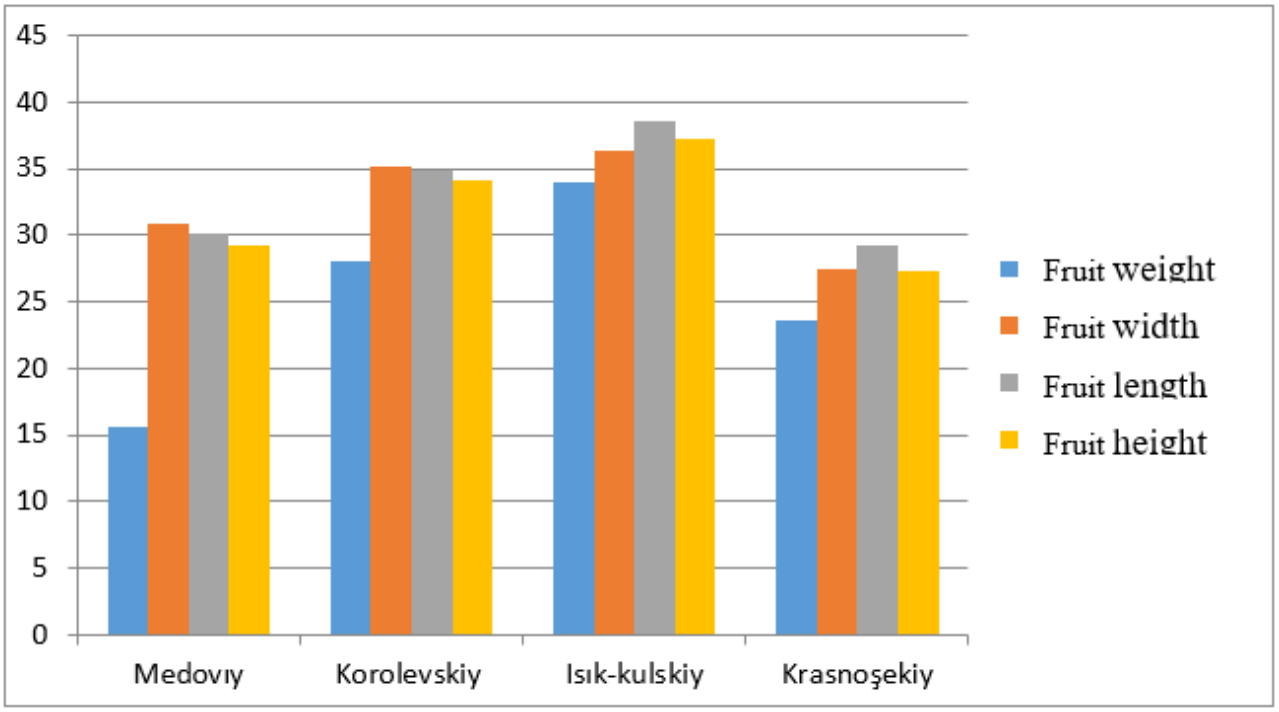

Figure 1. Fruit weight (g), width, length and height (mm) graph of the apricot varieties used in the experiment in 2019

Seed weight, width, and length

Seed weight, width and length values of the varieties were given in Table 3. When the varieties were evaluated in terms of seed weight, it was determined that the largest seeds belonged to the Medoviy variety with 2,8 g, followed by Isık-kulskiy variety with 2,4 g and the lowest value was Krasnoşekiy with 1,8 g.

In terms of seed width and length, the highest value was found in the Isık-kulskiy variety, and the Korelevskiy variety had the lowest values in terms of these features (Table 3).

Table 3. Seed weight, width and length values of the varieties in 2019

Varieties	Seed weight g	Seed width mm	Seed length mm
Medoviy	2,8	19,1	25,8
Korelevskiy	2,2	10,4	23,7
Isık-kulskiy	2,4	19,8	27,8
Krasnoşekiy	1,8	16,6	26,2

Bahar and Son (2016) determined the seed weight of the Ninfa variety between 2,44 g and 2,56 g in their study between 2007 and 2012, and between 2,58 g and 2,86 g in Tyrinthe variety. It is possible that the differences between our research findings and those of other researchers are due to differences in variety, climate and care conditions.

Fruit peel and flesh color of the varieties (L * a * b *)

The color measurements of the fruits of the varieties used in the experiment were determined as L, a *, b * values by measuring from both cheeks of 20 fruits with the help of the Minolta Color Meter (Minolta CR-300) and were given in Table 4.

According to the data obtained from apricot varieties in the experiment, it was obtained that the top color of the peel of the fruit had the lowest L* value in Medoviy (17,88), the highest L* value in Korolevskiy (27,00); for fruit peel ground color, lowest L* value was in Medoviy (18,48), the highest L* value in Korolevskiy (27,05); lowest fruit flesh color L* value was in Medoviy (12,87), and the highest L* value in Isık-kulskiy (15,21).

When the varieties were examined in terms of a * values, the lowest a * value in the fruit peel top and ground color was found in Medoviy (9,19; 7,17, respectively), the highest a * value was found in Krasnoşekiy (15,27; 10,79, respectively); the lowest a * value in fruit flesh was found in Medoviy (3,93), the highest a * value was found in the Isık-kulskiy variety (9,96) (Table 4).

When apricot varieties were examined in terms of b * values, the lowest b * value of the fruit peel top and ground color was found in Medoviy, the highest b * value was found in Medoviy (-0,28) and the highest b * value of the fruit flesh was found in Korolevskiy variety (0.95) (Table 4).

Yilmaz (2008) stated that the fruit surface color was usually “yellowish” according to the data obtained in domestic apricot varieties in Malatya province of Turkey. The researcher stated that in Ağerik and aprikoz apricot varieties, the surface color of the fruit was "white" and the coloration on the fruit surface is generally continuously plastered. Khadivi-Khub and Khalili (2017) reported that 68 of the 73 genotypes they examined in their study were yellow. Asma et al., (2018) reported that the 'Eylül' variety was in dull golden yellow color and 5% to 10% of the surface was reddened.

It was determined among the varieties used in the experiment that Medovıy variety had a red top color in places on an intense yellow ground color; Korolevskiy had a dominant yellow ground color and a red top color in places; Isık-kulskiy had a dominant red-orange top color over a very little yellow ground color; and Krasnoşekiy variety had an intense red color on a less yellow ground color.

Table 4. Values of fruit shell top color, ground color and fruit flesh color of varieties in 2019 (L * a * b *)

Varieties	Fruit peel top color			Fruit peel ground color			Fruit flesh color		
	L *	a *	b *	L *	a *	b *	L *	a *	b *
Medovıy	11,88	9,19	5,39	18,48	7,17	5,05	12,87	3,93	-0,28
Korolevskiy	27,0	11,4	12,32	27,05	10,04	10,04	13,51	9,10	0,72
Isık-kulskiy	21,76	13,41	6,91	20,45	10,67	6,38	15,21	9,96	0,63
Krasnoşekiy	21,33	15,27	6,73	20,12	10,79	7,24	13,83	8,35	0,95

Kernel weight, width and length of varieties, and seed taste

Kernel weight, width and length values and seed taste of the varieties were given in Table 5. When the varieties were compared in terms of kernel weight, it was seen that Medovıy and Isık-kulskiy varieties had the heaviest seeds with 0,8 g. The lowest value in terms of this feature belonged to the Krasnoşekiy variety with 0,4 g.

The kernel width and length values were determined in Isık-kulskiy variety the highest and the lowest in Krasnoşekiy variety.

The taste of the seeds of all varieties was determined as sweet (Table 5).

Table 5. Kernel weight, width, length and taste values of the varieties in 2019

Varieties	Kernel weight (g)	Kernel width (mm)	Kernel length (mm)	Seed taste
Medovıy	0,8	10,65	17,06	Sweet
Korolevskiy	0,6	11,50	16,68	Sweet
Isık-kulskiy	0,8	13,02	17,2	Sweet
Krasnoşekiy	0,4	9,13	16,17	Sweet

Water Soluble Dry Matter Amount of Varieties (% Brix)

The water-soluble dry matter amounts of the varieties in the experiment were given in Figure 2. According to the data obtained, the highest brix belonged to the Medovıy variety with 22%, followed by Isık-kulskiy with 21,3% and Korolevskiy with 19,6%, and the lowest value in terms of this feature was determined in Krasnoşekiy variety with 17,9%.

Khadivi-Khub and Khalili (2017) found that the brix content of 73 genotypes ranged from 15,00% to 23,00%. Cross et al., (2018) determined that the brix content of 12 superior genotypes ranged from 16,30% to 22,60%.

Brix contents of the varieties included in this experiment were also found to be compatible with these values.

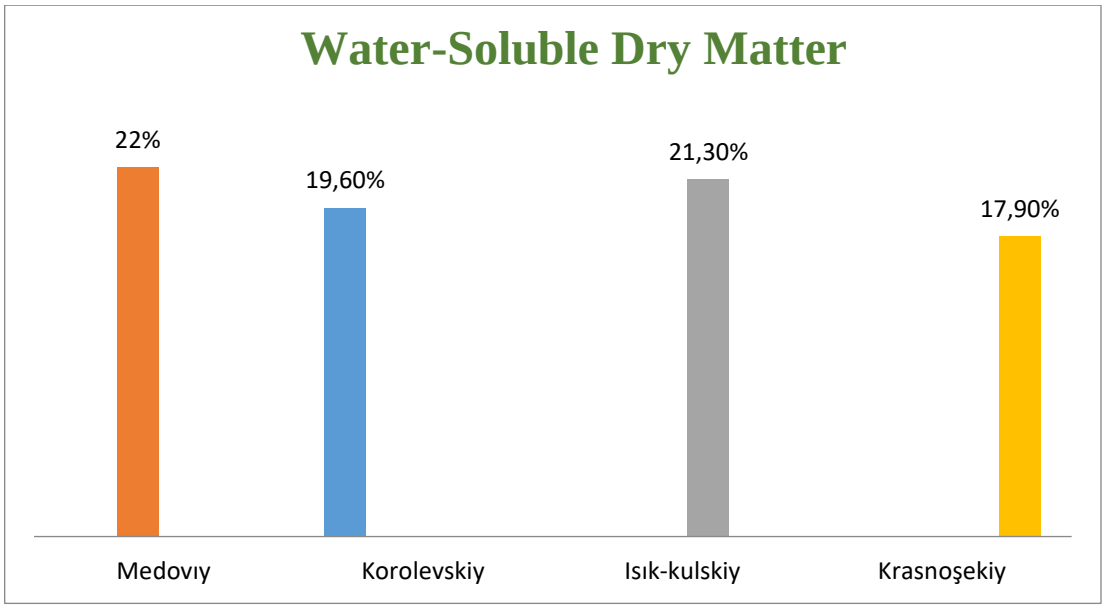

Figure 2. The graph of Water Soluble Dry Matter values of the varieties

CONCLUSIONS AND RECOMMENDATIONS

Within the scope of the thesis, phenological criteria such as bud swelling, first blooming, full blooming, fruit setting and fruit ripening and pomological values such as fruit weight, width, lenght, height, seed weight, width, lenght, fruit top color, ground color and fruit flesh color, kernel weight, width, length and taste, and water-soluble dry matter (brix) amount were recorded in the parcel with apricot varieties in 2019.

When the phenological observations made in apricot varieties were evaluated in general, in Medovıy, Korolevskiy, Isık-kulskiy and Krasnoşekiy varieties, bud swelling between March 12-15, beginning of blooming between March 16-17, full blooming on March 25, fruit set between April 3-4 and fruit ripening between June 26 - July 17 were recorded.

When the pomological analysis of the varieties included in this study was evaluated, the largest fruits in terms of fruit weight were the Isık-kulskiy variety with 34,0 g. The variety with the lowest fruit size was the Medovıy variety with 15,6 g. The seed size of this variety was found to be bigger than the other varieties. While the Krasnoşekiy variety had the most intense red top color, the Isık-kulskiy variety attracted attention with its completely hairless peel. The kernels of all varieties were determined as sweet, and the water-soluble dry matter values were between 22,0-17,9%.

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DETERMINATION OF POMOLOGICAL CHARACTERISTICS OF SOME LOCAL APPLE GENOTYPES GROWN IN KYRGYZSTAN

M. Ilgın[1,2], N. Begimbaeva[1]

1Kyrgyzstan-Turkey Manas University, Faculty of Agriculture, Department of Horticulture, Bishkek / Kyrgyzstan
2 Kahramanmaraş Sütçü İmam University, Faculty of Agriculture, Department of Horticulture Kahramanmaraş/Turkey

Abstract

This research was carried out in 2019 to determine some pomological characteristics of some local apple genotypes grown in Kyrgyzstan. Within the scope of the research, Aport (Isık-Köl), Prevoskod (Talas), Tomkins King, Zahatoy Ranet, Semerenko, Aygül (Isık-Köl) varieties grown in the region were examined in terms of fruit characteristics. Varieties were evaluated in terms of fruit weight, fruit width, fruit length, fruit stem thickness, stem length, fruit peel color, seed number, weight of one seed, fruit taste. According to the results of the research, it was determined that the average fruit weight of the examined varieties was between 159,3 to 69,8 g, fruit width was between 73,2-53,2 mm, fruit length was between 61,6-42,7 mm, fruit stem length was between 23,5 and 11,2 mm, fruit stem thickness was between 2,6 to 1,7 mm, and seed number was between 11 and 7,3.

Keywords: Apple, pomology, Kyrgyzstan

INTRODUCTION

In botany, apple (*Malus x domestica* Borkh.) is a type of fruit from the Rosales order, Rosaceae family and it is cultivated. It is known that its name, known as "alma" in ancient Turkish, comes from "al" (red), which is the color of the fruit. It is believed that the apple first appeared in Northern Anatolia, Southern Caucasus, the regions in the southwest of Russia and around Central Asia.

According to the Russian Botanical scientist Vavilov, there are eight gene centers on Earth. Of these gene centers, China, Central Asia and the Near East are shown as the gene center of apple, and with the addition of North America, which is the spreading area of different species and varieties, it is accepted that apple has four different gene centers in the world (Özbek, 1978). *M. domestica* (Phipps et al., 1990) and *Malus x domestica* Borkh. (Korban and Skirvin, 1984) are known as cultivated apples, and *M. sieversii* is known as wild apples in Central Asia.

Central Asia was reported to contain the largest diversity of *Malus*, and this area also appears to be the main gene center of cultivated apples (Janick and Moore, 1996). This is in line with Vavilov's hypothesis that wild apples and their close relatives in Central Asia were precursors to cultivated apples (Harris et al., 2002). Currently, *M. sieversii*, which grows wild in Kazakhstan and Kyrgyzstan, is thought to be the main progenitor species (Pereira-Lorenzo et al., 2009). *Malus sieversii* has very high similarity to *M. × domestica* in its morphology and fruit taste. According to observations made in extensive picking rounds, it was determined that *M. sieversii* contains all the fruit qualities in cultivated apples (Forsline, 1995). Similarly, Cornille et al. (2012) identified *M. sieversii* as the main species and *M. sylvestris* as the second important species for the evolution of cultivated apples. It was also reported that *M. sieversii* is the primary progenitor for cultivated varieties apples, and there is great interest in this species for genetic diversity studies by botanists (Zhang et al., 2015).

Wild apple genetic resources in Central Asia are extremely important, as choices for desired features in commercial apple varieties narrowed genetic diversity. Apple populations in Central Asia can form an important gene pool to tackle various problems such as resistance to biotic and abiotic stress conditions, fruit quality features, tree growth forms, and some other unresolved problems (Forsline et al., 2003).

Kyrgyzstan is one of the important gene centers of apples. In addition to walnut, peanut and almond species, there are important apple populations and forests in different parts of Kyrgyzstan. However, there are serious anthropogenic losses in these materials and they may disappear completely in the near future (Dzunusovavd., 2008). There are naturally three types of apples in Kyrgyzstan which are (*Malus sieversii* (Ledeb.) M. Roem, (*Malus kirghisorum*) and (*Malus niedzwetzkyana* (Dieck). C.K. Schneid)) and they are also known as the source of cultivated apples. *Malus sieversii* naturally spreads to the dry and mountainous parts of Kazakhstan, Kyrgyzstan, China, Tajikistan, Uzbekistan and Turkmenistan. *Malus kirghisorum* is genetically close to *Malus sieversii*, but it differs in fruit shape, color and other characteristics. In *Malus niedzwetzkyana* species, there are pink-purple pigmentations on leaves, flowers and fruits. These two species can be found in the same regions, but *Malus sieversii* is more common (Volk et al., 2009).

The development of new apple varieties is a process requiring time and money because a variety must have adequate and regular yield, commercial fruit quality, good post-harvest storability and shipping quality, high consumer demand, and finally, resistance to diseases, pests and storage defects (O'Rourke, 2003). Recently, demands from consumers gained more importance in variety development research. According to Pereira-Lorenzo (2009), important features to be considered are fruit size, shape, color, acidity, sweetness, taste, disease resistance, abiotic stress, harvest time, storability and shelf life.

According to the data of 2018, world apple production was realized as 86,142,197 tons from 4,904,305 ha area. Although many countries have a share in this production amount, China alone meets 45,55% of world apple production with 39,235,019 tons of apple production in 2,071,674 ha area. USA realized 5,4% of world apple production with 4,652,500 tons of apple production on 117,844 ha area. Poland realized 4,6% of the production with 3,999,523 tons on 161,790 ha area. Turkey realized 4,2% of the production with 3,625,960 tons on 174,690 ha area. Iran, Italy, India, Russian Federation, France and Chile are countries that produce significant amounts of apples (Anonymous, 2020).

Although Kyrgyzstan is the homeland of the species which are the ancestors of apple, it unfortunately lagged behind the world and neighboring countries in apple cultivation. Among the neighbors of Kyrgyzstan, China had the highest apple production in 2018 with a production of 39,235,019 tons on 2,071,674 ha area. This was followed by Uzbekistan with a production value of 1,130,335 tons in 98,117 ha area, by Tajikistan with a production value of 98,117 tons and by Kazakhstan with a production value of 34,680 tons. Kyrgyzstan ranked 5th and last with 144,889 tons of production on 27,748 ha area (Anonymous, 2020).

Since China and Central Asia are in the working area of gene centers, the richness of apple variety in Kyrgyzstan is quite high. Furthermore, the introduction of new varieties from abroad, especially in recent years, brought the danger of local varieties to disappear. It is important to determine the local varieties of apples, which have an important value in the fruit production sector of Kyrgyzstan, to select the ones with superior characteristics and to carry out studies to prevent them from disappearing.

With this study, it was aimed to determine the pomological characteristics of some apple varieties grown in Kyrgyzstan.

MATERIALS AND METHODS

Materials

This research was carried out using Aport (Isik-Köl), Prevoskod, Tomkins King, Zahatoy Ranet, Semerenko and Aygül (Isik-Köl) apple varieties in the laboratories of the Department of Horticulture, the Faculty of Agriculture, Kyrgyzstan-Turkey Manas University. Varieties were sourced from local markets.

Methods

20 randomly picked fruits were measured from the fruit samples brought to the laboratory to represent each variety, and the obtained values were averaged. The following parameters were evaluated for each variety.

Fruit weight (g) : The fruit weight of randomly selected fruits from each variety was determined by weighing with a scale with a sensitivity of 0.01 g.

Fruit width (mm) and fruit length (mm) : The fruit width and length of the fruits selected randomly from each variety were determined by measuring with a digital caliper.

Fruit stem length and thickness (mm): The fruit stem length and fruit stem thickness of randomly selected fruits from each variety were measured with a digital caliper.

Fruit peel color: It was determined by observing and comparing.

Number of seeds (piece): It was determined by seeds extracted from each fruits and counting them.

One seed weight (g): The weight of one seed extracted from each variety of fruits was determined by weighing on a sensitive scale.

Flavor and aroma of fruits: The aroma was determined by sensory observations and the taste was determined by scoring 1-5.

FINDINGS AND DISCUSSION

Fruit weight

The fruit weights values of 6 varieties were shown in Table 1. When the varieties were compared in terms of fruit weight, the highest value was in the Semerenko variety with 159,3 g, and the lowest value was in the Aygül variety with 69,8 g. Other varieties were between these two.

In a study conducted by Bostan and Şenol (2009) in Ünye (Ordu) and its surroundings, they reported that the fruit weight was between 59,79 g (Kava-1) and 273,41 g (Watermelon). In their study in Iran (Mashhad), Farrokhi et al., (2011) found that fruit weight varied between the lowest 7,1 g and the highest 181,67 g. In the study conducted by Mratinić and Akšić (2012) in Southern Serbia, it was stated that fruit weights varied between 70,00-193,33 g. In the study conducted by Kırkaya (2013) in the apple population in the district of Persembe, fruit weight was found to be between the lowest 76,24 g and the highest 247,23 g. As a result of his analysis on ripe fruits at harvest time, Zawli (2019) found that fruit weight ranged from the lowest 41,4 g (Nazuk Badan-6) to the highest 142,8 g (Atri-3),.

There are similarities and differences between the values obtained by researchers in their studies and the values obtained from this study. This situation is thought to be due to the difference in the varieties and ecologies used.

Fruit width (mm)

According to the data obtained, it was determined that the width of the fruit varies between the highest 73,2 mm (Prevoskod) and the lowest 53,2 mm (Aygül) (Table 1).

In the study conducted by Karakaya et al. (2015) to determine the phenological and pomological characteristics of the local apple variety in Yağdere district, it was determined that the

fruit width was between 59,51-87,62 mm. In their study conducted under Erzurum conditions, Karşı et al. (2016) reported that fruit width varied between 5,07-7,59 cm

Fruit length (mm)

The findings on the fruit lengths of the 6 apple varieties examined were shown in Table 1. Fruit length values of the varieties varied between 61,6 and 42,7 mm (Table 1).

In a study they conducted in the United States of America and Canada, Miller et al. (2004) reported that the average fruit length of the apples was between 65-80 mm. In a study conducted by Karlıdağ and Eşken (2006) in the upper Çoruh Valley of Erzurum province in Turkey, they determined the fruit length between 51,84 mm (Demir) and 77,10 mm (Hishış). In his study in Afghanistan, Zawli (2019) determined the lowest fruit length as 34,38 mm (Maliki) and the highest 62,84 mm (Atri-3).

Table 1. Fruit weight, fruit width and fruit length values of the apple varieties used in the experiment in 2019

Varieties	Fruit weight (g)	Fruit width (mm)	Fruit length (mm)
Aport (Isik-Köl)	128,6	70,2	55,3
Prevoskod	124,0	73,2	61,6
Tomkins King	121,2	65,6	57,3
Zahatoy Ranet	144,9	72,2	58,2
Semerenko	159,3	68,4	58,7
Aygül (Isik-Köl)	69,8	53,2	42,7

Fruit stem length (mm)

Fruit stem length value of the varieties was given in Table 2. According to the table, the highest value in terms of stem length was determined in the Prevoskod variety with 23,5 mm and the lowest value in Semerenko variety with 11,2 mm. Other varieties were between these two varieties (Table 2).

In a study conducted between 2002 and 2005 in the Camili region of Artvin province in Turkey by Serdar et al. (2007), they found the fruit stem length of 32 local apple varieties between 7,6 and 22,3 mm. In his study on apple genotypes grown in the district of Perşembe, Kırkaya (2013) determined the fruit stem length in the range of 8.31 mm and 27.26 mm.

In our studies, it was observed that fruit stem lengths of apple varieties were in parallel with the stem lengths of both local and foreign varieties in other regions.

Fruit stem thickness (mm)

Fruit stem thickness values of the varieties included in the experiment were given in Table 2. Fruit stem thickness values of the varieties were found between 2,6 and 1,7 mm. The highest value in terms of this feature belonged to Zahatoy Ranet variety.

Fruit peel color

Fruit peel color was evaluated visually. When the fruit peel color of the varieties was examined, it was determined that the upper color of the Aport and Aygül varieties was the dominant color and it was dark red in the Aport variety and rose red in the Aygül variety. In these two varieties, yellow ground color was found in places. Preveskod variety is a type in which red top color is dominant. The Tomkins King variety has red stripes on the yellow ground color, while the

Zahatoy Ranet variety is a variety with a light green ground color and a red top color in places. In Semerenko variety, completely light green-yellow color is dominant (Table 2).

Table 2. Fruit stem length, stem thickness values and fruit peel colors of the apple varieties used in the experiment in 2019

Varieties	Fruit stem length (mm)	Fruit stem tickness (mm)	Fruit peel color
Aport (Isik-Köl)	21,8	2,1	Yellow ground, red top color
Prevoskod	23,5	1,8	Dark red
Tomkins King	15,9	1,7	Light yellow ground, top color with red stripes
Zahatoy Ranet	14,6	2,6	Light green ground, slightly light red top color
Semerenko	11,2	2,5	Light green
Aygül (Isik-Köl)	17,9	1,9	Light red top color

Seed number (piece)

In terms of the number of fruit seeds, it was determined that the highest number of fruit seeds ranged between 11,0 (Semerenko) and the lowest number of fruit seeds 7,3 (Tomkins King). These values of the varieties were given in Table 3.

Weight of one seed (g)

One seed weight value of the varieties was given in Table 3. Accordingly, in terms of this feature, Aport variety had the highest value with 0,2 g, and Tomkins King and Aygül varieties had the lowest value with 0,04 g.

In his study entitled determination of phenological and pomological properties of some apple varieties grafted to M9 mother in ecological conditions of Çorum province of Turkey, Çulha (2010) determined that the number of seeds in fruits ranged from 6,66 pieces (Fuji) to 8,66 pieces (RedChief, Starking Delicious) According to their determination in some standard and local apple (*Malus communis* L.) varieties grown in Gümüşhane province of Turkey, Barnabas et al. (2015) determined the number of seeds ranging from the lowest starking-1 to 3,85 pieces, the highest starking-2 to 8.70 pieces, and the seed weight from 0,04 g to 0,07 g in all varieties.

Table 3. The number of seeds, weight of one seed and fruit taste values of the apple varieties used in the experiment in 2019

Varieties	Number of seeds (piece)	Weight of one seed (g)	Fruit taste (1-5 scoring)
Aport (Isik-Köl)	10,0	0,2	2
Prevoskod	8,3	0,05	3
Tomkins King	7,3	0,04	2,5
Zahatoy Ranet	8,0	0,07	3,5
Semerenko	11,0	0,05	4
Aygül (Isik-Köl)	9,0	0,04	2

Fruit taste and aroma

The taste and aroma of the fruit were determined sensory. As a result of 1-5 taste evaluations made by a group of 10 people, the highest score was given to Semerenko (4) and the lowest score was given to Aport and Aygül (2). It was emphasized that the Aygül variety had a sour taste (Table 3). It was stated that the Aport variety was a scented apple and the Preveskod variety was a flavored variety. Moreover, it was determined that the waxy layer on the peel surface of Semerenko variety was more prominent than other varieties.

CONCLUSION AND RECOMMENDATIONS

Consequently, some pomological characteristics of 6 apple varieties grown in the ecological conditions of Kyrgyzstan and purchased from local markets were investigated in this study. The results obtained were summarized below.

Aport (Isik-Köl), Preveskod, Tomkins King, Zahatoy Ranet, Semerenko and Aygül (Isik-Köl) apple varieties were used in the experiment. Fruit weight values of the varieties were found between 159,3 and 69,8 g, fruit width between 73,2 and 53,2 mm, and fruit length between 61,6 and 42,7 mm. The stem length of the varieties was determined to be between 23,5 and 11,2 mm and the stem thickness between 2,6 and 1,7 mm. The number of seeds was found between 11-7,3 and weight of one seed between 0,2 and 0,04 g. The tastes of the varieties, which were subjected to 1-5 scoring as a result of the sensory analysis, were determined between 2 and 4.

Although Kyrgyzstan is one of the homeland regions of apples, the production is very low there. The following suggestions should be taken into account in order to improve apple cultivation in the country.

In order to have a place in the world markets, it is obligatory to obtain varieties suitable for the demands of the market and high quality marketable products.

It is beneficial to dismantle old and small gardens that are out of date and modernize them with new varieties and systems for export, and to establish new gardens with the correct, certified, spur varieties and dwarf or semi-dwarf clonal rootstocks. In these gardens, planting systems and cultural maintenance procedures should be applied correctly and without residue and harvested at the right time.

Climate change affects Kyrgyzstan as much as the world. For this reason, many local varieties that are resistant to biotic and abiotic stress conditions, that have high fruit quality and long storage period should be taken under protection and evaluated in breeding studies.

For qualified fruit storage, the number and capacities of mechanical cooling and controlled atmosphere storages must be increased and standardization and packaging in the product must be modernized.

Producers, public and private sector publishers and consultants, pruners and warehouse managers should receive in-service training on capping and modern garden establishment, management and post-harvest storage for quality fruit production and high yield.

R&D activities (in the fields of variety and rootstock breeding, cultivation and preservation techniques etc.) should be improved.

Especially in apples, precautions should be taken against venturia inaequalis and inside worm.

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DETERMINATION OF MORPHOLOGICAL AND AGRONOMIC PROPERTIES OF SOME F1 MELON POTENTIAL VARIETY CANDIDATES

Necibe Kayak[a], Yeşim Dal[b, c], Ünal Kal[b], Abdurahman Yaşar[a], Gülbanu Kıymacı[a], Önder Türkmen[b], Musa Seymen[b]

a: Selçuk University, Institute of Science and Technology, Konya / Turkey
b: Selçuk University, Faculty of Agriculture, Department of Horticulture, Konya / Turkey
c: Siirt University, Faculty of Agriculture, Department of Horticulture, Siirt / Turkey

Necibe Kayak, ORCID No:0000-0001-7104-8544, Yeşim Dal, ORCID No: 0000-0002-3806-6465 Ünal Kal, ORCID No: 0000-0002-3447-316X, Abdurrahman Yaşar ORCID No:0000-0001-9782-2032, Gülbanu Kıymacı, ORCID No: 0000-0003-3574-4993, Önder Türkmen, ORCID No: 0000-0003-3218-6551 Musa Seymen, ORCID No: 0000-0002-2742-137X

***Corresponding author:** mseymen@selcuk.edu.tr

Abstract

In this study; some morphological and agronomic characteristics of 83 F1 melon variety candidates were determined. The results obtained in yield and fruit characteristics were subjected to PCA analysis. As a result of the study, the study was explained as high as 68.1% in three components with PCA. In respect to fruit parameters, the highest positive correlation was found between fruit weight, shell thickness and seed cavity width. On the other hand, the highest negative correlation was found between yield per plant and seed cavity height. When PC1 and PC2 were evaluated together, considering the fruit quality parameters, the F1 39 was found promising potential candidate hybrid.

Keywords: *Cucumis melo*, fruit characteristics, morphologic features, PCA, yield.

1. Introduction

Melon (*Cucumis melo* L.) is a vegetable species belonging to the *Cucurbitaceae* family and has high morphological diversity and high polymorphism in terms of fruit structure (Fanourakis et al.,2000; Soltani et al., 2010). Approximately 28 million tons of melons are produced in the world. When countries are considered China is the first (15322.900 tons), while the Turkey is second (1760.426 tons), and Iran ranked third (1678.775 tons) and they are important melon production countries (FAO, 2018). Melons in Turkey, due to the show high morphological polymorphism, it has been reported that Turkey has rich melon genetic resources (Şensoy et al., 2007; Sarı and Solmaz, 2007). Therefore Turkey is also known as the secondary gene center in melon (Pitrat et al., 1999). Melon is a type of vegetable that is at the forefront of human nutrition with its different consumption patterns, nutritional content, and unique aroma. Although the protein content and calorie amount are not very high, its importance in nutrition is mostly due to its richness in sugars, vitamins, and mineral substances (Pitrat, 2008). They are a good dietary source which especially in

minerals, vitamin-A and C (Lester, 1997). Agricultural production aims to obtain the highest yield by providing the necessary inputs for the plant to reach its yield potential. For this purpose, the use of hybrid varieties in melons has increased in recent years. In hybrid varieties, significant success has been achieved in the development of desired varieties in terms of yield, quality, endurance, adaptation, disease and pest resistance, and seed production.

Eighteen local melon genotypes were collected from Diyarbakır central villages, Çermik district, and villages and their characteristics such as fruit weight, fruit length, fruit diameter, fruit shape index, SSCM, fruit shape, fruit flesh color, peel color, were examined according to UPOV criteria. As a result of the study; it has been reported that Diyarbakır local genotypes are divided into two groups as summer and winter melons (Tatar and Şensoy, 2020).

In another study, they collected 64 local melon genotypes from provinces, districts, and villages engaged in melon cultivation by conducting survey studies from Southeast Anatolia, Central Anatolia, Aegean, Mediterranean, Marmara-Thrace regions. As a result of the study, the morphological characteristics of 10 fruit characteristics (length, diameter, the shape of the longitudinal section, ground color at maturity, secondary colors in the shell, seal size, cracking in the fruit, and rickety) were determined and recorded. Significant differences were found between the genotypes collected in the study (Sarı and Solmaz, 2007).

In this study, some morphological and agronomic characteristics of 83 melon F1 hybrid lines obtained as a result of the hybrid breeding program were determined. The results obtained in yield and fruit characteristics were subjected to PCA analysis and it was aimed to determine the important parameters that distinguish the hybrids and to reveal the hybrids that are productive and high fruit quality in terms of these parameters.

2. Materials and Methods

The research was carried out with 83 hybrid lines were obtained from controlled pollination between qualified pure lines. The seeds of each hybrid line were sown by throwing a single seed into each sowing pit in the seedling growing trays filled with sterile peat moss on May 04, 2020. Until the seeds germinated and reached the planting size (2-3 true leaves), cultural practices were carried out regularly and on time in a controlled greenhouse conditions. The seedlings, which reached the planting size, were planted on the open field condition in Çumra district of Konya on May 25, 2020. The seedlings were planted at 180x120 cm distance, and 10 plants were located from each hybrid. After planting the seedlings, they were irrigated with drip irrigation, and during the vegetation period, cultural operations such as hoeing, throat filling; fertilization, disease, and pest control were carried out regularly. Morphological characteristics of hybrid lines were determined according to the International Union for the Conservation of New Plant Varieties (UPOV) parameters during the plant development period. Fruits the hybrid lines were harvested on 01 September 2020 and were weighed and the yield in the field was determined. The yield per plant (kg/plant) was determined with the rate per plant in the plot. Fruit weight (kg), fruit length (cm), fruit width (cm), seed cavity length (cm), seed cavity width (cm), rind thickness (mm), flesh thickness (mm) in four fruits determined from each hybrid line and water soluble dry matter (Brix) measurements were realized.

3. Results and Discussion

In the study, characterization studies were performed on 83 melon hybrid lines and the differences between them were evaluated with UPOV parameters. In terms of leaf character, it was determined as 29.06% single, 34.88% five, and 36.04% triple. In terms of leaf shape, it was observed as 51.16% pointed and 47.6% heart. Leaf lobe is 56.97% medium, 25.58% shallow, 17.44% deep. When the leaf color was examined, it was determined that 89.53% dark green and 63.95% dark green, 22.09% light green, 13.95% green. Leaf stem length was found as 91.86% long and 8.13% medium. When the genotypes were examined in terms of flower structure, it was determined that they were all andromonoic and mostly male flowers in the ratio of female to male flowers. The flower bud shape is 97.6% middle, flower bud size and flower size is 98.83% middle. The shape of the flower ovary is 98.83% round.

When the fruit is examined in terms of the longitudinal section, it is 41.6% round, 26.1% elliptical, 11.9% flattened, 10.7% broad elliptical, 3.5% ovoid, 2.3% inverted egg, and dominant. The fruit surface's main color is green in 70 genotypes (83.3%). Fruit speckle density was determined as 63% medium, 25% no or very little, 2.3% sparse and 8.3% dense. No warts were observed in all genotypes. Groove structure in fruit is weak in 78 genotypes (92.8%). Fruit net structure and net shape were observed as 96.4% absent in 81 genotypes and only punctate. Fruit flesh color is greenish-white in 73 genotypes (86.9%), orange in 7 genotypes (8.3%), white in 2 genotypes (2.3%), and green in 1 genotype (1.1%). The highest yield per plant was found to be 74 (9.84), 25 (7.52) and 1 (7.42). The highest fruit weight was determined as 16 (5.44), 39 (4.9), 82 (4.02). In terms of fruit length, 16 (31.67 cm) and 75 (26.14 cm) had the longest fruits, while genotypes 23 (14.43 cm) ad the shortest fruits. The highest fruit diameter was found in 61 (19.63 cm) and 33 (18.20 cm), while 2 (13.08 cm) and 6 (13.46 cm) had the shortest fruit diameter.

While the length of the seed cavity was the highest in 14 (14.14 cm) and 2 (14.12 cm), it was the lowest in 37 (7.93 cm) and 23 (7.93 cm). While the width of the seed cavity was highest in genotypes numbered 78 (10.47 cm) and 65 (10.07 cm), it was lowest in 2 (6.92 cm) and 6 (6.18 cm). Fruit thickness was found the highest in 77 (14.57 cm) and 15 (16.80 cm), while it was found the lowest in 6 (6.41 cm) and 22 (5.96). While fruit rind thickness was found the highest in 1 (42.93 cm) and 39 (45.35 cm), on the other hand 2 (21.67 cm) and 64 (28.15 cm) produced the lowest. In respect to water-soluble dry matter (SSC), the highest mean values were obtained from 56 (13.02 Brix °) and 45 (12.75 Brix °), while the lowest mean values were in 41 (6.80 Brix °) and 38 (8.34 Brix).

In a study conducted by collecting from different locations, it was reported that the melon genotypes had a Brix range of 19.4-7.8 (Tatar and Şensoy, 2020). In another melon study collected from the lake region, it was reported that the interval was between 8.33 Brix and 16.54 Brix °(Erdoğan, 2016). Dal et al., (2016), Turkey's collected from different regions and S4 step up spontaneously updates made melon (*Cucumis melo* L.) accessions of his study to determine the morphological diversity, the fruit forms 49% of the global% 39.6 ovals, 5.6% preform, 3.75% acorn, 1.8% flat, and dominant fruit skin colors; 45.2% was green, 41.5% was brown, 9.4% was pale green, 1.8% was light yellow, 1.8% was blackish green. Crying in the fruit was stated as low in 77.3%, medium in 1.8% and high in 3.7%. The flesh was found to be cream-yellow in 52.8%, white in 16.9%, orange in 15% and green in 15%. Krasteva (2002) determined that 138 of the 206 melon genotypes grown in Bulgaria have a fruit weight of 3.6-5.5 kg and a rind thickness of 0.6-1.5 cm in 151. In the genotype of 8 winter melon collected from Diyarbakır central villages, Çermik district and villages, it has been determined that fruit length varies between 39.70-20.45 cm and fruit diameter between 29.13-20.00 cm (Tatar and Şensoy, 2020). Studies show that there are morphological and agronomic differences in melon genotypes.

Yield and fruit characteristics measurements obtained from melon hybrid lines were subjected to PCA (Table 1). As a result of the PCA, the study explained as high as 68.1% in three components. Studies have reported that in order to use PC analysis, more than 25% of the first two components of the study should be disclosed (Mohammadi and Prasanna, 2003). The strong disclosure of PCA is clear that this analysis will yield important conclusions about the usability and parameters being looked at. As a result of PCA, the first component (PC1) explained 38.6% of the study, and fruit weight, fruit length, fruit width, seed cavity width, rind thickness and fruit flesh thickness parameters were the most positively explained parameters. The second component (PC2), on the other hand, explained 16.8% of the study, while fruit width and solubility were the highest positively explained parameters, while fruit length and seed cavity size parameters were negatively explained. On the other hand, the third component (PC3), explained 12.7% of the study, and the size of the seed cavity and the SSC were the parameters explained in the positive direction and the seed cavity width in the negative direction.

Table 1.PCA results obtained from fruit measurements of F1 melon variety candidates

	PC1	**PC2**	**PC3**
Eigenvalue	3.47	1.51	1.14
Variance%	38.6	16.8	12.7
Total variance %	38.6	55.4	68.1
Eigenvectors			
Yp	-0.07833	0.20829	0.28380
FW	**0.43908**	0.04031	0.20980
FS	**0.42835**	**-0.37290**	0.22107
FW	**0.43297**	**0.30374**	-0.26453
CHS	0.27404	**-0.59369**	**0.30107**
CHW	**0.34316**	0.09908	**-0.57194**
CT	**0.36112**	0.05094	-0.11597
FFT	**0.32521**	**0.37379**	0.27346
WSDM	0.03329	**0.46806**	**0.50060**

Yp- Yield per plant; FW- Fruit weight; FS- Fruit size; Fw-Fruit width; CHS-Core house size; CHW- Core house width; CT- Crust thickness; FFT- Fruit flesh thickness; WSDM- Water soluble dry matter

Using PC1 and PC2 components, a loading plot chart was created to examine the mutual relationship between yield and fruit characteristics (Figure 1). It has been reported that there is a positive relationship if the angle between the vectors in the figure is <90^{o}, there is a negative relationship if the angle is> 90^{o}, and if the angle between the vectors is 90^{o}, there is no significant relationship (Yan and Kang, 2003; Yavuz et all., 2020). When the figure was examined, the highest positive correlation was found between fruit weight, shell thickness and seed cavity width. On the other hand, the highest negative correlation was found between yield per plant and seed house height.

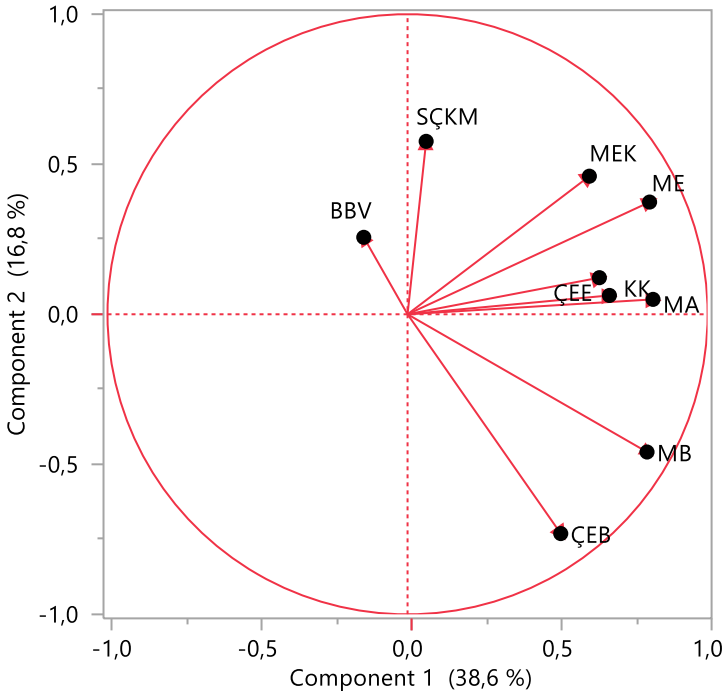

Figure 1. PCA obtained from the fruit characteristics of F1 melon variety candidates. ÇEE- Seed house width; KK- Skin thickness; MEK- Fruit flesh thickness; SSKM- Water soluble dry matter)

A score plot graph was created to evaluate 83 hybrid melon lines by using PC1 and PC2 components (Figure 2). When the figure is examined, G16, G39 and G78 were the genotypes that gave the best results in terms of fruit weight, fruit length, fruit width, seed cavity width, rind thickness and fruit flesh thickness parameters found in PC1. On the other hand, G72, showed significant results in terms of fruit width, solubility, fruit size and seed cavity length. When PC1 and PC2 are evaluated together, the G39 hybrid line, which is in the positive region of both, shows important results and is explained in terms of fruit quality parameters, emerged as promising.

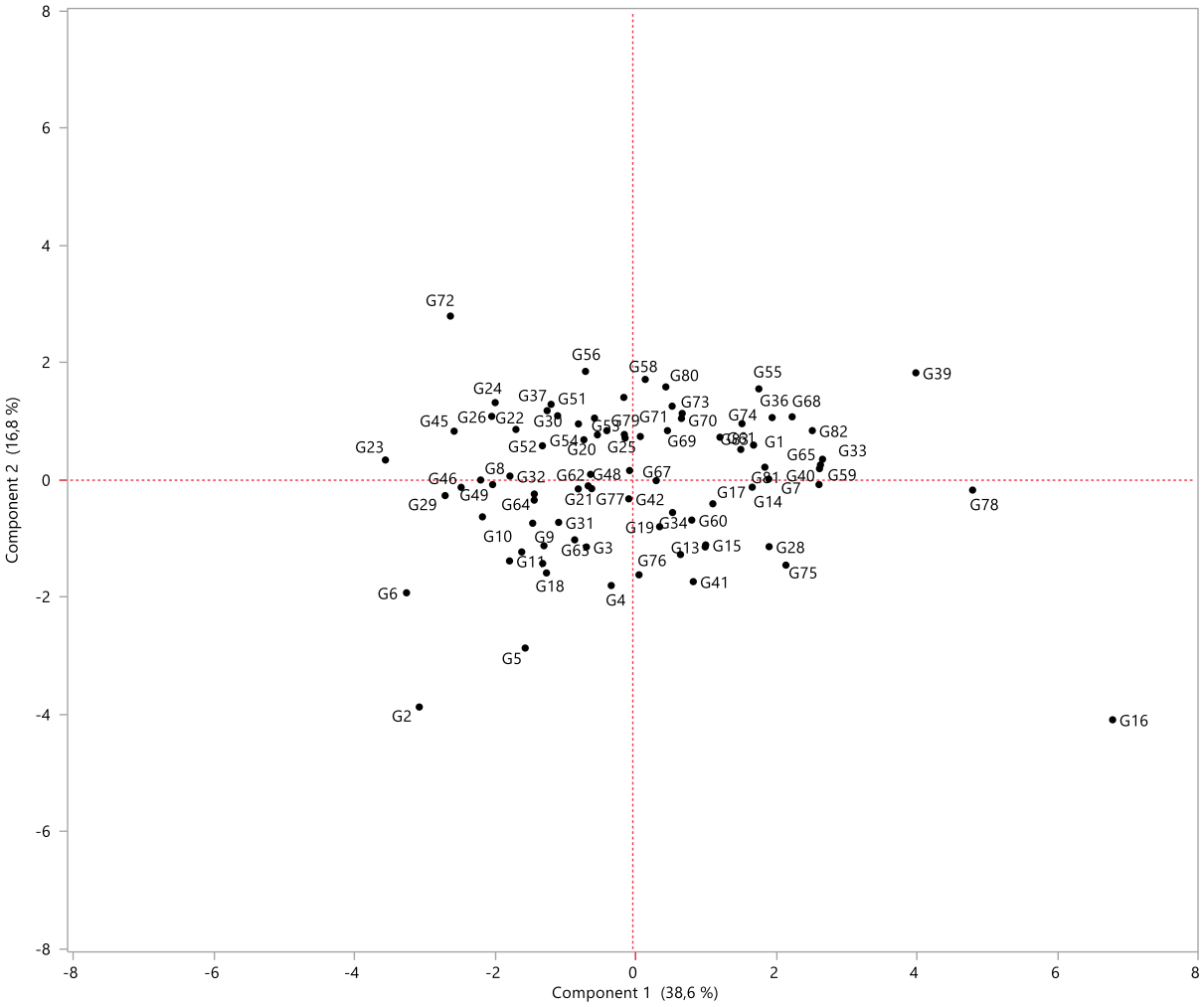

Figure 2. Score plot graph obtained from PC1 and PC2 as a result of PCA made from fruit characteristics of F1 melon variety candidates

4. Result

The morphological and agronomic characteristics of 83 hybrid lines in melon were evaluated and genotypes were interpreted. As a result of the study, some differences occurred in terms of morphological features in leaves, flowers, fruits and seeds. Important differences have emerged between yield and fruit measurements, which are important in melon varieties. As a result of the PCA, the study explained as high as 68.1% in three components. The highest positive correlation between melon fruit parameters was found between fruit weight, shell thickness and seed house width. On the other hand, the highest negative correlation was found between yield per plant and seed house height. When PC1 and PC2 were evaluated together, the G39 hybrid line, which showed important results in terms of fruit quality parameters, emerged as promising. Hybrid lines, which have shown important results in the study, should be taken to yield trials in wider land and their performance should be explained more clearly.

5. Resources

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STATISTICAL ANALYSIS OF MORPHOLOGICAL FEATURES OF LOCAL BEAN POPULATIONS

Necibe Kayak[a], Ünal Kal[b], Yeşim Dal[b], Gülbanu Kıymacı[a], Münevver Ağca[b], Neslihan Issı[b], Arif Selim Arıcı[b], Musa Seymen[b],* , Önder Türkmen[b], Ertan Sait Kurtar[b]

*[1]: necibe.kayak@gmail.com

a: Horticultural Departments, Graduate School of Natural Sciences, University, Konya-Turkey
b: Horticulture Department of Agriculture Faculty, Selçuk University, Konya-Turkey

ABSTRACT

In our country, bean genetic resources are an issue that has not been studied sufficiently in breeding studies, the number of cultivars and production amount developed are not at a sufficient level. For this reason, it is very important to reveal the existing richness in terms of bean gene resources in our country through researches and to use them in developing new varieties and modern agricultural systems. The research aims to provide the basis for future breeding studies with the characterization data of 29 bean genotypes developed for fresh consumption. In the study, measurements, and observations were taken in the plant, flower, pod, seed, and productivity according to the UPOV criteria. As a result of the study, the results obtained in yield and fruit characteristics were subjected to PCA analysis. The total variance of working with PCA was explained with a rate of 57,840%. The PCA graph shows the similarities reflecting the genotypes in the table in terms of the measured variables. The PCA graph shows the similarities reflecting the genotypes in the table in terms of the measured variables. When the cluster analysis is examined; It has been determined that genotypes are divided into two groups on the axis of PCA1 and PCA2. It was seen that the genotypes numbered 6, 8, and 23 were different from the others in the cluster. As a result of the research, it was revealed that genotypes differ from each other in terms of morphological features.

Keywords: Bean (*Phaseolus vulgaris* L.), Diversity, PCA

1. Introduction

Bean (*Phaseolus vulgaris* L.); *Leguminosae* or *Fabaceae* (legumes) family is included in the genus *Phaseolus.* It has been reported that there are around 230 species of beans in the world and 20 of them can be used in human nutrition and the most cultivated species is *P. vulgaris*. The fresh broad bean production in the world is 24,752,675 tons on 15,677,394 hectares and 30,434.28 tons of dry broad bean production are 34,495,662 hectares. World production of beans in the first place, while China, Turkey with 580 949 tonnes of world production of 2.3% takes place in the fourth reputation by satisfying (FAO, 2018).

Among the legumes, beans are the third most important plant species in the world (Blair et al., 2009). Beans are an important source of minerals (calcium, iron, phosphorus), vitamins (B1 and B2), and protein (18-31.6%) (Karakuş et al., 2005). The daily protein consumption per person in the

world is 79 grams as of 2011. 48 grams of this is of vegetable origin. The daily protein consumption per capita in Turkey as of the 2011 year is 103 grams. 72 grams of this is of vegetable origin (FAO, 2018). The grain legumes, meet 33% of the protein needed by humans. Although Turkey beans gene center, a large number of regional characteristics different from each other has grown and genetic material. The genetic potential uncovering of bean types in Turkey and to determine whether it has changed with the environmental influences are important. Variation in plants can be determined by differences in morphological, biochemical, and DNA levels (Svetleva et al., 2003). Knowing and defining the morphological features of variations is extremely important for classical breeding studies. The relationships of these variations with each other help in defining the genetic characteristics of the population (Karataş et al., 2017). The morphological characteristics of different types of fruits in the family of Leguminosae in the world and in our country are examined in studies that have been examined according to UPOV (International Association for the Protection of New Plant Varieties) criteria. In comparing plant and fruit characteristics of varieties with each other, principal component analysis is widely used, and with these data, characteristics that define and distinguish genotypes are determined, as well as genotypes that show superior characteristics in terms of distinctive features (Panayotov et al., 2000).

Seymen et al. (2010), using 8 commercial varieties, namely Nadide, Massay, Nova, Gina, Sarıkız, Romano, Bourgondia, and Goffora, to determine the yield and some quality elements of some dwarf green bean varieties under Konya conditions, the yield, and yield elements differ significantly between varieties. The highest yield was obtained from the Sarıkız (1551 kg/da) variety, the lowest yield was obtained from the Bourgondia (605 kg/da) variety, and Sarıkız ranked first in yield per plant and the number of pods per plant.

Erdinc (2012) obtained from different regions of Turkey 125 bean genotypes have done their work aimed at determining the diversity between various plant characteristics evaluated genotypes. In genotypes, emergence time, growth type, flowering time, fresh pod harvest time, middle leaflet shape, flag color, bracke color and length, number of flower buds and pods in cluster, ground color of the pod, second color in pod, crispness, stringiness, pod length and width, hundred grain weight, seed shape, the main color in seed and dominant second color were examined. It has been determined that there is a wide variation among genotypes in terms of traits. It has been determined that the genotypes are strikingly grouped as South American (Andean) and Central American (Mesoamerican) origin, especially according to the weight of the hundred grains. In the study, it was determined that there is a wide variety in terms of the plant characteristics examined among the genotypes.

In our study, some morphological and agronomic characteristics of 29 bean genotypes developed for fresh consumption were determined. The results obtained in yield and fruit characteristics were subjected to PCA analysis to determine the important parameters that distinguish genotypes, and it was aimed to reveal the high fruit quality hybrids in terms of these parameters.

2. Materials and Methods

The trial was conducted in the Selcuk University Faculty of Agriculture Application Site in 2020. A total of 29 genotypes were used as plant material in the experiment.

The trial pattern was set up with 3 replications and 10 plants per repeat with trial random blocks. The study was started on May 29, by planting seeds at 50x100 cm distances. In the experiment, weed control was regularly carried out by hoeing, and irrigation was carried out with drip irrigation. The first harvest ended on 20 August, the second harvest on 15 September and the last harvest on 27 September. The morphological characteristics of hybrid lines were determined according to the International Union for the Conservation of New Plant Varieties (UPOV).

3. Results and Discussion

In the study, characterization studies performed on 29 bean genotypes were evaluated with UPOV parameters, and the differences between them were evaluated.

In the study, average pod length (13.96 mm), pod width (13.16 mm), pod meat thickness (1.62 mm), pod beak length (6.83 mm), number of seeds in fresh pod (5 pieces), thousand seed weight (385.10 gr), seed length (11.69 mm), seed width (5.65 mm), seed height (4.22 mm), average fruit number (8).

In the study, characterization studies performed on 29 bean genotypes were evaluated with UPOV parameters and the differences between them were evaluated. When all the data on UPOV observations are used, it was determined that it was possible to explain all variation in the data using a total of 42 components. However, the high number of components makes it difficult to show the analysis results. To determine the acceptable number of dimensions in Principal Component Analysis (Kaiser, 1961), it was emphasized that Principal Components with loading value (Eigenvalue) above 1 should be taken into account in explaining the change in standardized data. For this reason, 12 features have been analyzed.

Yield and fruit characteristics measurements obtained in bean genotypes were subjected to PCA. Studies have reported that to use PCA analysis, more than 25% of the first two or three components should be disclosed (Mohammadi ve Prasanna, 2003). As a result of the analysis, the first three components explained 26.383%, 18.298% and 13.159% of the variance, respectively. As a result of principal components analysis, the total variance is 57.840%. As a result of the PCA,

26.383% of the first component (PC1) study was explained, and the thousand grain weight, seed length, seed width, seed height parameters were the most positively explained parameters. The second component (PC2), on the other hand, explained 18% of the study, and the stringiness was the highest parameter in the positive direction and the pod length was the highest parameter in the negative direction. The third component (PC3), on the other hand, explained 13.15% of the study, and the number of seeds in fresh pods was the highest parameter that was positively explained (Table 1).

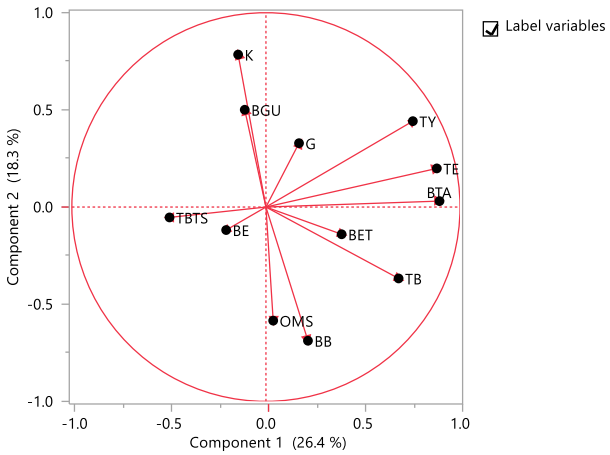
Table 1. PCA results obtained from the measurements of Bean Genotypes

	PCA1	**PCA2**	**PCA3**
Eigenvalue	3.165	2.195	1,579
Variance %	26.383	18.298	13.159
Total Variance %	26.383	44.681	57.840
G	0.09578	0.22172	-0.4158
K	-0.08056	0.52935	-0.1257
BB	0.12167	-0.46425	-0.2307
BE	-0.11524	-0.07986	0.53210
BET	0.21920	-0.09457	-0.1672
BGU	-0.06138	0.33772	-0.2852
TBTS	-0.27926	-0.03610	0.39585
BTA	0.50263	0.02059	0.28865
TB	0.38411	-0.24791	-0.1736
TE	0.49484	0.13412	0.13241
TY	0.42540	0.29821	0.25239
OMS	0.02100	-0.39449	-0.1190

G: brittleness, K: stringiness, BB: plant height, BE: plant width, BET: pod thickness, BGU: Pod Beak Length TBTS: Number of Seeds in Fresh Pod, BTA: Weight of thousand grain, TB: Seed Size, TE: Seed Width, TY: Seed Height, OMS: average number of fruits

Using PC1 and PC2 components, a loading plot chart was created to examine the mutual relationship between yield and fruit characteristics (Table 2). It has been reported that there is a positive relationship if the angle between the vectors in the figure is <90o, there is a negative relationship if the angle is> 90o, and if the angle between the vectors is 90o, there is no significant relationship(Yan and Kang, 2003; Yavuz et al., 2020). When the figure was examined, the highest positive correlation was found between seed width, thousand grain weight and seed height. On the other hand, the highest negative correlation was found between curliness, pod beak length and pod length.

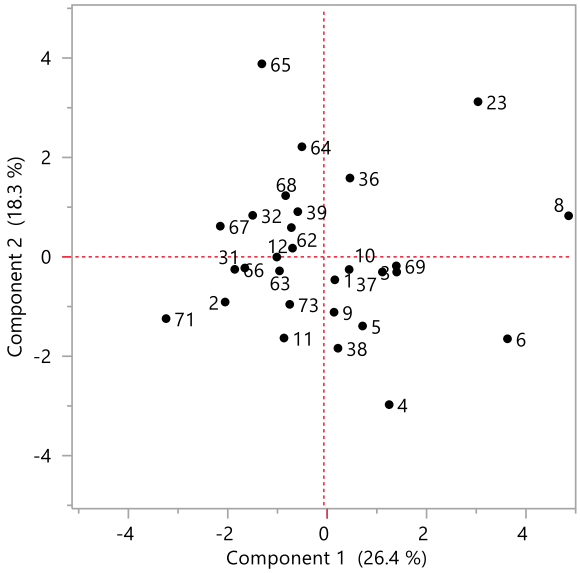
Table 2. PCA result from fruit characteristics of bean genotypes. Loading plot graph obtained from PC1 and PC2.



(G: Brittleness, K: Fishbone, BB: Pod Size, BE: Broad Bean Width, BET: Pod Meat Thickness, BGU: Pod Beak Length, TBTS: Number of Seeds in Fresh Pod, BTA: 1000-seed weight TB: Seed Size, TE: Seed Width, TY: Seed Height, OMS: Average Fruit Number)

Score plot graph was created to evaluate 29 bean genotypes using PC1 and PC2 components (Table 3). When the figure is examined, the genotypes with the number 23, 8, 6 in terms of seed width, thousand grain weight and seed height parameters have emerged as the best results in PC1. Genotypes numbered 65, 4, on the other hand, showed significant results in terms of curl, pod beak length and pod length.

Table 3: PCA result obtained from fruit characteristics of bean genotypes, Score plot graph obtained from PC1 and PC2



4. Result

Genotypes were interpreted by evaluating the morphological and agronomic characteristics of 29 genotypes in beans. As a result of the study, some differences occurred in terms of

morphological features in fruits and seeds. Significant differences emerged between yield and fruit measurements, which are important in bean varieties.

As a result of the PCA, the study explained as high as 57,840% in three components. Genotypes number 23,8,6 were found to be promising. Hybrid lines, which showed important results in the study, should be taken to yield trials in wider land and their performance should be explained more clearly.

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BLACK GARLIC (*Allium sativum* L.) AND BIOLOGICAL ACTIVITIES

O. Tomar[1] and Ö. İstek[2]

[1]Kocaeli University, Faculty of Agriculture and Natural Science, Arslanbey Campus, Kocaeli, Turkey
[2]Afyon Kocatepe University, Engineering Faculty, Department of Food Engineering, Afyonkarahisar, Turkey.
oktaytomar@hotmail.com, omeristek@gmail.com

ABSTRACT

Black garlic is actually a processed food. Fresh garlic (*Allium sativum* L.) is obtained as a result of fermentation under certain temperature and dehydration conditions. As a result of these reactions, the bitter taste and smell of the garlic is lost. There is also an increase in nutritional values. Studies have shown that black garlic is superior to the biological activity of fresh garlic. It stands out especially with its antioxidant activity. The resulting black garlic functions such as anti-cancer, anti-obesity, anti-inflammatory, immunostimulator, anti-allergic, hepatoprotective, cardioprotective, and oxidative stress syndrome. In addition, it is known to have beneficial effects in terms of memory and nervous systems. In this review, investigations were made about the characteristics and biological activities of black garlic.

Keywords: Black garlic, biological activity, fermentation, antioxidant, anti-obesity.

INTRODUCTION

Garlic (*Allium sativum* L.), a member of the *Alliaceae* family, is a popular food product used in table, traditional and modern medicine. Not only does it have a strong flavor and distinctive flavor, but also in its content; There are various bioactive organosulfur compounds including allicin, diallyl disulfide, diallyl trisulfide, S-allyl-cysteine, S-allyl-mercaptocysteine, alixin, 1-propenyl allyl thiosulfate. Therefore, garlic; It has been reported as an important source of healing in many literatures due to its various health benefits such as anticancer, antioxidant, antibiotic, antilipidemic, antidiabetic, anticoagulant, antimicrobial, anti-constipation, antiparasitic, diuretic and hepatoprotective effects (Ried et al., 2013; Adaki et al., 2014; Bayan et al., 2014). Also, in traditional medical practices; garlic is used to treat amoebic and bacillus dysentery, wound infection, chronic bronchitis, hypertension, whooping cough and pinworm infection (Tran et al., 2019). In addition, it has been shown that bioactivity and garlic components differ considerably between different cultivars (Chen et al., 2013; Iloki-Assanga et al., 2015). Garlic, direct or black

garlic, smoked garlic, garlic oil, garlic oil macerate, extract, powder, supplement pill, garlic juice, alcoholic tincture, etc. including food processing or beer products (Santos and Carvalho, 2014).

Among the garlic processing products, black garlic is emerging as one of the best-known functional foods on the market. Compared to raw garlic, black garlic has a typical black color, sweet taste, and chewy texture with no offensive odor. In addition, black garlic has been found to have various bioactivities, including anticancer, anti-obesity, immunomodulatory, hypolipidemic, antioxidant, hepatoprotective and neuroprotective effects (Kimura et al., 2017).

BLACK GARLIC AND ITS PRODUCTION

People from Asian countries such as Thailand, South Korea, and Japan have been producing black garlic as a traditional food for centuries. However, it has entered the global market in recent years. Black garlic is produced by fermentation of whole fresh garlic at high humidity and temperature. This results in the transformation of garlic to black through a series of non-enzymatic browning reactions such as the Maillard reaction, oxidation of phenols and caramelization. When garlic undergoes fermentation, not only does the physicochemical properties of the garlic change, but also the concentration of bioactive compounds increases (Kimura et al., 2017).

Choi et al. (2014) reported in their study that the moisture and pH of garlic decreased with the fermentation process, whereas reducing sugar and total acidity increased. In addition, the color spectrum and composition of amino acids of black garlic changed compared to fresh garlic. The resulting black garlic has an elastic and chewy texture. In addition, a new sweet taste is created without the irritating garlic flavor. In addition, black garlic compared to fresh garlic; Organosulfur compounds such as polyphenols, flavonoids, tetrahydro-β-carboline derivatives, S-allyl-cysteine and S-allyl-mercaptocysteine and antioxidant compounds have increased values.

In their research; When black garlic and fresh garlic were compared, it was reported that the total polyphenols and flavonoids value of black garlic increased 9.3 and 1.5 times, respectively (Kim et al., 2013). It has been demonstrated that the concentration of S-allyl-cysteine, one of the most important organosulfur bioactive compounds of garlic, increases between 4.3 and 6.3 times in black garlic depending on the heating process (Bae et al., 2014).

In recent years, black garlic has increased in consumption demand due to its delicious and bioactive compounds. It is also among the prominent products in the functional food market. In addition, black garlic is not only attracting the attention of its consumers, but also by its researches and producers in improving the production procedure and innovation of processing products. Black garlic production processes; Different programming is done depending on temperature, relative humidity, time and materials (Zhang et al., 2016).

HEALING EFFECTS OF BLACK GARLIC

Anticancer Effect

Cancer is one of the leading causes of death worldwide. It is a disease caused by uncontrolled or abnormal growth of cells and tissues in our body. Due to the reports that black garlic has anticancer effect in recent years, some researchers suggest that black garlic can be used in meals to prevent and treat cancers from stomach cancer to leukemia. The mechanism of anticancer effects of black garlic in different cancer diseases, induction of apoptosis, cell cycle arrest, and inhibition of tumor growth and invasion have been demonstrated (Tran et al., 2019).

Wang et al. (2012) suggest that aqueous extracts of black garlic may induce apoptosis of human gastric cancer cell line SGC-7901 in a dose-dependent manner. In addition, it has been found that black garlic has an inhibitory effect on tumor growth in tumor-bearing mice.

Dong et al. (2014) reported that black garlic shows anticancer effects on colon cancer cell lines. It has also been found that the cell cycle of the HT29 human colon cancer cell line can be stopped when treated with an alcoholic extract of black garlic.

Effect on Dyslipidemia and Anti-obesity

Obesity is an important problem in Western and developed countries, causing various metabolic syndromes and chronic diseases and threatening public health. Obesity can be prevented by a combination of a healthy nutritional balance between physical activity, energy intake and expenditure. Black garlic is known to be a prominent lipid and weight-reducing component (Finimundy et al., 2014).

Ha et al. (2015) found that diets supplemented with 1.5% black garlic extract can only reduce weight in high-fat models. It has also been reported to reduce kidney and epididymal fat. Also, black garlic extract alleviates dyslipidemia caused by a high-fat diet. In their study, it was observed that black garlic has a lowering effect on plasma total lipid, total cholesterol and triglyceride levels. In contrast, the high-density lipoprotein cholesterol (HDL) of the black garlic group was found to be higher than the high-fat diet group. Treatment with black garlic has been shown to reduce both glucose and insulin in plasma levels on a high-fat diet.

Chen et al. (2014) suggested that the anti-obesity effect of methanol extract of black garlic may be related to lipogenesis, adipokine biosynthesis, fatty acid oxidation, fatty acid and glucose transport, and lipolysis in both adipose tissue and liver.

Antioxidant Properties

Black garlic contains abundant antioxidant compounds, including polyphenols, alkaloids, flavonoids, S-allyl-cysteine, and antioxidant intermediates derived from the reaction in Mail (Choi et al., 2014; Kimura et al., 2017). In the studies of

Wang and Sun (2017), it was determined that black garlic ethanol extract has the same DPPH radical inhibitory effect as vitamin C at concentrations of 200 and 250 μg ml^{-1}. In addition, Lee et al. (2009) A diet supplemented with 5% black garlic extract reduces oxidative stress and diabetes complications. A strong antioxidant capacity is exerted through the ABTS radical activity of black garlic, four times higher than raw garlic, and the suppression of oxidative stress.

The antioxidant effect of black garlic has been proven in clinical studies. In the previous study, Wang et al. (2012) conducted a double-blind, parallel design study with an untrained male population of similar age and body mass index for 14 days to compare the effect of black garlic and placebo on exercise-induced oxidative stress and recovery.

Liu et al. (2018) reported that black garlic has a beneficial effect on coronary heart disease patients. Black garlic exhibits an increase in chronic heart failure by increasing the left ventricular ejection fraction value and quality of life scores and circulating antioxidant levels, while brain natriuretic peptide (BNP) precursor N-terminal decline is a biomarker for its severity.

Anti-inflammatory Effect

Inflammation is the process by which our immune system responds to injury, infection, and toxin. Inflammation plays a vital role not only in the wound healing and repair process, but also in protecting our body from foreign invaders, including viruses and bacteria. However, chronic inflammation can have a negative impact on our health, which manifests itself in various chronic diseases, from heart disease to rheumatoid arthritis and lupus (Galland, 2010).

In recent years, black garlic comes to the fore in the treatment of inflammation and septicemia-related diseases. Aqueous extract of black garlic inhibits the production of pro-inflammatory cytokines, including nitric oxide (NO) and tumor necrosis factor α (TNFα) and prostaglandin (PG) -E2 (Oh et al., 2012; Kim et al., 2014).

Zhang and Jilg (2017) in their study; It was concluded that five different black garlic extracts, including hot aqueous extract, ethanol supernatant extract, ethanol precipitate extract, deproteinized ethanol supernatant extract and deproteinized ethanol precipitate extract, improved the regulatory effect. It has been found that due to the effect of LPS on macrophage growth inhibition, it also reduces TNF α, IL-6 and IL1β formation in macrophages.

Neuroprotective Effect

It has been reported that black garlic has beneficial effects on memory and nervous system through its antiamnesic effect, improving cognitive impairment and preventing neuroinflammation and neurotoxicity (Tran, 2020).

Nurmasitoh et al. (2018) demonstrated that ethanol extract of black garlic strongly protects the murine medial prefrontal cortex from oxidative stress induced by monosodium glutamate by improving working memory performance and preventing pyramidal neurons from modification of neuronal architecture.

In different studies, it has been found that various doses of black garlic extracts (2.5 to 10 mg 200 g^{-1} body weight) also inhibit the detrimental effects of monosodium glutamate on spatial memory and total pyramidal neurons in the CA1 region of the hippocampus (Hermawati et al., 2015). In addition, the protective effect of black garlic on the nervous system has been documented as a curative effect on neuroinflammation and cognitive impairment, a pathological evidence of Alzheimer's disease (Nillert et al., 2017).

Hepatoprotective Effect

The liver is a vital organ that performs biochemical production related to detoxicity, protein biosynthesis and digestion. However, the liver is vulnerable to drugs, chemicals, alcohol, solvents, infection, and nutritional supplements. It has been demonstrated that black garlic protects the liver from side effects such as hepatoxicity and apoptosis of the anticancer drug cyclophosphamide (Ahmed, 2018).

Ahmed (2018) reported that black garlic supplementation (200 mg kg^{-1} body weight) improved histological change, DNA damage and biochemical parameter change in blood (bilirubin, alanine transaminase (ALT), aspartate transaminase (AST)) and increased hepatic antioxidant.

One explanation for the hepatoprotective effect of black garlic is that it has been reported that black garlic can improve cell death and reduce lipid peroxidation, oxidative stress and inflammation through regulation of the JNK signaling cascade. It has been found that black garlic shows hepatoprotective effects not only in acute toxicity, but also in chronic conditions (Kim et al., 2011).

Shin et al. (2014) reported that black garlic supplementation not only protected the liver from acute toxicity induced by carbon tetrachloride or D-galactosamine, but also improved lipid profile and liver damage in the hepatic steatosis model.

CONCLUSION

Black garlic is a well-known garlic preparation that is fermented at high humidity and temperature, arranged to not only remove the strong and unpleasant aroma of fresh garlic, but also improve its nutritional composition, bioactivity and taste values. After its introduction over the past few decades, black garlic has become a functional food that has arisen due to its wide-ranging biological functions, including antioxidant, anti-inflammatory, anticancer, hyperlipidemia-lowering, anti-obesity, hepatoprotective and neuroprotective effects. Their bioactivity and therapeutic benefits have been the subject of numerous extensive studies at both the in vitro and in vivo levels. Recently, there are only a few clinical studies proving the health benefits of black garlic on cardiovascular diseases. Therefore, more research focusing on the safety aspect and other medical applications of black garlic is needed to provide a comprehensive overview of the therapeutic effects of black garlic.

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DETERMINATION OF THE ANTIBACTERIAL EFFECT OF EXTRACTS OF PEACH TREE (*Prunus persica* L.) RESIN IN DIFFERENT SOLVENTS

O. Tomar[1] and Ö. İstek[2]

[1]Kocaeli University, Faculty of Agriculture and Natural Science, Arslanbey Campus, Kocaeli, Turkey
[2]Afyon Kocatepe University, Engineering Faculty, Department of Food Engineering, Afyonkarahisar, Turkey.
oktaytomar@hotmail.com, omeristek@gmail.com

ABSTRACT

Peach tree resin (*Prunus persica* L.) is known as exus gum from the *Rosaceae* family. The leaks that this tree secretes for the purpose of closing and repairing the slits formed in its branches and bark are defined as peach resin. The peach tree, which is native to China. It also has an antibacterial properties in content due to the phenolic component of naringen. In this study, ethanol obtained from peach tree resins, *Bacillus cereus* (ATCC 14579), *Listeria monocytogenes* (ATCC 51774), *Escherichia coli* (ATCC 25922), *Enterobacter aerogenes* (ATCC 13048), *Salmonella Typhimurium* (ATCC 14028), *Staphylococcus aureus* (ATCC 6538) and *Pseudomonas aeruginosa* (ATCC 15442) antimicrobial effect against 7 different foodborne pathogenic bacteria such as disc diffusion method. Minimal inhibitory concentration (MIC) and minimum bactercidal concentration (MBC) values on pathogenic bacteria were also detected. As a result of the research; The highest antibacterial effect was observed in the methanol extract of peach tree resin against *Staphylococcus aureus* with a zone diameter of 17.52±3.14 mm, while *Listeria monocytogenes* were found to be followed by ethanol extract with a zone diameter of 15.52±2.24 mm. The lowest MIC and MBC values were found to be 0.070 mg L^{-1} and 0.047 mg L^{-1} respectively against *Staphylococcus aureus* in peach methanol extract. The results are compared to the reference values of Eucast, CLSI and the National Microbiology laboratories; *Staphylococcus aureus* was found to be susceptible to ethanol, *Listeria monocytogenes*' ethanol extracts. *Salmonella Typhimurium*, on the other hand, was found to be resistant to methanol and distilled water extracts.

Keywords: Peach resin, antibacterial, naringenin, MIC, MBC.

INTRODUCTION

The resin produced from the fruit and trunk of trees as a result of mechanical injury or microbial invasion is composed of polysaccharides with complex structures (Simas-Tosin et al., 2010; Qian et al., 2011; Yang et al., 2018). In the polysaccharide components of the resins, it is reported that arabinose, xylose, galactose, glucose and uronic acids (Stephen, 1983).

Peach (*Prunus persica* L.), whose homeland is China, belongs to the Prunus genus, which belongs to the Prunoideae subfamily, of the Rosaceae family of the order Rosales. Turkey is a country suitable for growing peaches aspect of climate and soil structure. Especially in our country,

the province of Bursa and the Mediterranean Region stand out with peach cultivation (Seçmen et al., 2018).

The polysaccharides of peach resin belong to the acidic group of arabinogalactans. Polysaccharide content consists of arabinose (50%), galactose (37%) and uronic acid (13-14%) (Qian et al., 2011). In addition, the most naringenin component is in phenolic content (Dimkić et al., 2016). Naringenin component shows antimicrobial properties, it has been found to be quite effective in inhibiting gram-negative bacteria (Han and You, 1988).

In this study; Resins collected from peach trees in orchards in Bursa city center and districts; The antimicrobial effects, minimal inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) values of methanol, ethanol and distilled water extracts on some food pathogenic bacteria were determined.

MATERIALS AND METHODS

Materials

Peach tree resin (*Prunus persica* L.) used in the study was collected by hand from the trunks of trees in orchards in Bursa city (Turkey) center and its districts. The collected resins were dried in the shade and in the open air. The dried resins were stored at 4 °C in sealed and colorless bottles.

As gram positive bacteria used in the study; *Staphylococcus aureus* (ATCC 6538), *Listeria monocytogenes* (ATCC 51774), *Bacillus cereus* (ATCC 14579) species and as gram negative bacteria *Salmonella Typhimurium* (ATCC 14028), *Pseudomonas aeruginosa* (ATCC 15442), *Escherichia coli* (ATCC 13048) strains were used.

Methods

Preparation of Peach Resin Extracts

Peach tree resins kept at 4 °C were pulverized by passing through a laboratory type mill. Taking 50 grams of powder resins, 190 ml (w v^{-1}) of methyl alcohol, 85% ethyl alcohol and distilled water were added as solvent in three separate samples. The prepared solutions were shaken in a 120 rpm shaker device (Wiseshake SHO-2D, Witeg, Germany). Then the solutions were filtered with the aid of sterile filter (Whatman No:32) papers. The solvent and extracts were removed with a rotary-evaporator (Heidolph, Germany). The extracts obtained were sealed in colorful bottles in a way that is not airtight. It was stored in a dark and cool environment until the analysis was completed (Karakoç and Gökçe, 2013; Akarca et al., 2018).

Determination of Antimicrobial Activity, MIC and MBC Values

Disk diffusion method was used to determine antimicrobial activity. 10 ml of extracts prepared by using three different solvents (methanol, ethanol and distilled water) were taken into sterile petri dishes and absorbed at 4 °C for 60 minutes into empty discs (Bio-Disc) (Akarca et al., 2019). For inoculum, growing from non-selective media in an overnight culture was taken from single falling colonies with the aid of a sterile loop. The recovered colonies were suspended in physiological saline until a homogeneous turbidity formed. The inoculum density of the suspensions was adjusted to equal the 0.5 McFarland standard (Bauer et al., 1959; Bauer, 1966). The prepared Mueller Hinton Agars (Merck 1.05437) were made in 15 minutes from the inoculum with a swab bar in three directions. After the medium was left to absorb the inoculum for 10 minutes, the extracted discs were placed in separate plates at distances that would not touch each other (Bauer et al., 1959; Bauer, 1966). Later, it was left for incubation at appropriate temperatures and times according to Table 1 (Anonymous, 2018). The inhibition diameters formed were measured in mm with the help of a digital caliper.

Table 1. Bacteria used in the study and incubation conditions (Anonymous, 2018).

Bacteria	**Incubation conditions**
Staphylococcus aureus *Escherichia coli* *Salmonella Typhimirium* *Enterobacter aerogenes*	Aerobic 16-20 hours at 35±1 °C
Bacillus cereus *Pseudomonas aeruginosa*	Aerobic 24-48 hours at 30±1 °C
Listeria monocytogenes	Air and 5% CO_2 mixture at 35±1 °C 16-20 hours

Bifold dilution method was used to determine the MIC values. 1 ml of nutrient broth (Merck 1.05443) was placed in six sterile tubes separately for each peach resin extract. Separately, 2 ml of peach resin extracts were added into a tube. 1 ml was taken from the tube containing peach resin extract, added to the tube containing 1 ml nutrient broth and mixed homogeneously with Vortex aid (IKA MS-3, Germany). Then, 1 ml of the contents of this tube was taken and transferred to the next tube. The process was continued in the same way until the last tube. 1 ml extract-medium was taken from the last tube number 6 tube and discarded. In this way, equal amounts of dilutions were obtained in each tube, but the concentrations were halved compared to the previous one. In this way, equal amounts of dilutions were obtained in each tube, but the concentrations were halved compared to the previous one. Accordingly, the concentration of the resin extract in the first tube is 800 mg L^{-1}, in the following tubes the concentration is respectively; It was provided to be 400, 200,

100, 50 and 25 mg L^{-1}. In addition, positive control tubes containing only 1 ml of nutrient broth and negative control tubes containing 1 ml of extract and 1 ml of Nutrient broth were also created. 1 µl (10^6 cfu ml^{-1} adjusted for 0.5 McFarland turbidity) pathogenic bacteria were individually inoculated into all tubes except the negative control. The tubes were left to incubate for 16-20 hours at a suitable temperature according to the pathogens and bacteria they contain. At the end of the period, half of the total of the previous tube concentrations that improved with the concentration of the tube without any visible microbial development in the tubes was accepted as the MIC value (Abubakar, 2009; Aamer et al., 2014).

In determining the MBC effect of peach tree resin extracts on pathogenic bacteria used in the study, 1 µl of each tube was taken from each tube with no microbial growth in MIC analysis, and it was planted in Mueller-Hinton agar plates using the smear plate method. Afterwards, the medium was allowed to absorb the sample for 10 minutes. It was left to incubate for 24 hours under appropriate conditions. The lowest concentration with no improvement after incubation was determined as the MBC value of peach resin extracts against the bacterial species tested (Dhiman et al., 2011; Owuama, 2017).

RESULTS AND DISCUSSION

The results of the antimicrobial effects of extracts of peach tree resin prepared using different solvents on seven different pathogenic bacteria are shown in Table 2. Zone diameters after incubation were evaluated as mm. It was made in 4 separate parallel and calculated by taking its arithmetic mean.

Table 2. Antimicrobial Effects of Prepared Peach Tree Resin (*Prunus persica* L.) Extracts on Some Pathogen Bacteria (mm zone diameter).

	Zone Diameters (mm) / Std Deviation		
Bacteria	**Methanol**	**Ethanol**	**Distilled Water**
Listeria monocytogenes (ATCC 51774)	13.19±1.07	15.52±2.24	10.15±1.21
Enterobacter aerogenes (ATCC 13048)	8.42±0.19	9.15±1.18	8.17±0.04
Staphylococcus aureus (ATCC 6538)	17.52±3.14	13.08±1.19	12.09±1.52
Escherichia coli (ATCC 25922)	9.41±0.86	10.16±1.32	8.16±0.05
Salmonella Typhimirium (ATCC 14028)	7.75±0.27	9.04±0.21	8.41±0.16
Bacillus cereus (ATCC 14579)	13.24±2.15	11.82±0.96	14.72±1.37
Pseudomonas aeruginosa (ATCC 15442)	9.05±0.97	9.12±0.96	9.55±0.99

The MIC and MBC values of peach tree resin extracts on some pathogenic bacteria are given in Table 3. Values are determined in mg L^{-1}.

In our research; The antimicrobial effect of the extracts obtained by using some solvents (methanol, ethanol and distilled water) of peach tree resin on gram positive and negative bacteria

was determined using disk diffusion method. According to the data obtained, the most antimicrobial effect of methanol extract was on *Staphylococcus aureus* with a zone diameter of 17.52±3.14 mm and the least effect was; It was found to be on *Salmonella Typhimurium* with a zone diameter of 7.75±0.27 mm (Table 2).

The greatest effect of ethanol extracts; It was determined that it was on *Listeria monocytogenes* with a zone diameter of 15.52±2.24 mm, but the least effect was on *Salmonella Typhimurium* with a zone diameter of 9.04±0.21 mm. Distilled water extract of peach tree resin had the highest effect against Bacillus cereus with a zone diameter of 14.72±1.37 mm, and the least effect against *Escherichia coli* and *Enterobacter aerogenes* with a zone diameter of 8.16±0.05, 8.17±0.04 mm, respectively. determined (Table 2). When the obtained results are compared with reference values of EUCAST and CLSI laboratories; It has been determined that all extracts are sensitive to Staphylococcus aureus, whereas Enterobacter aerogenes are resistant (Anonymous, 2018).

Table 3. MIC and MBC values (mg L^{-1}) on some pathogen bacteria of extracts of prepared peach tree resin (*Prunus persica* L.).

	MIC and MBC Values (mg L^{-1})					
	Methanol		**Ethanol**		**Distilled Water**	
Bacteria	**MIC**	**MBC**	**MIC**	**MBC**	**MIC**	**MBC**
Listeria monocytogenes (ATCC 51774)	0.281	0.188	0.141	0.094	0.375	0.250
Enterobacter aerogenes (ATCC 13048)	0.563	0.375	0.563	0.375	0.750	0.500
Staphylococcus aureus (ATCC 6538)	0.070	0.047	0.281	0.188	0.375	0.250
Escherichia coli (ATCC 25922)	0.563	0.375	0.375	0.250	0.750	0.500
Salmonella Typhimirium (ATCC 14028)	>0.750	>0.750	0.563	0.375	>0.750	>0.750
Bacillus cereus (ATCC 14579)	0.188	0.125	0.281	0.188	0.141	0.094
Pseudomonas aeruginosa (ATCC 15442)	0.563	0.375	0.563	0.375	0.563	0.375

It was determined that the lowest MIC value was *Staphylococcus aureus* (0.070 mg L^{-1}) in the methanol extract of peach tree resin, whereas the highest value was against *Salmonella Typhimurium* (> 0.750 mg L^{-1}) in methanol and distilled water extracts (Table 3).

As a result of our research; The lowest MBC value was found to be 0.047 mg L^{-1} on *Staphylococcus aureus* species of methanol extracts of peach tree resin. On the other hand, the highest MBC values were determined to be > 0.750 mg L^{-1} in *Salmonella Typhimurium* versus methanol and distilled water extracts (Table 3).

Yao et al. (2013) studied the antibacterial effect of oligosaccharides obtained from peach resin. In this study, inhibition diameters of oligosaccharides on some bacteria *Bacillus subtilis*, *Staphylococcus aureus* and *Escherichia coli* were reported as 9.01 mm, 10.12 mm and 11.04 mm,

respectively. There is a difference between the study and our research. This is due to the different antibacterial material used.

CONCLUSION

In this study, the antimicrobial effects of extracts of peach tree resin in different solvents on some pathogenic bacteria were investigated. The study found that methane extracts have a more antimicrobial effect and lower MIC and MBC values than other solvents.

Most of the unnatural antimicrobial preservatives used in its production are one of the biggest problems for food producers. Consumers are uncomfortable using chemically derived additives in food production. Because there are concerns about some undetermined side effects. Therefore, manufacturers are looking for alternatives in additives.

For this reason, research is being carried out on antimicrobial effects on plants and by-products to prevent the development of foodborne pathogenic bacteria and it has been revealed that they have high levels of effects.

The results of our research are thought to be used for this purpose of peach tree resin (*Prunus persica* L.). It is also predicted that it will contribute in other studies. Tree resins are easy to obtain in our country, abundant and cheap compared to other alternatives. The addition of peach tree resin for its use as a preservative in foods is important for both manufacturers and consumer groups.

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GENOME WIDE AND GENE SPECIFIC EPIGENETIC ANALYSES IN *Fusarium* SPECIES

Ö. Sefer[1, 2], M.S. İbişoğlu[1,2], S. Yılmaz[1], E. Yörük[1*]

[1]1Istanbul Yeni Yuzyil University, Faculty of Arts and Science, Department of Molecular Biology and Genetics, Istanbul, Turkey
[2]Istanbul University, Institute of Science, Program of Molecular Biology and Genetics, Istanbul, Turkey
*Corresponding author: ozlem.sefer@yeniyuzyil.edu.tr

Abstract

Fusarium graminearum and *F. culmorum* are the predominating causal agents of the head blight and crown rot diseases of all small grain cereals worldwide. In this study, the relationship between epigenetics characteristics with phenotypic and genetic traits in *Fusarium* isolates from Turkey have been investigated. The asexual and sexual reproduction characteristics of the isolates were achieved with counting macroconidium and linear growth rate analyses. Genomic and epigenetic profiles were revealed by RAPD and CRED-RA methods. Non-digested, *Msp*I-digested, and *Hap*II-digested gDNA samples were subjected to polymorphism analysis with RAPD primers. Bands with range of 131-172 were obtained in totally six different analyses. Average similarity values were determined as %42.7, %48.4 and %49.2 with %49.65, % 58.15 and %57.5 respectively in RAPD, *Hap*II-digested and *Msp*I-digested analyses in *F. graminearum* and *F. culmorum* isolates, respectively. The *Top1, Mgv1, Chs1, RED, URA, tri6, tri101-tri5* genes were amplified from non-digested, *Hap*II digested and *Msp*I digested gDNA samples. The Type I - Tip IV methylation differences were determined in all the genes except for *Chs1*. *RED, URA, tri5, tri6, Top1,* and *Mgv1* genes were subjected to gene expression analysis in two or four samples. Lower levels of similarity for gene expression values were detected among isolates with contrast epigenetic profiles. Fungal isolates with closely related epigenetic profiles were found to be similar genetical characteristics in RAPD assays at a crucial level. The data obtained in the study suggest that epigenetic typing may be a powerful tool in distinguishing complex phenotypic traits for plant pathogen *Fusarium* species.
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Keywords: *Fusarium culmorum, Fusarium graminearum,* Epigenetics, CRED-RA, PCR.

INTRODUCTION

Fusarium graminearum and *F. culmorum* cause head blight and crown rot diseases of small grain cereals worldwide. The epidemics of *Fusarium* diseases have been increasing due to the changes in climatic conditions and crop rotations (Yli-Mattila et al., 2013; Miedaner et al., 2008). The detailed characterization of *F. graminearum* and *F. culmorum* has become important more than ever since these species have high levels of genetic and phenotypic diversities (Miedaner et al., 2008; Chung et al., 2008). In this content, species specific identification of these species by SCAR markers was carried out successfully (Schilling et al., 1996; Nicholson et al., 1998). However, several isolates from different regions of the world have not been identified at species level by these SCAR markers. Similarly, subspecies or species complex member diagnosis investigations resulted in confusing data (Carter et al., 2000, 2002; Waalwijk et al., 2003; Yörük and Albayrak, 2013; Lee et al., 2015). These findings reveal that novel approaches in detailed characterization for *Fusarium* species are needed in near future.

F. graminearum is a hemi-biotrophic fungus predominating causal agent of head blight worldwide. The haploid genome consists of four chromosomes with total size of 36.1 Mb, 13937 genes and 48.33%GC content (Bai and Shaner, 2004; Cuomo et al., 2007; Trail, 2009). *F. culmorum* is a necrotrophic fungus as major agent of crown rot. The draft genome size was reported as 39 Mb with four chromosomes. However, detailed annotations for *F. culmorum* genome is missing from the literature currently (Saharan et al., 2004; Urban et al., 2016). *F. graminearum* and *F. culmorum* produce trichothecenes, zearalenone and fusarin C. Class B-trichothecenes are main mycotoxins produced by these fungi (Desjardins and Proctor, 2007). 3-acetyldeoxynivalenol (3-

ADON), 15-acetyldeoxynivalenol and nivalenol (NIV) have been accepted as three chemotypes of *Fusarium* species producing class B-trichothecenes. 15-ADON and 3-ADON were the predominating chemotypes for *F. graminearum* and *F. culmorum*, respectively (Pasquali and Migheli, 2014). The core *tri5* gene cluster and additional genes are responsible for NIV, 3-ADON and 15-ADON synthesis. There are missing points related to chemotyping and gene expression analysis related to trichothecene synthesis. The several findings obtained from generic PCR tests have not been consistent with chromatographic analysis (Gilbert et al., 2001; Pasquali and Migheli, 2014). Thus, novel approaches are needed in the obtaining reliable and precise data related to genetic characterization of *Fusarium* isolates.

The investigations related to epigenetics and epigenomic characterization of *F. graminearum* and *F. culmorum* are missing from the literature. Methylation differences-based profiling analysis could be used in detailed characterization of *Fusarium* isolates. The correlation between several important traits which are important in disease management such as host, chemotype, sample collection year, geographic regions could be constructed more efficiently as compared to data obtained from genetics analysis. In this study, it was aimed to reveal the genome wide and gene specific differences in methylation profiles for *Fusarium* isolates from Turkey.

MATERIAL AND METHODS

Fungal materials and *in vitro* Cultivation

22 *F. graminearum* and 37 *F. culmorum* isolates were provided from Samsun Ondokuz Mayıs University culture collection and *F. graminearum* H-11 reference strain from Seoul National University culture collection (Table 1). All isolates were cultured in potato dextrose broth (PDB) and potato dextrose agar (PDA) at room temperature for 7 days. Cultures were used for spore count, linear growth rate (LGR), RNA and genomic DNA isolation. Identification of all isolates was carried out according to Yörük et al (2013).

Table 1. Fungal materials used in this study. Isolates with no asterisk belong to *F. graminearum*, ‘’*’’ shows *F. culmorum* isolates, and ‘’**’’ shows isolate added to study after epigenetics assays.

Isolate	Spore Quantity	LGR	Isolate	Spore Quantity	LGR	Isolate	Spore Quantity	LGR	Isolate	Spore Quantity	LGR
F1*	5.32×10^{6}	9,625	9F*	2.04×10^{6}	11,50	15-5TR*	x	x	3F	4.72×10^{6}	11,63
F2*	$1,5\times10^{7}$	11,38	10F*	5.2×10^{5}	8,750	14-8TR*	3.80×10^{6}	12,25	4F	6.68×10^{6}	12,00
F3*	$7,68\times10^{6}$	10,25	11F*	9.2×10^{5}	6,625	12-1TR*	3.2×10^{5}	11,25	5F	5.2×10^{5}	14,13
F4*	5.12×10^{6}	10,50	12F*	1.2×10^{5}	11,88	09-2TR*	2.4×10^{5}	10,50	6F	5.44×10^{6}	11,75
F10*	5.6×10^{5}	9,375	13F*	3.92×10^{6}	14,63	14-9TR*	x	x	7F	3.92×10^{6}	11,63
F12*	5.28×10^{6}	9,875	17F*	4.8×10^{7}	11,63	10-2TR**	x	x	14F	5.68×10^{6}	12,25
F14*	$8,80\times10^{6}$	9,875	18F*	1.2×10^{5}	10,50	09-1TR*	7.16×10^{6}	8,250	15F	x	x
F15*	8×10^{4}	11,13	19F*	4.84×10^{6}	10,63	15-2TR*	7.92×10^{6}	11,88	14-4TR	x	x
F16*	$5,36\times10^{6}$	10,75	20F*	1.16×10^{6}	10,13	F5	6.68×10^{6}	13,63	14-5TR	5.64×10^{6}	13,13
F17*	$3,40\times10^{6}$	11,38	14-1TR*	1.01×10^{6}	11,38	F6	2.8×10^{5}	14,13	14-6TR	4×10^{4}	13,75
F19*	1.2×10^{7}	13,38	14-2TR *	6.08×10^{6}	12,00	F7	8.08×10^{6}	11,13	14-7TR	8×10^{4}	17,25
F20*	6.4×10^{5}	11,00	15-1TR *	1.68×10^{6}	12,25	F8	1.216×10^{7}	9,750	15-6TR	x	x
F21*	5.20×10^{6}	10,75	14-3TR *	1.92×10^{6}	11,50	F9	7.76×10^{6}	11,00	10-1TR	x	x
F24*	1.64×10^{6}	10,25	15-3TR*	7.00×10^{6}	13,75	1F	1.92×10^{6}	13,00	13-1TR	x	x
8F*	2.16×10^{6}	10,25	15-4TR*	1.5×10^{6}	12,50	2F	4.68×10^{6}	12,63	H-11	$5x10^{6}$	10,38

Analyses of asexual and linear growth ability of fungal cultures

2 mm2 agar pieces from PDA of 7 days old cultures were inoculated to 10 ml PDB and incubated at 25±2ºC, 150 rpm for 7 days. At the end of the incubation period cultures were filtered and spores were counted by using Thoma lam. Linear growth rates were measured by agar dilution technique.

Genomic DNA isolation and CRED-RA analyses

For CRED-RA analyses genomic DNAs were isolated from 7 days old fungal cultures by DNA isolation kit (Bio basic, Canada). 100 mg Mycelium were harvested and pulverized in liquid nitrogen. Following steps of isolation were carried out according to manufacturer’s instructions. The quality of DNAs was controlled with a 1% agarose gel and the quantity of DNAs was measured spectrophotometrically. CRED-RA analyses were carried out with nondigested, *MspI* digested and

HpaII digested genomic DNA of 57 *Fusarium* isolates. Genomic DNA digestion reactions with *MspI* and *HpaII* (Takara, Japan) were performed according to manufacturer's instructions. For RAPD PCR of CRED-RA analysis, 17 RAPD primers were used (Yörük and Albayrak, 2013). Reaction were carried out in 25µl total volume containing 1X PCR buffer, 3 mM/µl $MgCl_2$, 0.5 mM/µl dNTP mixture, 1.6 pmol/µl primer, 0.06 U/µl *Taq* DNA polymerase and 2 ng/µl DNA. The amplification conditions consisted of one initial denaturation step at 94°C for 3 min followed by 4 cycles of 94ºC for 1 min, 35ºC for 1 min and 72°C for 3 min, 40 cycles of 94ºC for 30 sec, 37ºC for 30 sec and 72°C for 2 min. The reactions were completed by a final extension step at 72°C for 5 min. PCR products were resolved in 2% agarose gel electrophoresis at 100 V for 2 hours. The dendrogram and genetic similarity analysis were carried out by UPGMA method and Nei&Li's co-efficient using MVSP 3.1 software.

Analyses of gene specific methylation profiles

Methylation profiles of seven genes (*Top1* "Topoisomerase I", *Mgv1* "Map kinase", *Chs1* "chitin synthase", *tri6* "TRI6 transcription factor", *tri101* "acetyl transferase"/*tri5* "trichothecene synthase", *RED* "reductase" and *URA* "ammonium ligase") that have functions in fundamental biological pathways of *F. graminearum* ve *F. culmorum* were analyzed with amplification of *MspI* and *HpaII* digested genomic DNA using gene specific primers. Sequences of these 7 genes (*Top1*, *Mgv1*, *Chs1*, *tri6*, *tri5*, *URA* and *RED*) were obtained from NCBI data base and variations at *MspI* and *HpaII* restriction sides in fungal isolates were screened and primers were designed by using Primer 3 software (Table 2). PCR was performed in a total volum of 25 µl that contains 1X PCR buffer, 2.5 mM/µl $MgCl_2$, 0.1 mM/µl dNTP mixture, 0.4 pmol/µl primer, 0.04 U/µl Taq DNA polymerase and 2 ng/µl DNA. The reaction was carried out one initial denaturation step at 94°C for 5 min followed by 35 cycles of 94ºC for 1 min, 58ºC for 1 min and 72°C for 2 min. The reaction was completed by a final extension step at 72°C for 10 min. PCR products were run in 1% agarose gel electrophoresis at 80 V for 1 h and compared according to absence or presence of interested bands. Data were statistically evaluated by two-way ANOVA as the rearing system, the line of the birds and their interaction were included in the model. The Fit model procedure of JMP v.7 software package was used to perform the statistical analysis (JMP Version 7, SAS Institute Inc. Cary, NC).

Table 2. Fungal materials used in this study. Isolates with no asterisk belong to *F. graminearum*, ''*'' shows *F. culmorum* isolates, and ''**'' shows isolate added to study after epigenetics assays.

Gene name	Primer name	Primer sequence	Band size (bp)	Gene name	Primer name	Primer sequence	Band size (bp)
*Top1**	spanTopo1F spanTopo1R	ttcagatcccagtccctgac tcactctcgcttgccttctt	1062	*Top1***	ST6 F ST6 R	aaatttatgatattgataatttttttatat cactattaatttatacttaaactcatacc	410
*Chs1**	spanChs1F spanChs1R	tttgaactcgggctacgaac agggggttgaacagcttctt	1230	*Top1***	AT F2 AT R2	attgatattaaaggtagttggttaataa tattaaaacttatattatcattcaaaaaat	504
*tri6**	spantri6F spantri6R	taccaatcgtgtcccctctc cgccaaactcgtcatcattt	874	*RED***	Red2-F Red2-R	tggttgtgtttgaccgaaaa gagtttggcttctggtgctg	780
*URA**	spanUra1F spanUra1R	ccgaccaacttcattccatt Cgctcaatccaatcctgaat	1080	*β-tubulin***	QPCRBTUBF QPCRBTUBR	agggtcattacaccgagggt gtaccaccaccaagagagtgg	121
*RED**	spanREDF spanREDR	tggttgtgtttgaccgaaaa gtcgcactcctccaatcaat	1380	*Mgv1***	mgvrtf mgvrtr	aggttcaacgattccgacag gaccattaccctgaggcaga	100
*Mgv1**	2spanmgvF 2spanmgvR	tgcattgctcctgtttcatc tctcttctcattccaggcatt	1842	*tri5***	Tox5-1 Tox5-2	gctgctcatcactttgctcag ctgatctggtcacgctcatc	658
*tri5**	Tri5FullF Tri5Full2R	atggagaactttcccaccgagtatt ttactccactagctcaattga	1187	*URA***	ura2f ura2r	atgattaatgttatgattagggtggtataa tacaaaaacttaaaaaaaccctcctatt	466

Fungal materials and in vitro cultivation

Two *F. graminearum* (10-2 and 14-7) and two *F. culmorum* (10F and 11F) isolates that show higher similarity in their CRED-RA analysis, were chosen for gene expression analysis. In addition, two isolates (F4 and 7F) that have lower similarity with these 4 isolates, were included also. RNA isolation of these 6

isolates were carried out with Tripure reagent (Roche) from 100 mg mycelium. Fungal materials were pulverized in liquid nitrogen and following steps were performed according to manufacturer's instructions. Quality and quantity of RNAs were controlled and cDNA were synthesed by cDNA synthesis kit (Vivantis, Malaysia). Real-Time PCR analysis were performed in a total volume of 20 µl containing 1XSybr Green mix, cDNA (equal to 1 µg RNA), 5 pmol reverse and 5 pmol forward primers (see Table 2). The reaction was carried out one initial denaturation step at 95°C for 2 min followed by 45 cycles of 95ºC for 10 sec, 58ºC for 15 sec and 72°C for 20 sec. 4-log dilution series were used to construct standard graphics and $2^{-\Delta\Delta CT}$ formula was used to evaluate the gene expression patterns (Livak and Schmittgen, 2001).

Two fungal isolates, *F. graminearum* 14-7TR and *F. culmorum* 10F, were used as positive calibrators to determine proportional changes in gene expressions. Significance ($p<0.05$) of Real-Time PCR results were analyzed by GraphPad Prism 5.0 software (Dr. Harvey Motulsky, A.B.D.). One-way ANOVA and Tukey multiple variance analysis were performed for statistical verification of results. Mean ± standard deviation (Mean±SD) values were used in colon graphic for evaluation of significant differences. Confidence interval is 0.05 (95%).

RESULTS

Results of sexual and asexual reproduction analyses

59 *Fusarium* isolates were subcultured in PDA and 51 of the isolates were able to be grown effectively (Figure 1, Table 1). *F. graminearum* H-11 reference strain was also used as positive control for sexual and asexual reproduction analyses. The lowest spor production amount (4x104) was detected in *F. graminearum* 14-6TR isolate while the highest (4.8x107) in *F. culmorum* 17F (Table 1). The average linear growth value of effectively reproducing isolates was determined as 11.497 mm/day and reference strain H-11, as 10.38 mm/day. *F. culmorum* 11 F isolate showed minimum linear growth rate (6.625 mm/day) while *F. graminearum* 14-7TR isolate maximum (17.25 mm/day). 10-2TR isolate which was not efficiently grown on PDA was integrated to further studies after epigenetics analysis.

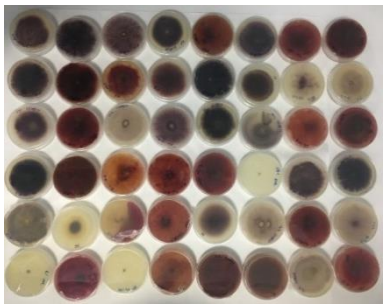

Figure 1. *In vitro reproduction profiles of seven days old fungal cultures.*

RAPD and CRED-RA analyses

Different band patterns in all isolates were obtained with 10 of 17 primers in RAPD and CRED-RA analyses. However, 7 primers were not able to give positive results. In *F. graminearum* isolates, the highest band numbers (23 bands) were obtained from the reaction of OPA04 with nondigested DNA while lowest (6 bands) by OPA08 with *HpaII*-digested DNA. Similarly, maximum (23 bands) and minimum (8 bands) band numbers were observed in *F. culmorum* isolates from the reaction of OPA01 with nondigested DNA and from the reaction of OPA08 with *MspI*-digested DNA respectively. Total band numbers in *F. graminearum* from the reaction of nondigested, *HpaII*-digested and *MspI*-digested were determined as 172, 131 ve 154 respectively. In *F. culmorum* total band numbers were 166, 131 and 149 in nondigested, *HpaII*-digested and *MspI*-digested reactions respectively.

Average similarity was found as 42.7% in RAPD analyses of *F. graminearum* isolates. In addition, *HpaII*-digested and *MspI*-digested RAPD reactions were resulted 48.4% and 49.2% average similarity in *F. graminearum* isolates. In *F. culmorum* isolates, average similarity of RAPD performed with nondigested, *HpaII*-digested and *MspI*-digested DNA were found as 49.65%, 58.15% and 57.5% respectively. UPGMA based dendograms, based on the similarity matrices, showed 2 major subbranches in nondigested, *HpaII*-digested and *MspI*-digested group profiles of both species (Figure 2). 10-2 and 14-7 were determined as closest isolates in *F. graminearum* while 10F and 11F in *F. culmorum*. When these 4 isolates were taken as reference, 3F and 7F isolates of *F. graminearum* showed the lowest similarity. Among the *F. culmorum* isolates, 09-1 and F4 showed the lowest similarity.

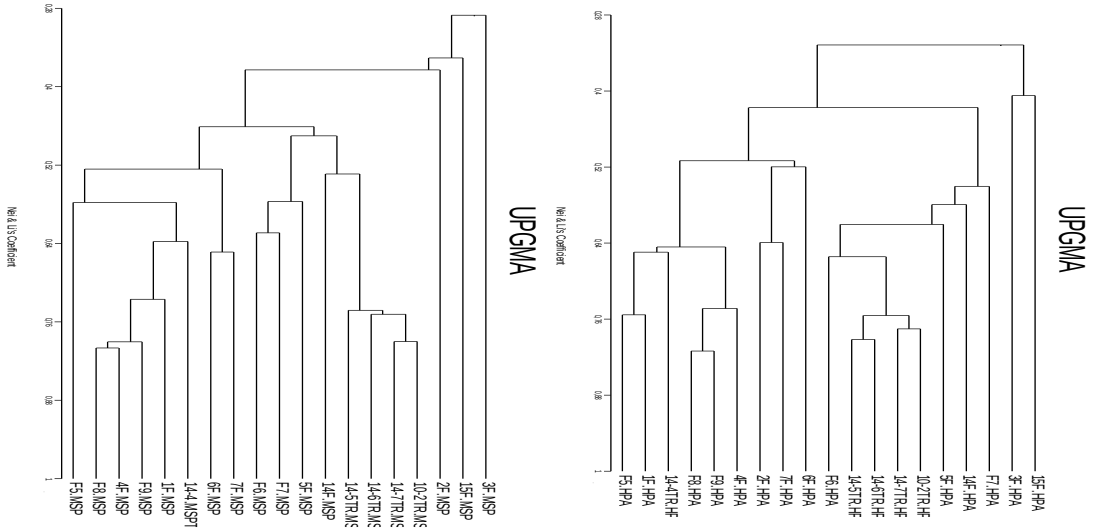

Figure 2. Dendograms obtained from gDNAs of *F. graminearum* isolates. *HpaII*-digested (right) and *MspI*-digested (left).

Gene specific methylation profiling analyses

Methylation analyses were carried out for 7 genes (*Top1, Mgv1, Chs1, tri6, tri5, URA* and *RED*) by PCR of nondigested, *HpaII*-digested and *MspI*-digested genomic DNA with gene specific primers.

Expected lengths fragments of all seven genes were successfully amplified from nondigested gDNAs with gene specific primers (Table 3). However, PCR of digested DNAs either with *HpaII* or *MspI* resulted in different patterns with respect to isolates and genes. Two isolates of *F. culmorum*, 10F and 11F, showed same amplification profiles with *HpaII*-digested PCR. Similarly, *F. graminearum* isolates, 10-2TR and 14-7TR, had same profiles in *HpaII*-digested PCR. In spite of similar results of *HpaII* profiles, PCR of *MspI*-digested gDNA showed dissimilarities between isolates of same species (Table 3). All results of gene specific methylation essay proved that except *Chs1*, other six genes have Type I-Type IV epigenetic profiling differences.

Table 3. Gene specific methylation analyses by PCR of nondigested (N), *HpaII*-digested (H) and *MspI*-digested (M) gDNA. Presence (+) and absence (-) of PCR products.

	RED			***Mgv1***			***Tri6***			***Chs1***			***Top1***			***URA***			***tri5***		
	N	**H**	**M**	**N**	**H**	**M**	**N**	**H**	**M**	**N**	**H**	**M**	**N**	**H**	**M**	**N**	**H**	**M**	**N**	**H**	**M**
10F	+	+	+	+	-	+	+	+	+	+	-	-	+	-	+	+	-	+	+	+	+
11F	+	+	+	+	-	-	+	+	+	+	-	-	+	-	-	+	-	-	+	+	+
10-2TR	+	-	+	+	-	-	+	-	+	+	-	-	+	-	-	+	-	+	+	-	+
14-7TR	+	-	+	+	-	-	+	-	+	+	-	-	+	-	-	+	-	-	+	-	-

Gene expression analyses

Proportional changes in gene expressions of *F. graminearum* 14-7TR and *F. culmorum* 10F isolates were evaluated as "1". Cycle numbers of Cp for endogenous gene were determined between 19.15 and 23.0. Higher and lower Cp values of *Mgv1, RED, tri5* and *URA* genes were determined as 18.97-24.62, 28.58-35.42, 24.26-32.21 and 23.86-34.32 respectively. Average proportional change values of *RED* expression in 10-2TR was found as 0.017 while 5.59 in 11F. 10-2TR and F4 isolates had minimum (0.02) and maximum (18.57) average proportional change values of *URA* expression. The lowest (0.04) and highest (0.3) values of *Mgv1* were determined in 7F and 11F isolates respectively. 10-2TR and 11F isolates had minimum (0.005) and maximum (0.67) average proportional change values of *tri5* expression. In *F. culmorum Top1* gene and in *F. graminearum tri6* gene showed undetermined Cp value.

One-way ANOVA analyses proved that isolates of both species have significant differences in *Mgv1* expression when compared with positive calibrators ($p<0.001$). Statistical analysis of *tri5* gene expression showed that 11F isolate do not has any significant differences while F4 ($p<0.01$), 10-2TR ($p<0.001$) and 7F ($p<0.001$) have. Real-Time PCR analysis of *RED* gene revealed that *F. graminearum* have significant differences ($p<0.01$) while *F. culmorum* do not have. *URA* gene did not show any significant differences in the isolates ($p>0.05$). Consistent with the epigenetics analyses results of 10F and 11F isolates that showed similar pattern in all genes except *RED*, expression profiling was also similar (Figure 3). Similarly, *F. graminearum* isolates, 10-2TR and 14-7TR that showed high similarity in their epigenetics analyses, all genes except *RED*, expression profiling was also similar when compared with 7F isolate (Figure 3).

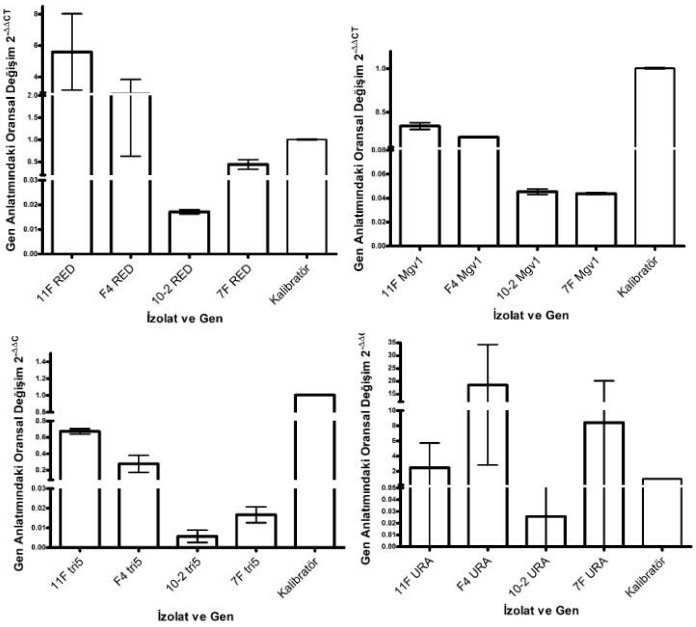

Figure 3. $2^{-\Delta\Delta CT}$ values of 10F ve 14-7TR isolates as positive calibrators

DISCUSSION

Genotyping analysis is important step in the struggling with *F. graminearum* and *F. culmorum*. Moderate and/or high level of morphological and genetic diversity have been reported for worldwide collections (Miedaner et al., 2008; Pasquali and Migheli, 2014). The common fungicides have been frequently used in disease management. This strategy provides short term solution to overcoming the diseases. The sexual recombination and high level of diversity could be possible explanations/reasons for fungicide resistance in homothallic *F. graminearum*. But detailed knowledge is needed for the reason of fungicide resistance in monophyletic species *F. culmorum* (Miedaner et al., 2008). The evaluation of genomics and epigenomics diversity in these two species was aimed in this study. The precise correlation was detected between LGR capacity, sample collection years (the years 2006-2014) and hosts characteristics was detected by CRED-RA analysis. In terms of LGR, collection year and host characteristics, isolates with similar epigenetic or epigenomic profiles were co-clustered in dendrograms. 10-2TR and 14-7TR *F. graminearum* isolates yielded highly similar *Hap*II and *Msp*I digestion profiles. This similarity was found at the gene-specific analysis. These two isolates had low level of LGR and spore values whereas 3F and 7F isolates had higher LGR and

spore values. The isolates were co-clustered in *Hap*II and *Msp*I digestion analysis in terms of the collection year. Similar precise correlation was detected among *F. culmorum* isolates (10F/11F and F4/09-1TR) in terms of collection year, LGR and spore values. It could be assumed that Type I-IV methylation patterns could be linked to phenotypic characteristics of isolates.

Type I-IV epigenetics variation were found at gene-specific methylation analysis. While Type I and Type IV methylation differences were detected for *RED* and *tri6* genes, four methylation pattern differences were found for remaining genes but *chs1*. Alterations for expression levels of *Mgv1, RED, tri5* and *URA* genes in real time PCR analysis. The correlation as in CRED-RA assays were detected between selected isolates in gene expression analysis but *RED* gene. No significant difference was found at *URA* expression according to positive calibrator. In terms of gene expression and gene specific methylation analysis, *URA* gene does not provide correlation for Type I-IV patterns among selected isolates. *RED* gene provides positive correlation between selected isolates in for gene expression analysis not for gene specific assays. However, positive correlation between selected isolates of two species were detected via gene expression and gene specific methylation analysis for *Mgv1* and *tri5* genes. The findings showed that PCR and RT-PCR based methylation analysis could provide powerful tool for discrimination and comparison of fungal isolates with distinct characteristics.

CONCLUSIONS

In this study, epigenetic differences patterns in *F. graminearum* and *F. culmorum* isolates were investigated at the gene and genome levels. Especially as a result of the data obtained, the year and aggressiveness criteria are thought to be in close relationship with epigenome analysis. In the meantime, this study reveals that *Mgv1, tri5* and *URA* genes may be useful in detecting differences in epigenetic levels in species belonging to the genus *Fusarium* and even establishing correlations between direct aggressiveness and collection years. To make an assessment in terms of host and geographic region, it may be preferable to work with more samples in epigenome analysis and study with other genes. Generally, this study showed that epigenetic/epigenomic screening studies could be adaptable to *Fusarium* isolates as well as other biotrophic, necrotrophic and hemi-biotrophic fungi.

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MODELLING THE SEASONAL PRODUCTIVITY OF NATURALISED PASTURE IN THE SOUTH OF CHILE

P. Flores[1*] · I. López[2-4] · P. Kemp[2] · J. Dörner[3-4]
[1] Departamento de Ciencias Naturales y Tecnología, Universidad de Aysén, Obispo Vielmo 62, Coyhaique, Chile.
[2]Institute of Agriculture and Environment, Massey University, Palmerston North, New Zealand.
[3] Institute of Soil Science, Faculty of Agricultural Science, Universidad Austral de Chile, casilla 567, Valdivia, Chile.
[4]Research Center on Volcanic Soils, Universidad Austral de Chile, casilla 567, Valdivia, Chile.

*Corresponding author: Paulina G. Flores paulina.flores@uaysen.cl

Abstract

In the last few decades, considerable research has been conducted on pastures in the south of Chile; most of it related with pasture production. There is a large amount of data providing a very useful resource to develop models for pasture production. The aim was to evaluate decision tree models for predicting seasonal pasture production and the effects of environmental factors and management inputs on pasture production. Decision tree models for seasonal pasture production were developed on naturalized pastures. Environmental data collected included pasture management variables as well as soil chemical analysis attributes, soil physical properties and climatic variables (rainfall [annual, spring, summer, autumn and winter]). A traditional regression modelling approach was also used to provide a comparison for the performance of the decision tree model. The highest Spring productivity (4746 kg/ha) was found with a rainfall equal or more than 91.3 mm. The highest Summer productivity (2712 kg/ha) was found with soil pH more than 5.6. The highest Autumn productivity (3172 kg/ha) was with a rainfall equal or more than 131.4 mm, and the highest Winter productivity (3012 kg/ha) was under low soil aluminum saturation. The decision tree model showed a high correlation between the predicted and the observed value. The successful integration of the most important variables influencing pasture production with the decision tree models provided a new approach to understand the effects of environmental factors and management inputs on pasture production in humid temperate regions, such as the south of Chile.

Keywords: decision tree, modelling, predicted value, pasture productivity, temperate climate

INTRODUCTİON

Accumulated herbage mass in temperate regions, have been research subject of great relevancy for pastoral grazing systems (Balocchi and López 2009; López et al., 2009; Keim et al., 2014). The seasonal accumulated herbage mass can be modified by agronomical decisions and management, as well as, by environmental factors (Flores et al., 2017). All these contribute to the sustainability of grazing systems. Therefore, variables such as climate (temperature, rainfall and radiation), soil (slope and texture, nutrients and porosity) and the grazing animals determine seasonal pasture growth.

In the south of Chile, 91% of pastures are naturalized, with grass species such as *Bromus valdivianus* Phil., *Holcus lanatus* L. and *Dactylis glomerata* L. spontaneously growing, while 9% of the pastures are cultivated with species such as *Lolium perenne* L. and *Trifolium repens* L. (Teuber, 2009). A large percentage of the naturalized pastures (48%) have a degree of degradation and are colonized by species such as *Agrostis capillaris* L., *Anthoxanthum odoratum* L., *Leontodon nudicaulis* (L). Porter and *Hypochaeris radicata* L., with negative productive, environmental and social consequences. The application of fertilizer, the sowing of seeds and grazing management have been applied to restore degraded pastures. As a result of these inputs, significant changes have occurred in the accumulated herbage mass towards a more productive plant community with better forage value.

The challenge is to determine how all environmental factors, such as climate and management factors (e.g. soil temperature, rainfall, fertilizer application strategies) influence pasture productivity in the pasture ecosystem. One approach to determine the relative effect of environmental factors on pastures species is by using meta-analysis with a complex data set that contains potential environmental factors and measurements of the abundance of species (Erickson and Nosanchuk, 1992). Decision tree is a data mining method that can be applied in environmental modelling for sustainable ecological management of pasture (Corson et al., 2007; Duff et al., 2012; Zhang et al., 2005; Wan et al., 2009). A Decision tree model has been used to predict species abundance (Zhang et al., 2005), pasture production (Zhang et al., 2006), vegetation classification (Yang et al., 2003) and nitrogen utilization efficiency in pastures (Zhang and Tillman, 2007) showing its ability to predict the relative importance of factors involved in pasture management.

In this study, a decision tree modelling approach was used to model the seasonal pasture productivity in the south of Chile. A traditional regression modelling approach was also used to provide a comparison for the performance of the decision tree model. The aim of the study was to identify environmental variables that strongly affect the seasonal pasture productivity.

2. MATERIAL AND METHODS

2.1 Study area

The pasture data were collected at the Santa Rosa Research Station of Universidad Austral de Chile (39º 47’ 26” S, 73º 14’ 12” W) 9 km east of Valdivia city, Chile, at 25 m a.s.l., with 2350 mm of average annual rainfall. The soils are classified as Duric Hapludand (IREN et al., 1978). On April 2010, three methods of pasture improvement were established on a degraded naturalized pasture. The study was finished in April 2013. There were four treatments: a) Naturalized fertilized and limed pasture (FP) composed by *Agrostis capillaris* L., *Leontodon nudicaulis* L. Banks ex Lowe, *Lolium perenne* L. and *Trifolium repens* L.; b) *L. perenne* and *Trifolium repens* L. sown mixture pasture; c) Sown diverse pasture comprised of *L. perenne*, *T. repens*, *Holcus lanatus* L., *Dactylis glomerata* L. and *Bromus valdivianus* Phil.; and d) Naturalized pasture without lime or fertilizer addition (NFP). Each pasture occupied 400 m2 plots, distributed according to a complete randomized block design with three blocks.

All the sown pastures received the same annual amount of fertilizer and lime as the NFP: 180 kg N ha^{-1} $year^{-1}$, 120 kg P2O5 ha^{-1} $year^{-1}$, 120 kg K2O ha^{-1} $year^{-1}$ and 2 t ha^{-1} $year^{-1}$ of lime. Each plot was grazed by 25 two years old sheep, Austral breed, live weight 55 ± 2.4 kg (average ± SEM) and body condition 2.7± 0.27 (average ± SEM). Pregrazing herbage mass target was about 2.100 to 2.300 kg DM ha^{-1}. Postgrazing residual herbage mass target was about 1.000 to 1.200 kg DM ha^{-1} (Matthews et al., 2004). The maximum length of defoliation interval was 60 days.

2.2 Dataset

Environmental data included soil pH in both water and $CaCl_2$, soil organic matter, mineral nitrogen, Olsen-P, aluminum saturation, soil penetration resistance and climatic variables (annual and seasonal rainfall). Sensors placed at 10 cm of soil depth registered annual and seasonal mean daily available soil water and mean daily soil temperature. Pasture productivity was assessed using the rising plate method (Earle and McGowan, 1979) with a calibrated equation: y=174,76x + 232,04 (R^2 0.8). The trim technique (Radcliffe et al., 1968) was used with a 0.1 m^2 quadrat and cutting the pasture to a soil level.

Soil fertility level was determined in each plot. Soil samples were taken from the plots for chemical analysis (0-20 cm depth), such that five soil subsamples comprised one plot sample. Soil samples were air dried and analyzed for pH, organic matter, soil mineral nitrogen, Olsen P, aluminum saturation following Sadzawka et al., (2006) method. Soil mineral nitrogen was measured as N–NO_3 and N–NH_4 using KCL as extract and Kjeldahl digestion method (Bremner et al., 1996). Olsen P was determined by extraction with sodium bicarbonate (Olsen, 1954). Soil resistance in the field was evaluated with a penetrometer (06.01 Hand Penetrometer, Eijkelkamp, Agrisearch Equipment, Giesbeek, The Netherlands). Thus, penetrometer measurements of the first 10 cm of soil depth were taken in each plot and the soil mechanical strength determined for each case. Soil water content and temperature were measured (3 repetitions per plot) with a TDRs (SM200 soil moisture sensors, Delta T Devices, Burwell Cambridge, United Kingdom and Pt100 soil temperature sensors, ZIEHL Industrie Elektronik GmbH + Co KG, Stuttgart, Germany). The soil water and temperature sensors were installed in December 2010 at 10 cm depth in each treatment. The TDR sensors were calibrated following the technique in the SM200 User Manual 1.1 (Delta-T Devices Ltda., 2006). Weather variables, such as rainfall, were measured at a meteorological station located in the study area (Table 1). There was a total of 26 variables, which included 21 input variables (independent variables) and 4 target variables (dependent variables; Table 1).

Table 1. Input variables used in the decision tree and regression analyses

Variable symbol	Unit	Range	Variable description
Input variables			
pH	–log 10 [H+]	5.5-6.1	Soil pH
OM	%	13.3-16.6	Soil organic matter
N_mineral	(mg kg^{-1})	28-60.4	Soil mineral nitrogen
Olsen_P	(mg kg^{-1})	8.5-12.7	Soil Olsen P
Al_sat	%	0.4-14.3	Soil aluminum saturation
Pntr	kpa	1190-3081	Soil penetration resistance
Vol_y	%	4-98.8	Annual mean daily soil water content
Vol_sp	%	12.5-44.9	Spring mean daily soil water content
Vol_su	%	2-41.1	Summer mean daily soil water content
Vol_au	%	3.3-68.8	Autumn mean daily soil water content
Vol_wi	%	11.4-89.5	Winter mean daily soil water content
T_y	°C	8.1-18.3	Annual mean daily soil temperature
T_sp	°C	8.6-21.1	Spring mean daily soil temperature
T_su	°C	11.6-22.1	Summer mean daily soil temperature
T_au	°C	8.1-18.6	Autumn mean daily soil temperature
T_win	°C	4.3-12.4	Winter mean daily soil temperature
Rain_y	mm	103.5-149.9	Annual rainfall
Rain_sp	mm	30.7-151.4	Spring rainfall
Rain_au	mm	114.3-164.5	Autumn rainfall
Rain_wi	mm	254.3-312.1	Winter rainfall
Rain_warm	mm	82.7-200.8	Spring and Summer rainfall
Targets variables			
Spring productivity	kg DM ha^{-1} $season^{-1}$	853-8846	Spring aboveground dry matter per hectare
Summer productivity	kg DM ha^{-1} $season^{-1}$	563-3245	Summer aboveground dry matter per hectare
Autumn productivity	kg DM ha^{-1} $season^{-1}$	661-6890	Autumn aboveground dry matter per hectare
Winter productivity	kg DM ha^{-1} $season^{-1}$	872-4948	Winter aboveground dry matter per hectare

3. RESULTS

3.1 Decision trees models

Soil mineral N, Spring rainfall, pH, soil penetration resistance and Spring mean daily soil temperature were the most significant variables influencing Spring pasture productivity. The greatest Spring productivity was 4746 kg DM $ha^{-1}season^{-1}$ found in pastures with Spring rainfall greater than 91.3 mm. The lowest Spring productivity (1161 kg DM $ha^{-1}season^{-1}$) was observed when soil mineral N was less than 31.7 mg kg^{-1}, with a low pH (<5.6) and soil penetration resistance more than 1648 kpa (Figure 1a).

Pasture Summer production was strongly determined by pH, soil mineral N and Olsen P, Summer mean daily soil and temperature, Spring and Summer rainfall and Summer mean daily soil water content. The greatest pasture Summer production (2712 kg DM ha-1season-1) was observed when the soil had a pH greater than 5.6 and levels of soil mineral N larger than 50.8. The lowest Summer production (1257 kg DM ha-1season-1) was associated to soil pH lower than 5.6, with low Summer mean daily soil temperature minor than 19.7°C and soil Olsen P less than 12.3 mg kg-1 (Figure 1b).

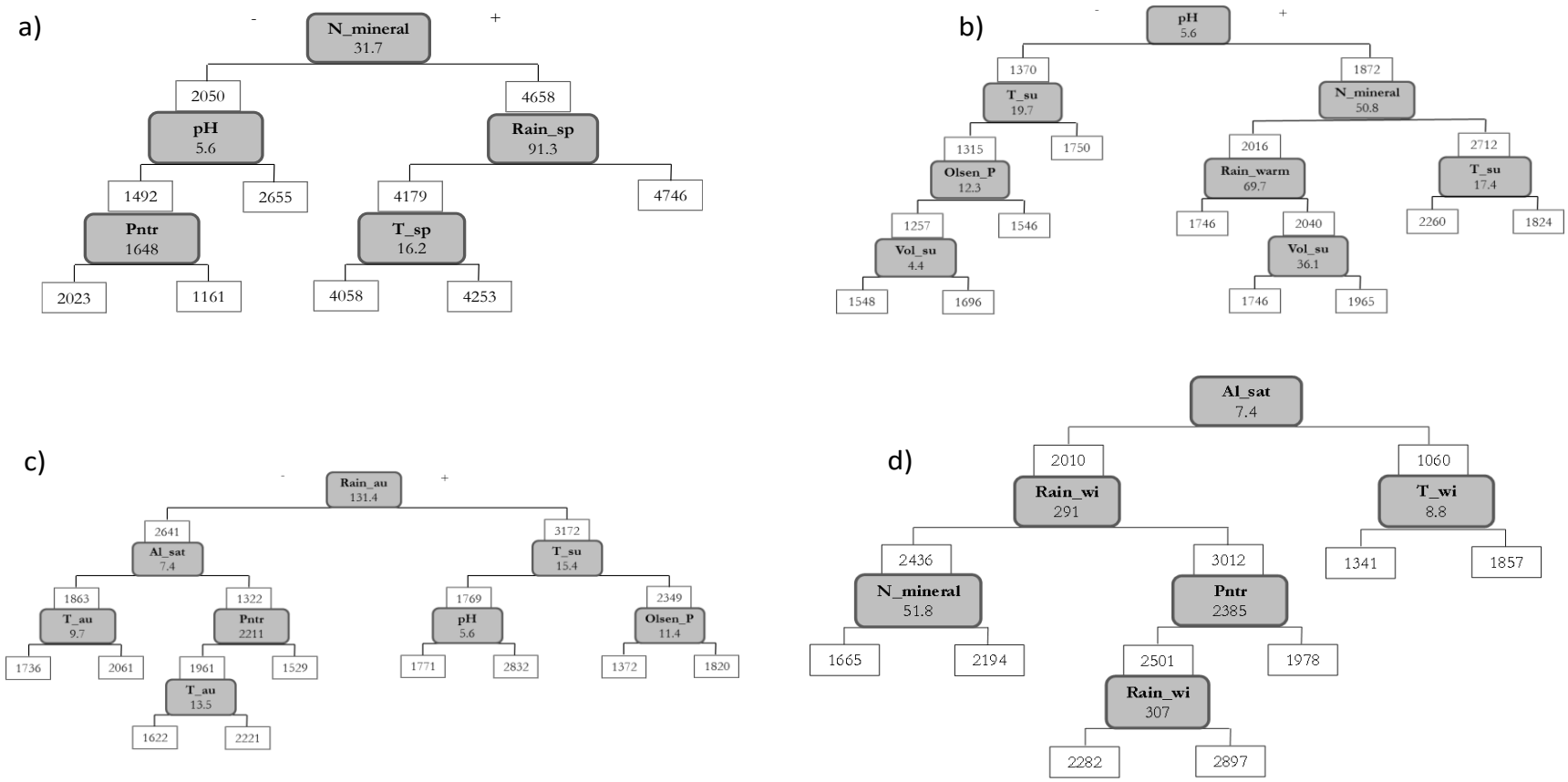

Fig. 1 The decision tree models for seasonal productivity (kg DM $ha^{-1}season^{-1}$). Shaded rectangles contain an input variable and split point. Predicted productivity (kg DM $ha^{-1}y^{-1}$) is in unshaded rectangles. Prediction goes to the left-side branch (-) if the splitting variable is less than the split-point, and goes to the right-side branch (+) if the splitting variable is equal to, or more than split point; a) Spring; b) Autumn; c) Winter; d) Summer. See Table 1 for variable symbols and unit descriptions. See the caption of Fig.1 for the description of decision tree model interpretation.

Pasture production during Autumn was strongly determined by the rainfall levels, Summer mean daily soil temperature, soil aluminium saturation, pH and Olsen P, Autumn mean daily soil temperature and soil penetration resistance (Figure 1c). The lowest Autumn pasture production (1322 kg DM $ha^{-1}season^{-1}$) was observed with low Autumn rainfall (<131.4 mm) and high soil aluminium saturation (>7.4 mg kg^{-1}). When the Autumn rainfall was greater than 131.4 mm, the predicted Autumn pasture production was 3172 kg DM $ha^{-1}season^{-1}$, which constituted the greatest pasture production observed for this season. Variables determining pasture winter production were soil aluminium saturation, Winter rainfall, Winter mean daily soil temperature, soil mineral N and soil penetration resistance. The highest Winter productivity (3012 kg DM $ha^{-1}season^{-1}$) was measured in pasture growing in low soil aluminium saturation and high Winter rainfall. The lowest pasture production was associated to high soil aluminium saturation (>7.4 mg kg^{-1}) and Winter mean daily soil temperature less than 8.8 °C (Figure 1d).

4. DISCUSSION

The decision tree models obtained were able to predict in a good manner pasture production. The models had a high correlation between the predicted values and the observed values indicating a high predictive accuracy, which was better than the regression models (Table 1, Figure 2). Similarly, to Zhang et al., (2006), the decision tree models were predictive of the effect of environmental variables on seasonal pasture production revealing the relative importance of environmental and management variables and their interaction.

The models showed that N, pH and aluminium saturation importantly determine seasonal pastures production. These three variables are related to pasture management. Nitrogen stimulates plant establishment and growth as has been positively correlated to pasture herbage mass production (Malhi et al., 2011) especially of fast-growing species such as *Lolium perenne* (Tharmaraj et al., 2008).

Nitrogen is a key mineral nutrient in pasture systems. In temperate grasslands, perennial legumes are very important for the biological N fixation (Nyfeler et al., 2011) that would otherwise need to be added with N fertiliser.

Rainfall has been recognised as a key factor stimulating pasture production (Zhang et al., 2006), which was an important factor for Autumn pasture growth. In Autumn when rainfall was equal or more than 131 mm could be possible achieve 3172 kg DM ha^{-1}. In Autumn the range of mean daily soil temperature (8.1-18.6°C) and soil moisture (3.3-68.8%) allows achieve a range of pasture growth rate between 661-6890 kg DM ha^{-1}, because tiller regrowth is recovery after a Summer drought period (Tomlinson and O'Connor, 2004). The N fertiliser application can accelerate the tillering process in these times of the year (Pakiding, 2012). It has been reported for mixed pasture (grass/legume) that *L. perenne* produced 5613 tillers m^{-2} in Autumn compared with 4816 tillers m^{-2} in Summer (Yu et al., 2008), and a natural fertilised pastures registered 9372 tillers m^{-2} in Autumn compared with 8654 tillers m^{-2} in Summer for *L.perenne*. The combined effects of temperature and soil moisture in Autumn have strong influence on pasture production and may reflect a change on pasture species composition.

In Winter, when mean daily soil temperature decreases the growth rate of the pasture there is a slowdown (Hennessy et al., 2008). During this season, leaf tissue turns over, leaf appearance rate and leaf senescence also slows down (Hennessy et al., 2006). From the point of view of soil aluminium saturation around 7.4% is considered high, constituting a permanent constraint to plant

growth during the whole year around (Matu´sˇ et al., 2006). Winter production is restricted by low soil temperatures, which decrease soil microbial activity and plant metabolic activity. The higher pasture yield was reached in spring with a possitive effect giving by N fertiliser (40 kg N ha^{-1} $season^{-1}$), soil temperature and rain. The relationship between N, soil temperature and rain showed an important robustness in pasture production modelling on temperate climate. The pastures in southern Chile have seasonal period of growth when N deficiency limit pasture growth.

After Winter N deficiency results from N leached from the wet soil. The strategic N application on Spring may stimulate the fast establishment of new species. In Summer to achieve a pasture production prediction of 2712 kg DM ha^{-1} is necessary a soil pH equal or more than 5.6 and N soil mineral equal or more than 50.8 mg kg^{-1} when there is drought conditions and high temperatures. The fertiliser applied in Spring would predict Summer production in terms of dry matter.

The models selected the soil penetration resistance as a predictor variable of low pasture productivity on Spring, Autumn and Winter (predictive values of 1648, 2211 and 2385 kpa, respectively). Studies showed that soil resistance decrease as a function of soil water content increase in a time scale (Lapen et al., 2004; Dec et al., 2011) and has been positively correlated with pasture yield (Dörner et al., 2013). However, sometimes, changes in the Pntr there are not related with soil water content in grazing pastures due to animal hooves compact, deform, kneaded and homogenize to soil (Peth and Horn 2006; Dec et al., 2011; Krümmelbein et al., 2009; Dörner et al., 2013). Dec et al., (2011) concluded that grazing animal generate irregular soil compaction causing high spatial variability of penetration resistance not related to changes in water content. The interacting effects of environment and pasture management on seasonal production are of interest to producers and researches. The reasonable agreement between pasture management variables, soil properties, climatic variables and decision tree models contribute to sustainable pasture development.

Conclusions

The decision tree models developed in this study revealed the importance of the environmental variables influencing seasonal productivity in humid temperate pasture in the south of Chile. Soil mineral nitrogen, pH and aluminum saturation were the most important variable influencing seasonal growth, except by rain, which was the most important in Autumn. The decision tree model had better performance than regression models for predicting pasture productivity with respect to model fit because had a high correlation between the predicted and observed value.

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USE OF BIOCHAR IN AGRICULTURE

Raziye KUL

Ataturk University, Faculty of Agriculture, Department of Horticulture, Erzurum

Abstract

Biochar, which has very promising potential for sustainable agriculture and ecology has attracted the attention of researchers, entrepreneurs, and other stakeholders, recently. Biochar is a solid biological material that synthesized through pyrolysis of different biomass sources. It can be derived from different potential sources of biomass such as agricultural waste, bioenergy crops, forest residues, kitchen waste, sewage sludge, and animal refuse. In this review, remarkable findings of studies conducted on investigating the biochar application on improving crop productivity, soil fertility, and mitigating abiotic stress have been examined. The effect of biochar on soil fertility, plant growth, and alleviating stress interactively determined by the properties of the applied biochar and the soil, the application dose, and the requirements of the applied product. However, numerous studies have been published reporting that biochar has on potential direct or indirect benefits in agriculture. In studies reviewed has been put forward that biochar using improves the physical, chemical, and biological characteristics of the soil. Also, biochar has been proven that increase the yield and quality of cultivated plants to have high potential in agricultural use.

Keywords: Biochar, Crop productivity, Soil fertility, Alleviating abiotic stress, Sustainable agriculture

INTRODUCTION

According to the scenario emerging in the researches, with the world's population expected to reach 9,7 billion people by 2050, the food demand of the booming population estimated to would present a growing challenge in the next ten years (UN DESA, 2019). This situation causes a lot of pressure on the agricultural sector for sustaining life on Earth (Czekała et al., 2019). The conventional agricultural practices that centered to maximize production to meet this demand are based on the have intensely used of synthetic fertilizers, pesticides, energy, hybrid seeds, water, and agricultural machinery. These practices result in direct and indirect environmental impacts such as loss of soil fertility, soil erosion, greenhouse gas emissions, the degradation of freshwater ecosystems, and loss of biodiversity (Gowdy and Baveye 2019).

Sustainable agriculture which aims to minimize the environmental damage of intensive land use in conventional agriculture also attempts to find conservation agricultural practices that may mitigate adverse impacts (Saha and Bauddh, 2020). A lot of sustainable practices like the application of compost, vermicompost, biofertilizer, and biochar, etc., have been investigated as fertilizer and soil conditioner and found substantially effective. Biochar is produced by processes, involving thermal conversion of biomass, such as pyrolysis, combustion, torrefaction, flash carbonization, gasification, and hydrothermal carbonization, (Kumar and Bhattacharya, 2020). The most preferred method of biochar production is pyrolysis because of the efficiency and simplicity of the process (Cha et al., 2016). Terra Preta soils, which are very fertile and with a high content of organic carbon, have inspired the artificial production of biochar and its use in agricultural lands. Terra preta known as "Amazonian dark earth" or "Indian black earth" and produced artificially by mixing charcoal with manure, compost, faeces, bones, and plant residues at low-temperature is owed its characteristic black color to its weathered biochar content. Researchers have

emphasized that discovery of the nutritional significance of Terra preta developed the interest in the application of worldwide as soil amendment of biochar (Novotny et al., 2015).

Biochar production carries out using a wide range of feedstock (biomasses) such as agricultural waste, bioenergy crops, forest residues, kitchen waste, sewage sludge, and animal refuse (Mazac 2016). The resulting biochar during the conversion is largely retained the mineral content of the feedstock. Therefore, the mineral ash content of different feedstock and has been reported that can be a relationship between that and productivity of biochar added to the soil (Oni et al., 2019). The resulting biochar has a conversion to predominantly stable, recalcitrant organic carbon (C) compound, when the feedstock is heated to temperatures usually between 300 and 1000 °C, under low (preferably zero) oxygen concentrations (Xie et al., 2015). Biochars are characterized by a total organic carbon (30–70%) at high concentration depending on the pyrolysis conditions and feedstock type. It is also reported to have features such as high pH, and high electrical conductivity, high mineral contents and very porous (Qayyum et al., 2015). Biochar added to the soil has many aspects, from increasing soil fertility to increasing yield, carbon retention, improving soil texture, pollution control, enhancing nutrient absorption, and hosting useful microbial communities (Gunarathne et al., 2017). In many studies, it has been stated that biochar applied to the soil contributes to the increase of crop and soil fertility (Zhang et al., 2020). At present, however, very little biochar is used in agriculture because its agronomic value in terms of crop response and soil health benefits has not yet been measured, and the mechanisms that increase soil fertility are not fully understood (Elad et al., 2011). But it has been supported by many studies that biochar can to be prove a key and accessible input for sustainable agriculture by improving soil fertility, crop productivity, and mitigate global warming (Semida et al., 2019). However regional conditions such as climate, soil chemistry, and soil condition are known that influence the agronomic benefits of biochar. In addition to these, the effects of biochar application on soil fertility, plant growth, and crop yield varies according to crop varieties, biochar application rates, biochar physical and chemical properties, chemical fertilizers use case (Günal and Erdem 2018). This situation offers a wide range of research opportunities to evaluate the responses of different plants to different biochar. Therefore, long-term data in relation to specific plants and specific soil parameters is crucial to promote biochar use in plant productivity.

1. Effects of Biochar Application on Soil Properties and Plants Growth

Intensive farming practices have reduced the quality and fertility of the soil, and eliminated the self-cleaning feature, removing the soil from sustainability. The biochar application is a sustainable approach to combating this problem. Studies have shown that biochar improves the chemical, biological, and physical properties of the soil, and additionally, it has been found to directly provide nutrients to the soil (Buss et al., 2016). Biochar is found more effective than other organic matter like compost and manure as it has a greater capacity of retaining nutrients for the plants. Various studies have shown that biochar increasing crop yield and improving soil quality (Laird et al. 2009). Characteristics of biochar materials will vary depending on the biochar feedstock and pyrolysis conditions (McBeath et al., 2015). Biochar's positive impact on plant growth can be explained by expanded the surface area of soil, healing of soil physical, chemical, and biological properties, providing nutrients to plants, and thus the increase in the absorption of nutrients by the plant (Nigussie et al., 2012). Biochar has a large surface area due to its very porosity. This porous surface creates a great home for many beneficial microbes (Kolton et al., 2011). Besides, the porous surface of biochar increases the water holding capacity of the soil to which it is added, and thus the water needed by the plant can be stored in the soil for a long time. Biochar amendments can reduce bulk density in the soil, thus can allow the uptake of nutrients from the soil solution by increasing root penetration (Lehmann and Joseph, 2015). Increased cation exchange capacity with biochar application is an important parameter that might cause increases in the retention of the nutrients like phosphorus and nitrogen in the soils. In addition, it holds nutrients in the soil to help reduce the leaching of nutrients into groundwater (Biederman and Harpole,

2013). It is reported that the effect of biochar on the soil and plant varies depending on the feedstock derived-biochar, the properties of the applied soil, and the plant species (Prapagdee and Tawinteung, 2017).

2. Effects of Biochar Application on Mitigation of Abiotic Stress

Abiotic stresses such as drought, salinity, and the presence of excess levels of heavy metal in the soil lead to a decrease in the productivity and growth of cultured crops worldwide (Taylor and Korstad, 2020). Recently biochar has gained popularity due to its favorable effects on soil which include: increasing organic carbon of the soil, decreasing the acidity of the soil, mitigating salinity of the soil, improving drought condition of the soil, reducing the heavy metal concentration of the soil (Taylor and Korstad, 2020). Several studies have been found that application of biochar to the soil enhances the physicochemical and biological properties of soil and overcome the negative effects created by the stressed conditions. Application of biochar to mitigate the impacts of major abiotic stresses especially drought, salinity, and heavy metal has been found very effective (Kumari et al., 2020). Drought stress is an important environmental factor responsible for the reduction in the growth and yield of cultivated plants (Bodner et al. 2015). Researchers have reported that be beneficial effects of biochar application to mitigate the negative effects of drought (Akhtar et al., 2014; Paneque et al., 2016). For example, it has been reported that biochar applications increase the leaf area and plant height of okra (Batool et al. 2015) and maize (Haider et al. 2015). Some studies have been found that biochar significantly improve the growth and yield of plants under drought conditions (Mannan and Shashi, 2019). Biochar application produced an increase in the plant growth and seed yield of tomato (Agbna et al., 2017) under water deficit conditions. Salt stress is reported to be one of the other important agricultural problems limitings crop production, especially in arid and semi-arid regions (Hussain et al., 2019). Biochar balances air porosity in soils and water holding capacity, thus it promotes benefits in plant growth in saline soils by reducing oxidation stress and osmotic stress (de Vasconcelos, 2020). Several studies observed that the application of biochar has been shown to be effective in reducing salinity stress by improving soil physicochemical and biological properties directly related to Na removals (Dahlawi et al., 2018). Heavy metal accumulation in the soil is another concern threatening agricultural production. Heavy metals contaminated plants cause losses in crop production and risks for human and animal health. The immobilization of toxic elements in soil is among the potential properties of biochar (Yang et al., 2020). Biochar has a porous structure and negatively charged surface including functional groups such as hydroxyl, carboxyl, carbonyl, and phenoxyl (Uchimiya et al., 2011). The porous structure of the biochar surface and the presence of functional groups there gives adsorption potential for toxic substances, such as lead (Pb), copper (Cu), nickel (Ni), cadmium (Cd), and arsenic (As) in heavy metal contaminated soils. These properties give biochar an important adsorbent feature, when applied to the soil (Nartey and Zhao, 2014). Biochar, which has excellent absorption capacity, acts as an important binding phase for different pollutants in the environment. Researchers have suggested that biochar is an effective sorbent for a variety of dangerous inorganic and organic pollutants due to its functional and sorptive properties (Bashir et al., 2017).

CONCLUSIONS

Based on the above studies reviewed that biochar has potential direct or indirect benefits in agriculture. It has been put forward that more field-based and longer-term studies should be done needed to observe the reaction of biochar in time and the adaptation of the environment to its addition in soil. As a result, biochar is a sustainable alternative to the existing chemical fertilizers by improving its long-term impacts on soil quality and fertility.

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THE EFFECTS OF *Hyphantra cunea* ON SOME PARAMETERS OF MAIZE

R.YAVUZ 1

1 Provincial Directorate of Agriculture and Forestry, Duzce, Turkey

Abstract:

This research was conducted to reveal the effects of *Hyphantria cunea* Drury on some parameters of maize. The research was carried out in Düzce Ağa District 266, 403 and 726 parcels in 2020. Dekalp 6777 maize variety was sowned on the parcels on 2 July 2020. During the production season, weed control, fertilization, 2 times sprinkler were carried out. As of September 14, 2020, *Hyphantria cunea* Drury have reached maize plants in the northwest of the area and have fed with their leaves. The average plant height measured in samples taken from areas not reached by Hyphantria cunea Drury is 2.65 cm, the cob length is 22.6 cm, and the diameter of the cob is
4.83 cm. The plant height measured in the areas it reaches is 2.06 cm, the cob length is 18.6 cm, and the diameter of the cob is 4.2 cm. According to the data obtained, statistically significant difference was found between the areas reached and not reached by *Hyphantria cunea* Drury. It has been determined that *Hyphantria cune* is fed with corn leaves to delay the harvest of maize for silage.With this study, it was concluded that it is necessary to fight against *Hyphantria cunea* Drury in maize areas sowned as the second crop in Düzce and similar ecologies.
Keywords: Damage, Duzce, Harvest, Second crop, Yield

INTRODUCTION

Posing an agricultural and economic threat, *Hyphantria cunea* is significant due to its high polyphagy, which puts a wide variety of plant species at potential risk. According to the FAO (2007) a female fall webworm (*Hyphantria cunea*) may lay up to 500/600 eggs at a time and there can be up to four generations of the moth in a single year.

The facility of the larvae to withstand starvation for up to 2 weeks means that they can easily be transported on vehicles to different areas and survive to initiate new infestations. *Hyphantria cunea* can spread with vehicles, packing material, host plant material, etc (Smith et al. 1992).

The fall web worm (*Hyphantria cunea*) can impact a wide variety of crop and cultivated broadleaf plant species. In Europe it is a serious pest in Bulgaria, Romania, Hungary, former Yugoslavia, Russia and northern Italy. *Hyphantria cunea* the first time in 1975 in Turkey, Edirne, Tekirdağ and was seen in Istanbul, then spread to the Black Sea Region (İren, 1977; Baş, 1982; Işık and Yanılmaz, 1992).

According to Biosecurity New Zealand heavy feeding by the caterpillars over time, can lead to defoliation (leaf loss) and limb and branch dieback. Trees/plants are often totally defoliated by the late-instar larvae, particularly in the second generation. Environmental impacts are likely given the high polyphagy and impact on individual plants. H. cunea is a threat to orchards, ornamentals and forest trees in some regions in Central and eastern Europe, as well as in eastern Asia. It is particularly damaging to ornamentals (Wittenberg, R. (ed.) 2005).

Newly emerged larvae immediately begin to spin a silken web over foliage on the terminal portions of the branches. The larvae feed on the leaves within the webs. As the larvae grow, webs enlarge and enclose more foliage. Large portions of tree branches are commonly enclosed by such webs, and are most apparent from mid- to late-summer. Early stage larvae feed on the upper surfaces of the leaves, and late instar larvae eat entire leaves except for larger veins and midribs. Experiments showed that sixth-instar larvae of *H. cunea* can consume a daily average of 435mm² of fresh ash foliage while seventh-instar larvae brought it to an average of 814mm² (Smith et al. 1992).

Hyphantria cunea , which has two generations per year in Turkey, has become an important pest of almost all fruit trees, especially in large hazelnut fields in the Middle Black Sea Region, where it was seen in 1982 (Baş, 1982; Özay, 1997; Selek, 1998; Tuncer and Kansu, 1994) . Özay (1997) found that H. cunea caused damage on Salix alba and S. excelsa in İstanbul, Kocaeli and Sakarya, and on Populus species in Selek (1998) Sakarya and Kocaeli.

This research was carried out to reveal the effects of *Hyphantria cunea* Drury on some parameters of corn, which is cultivated as the second crop after wheat and barley in Düzce and similar ecologies. In Turkey, there is no research about the damage to the Hyphantria cunea the corn plants. This study has the potential to be a reference for future studies.

MATERIALS AND METHODS

The adult fall web worm (*Hyphantria cunea*) has a wingspan of 25-31mm and is snowy white, usually with dark spots on the wings. Larvae are brownish-grey, 25 - 30/40mm long, and have 12 small warts surmounted by characteristic tufts of hair, Their silk nests enclosing a number of leaves are characteristic. Eggs are small, yellow or light green, and usually located in hair-covered masses on the underside of leaves. Mature larvae are 25-31mm long and covered with silky hairs. Colour varies from pale yellow to green, with a black stripe on the back and a yellow stripe on each side. Head colour varies from red to black. Pupation occurs in thin cocoons usually spun in

the duff or just beneath the surface of the soil (Wittenberg, R. (ed.) 2005).

In Central Europe there are usually 2 generations per year. Pupae overwinter in the bark cracks or in the soil. Adults fly in April-May and lay eggs in groups, usually on the underside of leaves. Larvae usually have 7 instars, but up to 11 can be observed. Early instars are gregarious and build colonial silk nests enclosing leaves, in which they live to the fifth to sixth instars when they become solitary and disperse. Then, they pupate in refuges and emerge for a second generation, which flies in July-August In North America from May to July, adult moths lay their eggs. Eggs hatch within two weeks and the larvae immediately begin feeding and constructing webs. Larvae feed and webs continue to enlarge for four to eight weeks. There are at least two generations per year in the South (Wittenberg, R. (ed.) 2005).

The research was carried out in Düzce Ağa District 266, 403 and 726 parcels in 2020. Dekalp 6777 variety was used. With its plant and cob structure, it is a silage corn seed that is both wet and good in silage yield and suitable for enterprises aiming to increase milk yield. It is in the FAO 700 group. Second crop is suitable for cultivation in June to July.

Dekalp 6777 maize variety was sowned on the parcels on 2 July 2020. During the production season, weed control, fertilizaton, 2 times sprinkler were carried out.

Figure 1. Feeding with maize leaves of *H. cunea*. Figure 2. Damage of *Hyphantria cuna*

As of September 14, 2020, *Hyphantria cunea* Drury have reached maize plants in the northwest of the area and have fed with their leaves (Figure 1 and Figure2).

Figure 3.Damage of maize leaves.

Figure 4. Damage of maize leaves

Hyphantria cunea damages by eating the leaves of the maize (Figure 3 and Figure 4). The area around 100 meters long and 20 meters wide was affected by the pest (Figure 5 and Figure 6). Its detrimental effect lasted until October 14th. With the onset of the cold, the pest went to wintering.

Figure 5. Areas affected by *Hyphantria cunea*.

Figure 6. Areas affected by *Hyphantria cunea*.

Maize plant areas that the pest cannot reach (Figure 7 and Figure 8). Total planted area was 2 hectares. Plant height, cob length and cob diameter were measured, representing the areas reached and not reached by Hyphantria cunea Drury. The distance between the exit point of the tassel from the soil level of 10 plants randomly selected from each plot was measured as plant height (cm). After the leaves of 10 cobs randomly selected from each plot were stripped, the

distance between the cob stalk and the end of the cob was measured as the length of the cob (cm). The diameter of the cob was determined by measuring with a caliper from the middle points of the cobs whose length was measured. The data obtained were analyzed using the SPSS statistical package program.

Figure 7. Areas undamaged from *H.cunea*.

Figure 8. Areas undamaged from *H. cunea*.

RESULTS AND DISCUSSION

The average plant height measured in samples taken from areas not reached by *Hyphantria cunea* Drury is 2.65 cm (a). The plant height measured in the areas it reaches is 2.06 cm (b). The difference between the measurements was found to be statistically significant.

Figure 9. Parcel of Control Parsel

Figure 10. Parcel affected by *Hypantria cunea*

Figure 11. Lengths and diameters of cob

The cobs on the left side of the photograph, unaffected by the *Hyphantria cunea*, measured 22.6 cm (a) in length. The cobs on the right side of the photograph, affected by the Hyphantria cunea, measured 18.6 cm (b) in length. The difference between the measurements was found to be statistically significant.

The cobs on the left side of the photograph, unaffected by the *Hyphantria cunea*, measured 4,83 cm (a) in diameter. The cobs on the right side of the photograph, affected by the *Hyphantria cunea*, measured 4,2 cm (b) in diameter. The difference between the measurements was found to be statistically significant.

Figure 12 . Harvest maturity for silage

Figure 12. harvest maturity for silage

It has been determined that in areas where there is no *Hyphantria cunea* damage, the milk line in the grains is between 1/3 and 50%, whereas in the areas with *Hyphantria cunea* damage, the milk line has not yet started to form, so Hyphantria cunea is fed with the leaves of the corn and delayed the harvest of silaged corn.

According to the data obtained, statistically significant difference was found between the areas reached and not reached by *Hyphantria cunea* Drury. Other cultivated plants such as grapevine, maize or soyabean can be attacked by Hyphantria cunea (Wittenberg, R. (ed.) 2005). The results obtained correspond to those reported by Wittenberg (2015).

CONCLUSION

In Duzce and similar ecologies, green leaves decrease in forest and fruit trees in August and September. It has been observed that this has caused the second generation of *Hyphantria cunea* to move towards the second crop maize fields with large green leaves.

With the data obtained as a result of this study, it was determined that the second generation of Hyphantria cunea negatively affected the plant height, cob length and diameter of the second crop maize and delayed the harvest maturity.

With this study, it was concluded that it is necessary to fight against *Hyphantria cunea* Drury in maize areas sowned as the second crop in Düzce and similar ecologies.

This study demonstrated for the first time that Hyphantria cunea damage the maize in Turkey. It has a resource potential for future studies. It is thought that research should be continued in larger areas.

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EFFECTS OF WATERLOGGING ON SOME MORPHOLOGICAL, PHYSIOLOGICAL AND PHOTOSYNTHETIC PARAMETERS IN BARLEY

Sertan ÇEVİK[1*], Ayşin GÜZEL DEĞER[2]

[1] Vocational School of Mut, Mersin University, Mersin, Turkey
[2] Vocational School of Technical Sciences, Mersin University, Mersin, Turkey
*Corresponding author: srtncvk@gmail.com

Abstract

Waterlogging is an important abiotic stress factor that can affect a large part of the cultivated areas. Due to this stress, serious losses occur in agricultural production. As it is difficult to predict waterlogging, it is also difficult to take precautions in this regard. The prediction that the frequency of waterlogging will increase with the effect of global warming increases the importance of the studies to be carried out in this regard.

The barley (*Hordeum vulgare* L.) plant is an important grain product produced intensely in the world and, like all other agricultural plants, is highly affected by waterlogging. In this study, the changes occurring in barley exposed to waterlogging stress for 15 days were examined by morphological, physiological and photosynthetic analyses. According to our results, waterlogging significantly suppressed the growth and development of barley plants. In particular, photosynthetic parameters remarkably affected. Leaf water potential increased with waterlogging. There are different results in the literature related to this situation and the subject is open to study. As a result, it can be said that waterlogging affects the development of barley plants, especially by suppressing photosynthesis efficiency.

Keywords: Waterlogging, Barley, Photosynthesis, Plant development

Introduction

Plants are exposed to environmental stresses in their natural habitats or fields throughout their lives. These environmental stresses categorized as biotic and abiotic stress factors cause serious product losses in plants. The published reports reveal that environmental stress-induced product losses can be up to %50. One of the factors that cause serious product losses is waterlogging (Martinez et al., 2019; Ashraf, 2012). Waterlogging is a stress factor that negatively affects %10 of the total cultivated land on earth. Waterlogging cause anoxia conditions in the soil, limiting root development, and affecting plant growth and development (Yavaş et al., 2011). Scientists investigating climate change have reported that waterlogging will occur more frequently in the near future (Bansal and Srivastava, 2015). This situation increases the importance of the measures to be taken against waterlogging. Perhaps the most important of these measures is to try to understand the mechanisms that plants develop against to the waterlogging situation.

Barley has been grown since ancient times and is the fourth most grown grain product in the world after wheat, corn and rice (Tricase et al., 2018). Although barley is mostly used for industrial purposes and animal feed, today it can also be used as an additive for human nutrition (Çevik et al. 2019). The increasing need for barley in the world day by day makes the issue of reducing the environmental stress pressure on barley production a much more important today.

In this study, we aimed to reveal the changes caused by waterlogging stress in barley plants by morphological, physiological, and photosynthetic analyses. The results revealed that waterlogging significantly decreased the growth of barley plants, especially by negatively affecting photosynthetic activity. The data obtained from this study may provide important clues for the extensive molecular studies to be carried out to reduce the productivity loss caused by waterlogging in barley plants.

Material and Methods

Plant Material and Waterlogging Stress Treatment

Hordeum vulgare L. seeds were obtained from Koçaş Agricultural Management Directorate. Seeds were imbibed in the water at 22 °C for 1 day and planted to pots containing %70 torf and %30 clay. Plants were grown at 22/18 °C (day/night) temperature, 65 ± 5 humidity, and 230 μmol m^{-2} s^{-1} light for 5 days. After that, waterlogging treatment exposed for 15 days. The water in the waterlogged containers was maintained at 1–2 cm above the soil surface (Figure 1). Control plants were well-irrigated in every other day.

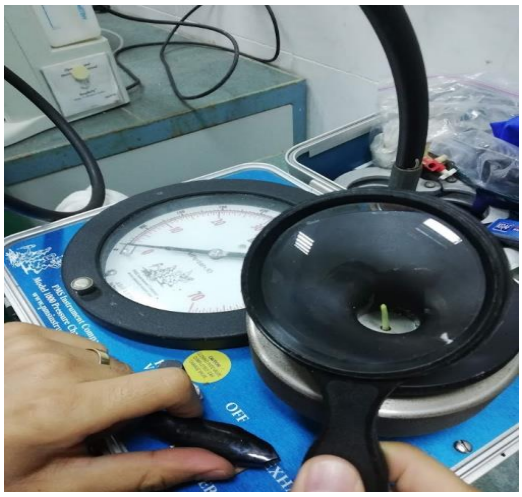
Figure 1. Barley plants exposed to waterlogging stress.

Morphological, Physiological and Photosynthetic Analysis

Ten plants were used for all measurements in control and waterlogging stressed groups. ***The stem diameter*** at 2 cm above the soil surface was measured for waterlogging-stressed and control plants by using a digital caliper (Figure 2). ***Leaf water potential*** (LWP, Ψleaf) was measured by using the PMS Instrument Model 1000 pressure chamber (Figure 3).

Figure 2. Measurement of stem diameter by using digital

Figure 3. Measurement of leaf water potential by using pressure



Number of leaves and ***plant height*** were determined for both stressed and control plants. For the measurement of ***seedling lengths***, the part from soil level to the growth tip in seedlings was measured in centimeters (cm) with a ruler. 10 seedlings from control and waterlogging stressed plants were cut from soil level and weighed on a sensitive scale and their ***fresh weights*** were determined. These plants were then kept in an oven for 48 hours at 70 °C and were weighed again to determine their ***dry weight***.

Leaf chlorophyll concentration was determined using a portable SPAD-502 meter (Minolta, Japan). Readings were taken from the leaves of ten replicates at the end of the experiment (Figure 4).

Figure 4. Measurement of leaf chlorophyll content by using SPAD meter.

To determine ***Photosystem II efficiency*** chlorophyll fluorescence parameter ((Fv'/Fm') = Quantum yield in light adapted leaves) was measured by a portable fluorimeter (FluorPen FP100, Photon System Instruments Ltd, Drasov, Czech Republic).

Statistical Analysis

Data were given as means ± standard deviation (SD). Significant differences between control and waterlogging-stressed samples for all measurements were analysed by Student's t test.

Results and Discussion

Barley (*Hordeum vulgare*, L.) plants were exposed to waterlogging stress for 15-days. Waterlogging stress affected differently all morphological, physiological and photosynthetic parameters measured in this study.

Waterlogging negatively affected development and growth in barley plants (Figure 5).

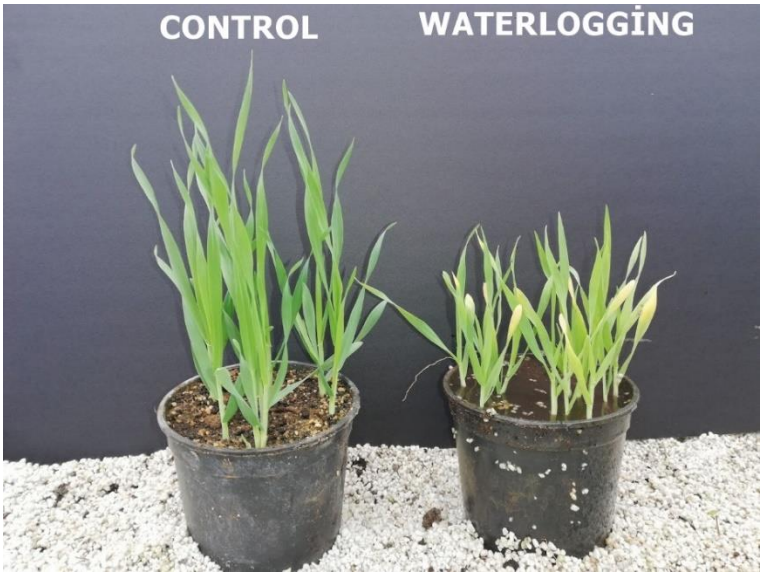


Figure 5. Effect of waterlogging stress on development of barley plants.

Waterlogging stress significantly decreased average number of leaves, stem diameters, fresh and dry weights and plant height in barley plants (Table 1). As seen in Table 1, the percentages of the decreases were quite striking; %32 in stem diameter, %41 in plant height, %25 in leaves numbers, %55 in fresh weight, %39 in dry weight.

Table 1. Effect of waterlogging stress on stem diameter, plant height, leaf numbers, stem fresh weight, stem dry weight in *Hordeum vulgare* L. The values (mean and standard deviation) followed by different letters are significantly different at least significant difference test ($p<0,05$).

	Control	**Waterlogging Stress**
Stem diameter (mm)	$2,58\pm0,23^a$	$1,75\pm0,29^b$
Plant height (cm)	$15,48\pm0,45^a$	$9,14\pm0,56^b$
Number of leaves	$4,7\pm0,78^a$	$3,5\pm0,5^b$
Stem fresh weight (gr)	$0,508\pm0,08^a$	$0,23\pm0,07^b$
Stem dry weight (gr)	$0,062\pm0,01^a$	$0,038\pm0,01^b$

Plant height was significantly decreased by waterlogging. Similar results also reported by other researchers in different plants (Barickman et al., 2019). In the literature, different theories

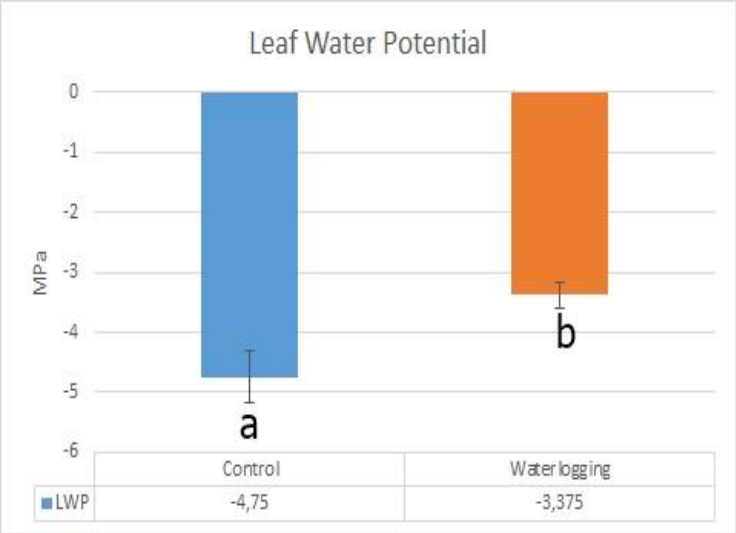
have been proposed regarding the reduction of plant height under waterlogging. Aldana et al. (2014) suggested that lack of phytohormones synthesized in the root system such as cytokinins and gibberellins may be reason of this decreasing. Low oxygen transport (Dennis et al., 2000) and nutrient uptake (Kuswantoro, 2011) also reported in other papers as factors for plant growth inhibition under waterlogging conditions. All these reasons may affect plant development but also, according to our photosynthetic parameter results; reducing photosynthesis activity may also cause inhibition of plant growth. Stem diameter was significantly reduced by waterlogging in this study, similar results also reported by Promkhambut et al. (2011) on sorghum at different growth stages.

Waterlogging also decreased plant fresh and dry weight in this study. Some researchers reported that waterlogging creates an anaerobic condition in soil, these conditions may lead to an increase in the soil some elements like P, Fe, Mn (Kozlowski and Pallardy, 1997; Baracaldo et al., 2014). Despite increasing of element concentration in soil under waterlogging conditions, some researchers also showed low element concentration in roots and leaves (Morad and Silvestre, 1996; Steffens et al., 2005). Steffens et al. (2005) conducted an experiment to explain this confusing situation, and they showed that even if there were enough minerals in the soil, there must be enough oxygen for these minerals to be absorbed by the root. In the light of these findings, we can say that waterlogging may have reduced the fresh and dry weight of barley by preventing mineral uptake to the roots.

Plant water status was the other parameter that affected by waterlogging stress in this study. Waterlogging stress increased leaf water potential (LWP) compared to control plants. LWP was -4,750 MPa in control, -3,375 MPa in waterlogging stressed plants ($p<0,05$) (Figure 6). Different results have been reported by researchers about leaf water potential under waterlogging conditions. Some researchers have found that waterlogging has reduced leaf water potential (Ashraf and Rehman, 1999; Yi et al. 2006; Barickman et al., 2019), while others have reported, on the contrary, increased (Jackson et al., 1978; Liao and Lin, 1994) or not changed (Oosterhuis et al. 1990; Ahmed et al. 2002; Ashraf and Arfan, 2005). Naidoo (1983) reported that the 10-day waterlogging stress did not change the water potential in the *Bruguiera gymnorhiza*, the plants under 20 days of stress had higher LWP compared to control, but when the duration of the stress was over 40 days, the LWP was much lower than the control plants. This may an indication that the LWP may change depending on the duration of the waterlogging stress. Else et al. (2001) showed that the leaf water potential decreased significantly within the first few hours after the waterlogging stress, but the stress and control group values were close to each other since the 24th hour of waterlogging. Zeng et al. (2013) emphasized that the leaf water potential increased in barley plants under waterlogging and LWP may change depending on the genotype and soil content. Taken

together all of these literature, changes in LWP under waterlogging should be investigated through extensive studies.

Figure 6. Effects of waterlogging stress on leaf water potential in barley plants. The values (mean and standard deviation) followed by different letters are significantly different at least significant difference test ($p<0,05$).



Photosynthesis related parameters also decreased in waterlogging-stressed plants. Leaf chlorophyll content (Figure 7) and PS II efficiency (Figure 8) were significantly decreased by the 15-days waterlogging treatment in barley plants. Similar results also reported by other researchers (Wang et al., 2017; Barickman et al. 2019). Chlorophyll has a vital role in the photosynthesis mechanism (Barickman et al. 2019). The reduction of chlorophyll content may also cause a decrease in the photosynthetic rate. However, the decline in PS II efficiency indicates that waterlogging damage to PS II, this may reduce the photosynthesis potential energy of PSII and result in decline photosynthetic rate (Ren et al., 2016). Some researchers showed that waterlogging causes stomatal closure in plants (Bradford and Hsiao, 1982, Else et al., 2009, Aldana et al., 2014). Closing of stomata reduces intercellular CO_2 concentration, transpiration, and photosynthesis. Yordanova et al. (2005) found that only within the first few hours of waterlogging, fast and strong stomata closure have been observed in barley plants. This finding may indicate that stomata of barley plants respond very quickly to waterlogging.

Figure 7. Effects of waterlogging stress on Leaf chlorophyll content in barley plants. The values (mean and standard deviation) followed by different letters are significantly different at least significant difference test (p<0,05).

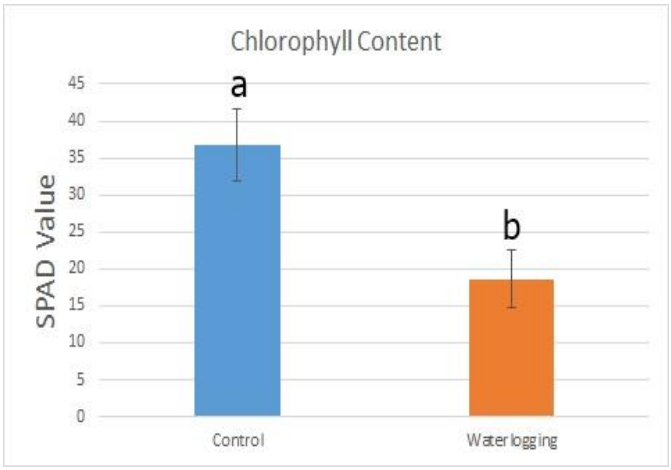
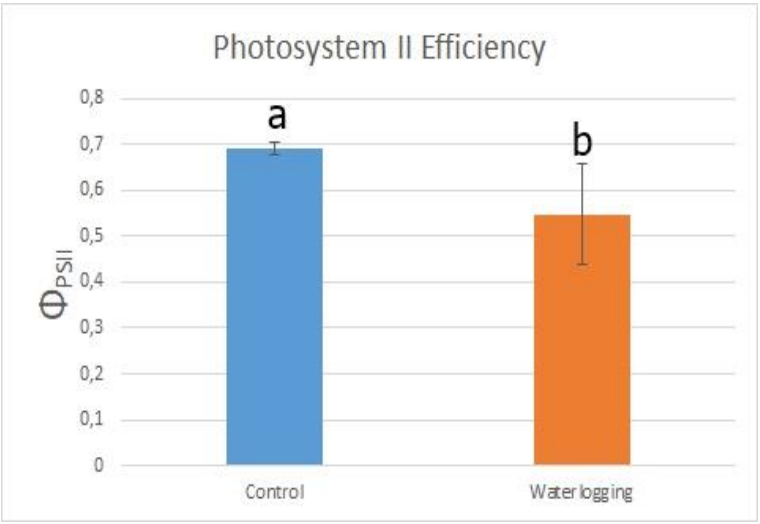


Figure 8. Effects of waterlogging stress on PS II efficiency in barley plants. The values (mean and standard deviation) followed by different letters are significantly different at least significant difference test (p<0,05).



Conclusion

The present study compares the morphological, physiological and photosynthetic parameters of barley (*Hordeum vulgare* L.) under waterlogging stress. When all measurements were taken into consideration, waterlogging stress reduced growth and development of barley by affecting photosynthesis mechanism. However, there are different results about LWP under waterlogging conditions. We think that extensive molecular and physiological studies should be conducted to reveal changes in LWP under waterlogging in barley.

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POSTHARVEST UV-C TREATMENTS TO MAINTAIN COLD STORAGE QUALITY OF BLACKBERRY FRUITS

F. K. Sabir[1], S. Unal[1], M. K. Aslan[2] And D. Metin[2]

[1] Horticulture Department, Agriculture Faculty, Selcuk University, Konya, Turkey

[2] Graduate School of Natural and Applied Science, Selcuk University, Konya, Turkey

Abstract

Ultraviolet (UV-C) treatment is one of the alternative strategies against chemical uses in extending postharvest quality of the horticultural fruits. The blackberry fruits cv 'Jumbo' at commercial maturity was subjected to UV-C radiation with various application duration (0, 5 and 10 minutes). After treatments, all the fruits were kept at 1°C and 90% relative humidity for 10 d. Weight loss, total soluble solid, titratable acidity, pH, visual quality, total phenol and total antioxidant analyses were performed initially on 4th, 7th, or 10th day of storage to compare the effectiveness of treatments. UV-C treated fruits were higher in titratable acidity, and exhibited less biochemical changes than the control fruit at the end of storage. UV-C treatment reduced the weight loss and exhibited markedly better visual quality with greater effect at 5 min than 10 min. Considering the overall findings, this study revealed that postharvest 5 min UV-C treatment maintained the storage-life and conserved the valuable marketing features of blackberries over 10 d in cold storage.

Keywords: Blackberry, UV-C, postharvest, quality

INTRODUCTION

Blackberry production is increasing worldwide to meet a growing demand from consumers, especially in the fresh market (Lawrence and Melgar, 2018). Blackberry is a fruit that has multiple valuable compounds such as anthocyanins and polyphenolic compounds that make it a highly desirable fresh produce. Moreover they are rich nutrients such as proteins, carbohydrates, fats, fibers and several vitamins (Sabir et al., 2019; Pérez et al., 2020).

To get the maximum quality at harvest and maintain this quality during transport and commercialization until the fruit is consumed, it is essential to harvest berries at the optimum stage of maturity (Kumar et al. 2018). Blackberry is a highly perishable fruit and have a short postharvest life influenced by the presence of fungal pathogens (Vilaplana et al., 2020). Besides, postharvest life of blackberries is also limited by their sensitivity to water loss, softening and physical injuries (Sabir et al., 2019) Therefore, blackberry fruits destined for fresh markets became unmarketable after 2 or 3 days when stored at 0°C due to fruit rot and leakage (Hardenburg et al. 1986).

UV-C treatment (180–280 nm) has been evaluated as a postharvest treatment for fresh fruits and vegetables including to reduce pathogen growth (Pristijono et al., 2019). The US Food and Drug Administration approved the UV-C irradiation treatment as a postharvest method of

horticultural crops (FDA 2002), which is effective against harmful microorganisms of entire organization by inhibiting DNA replication, and not only the surface of food (Xu and Liu, 2017).

Studies have shown that UV-C irradiation can improve the activity of defense enzyme, inhibit bacterial growth, and induce gene expression of disease resistance, thus delaying the maturity and senescence of postharvest fruits and vegetables (Xu et al., 2016). Postharvest UV-C treatment has the potential to become a low cost, low technology treatment for reducing fruit and vegetable loss in the supply chain (Pristijono et al., 2019).

The objective of this work was to select appropriate UV-C application duration (0, 5 and 10 min) and to evaluate the effect on postharvest quality attributes of blackberry during storage.

MATERIALS AND METHODS

Blackberries (*Rubus fructicosus* L.) of 'Jumbo' cultivar were harvested at full maturity stage and selected for uniformity of shape size and peel color (100% of the surface with black color). The pedicels of all the blackberries were cut with a sharp scissor leaving 1–2 mm of cap stem.

The fruits were randomly distributed into three groups for treatments. First group was evaluated as a control group untreated while two groups were assigned to different application duration of UV-C radiation (5 and 10 minutes). Blackberry fruits were irradiated using eight germicidal, low-pressure vapor lamps as described by El Ghaouth et al. (2000). The UV lamps were fixed at 25 cm above the sample placing spot and fruits were irradiated for 5 and 10 min.

After irradiate, about 250 g of each fruit sample was put in a rigid polypropylene cup and wrapped with film. Fruits were stored for up to 10d in a cold room at 1°C (80–90% R.H.). Weight loss, total soluble solid, titratable acidity, pH, fruit color, visual quality, total phenol and total antioxidant analyses were performed initially on 4th, 7th, or 10th day of storage.

The weight loss (%) during postharvest storage was determined by periodical weighing, and calculated by dividing the weight change during storage by the initial weight:

Weight loss (%) = [(Wi – Ws)/Wi] × 100, where Wi = initial weight and Ws = weight at examined time.

SSC of blackberry samples of each package were blended for 30 s. SSC in the juice were determined using a refractometer (Atago, Tokyo, Japan) and results were expressed as %. Titratable acidity (TA) was determined by titrating 5 mL of juice using 0.1 N NaOH to pH 8.1, and expressed as % citric acid.

Visual attributes of the fruit (color, firmness, injuries and general appearance) were evaluated by five panelists for the general acceptability with the following scales: 9 (best quality) to 1 (worst). 5 point was evaluated the limit of acceptance of fruits.

Total phenol was determined according to the method of Singleton et al. (1999) with slight modifications. The 0.1 mL extract, 6.0 ml distilled water and 0.5 ml Folin-Ciocalteu reagent were mixed and vortexed. The mixture were incubated for 3 min and then 20% sodium carbonate solution was added and volume was made up to 10 ml by adding distilled water. The solution was incubated at room temperature for 2 h and the absorbance was measured at 760 nm. The total

phenol content was calculated on the basis of the calibration curve of gallic acid and was expressed as mg 100 g^{-1} FW.

Antioxidant activity was determined by the ferric reducing ability antioxidant power (FRAP) according to the procedure described by Benzie and Strain (1996). For this, 150 µL of extract and 2.85 mL of the FRAP reagent was incubated at 30 °C for 30 min. After incubation, reaction mixture was measured at 593 nm on a UV-vis spectrophotometer. Standard curve was prepared using different concentrations of 1 mM trolox and expressed as µmol kg^{-1}.

Statistical tests were performed in triplicate (replication) on three different treatments. The averages and standard deviation were calculated. Data from analyzed parameters were subjected to analysis of variance separately. Sources of variation were treatment, storage time and their interaction. Means were compared by Student's t-test at $P \leq 0.05$, using JMP statistical software version 5.1 (SAS Institute Inc., Cary, NC, USA).

RESULTS AND DISCUSSION

The percentage of weight loss increased during prolonged storage for control and both UV-C treatment durations while the effect of treatments on weight loss was found statistically significant. At the end of the cold storage, the greatest loss in weight occurred in non-treated control fruits (1.93%), while the lowest value was obtained from 5 min UV-C treatment (0.99%). Weight loss is a prime issue potentially devaluing defects in fresh blackberry fruit (Perkins-Veazie et al. 2000; Sabir et al.,2019), occurring quickly as blackberries have high transpiration rates (Joo et al., 2011) although these rates are often moderated by immediate cold storage (Meneghel et al. 2008). Besides cold storage condition, additional treatments such as UV radiation has been suggested for a more effective storage. UV-C treatment for 5 min was considerable effective on maintaining the turgidity of the blackberries during the 10 day storage.

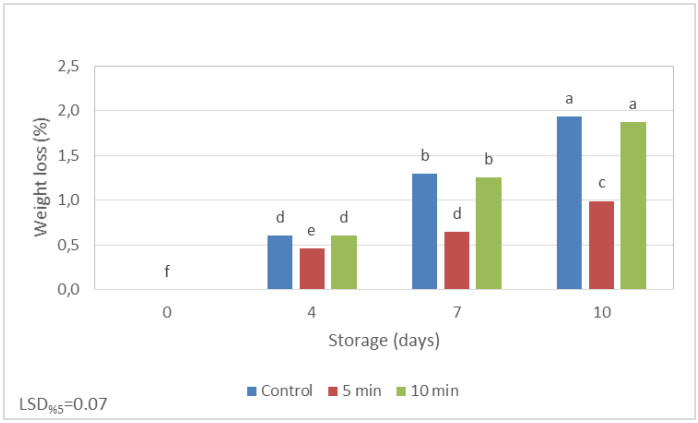

Figure 1. Effects of UV-C treatments on weight loss (%) of blackberry fruits during cold storage. Data with different letters are significantly different (P<0.05).

In general, SSC underwent a slight but insignificant increase through the storage (Table 1). At the harvest, SSC contents of fruits were 10.93%. These values increased during the storage

regardless from treatments. At the end of the storage, the highest SSC was observed in control (12.13%), while the least value was recorded in 5 and 10 min UV-C treatment (11.33%). General increment in SSC is a common issue seen in horticultural commodities due to loss in weight along with the prolonged cold storage (Moggia-Lucchini 1990) as well as gluconeogenesis pathway could also let to increase in SSC (Famiani et al. 2009) as the fruits such as blackberries store organic acids in vacuoles of the flesh cell. Delaying the conversion of such molecules could slow down the postharvest senescence of the produces.

Table 1. Effects of UV-C treatments on SSC (%), TA and pH of blackberry fruits during cold storage

	Treatments	Storage (days)			
		0	4	7	10
SSC	Control	10.93	11.07	11.70	12.13
	5 min UV-C		10.90	11.33	11.33
	10 min UV-C		11.03	11.10	11.33
TA	Control	1.547^{a}	1.076^{b}	0.789^{f}	0.678^{g}
	5 min UV-C		1.112^{b}	0.841^{f}	0.759^{f}
	10 min UV-C		0.997^{c}	0.872^{de}	0.889^{d}
pH	Control	2.96^{g}	3.51^{e}	3.87^{b}	3.94^{a}
	5 min UV-C		3.29^{f}	3.75^{c}	3.75^{c}
	10 min UV-C		3.59^{d}	3.71^{c}	3.76^{c}

LSD for SSC: N.S.; TA: 0.044; pH: 0.06. Data with different letters are significantly different ($P<0.05$)

As illustrated in Table 1, decrease in the TA value was recorded with the prolonged storage time and the differences between the treatments were statistically significant. At harvest, TA was 1.457%. At the end of the cold storage, the highest TA value was obtained from the fruits of the 10 min UV-C treated fruits (0.889%), while the lowest value was measured in the control fruits (0.678%). Fruit juice pH value was 2.96 at harvest and tended to increase during the cold storage across the applications. At the end of the experiment pH values were 3.94, 3.76 and 3.75 for control, 10 min UV-C and 5 min UV-C treatments, respectively (Table 1).

During the first four days of the storage period, no significant change occurred in visual quality, except for control where little reduction was detected. Later, the fruits belonging to control group underwent a noticeable decrease in visual quality around the 7 days. UV-C treatment, regardless of treatment durations, was capable of maintaining the visual quality up to the 10th day. At the end of the storage, control fruits had the lowest visual quality score (5.0) with significant difference from both of 10 min (6.3) and 5 min UV-C (7.0) treatments (Figure 2).

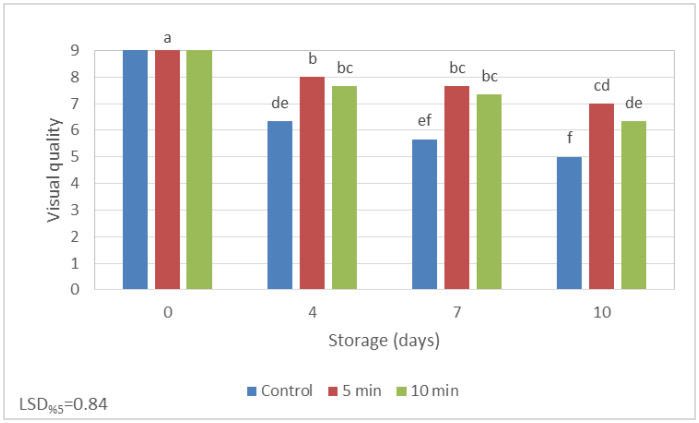

Figure 2. Effects of UV-C treatments on visual quality of blackberry fruits during cold storage. Data with different letters are significantly different (P<0.05)

Total phenol was 1.36 mg 100 g^{-1} at harvest with a slight change up to 4th d. Then it displayed progressive increase during the storage. However, UV-C treatments significantly retarded the change in total phenol. At the end of the cold storage, the highest total phenol was detected in the control fruits while the treatments have remarkable effects (Figure 3).

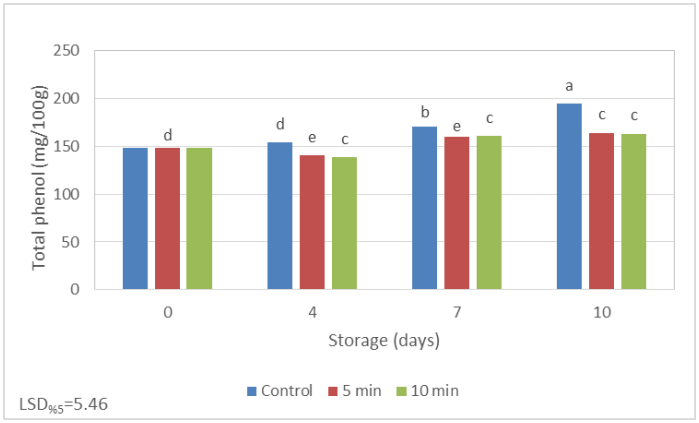

Figure 3. Effects of UV-C treatments on total phenol of blackberry fruits during cold storage. Data with different letters are significantly different (P<0.05)

Total antioxidant activity was 1.36 µmol kg^{-1} at harvest. Increase in the total antioxidant activity was recorded with the prolonged storage time and differences between the treatments were statistically significant (Figure 4). At the end of the cold storage, the highest total antioxidant activity was obtained from the fruits of 10 min UV-C treated (2.85 µmol kg^{-1}), while the lowest value was measured in the control fruits (2.54 µmol kg^{-1}). Blackberries are praised as being a good source of antioxidants. Change in functional properties like antioxidants is inevitable in blackberries as they are still alive after harvesting and keep respiring by taking up O_2 and releasing CO_2 and the respiration rate varies inversely with storage and shelf life as previously stated by Peretto et al. (2014).

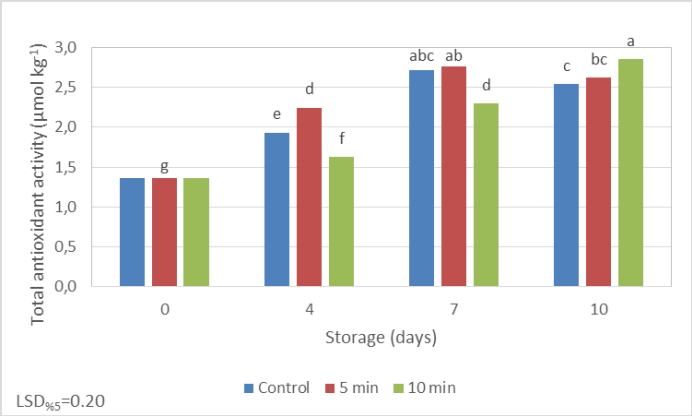

Figure 4. Effects of UV-C treatments on total antioxidant activity of blackberry fruits during cold storage. Data with different letters are significantly different ($P<0.05$)

CONCLUSION

Blackberries have a short postharvest life influenced by the presence of fungal pathogens and its susceptibleness to mechanical damages, softening, and water loss. UV-C, known to be an effective tool on extending the postharvest quality of horticultural commodities, was tested at various treatment durations (0, 5 and 10 min) for effectiveness on postharvest quality maintenance of blackberry stored at cold storage conditions.

UV-C treated fruits were higher in titratable acidity, and exhibited less biochemical changes than the control fruit at the end of storage. UV-C treatment reduced the weight loss and exhibited markedly better visual quality with greater effect at 5 min than 10 min. Considering the overall findings, this study revealed that postharvest 5 min UV-C treatment maintained the storage-life and conserved the valuable marketing features of blackberries over 10 d in cold storage. UV-C irritation may be recommended as a low cost, environmental friendly and sustainable method for extending postharvest quality of blackberry cold storage, without significant adverse effect on produces.

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THE EFFECTS OF DIFFERENT ROOTSTOCK AND GRAFTING METHODS ON PLANT GROWTH AND YIELD IN TOMATO

S. Unal[1], M. Paksoy[1]

[1]Selcuk University Agriculture Faculty Horticulture Department, Konya, Turkey

Abstract

The study was carried out in Antalya Grow Fide A.Ş. and Agriculture Faculty of Konya Selcuk University in greenhouses in order to determine the suitability of different rootstock and grafting methods in tomato. As plant materials Fantastic 144 Fı tomatoes cultivar, as rootstock 7-RZ and 61-53; as grafting methods cleft graft and tongue graft were used. The experiment was conducted in the randomized blocks desıgn as four replications. In this study is examined success rate, rootstock diameter, scion diameter, seedling height, callus formation, plant height, stem diameter, number of leaves, total yield, average fruit weight of fruit, total soluble solid content, pH, titratable acidity and fruit quality classification.

In the study, it was determined that there were no significant differences in terms of rootstocks and grafting methods. Therefore, it was concluded that both rootstocks and grafting methods could be preferred.

Keywords: Vegetables, Grafting, Rootstocks, Scion, Grafting Methods

INTRODUCTION

Total greenhouse area in Turkey reached 789,604 decares as of 2019. Total of the products grown in greenhouse is 7,814,543 tons of vegetables and 4,083 tons of these vegetables are tomatoes (TUIK, 2019). Mediterranean Region in Turkey, especially has a suitable ecology for greenhouse agriculture. Greenhouse vegetable cultivation in Antalya, which has been in the Mediterranean zone since the 1960s, has an important agricultural activity in the region.

The use of grafting and grafted seedlings in vegetable growing started in countries such as Japan and Korea and then spread to some European and Asian countries. The first graft process was initiated in the late 1920s by grafting watermelon (*Citrullus lanatus*) on a gourd (*Lagenaria siceraria*) rootstock in Korea and Japan to prevent a decrease in yield due to Fusarium wilt (Edelstein, 2004). For the first time, vegetable grafting procedure are tackled in a study on grafting eggplant on tomato in 1987 in Turkey. The effects on yield and quality were investigated by grafting two hybrid eggplant varieties on two different tomato rootstocks. As a result, more yield was obtained from grafted plants than other plants (Vuruşkan and Yanmaz, 1989).

Studies with grafted seedlings production has increased in recent years in Turkey. Seedlings grafted on eggplant, tomato, cucumber, melon and watermelon are produced by some private seedling companies and given to the producer. The cost of grafted seedlings is approximately three times higher than ungrafted seedlings due to the use of hybrid seeds for the grafting process, the

application of the graft by experienced personnel, a good technical infrastructure, a larger area and time in the plantation.

Grafted seedlings are used for resistant to soil borne diseases and nematodes, extended harvest period as a result of stronger growth of plants, tolerance to adverse soil conditions such as salinity and moisture, effective intake of water and nutrients from the soil, more resistant to biotic and abiotic stress conditions, earliness and high yield due to its positive effects. (Yetişir, 2001; Han et al., 2003). There are also negative aspects such as the need for extra time, area and material in graft, the need for experience and conflict problems. Since the vegetables have 80-90% water in their forms, the success rate in graft is lower than perennial plants.

In this study, it is aimed to reveal the effects of Fantastic l44 F1 tomato variety grafted on 7-RZ and 61-53 rootstocks on fruit yield and quality.

MATERIALS AND METHODS

Seedling growing and grafting process was carried out by Antalya Grow Fide A.Ş., the other part of the research was carried out in Research and Application Greenhouses belonging to Selcuk University Faculty of Agriculture, Department of Horticulture. In the experiment, as plant material Fantastic 144 F1 tomato variety, as rootstock 61-53 (Kemerit) and 7-RZ were used. Seedlings were grafted with cleft graft and tongue graft. The scalpel was used in making grafts. After the grafts were made, the rootstock-scion was attached properly with the help of a clip. In order to grow seedlings, rootstock and pen seeds were seeded in viols at certain time intervals and covered with vermiculite and taken to the germination room. Seedlings were kept in germination rooms until the time of graft.

After grafting, the seedlings were kept for a week in the germination room at 22-23 0C temperature, 80-90% relative humidity and the graft retention rates (%) were determined. The seedlings were planted in the seedling planting areas determined according to the trial plan so that the grafting point remains on the soil. The trial random blocks were set up with 4 replications according to the trial pattern. Before planting the seedlings in the greenhouse, the root throat diameter of the rootstock was measured as "mm" with the help of a caliper under the grafting point. Before the seedlings were planted in the greenhouse, the diameter of the pen was measured in "mm" under the grafting point with the help of a caliper. The grafted seedlings' heights were measured in "cm" with a ruler. Callus formation at the graft site was examined in 24 seedlings for each graft method. Callus formation amounts at the graft site were measured with a caliper and the results were determined in mm. In plant development, the plant height (cm) was determined by measuring every 20 days in 10 plants in each parcel and the average was taken. The stem diameter (mm) of 10 plants in each plot was measured with a caliper every 20 days and their averages were calculated. The number of leaves (number) of the plants in each parcel was recorded every 20 days and their average amounts were taken. The total yield (kg/da) and the total number of fruits (pieces/da) were determined by using the fruit weights and numbers obtained from each parcel in productivity. The average amounts of fruit yield (kg/da) and fruit numbers (units/da) obtained each month by using weekly harvests were determined. Taking into account the parcel yield and the number of plants, the yield per plant (g/plant) was calculated and the average amounts were recorded. In terms of product quality, the average fruit weight was found by taking 10 fruits randomly from each parcel during the harvest period and weighing and dividing the number by 10. The amount of water soluble dry matter (%), pH and titratable acidity values were determined in 5 fruits randomly taken

from each parcel. Fruit flesh firmness was determined in 5 fruits from each parcel that could represent the parcel. In addition, according to TSE standards, fruits were categorized as extra, l. and 2nd class. Costat statistical program was used to evaluate the numerical data obtained in the study. The averages were compared at 1% and 5% levels with the Tukey test.

RESULTS

Fifteen days after graft, the plants that grafted and continued to grow were counted and success rates (%) were calculated. The highest graft survival rate was obtained from 61-53 rootstock, followed by 7-RZ rootstock. According to the graft method; while the tongue graft was 89.8%, it was found 87.3% in the cleft graft. The effect of rootstocks, graft and rootstock x graft interaction on seedlings rootstock diameter was found to be insignificant. The diameters of 61-53 and 7-RZ rootstocks in seedlings are 4.11 mm and 4.47 mm respectively, while the rootstock diameters of cleft and tongue graft are 4.49 mm and 4.13 mm. While the effect of seedlings on scion diameter was not statistically significant compared to rootstocks and rootstock x graft interactions, it was found to be significant compared to graft techniques. The scion diameters in seedlings were 4.41 mm in 7-RZ rootstocks, 4.03 mm in 61-53 rootstocks, while the scion diameter of seedlings was 4.63 mm in the cleft grafting technique and 3.83 mm in the tongue grafting technique. As a result of the variance analysis applied to average seedling sizes, rootstocks, graft and rootstock x graft interactions were found to be insignificant at 5% level. It was observed that the seedling length obtained with 7-RZ rootstock was 19.92 cm, and the seedling length in 61-53 rootstocks was 19.18 cm. According to the graft techniques, it was observed that the seedling length was 19.84 cm for the cleft grafted seedlings and 19.25 cm for the seedlings grafted without tongue. As a result of the variance analysis applied to average callus formation, rootstocks, graft and rootstock x graft interactions were found to be insignificant at 5% level. It was observed that the callus formation obtained from the 7-RZ rootstock was 2.97 mm, the callus formation in the 6I-53 rootstock was 2.28 mm. According to the graft techniques, callus formation of the cleft-grafted seedlings is 2.57 mm, and the callus formation of the seedlings without the tongue is 2.63 mm (Table 1).

Table 1. Graft retention rate of rootstocks and grafts, rootstock diameter of seedlings, scion diameter, seedling length values and callus formation

Rootstocks and Grafts	Graft survival rate (%)	Rootstock diameter of seedlings (mm)	Scion diameter of seedlings (mm)	Seedling length (cm)	Callus formation (mm)
61-53	96.30	4.11	4.03	19.18	2.28
7-RZ	94.30	4.47	4.41	19.92	2.97
LSD (%5)	N.S.	N.S.	N.S.	N.S.	N.S.
Cleft graft	87.30	4.49	4.63 a	19.84	2.57
Tongue graft	89.80	4.13	3.83 b	19.25	2.63
LSD (%5)	N.S.	N.S.	-	N.S.	N.S.

Plant heights were measured at 20 days intervals from planting to harvest. As a result of the analysis of graft with average plant heights, the average plant height for rootstocks, grafts and rootstock x graft interactions were found to be insignificant, mostly at 5% level. Although not statistically

significant, the average plant height average values obtained with 61-53 rootstocks are higher than the plant height average values of 7-RZ rootstock (Table 2).

Table 2. Plant height values of rootstocks and grafts

Rootstocks and Grafts	Dates							
	31.05	20.06	10.07	30.07	20.08	10.09	30.09	20.10
61-53	47.41	94.99	111.67	126.92	146.78	167.24	186.16	205.40
7-RZ	45.26	89.03	105.44	123.60	143.99	161.49	179.28	194.68
LSD (%5)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Cleft graft	46.63	91.27	109.19	124.00	140.89	155.41	172.52	187.49 b
Tongue graft	46.04	92.76	107.91	126.52	149.89	173.32	192.92	212.59 a
LSD (%5)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	-

Stem diameters of rootstocks, grafts and plants related to rootstock x graft interactions were statistically insignificant. Stem diameter values of rootstocks and grafts are presented in Table 3. Although the largest average stem diameter values were not statistically significant, they were generally higher in 7-RZ rootstock than 61-53 rootstocks. In grafts, the stem diameter values of the tongue vaccine were higher than the stem diameter values of the cleft graft.

Table 3. Stem diameter values of rootstocks and grafts (mm)

Rootstocks and Grafts	Dates							
	31.05	20.06	10.07	30.07	20.08	10.09	30.09	20.10
61-53	9.70	10.25	10.46	10.62	10.84	11.10	11.39	11.68
7-RZ	9.56	10.34	10.52	10.69	10.86	11.15	11.53	11.47
Cleft graft	9.54	10.27	10.42	10.60	10.76	10.99	11.44	11.41
Tongue graft	9.72	10.32	10.56	10.71	10.94	11.25	11.48	11.74
LSD (%5)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

According to the results of the graft analysis made with the average values obtained from the leaf count in plants, rootstocks, grafting techniques and rootstock x graft interaction were found insignificant. The average number of leaves of the plants measured at 20 day intervals according to rootstocks and grafting techniques are given in Table 4. Although not statistically significant, the number of leaves of 61-53 rootstock was found to be higher than the number of leaves of 7-

RZ rootstock. Although the leaf count values of the cleft graft was not statistically significant, it was determined that the tongue graft was higher than the leaf number values.

Table 4. Leaf number values of rootstocks and grafts (number)

Rootstocks and Grafts	Dates							
	31.05	20.06	10.07	30.07	20.08	10.09	30.09	20.10
61-53	12.62	18.81	24.77	29.84	34.86	40.27	42.47	45.06
7-RZ	11.99	18.20	22.71	28.12	32.55	36.97	39.15	40.96
Cleft graft	12.11	18.20	22.62	28.03	32.07	36.47	38.21	39.86
Tongue graft	12.5	18.81	24.86	29.92	35.34	40.77	43.41	46.16
LSD (%5)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

As a result of the variance analysis performed with the obtained total yield values rootstocks, grafts and rootstock x graft interactions were found to be insignificant at 5% level. Although it is not statistically significant, the total yield of 61-53 rootstocks (12028.14 kg/ha) was found to be higher than the total yield of 7-RZ rootstock (11422.92 kg/ha). This difference means 5.03% efficiency. Likewise, the total yield of the tongue graft was found to be lower than the total yield of the cleft graft, although it was not statistically significant. This represents a 0.14% low yield. The yield values of the plants in July, August and September were not statistically significant compared to rootstocks and grafts. Although it is not statistically significant, the yield of August and October is higher on 61-53 rootstock than 7-RZ rootstock. The yield of September was higher in 7-RZ rootstock than 61-53 rootstock. Although it is not statistically different, according to the graft techniques, the fruit yield of the plants in which the tongue graft was applied in August and September was found to be higher than the fruit yield of the cleft graft applied plants. On the other hand, the yield in October was found to be higher in the cleft graft compared to the tongue graft (Table 5).

Table 5. Total yield of rootstocks and grafts (kg/da) and distribution of yield by months (kg/da)

Rootstocks and Grafts	Yield distribution by months (kg/da)			Total yield (kg/da)
	August	September	October	
61-53	3898.69	2569.48	5559.97	12028.14
7-RZ	3451.21	2866.94	5104.77	11422.92
Cleft graft	3597.32	2563.96	5572.70	11733.98
Tongue graft	3752.58	2872.46	5092.04	11717.08
LSD (%5)	N.S.	N.S.	N.S.	N.S.

As a result of the analysis of variance applied to the findings on average fruit weight, rootstocks, grafts and rootstock x graft interactions were found to be insignificant at 5% level. Average fruit weight obtained with 7-RZ rootstock is 124.87 g and average fruit weight in 61-53 rootstock is 121.53 g. According to the grafting techniques, it is seen that the average fruit weight of the cleft grafted plants is 128.07 g and the average fruit weight of the tongue grafted plants is 118.33 g. According to the results of variance analysis performed with the water soluble dry matter values (SSC) measured in fruits, rootstocks, grafts and rootstock x graft interactions were found to be insignificant at 5% significance level. Although it was not statistically significant, SSC of 61-53

rootstocks was 4.27% and SSC of 7-RZ rootstock was 4.35%. Likewise, in the grafting techniques it was observed that the SSC of the tongue inoculated plants was 4.37% and the SSC of the cleft grafted plants was 4.24%. pH values in tomato juices were measured with pH meter, and as a result of analysis of variance applied on average values rootstocks, grafts and rootstock x graft interactions were found to be insignificant at 5% level. The pH value obtained with the 7-RZ rootstock was 3.88, and the pH value in the 61-53 rootstock was 3.98. According to the graft techniques, the pH value of the cleft grafted plants was 3.9, and the pH value of the tongue inoculated plants was 4.07.

Titratable acidity values (TA) were measured in the fruit juice obtained after the juice was extracted from tomato fruits and as a result of variance analysis applied on average values, rootstocks, graft and rootstock x graft interactions were found to be insignificant at 5% level. In plants, TA of 61-53 and 7-RZ rootstock is respectively 0.26 mg / 100 ml and 0.27 mg / 100 ml. TA of the cleft and tongue graft appears to be 0.26 mg / 100 ml and 0.27 mg / 100 ml (Table 6).

Table 6. Effect of rootstocks and graft on fruit weight, SSC, pH and TA value

Rootstocks and Grafts	Fruit weight (g)	SSC (%)	pH	TA (mg/100ml)
61-53	124.87	4.27	3.98	0.26
7-RZ	121.53	4.35	3.88	0.27
Cleft graft	128.07	4.24	3.90	0.26
Tongue graft	118.33	4.37	4.07	0.27
LSD $_{(\%5)}$	N.S.	N.S.	N.S.	N.S.

Tomato fruits are classified as extra, 1st quality and 2nd quality according to TSE and calculated by weighing. Rootstocks, grafts and rootstock x graft interactions were not found to be statistically significant in the analysis of variance on extra and 1st quality fruits. In the 2nd quality fruits, fruit number values and yield were statistically significant in rootstocks and grafts. According to the rootstocks, the number of extra, 1st quality and 2nd quality fruits in 61-53 rootstocks was found to be higher than the number of fruits of 7-RZ rootstock. According to the graft techniques, the values of extra, 1st quality and 2nd quality fruits of the tongue graft were higher than the fruit number values of the cleft graft. According to rootstocks, extra, 1st quality and 2nd quality fruit yield values of 61-53 rootstocks were found to be higher than 7-RZ rootstock. According to the graft techniques, the extra, 1st class and 2nd class fruit yield values of the cleft graft were found to be higher than the fruit yield values of the tongue graft (Tables 7 and 8).

Table 7. Effect of rootstocks and grafts on the number of classified fruits (total)

Rootstocks and Grafts	Fruit classification (total)		
	Extra	1st quality	2nd quality
61-53	35232.40	66750.10	20190.90
7-RZ	34958.10	48602.30	12353.40
Cleft graft	31039	51737.5	11561.30
Tongue graft	39151.6	63614.90	20982.9
LSD $_{(\%5)}$	N.S.	N.S.	N.S.

Table 8. Effect of rootstocks and grafts on classified fruit yield (kg/da)

Rootstocks and Grafts	Fruit classification (kg/da)		
	Extra	1st quality	2nd quality
61-53	5838.85	6512.38	862.75
7-RZ	5089.87	5172.02	590.82
Cleft graft	6386.43	6073.11	882.82
Tongue graft	4624.44	5929.13	570.69
LSD (%5)	N.S.	N.S.	N.S.

DISCUSSION

The graft retention rate was between 87.3% and 96.3% according to the graft techniques and rootstocks. The morphological structure of the variety and the graft method effect the graft retention rate. In the graft method, the graft retention rate of the tongue graft was higher than the cleft graft. In this combination of grafts, the cut parts make better contact with each other, thus increasing the success of the graft. These results are higher than the findings of Vuruşkan and Yanmaz (l989) who conducted research on eggplant grafting on tomato rootstock. This can be attributed to the close morphological structure of the rootstock with the variety (Yarşi 2003, Yetişir 2001, Gebeloğlu et al, 2006). The scion diameter in seedlings was not found to be different according to the grafting techniques (4.63 mm in the cleft graft and 3.81 mm in the tongue graft) and rootstocks. These results Traka-Mavrona et al. (2000) parallels the findings of melon grafting on melon rootstocks. According to Yetişir (2001), rootstock and scion diameters affected significantly depending on the rootstock, but did not change significantly in graft techniques. This also differs with the findings in the study. The size of the seedlings did not differ according to the rootstock diameter in the seedlings, the number of leaves in the seedlings, the formation of callus at the grafting site, the grafting techniques and the rootstock. Rootstocks and varieties were found to be significant in the number of leaves found by Romano and Paratore (2001), Yetişir (2001). This difference may depend on the variety. The findings on plant growth were examined, while stem diameter and leaf number did not differ according to the grafting techniques and rootstocks, it was determined that the tongue grafting technique (212.59 cm) produced taller plants only in the results of 20.10 in plant height measurements. Vuruşkan and Yanmaz (1989) found a difference between graft techniques in terms of stem diameter and leaf number. In terms of the number of leaves, it is parallel to the results of the study, but does not differ in terms of stem diameter. The distribution of yield and yield by months was not statistically significant according to either the graft technique or the rootstocks. However, the total yield is at most 61-53 rootstocks (12028.14 kg/da), and in cleft graft (11733.98 kg/da). According to the research findings, it was not found significant among the total yield values compared to the rootstocks. Similarly when Ulukapı and Onus (2005) compared the yields in tomatoes, they stated that the yields were the same. Yarşi (2002), Dağıstan et al. (2005), Yetişir et al. In the results of (2O03), they emphasized that rootstocks effect the yield. The reason for the difference with the results of the research may be due to the different species or rootstock used. Regarding product quality, average fruit weight, SSC, PH, TA, extra, 1st quality and 2nd quality fruit weights were examined. These characteristics examined did not differ according to both rootstocks and grafting techniques. These results in the research findings are similar to the results of Yarşi et al (2002) and Yetişir (2001). SSC amount varied depending on rootstocks (Yetişir 2001). Traka-Mavrona et al. (2000) grafted different varieties on different rootstocks in melon and found no difference in terms of average fruit weight. When Ulukapı and Onus (2005) examined the quality characteristics of grafted tomato variety, they emphasized that there was a difference between the

fruits obtained from the plants grown with grafted seedlings and others. These results differ from the values in the study. In the study, it was determined that there were no significant differences in terms of rootstocks and grafting methods. Therefore it was concluded that both rootstocks and graft methods could be preferred.

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THE MONITORING OF THE FIRE BLIGHT SPREAD AND ITS DANGER FOR THE CONSERVATION OF GENETIC RESOURCES OF WILD APPLE VARIETIES IN THE FORESTS OF KYRGYZSTAN.

Tinatin Doolotkeldieva, Mahabat Konurbaeva , Saikal Bobushova, Sezim Zholdoshbekova

Kyrgyz-Turkish Manas University, Plant Protection Department 56 ,Prospect Ch.Aytmatov, Bishkek city, 720044, Kyrgyzstan

Abstract

In Kyrgyzstan, forest landscapes occupy small areas, only 4-5% of the country's total area. Apple forests as a component of natural walnut forests are represented mainly by wild species: Kyrgyz apple trees (Malus kyrghisorum), Sivers apple trees (M. sieversii), and Nedzvetsky apple (M. niedzweckiana).

Local species of apple trees are a vital genetic resource. They must be protected from possible hybridization with cultivated apple varieties and the invasion of dangerous pests and diseases.Moreover, the arrival of fire blight disease in the center of the origin of endangered fruit species is a significant threat to the whole forest ecosystem. The study aimed to release the spread of fire blight in orchards and natural forests of Kyrgyzstan and the phenotypic characteristics of the resistance of wild and commercial apple forms to fire blight.

Erwinia amylovora isolates as fire blight pathogen were identified by using the specific diagnostic primer pairs PEANT-1/PEANT-2. Specific primers targeting CRISPR genotypes were used for different spacer regions.

Screening for relative resistance or sensitivity of apple cultivars to fire blight was carried out in a quarantine isolated room. Nine different apple varieties were inoculated with highly virulent E. amylovora strain Zh-2 containing 10^{9} CFU/ ml. After a three-time artificial infection with interval ten days, the tested apple varieties like Earley Geneva, Redchief, Golden Delicious and Bellefleur have shown an evident resistance ability, and tested wild Nedzvetsky apples (M. niedzweckiana) have shown a moderate resistance.

Key words: *Local apple trees, vital genetic resources, Erwinia amylovora invasion, apple variety resistance*

1. INTRODUCTION

In Kyrgyzstan, forest landscapes occupy small areas, only 4-5% of the country's total area. Forest plantations grow in certain environmental conditions, soften the sharply continental climate of a mountainous country, and play an important ecological and socio-economic role.The state owns the forests in this country, and state authorities carry out forest resources management in cooperation with local authorities [First national forest inventory of the Kyrgyz Republic,2000; Forest Typology in the Kyrgyz Republic, 2008;Gan, 1970].

The main natural apple forest stands are located in the south of Kyrgyzstan. In the past, wild apple forests grew in the north of Kyrgyzstan, in the Kyrgyz mountain ridge; due to anthropogenic pressure, only small groups of these forests have survived in these places [Forest Typology in the Kyrgyz Republic, 2008; Vykhodtsev,1970]. As a component of natural walnut forests, Apple forests are represented mainly by wild species: Kyrgyz apple trees (*Malus kyrghisorum)* and Sivers apple trees (*M. sieversii)*. Among these species, another rare species of wild apple is Nedzvetsky apple (*M. niedzweckiana*). This species grows singly or in small groups [Forest Typology in the Kyrgyz Republic, 2008; Vykhodtsev,1970; Dragavtsev,1956].

Local species of apple trees are a vital genetic resource. They must be protected from possible hybridization with cultivated apple varieties and the invasion of dangerous pests and diseases.

Since fire blight was first reported in Kyrgyzstan in 2009, it has steadily spread from its original epicenter, the northern part, to the country's southern and eastern parts. 2011-2015 fire blight caused significant damage to orchards and genebanks in the country's northern and eastern regions. Moreover, since 2013, severe fire blight outbreaks have been annually observed in orchards of the southern regions, where the climate is more favorable for the development and spread of the pathogen. The study aimed to release the spread of fire blight in orchards and natural forests of Kyrgyzstan and the phenotypic characteristics of the resistance of wild and commercial apple forms to fire blight.

2.MATERIALS AND METHODS

2.1.Plant samples.

Expeditions were conducted in Jalal -Abad region, where Arslonbob natural forests with wild biodiversity of fruit trees and plants, including wild apple trees (*Malus sieversii*, *Malus niedzwetzkyana) and* pear trees (*Pyrus korshinskyi, Pyrus asia-mediae*). In total, we visited 28 sites around wild forests and the forestries in the heart of the wild natural forest. Approximately 150 samples were obtained from apple, quince, pear, hawthorn, and dog rose-trees with fire blight symptoms and without symptoms**.**

2.2.Molecular identification

Levan-positive, non-fluorescent culture at a concentration of 10^6 cells/ml in sterile distilled water suspension was prepared and used immediately or stored at -18 °C until PCR product was observed. For genetic characterization, genomic DNA was extracted from bacterial log phase liquid cultures grown overnight at 27 °C in LB medium using the DNeasy Blood and Tissue kit (Qiagen) according to the standard protocol as provided by the manufacturer. Specific diagnostic primer pairs PEANT-1/PEANT- 2, G1-F/G2-R [Llop,2000;Taylor,2001]were used. PCR analysis was conducted according to [Taylor,2001] protocol. Specific primers targeting previously identified CRISPR genotypes were used for different spacer regions [Rezzonico, 2011].

2.3. *In vitro* virulence test of *Erwinia amylovora* isolates

The virulence of *Erwinia amylovora* isolates was tested using an immature pear fruit assay according to the methods [Zhao,2005] with minor modifications. The suspension of *E. amylovora* cells in physiological saline were prepared containing 10^9 cells/ml. After the surface sterilization, immature pear fruits were inoculated with a suspension of *Erwinia amylovora* cells (10μkl) by a 0.2-mm syringe needle. Pear fruits were placed in a humid chamber for five days at 25°C. The test results were considered positive when the symptoms of plant tissue necrosis developed, and milky-white exudate was secreted in the inoculation area.

2.4. *In vivo* evaluation of apple seedlings susceptibility to fire blight

Screening for relative resistance or sensitivity of apple cultivars to fire blight was carried out in a quarantine isolated room. Two-year-old seedlings (clone stock) taken from the Botanical garden collection were used. Nine different apple varieties were planted in the pots 35.5 cm deep and 10.5 cm in diameter and grown for several weeks before injection (Table1) with conventional chemical contents (Table 2). For each cultivar, five trees were inoculated in one repetition. Artificial blight infection was carried by dissecting the tips of the two upper leaves of growing shoots (minimum shoot length 25 cm) with scissors soaked in a suspension of highly virulent E. amylovora strain Zh-2 containing 10^9 CFU/ ml (Fig.1). The length of necrosis about the shoots' total length was measured after incubation for four weeks at 25-27^0 C (day) and

20^0C (night), air humidity 85% in the quarantine room. Golden Delishes variety was used as resistant control, Bishkek local variety was used as sensitive control. Wild *Malus nedzwieckii* variety planted in pots was used as natural resistant control.

Table 1. Used apple varieties (*M.domestica)*

	Apple varieties (*M.domestica*)	Quantity of used fruit trees in inoculated plots	Quantity of used fruit trees in the control plots.
1.	Starkrimson	10	3
2.	Red Chief	10	3
3.	Belfler	10	3
4.	Golden Delishes	10	3
5.	Bishkek	10	3
6.	Nedzwieckii wild variety)	10	3
7	Idered	10	3
8	Early Geneva	10	3
9	Ligolina	10	3

Table 2. Soil chemical contents

	Humus %	pH	Total nitrogen	Soil content, mg / kg	
				P_2O_5	K_2O
Soil	3,12	7,95	244	150	550

Fir.1. The scissors moistened in a suspension of *Erwinia amylovora* strain Zh-2 and cut half of the leaf blade of several young leaves on young apple shoots

3. RESULTS

3.1. Molecular identification

With the PEANT-1/PEANT-2 primers, the presence of non-conjugative plasmid pEA2 was revealed in 14 *E. amylovora* strains. Six isolates were isolated from quince (*Cydonia spp)*; 4 isolates from cultivated apples (*M.domestica*);1 isolate from cultivated pears (*P. communis);* 1 isolate from young bushes of wild forms of pear trees *(Pyrus korshinskyi Litv)* and 2 isolates from hawthorn (*Crataegus turkestanica)*. Local quince varieties were the most sensitive to a bacterial blight than other pome fruit trees; a significant number of *E.amylovora* isolates obtained from introduced apple varieties. Complete CRR1 and CRR2 arrays from 14 *E.amylovora* isolates indicated identical in spacer organization for these isolates.All tested isolates were genotyped as A-derived. None of the isolated *E. amylovora* bacteria showed spacer deletions typical for the genotype Z or D.

3.2.In vitro assesment of susceptibility of apple varieties by artificial inoculation of fruits

The study of the pathogenesis of *E.amylovora* on host plants (on apple trees, pears) in an open space is not possible because of the high contagiousness of the pathogen. Moreover, to study this process in a greenhouse is also tricky since large areas are needed. Therefore, the researchers used immature pear fruits as an alternative. In nature, this bacterium uses the colonization of wounds as a mechanism of infection;therefore, immature fruits' infection is carried out by inoculating the wound. The test for the pathogenicity of *E.amylovora* using intact immature pear fruits or their slices is successfully used to analyze the virulence of *E. amylovora* genes [.Dardouri,2017].

In these experiments the suspectibilty of apple varieties was evaluated on the emergence of bacterial exudate drops on the surface of fruits after two to five days (Fig.2). In this case, the fruits have turn to brown. In the negative control, only necrotic lesions have observed at the injection site or no damage at all. In total, from the collection of the nursery of the Botanical Garden, 17 varieties of apple fruits were tested for susceptibility to *E.amylovora* (Table.3).

The degree of apple fruits infection was assessed according to the following scale:
1 absence of infection,
2 unclear symptoms,
3 the appearance of exudate in 30% of fruits on the 5th days- the low virulence,
4 the appearance of exudate on the 3rd days in 50% of fruits - moderate virulence,
5 the appearance of exudate on the 2nd days in 60-70% of fruits- highly virulence

According to evaluation by the presence of exudate formation on the surface fruits during 5 days, the Vkusnaya, Discovery, Caravella, and Ostankino varieties have showed a significant resistance to bacterial pathogen. Such varieties like Ainur, Starkrimson, Aichurek, and Borovinka have a medium tolerant; other varieties' were susceptible to bacterial pathogen.

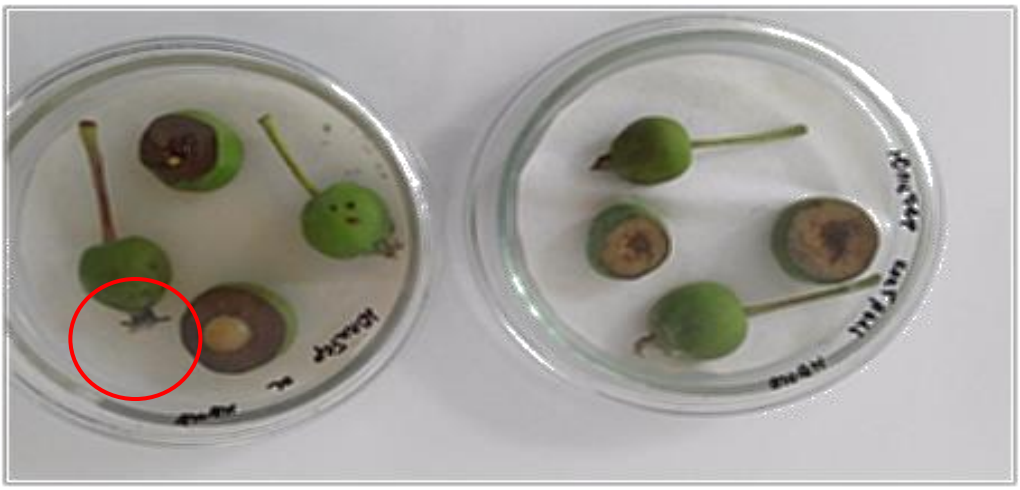

Figure 2. The emergence of bacterial exudate formation on friuts of Jupiter variety

Table 3. The susceptibility of apple varieties to bacterial pathogen *Erwinia amylovora*

№	Apple varieties	The susceptibilty degree of varieties to bacterial pathogen
1.	Jupiter	+++
2.	Rashida	++
3.	Kyrgyz zimnay	++
4.	Starkrimson	++
5.	Borovinka	++
6.	Aychurok	++
7.	**Vkusnay**	**+**
8.	Aport Alexandra	+++
9.	Diskavery	+
10.	Aynur	+
11.	Krymskay zimnay	+++
12.	King Luceus	+++
13.	Florina	+++
14	Karowella	+
15.	Ottawa	++
16.	Muntuaner	++
17.	Ostankino	+

Footnote :"+++" - sensitive; "++" - medium sensitive; "+" – resistant

3.3. In vivo evaluation of apple seedlings susceptibility to fire blight

Artificial inoculation of apples, pears, and other rosaceous hosts to determine their resistance to fire blight has been carried out by studies[Kellerhals, 2004]. In this study, the phenotypic evaluation was performed by

measuring necrosis's emergence on the leaves and shoots. The tested apple cultivars have reacted differently to artificial infection. As in the varieties Golden Delishes and Belfleur, after infection, necrotic spots appeared only for 3-4 days, and at the same time, the necrotic area did not spread to the leaf tissue. However, by the 7th day, necrosis manifested itself in all varieties. After two weeks of artificial inoculation, the varieties Idared, Starkrimson, Ligolina, Nedzvetsky were severely affected.Necrosis from infected shoots rapidly spread to the lower nodes. Fire blight symptoms have manifested in the varieties like Red Chief, Early Geneva, and Bishkek too, however, it extended only on the upper infected shoots.

While varieties like Bellefleur and Golden were less susceptible to fire blight. All sensitive varieties show notable symptoms like a shepherd's staff. It was especially noticeable in wild variety like Nedzvedsky. By day 21, the growth of new shoots was noted in such varieties like Red Chief, Earley Geneva, due to that the plants looked healthy.

For confirming the disease's symptoms in seedlings, amyloid-like colonies were re-isolated from diseased leaves and stems of seedlings on Levan agar. The largest amount of colony-forming units (CFU) of *E. amylovora* was found in the Idared variety and the smallest CFU was noted in the infected leaves of the Golden seedling, there were a total of $4,7*10^4$ (Table 4).

Table 4.The quantity of *Erwinia amylovora* **CFU**/ml, from five leaves

№	**Apple varieties**	**Erwinia amylovora CFU/ml**
1.	Idared	35,8*104
2.	Early Geneva	19,3*104
3.	Ligolina	23,4*104
4.	Starkrimson	33,7*104
5.	Red Chif	24,3*104
6.	Belfler	5,3*104
7.	Golden Delishes	4,7*104
8.	Bishkek	12,2*104
9.	Nedzvesky	26,1*104

Conclusions

Artificial infection of seedlings with *E.amylovora* has revealed that the most susceptible to fire blight disease were Idared, Starkrimson varieties. Microbiological analysis has also confirmed the higher amounts of *E.amylovora cells* in these varieties. The varieties like Earley Geneva, Redchief, have been assessed as moderately resistant to fire blight, this was confirmed not only symptomatically , but also by microbiological accounts of obtained pathogen’s cells reisolated from the surface of these plant materials.Variety Golden Delicious phenotypically assessed as moderately resistant, at the same time the organs (leaves and shooties) also contain amyl-like colonies. The seedlings of the Bellefleur variety has assessed as with average resistance to fire blight. Varieties Idared, Ligolin, plants are very weakened, leaves are small, poorly developed. Variety Nedzvetskiy can also be a reservoir of *Erwinia* bacterial cells were also

found in maximum numbers.These studies were carried out during 2 vegetation years, therefore these studies will be continued in the coming years.

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SOME MORPHOLOGICAL PROPERTIES OF QUALIFIED TOMATO INBRED LINES AND PRINCIPAL COMPONENT ANALYSIS OF THE RELATIONSHIP BETWEEN THESE PROPERTIES

Ünal KAL[a]*, Necibe KAYAK[b], Gülbanu KIYMACI[b], Yeşim DAL[a, c], Musa SEYMEN[a], Önder TURKMEN[a], Ertan Sait KURTAR[a]

[a]: Selçuk University, Faculty of Agriculture, Department of Horticulture, Konya/Turkey
[b]: Selcuk University, Institute of Sciences, Konya/Turkey
[c]: Siirt University, Faculty of Agriculture, Department of Horticulture, Siirt/Turkey

*Corresponding author: unalkal42@gmail.com

Abstract:

Tomato is one of the most grown vegetable species in the world and it is very important for human health. Both its suitable for fresh consumption and the fact that it can be processed product in different areas in the vegetable industrial sector are the main reasons for the high production and consumption. Unlike other tomato varieties, cocktail tomatoes are heavily consumed for fresh consumption. In this study, some morphological features of 77 different cocktail tomato inbred lines at the S5 level were observed according to UPOV parameters, and the measurements and observations were subjected to principal component analysis (PCA), and the relationships between them were tried to be determined. The study was explained at a rate of 63% in 6 components by PCA. According to the results; there was a positive correlation between Brix, fruit width, fruit size, and pericarp thickness. It was concluded that tomato genotypes had a significant variation and could be a gene source in future breeding.

Keywords: Tomato, PCA, correlation, breeding, morphological traits

Introduction

Tomato is one of the most produced vegetables in the world. Considering the 2018 data 182,256,458 tons of tomatoes are produced in an area of 4,762,457 hectares in the world (FAO, 2020). The intensive consumption of tomatoes all over the world is because it is rich in carotenoids, antioxidants, vitamins, and minerals, and its low content harmful to human health such as cholesterol and saturated fats (Adalid et al, 2010; Cammarano et al, 2020). Lycopene is one of the

most important carotenoids in tomatoes, as in other red fruits. It is reported that lycopene and other carotenoids contained in tomatoes are beneficial in preventing many diseases, especially preventing the increase of cancer cells (Flores et al 2017; Zhang et al, 2020). In addition to its effects on human health, tomatoes are suitable for both industrial and fresh consumption. Although there are lots of tomato varieties that are used in different ways in the industrial sector, cocktail tomatoes are mostly used for fresh consumption.

Due to its important properties, tomato is one of the most used vegetable species in breeding studies in the world. Developing tomato varieties with high yield, resistance to diseases, long shelf life, and high nutritional content in line with the demands of the consumer and the producer requests are important breeding goals in tomatoes (Brezeanu et al., 2019). In order to achieve these goals, it is necessary to benefit from the heterosis effect. (Herath et al., 2020; Liu, et al., 2020). In order to successfully achieve this heterosis effect, which is one of the necessary mechanisms for revealing quality hybrid varieties, it is necessary to know the specifications of the existing gene pool and also to distinguish the genetic differences in-depth. A large number of morphological and agronomic characters should be examined to reveal the differences between genotypes. Examining various traits in different lines is very important to understand the relationship between heterosis and genetic distance for multiple phenotypic traits. One of the most common methods used to interpret genotypes by dividing them into phenotype-based heterotic groups is principal component analysis (PCA) (Jin et al 2019). The principal component analysis is a clustering method that reduces the size of multivariate data by preserving most of the variance (Eriksson et al., 2006). It has been reported that the ratio of the first 2 or 3 components should be 25% to explain the principal component analysis correctly (Seymen et al.2019). Besides, interpretations can be made by drawing different graphs using the components obtained as a result of the analysis (e.g. Score plot, Loading plot).

In this study, the relationship between some morphological and agronomic features of 77 cocktail tomato inbred lines at the S5 level was tried to be explained using principal component analysis.

Material and Method

The study was carried out with 77 inbred cocktail tomato lines, which were self-pollinated as a result of controlled pollination in five years (at the S5 stage). The seeds of pure lines were sown on the seedling trays filled with sterile peat moss on January 10, 2020, by throwing a single seed in

each eye. Until the seeds germinated and the seedlings reached the the planting size (2-3 leaves) in greenhouse conditions, cultural practices were carried out regularly. The seedlings were planted in the greenhouse of Selko Arge Biotechnology LTD in Aksu-Antalya district on May 15, 2020, with planting distances of 50x50x90 cm with 5 plants from each line. After planting the seedlings, it was irrigated with drip irrigation, and during the vegetation period, cultural practices such as hoeing, middle breaking, pruning, fertilization, disease, and pest management were carried out regularly.

During the vegetation period, the morphological characteristics of the leaves, flowers, and fruits of the lines were determined according to the International Union for the Protection of New Plant Varieties (UPOV) specification document (Table 1). The yield was determined by weighing the fruits belonging to the harvested lines separately on 01 July 2020. Average fruit weight (g), fruit length (mm), fruit width (mm), pericarp thickness (mm), carpel number (piece), and water-soluble dry matter (Brix) measurements were determined on five fruits from each line.

Table 1. UPOV properties of 77 cocktail tomato lines observed in leaves, flowers, and fruits during the plant vegetation period.

Properties	**Value, ranges, measurement, and observation**
Plant growth type	Determinate, indeterminate
Leaf attitude	Semi-erect, horizontal, semi-dropping
Leaf length	Short, medium, long
Leaf width	Narrow, medium, broad
Leaflets	present, absent
Number of flowers	3-5 pieces, 6-10 pieces, more than 10
Time of ripening	Very early, early, medium, late, very late
Fruit color	Orange, yellow, pink, light red, red, dark red, zebra
Fruit cross-section	Not round, round
Fruit shape in longitudinal section	Circular, rectangular, cylindrical, elliptic, heart-shaped, obovate, ovate, pear-shaped

These measurements and observations were subjected to principal component analysis using the JMP statistical package program.

Results and Discussion

Tomato inbred lines in the study were evaluated according to UPOV parameters and differences between genotypes were revealed.

When the plant characteristics of lines were examined, it was found that 14% semi-erect, 58% horizontal, 27% semi-drooping in terms of leaf attitude. According to the leaf length, 43% of the lines were determined as short, 31% medium, and 26% longleaf. It was observed that the leaf

widths were narrow in 44% of the lines, medium in 48%, and wide in 8%. It has been determined that 95% of cocktail tomato lines have small leaflets in the leaf blade, but not in 5%. According to the number of flowers in the bunches, it was determined that 10% had 3-5 flowers, 17% had 6-10 flowers and 73% had more than 10 flowers. When the ripening times of the fruits were examined, it was observed that 13% of the lines matured very early, 52% early, 30% in the middle period, and 5% late. Fruits colors are pink in 3%, light red in 3%, red in 57%, dark red in 36%, and zebra in 1% of the genotypes. When genotypes are classified according to the longitudinal sections of fruits, it has been found that 30% are round, 3% rectangular, 9% cylindrical, 42% elliptic, 4% heart-shaped, 9% obovate, and 4% ovate. When the cross-sections of the fruits were examined, it was determined that 10% of them were not round and 90% of them were round (Table 2).

Table 2. Botanical and fruit observations of cocktail tomato lines

Genotypes	LA	LL	LW	L	NF	TR	FC	FLS	FCS
G1	7	5	3	1	7	5	5	5	2
G2	7	3	3	9	5	3	5	3	2
G3	5	7	5	1	7	3	5	6	2
G4	5	3	3	9	7	3	5	4	2
G5	5	3	3	9	7	3	5	5	2
G6	5	7	5	1	7	3	5	3	2
G7	5	7	5	1	7	3	5	6	2
G8	5	3	5	1	7	1	6	5	2
G9	5	7	5	1	7	3	5	6	2
G10	5	5	5	1	7	5	5	3	2
G11	5	7	5	1	7	5	5	6	2
G12	5	7	5	1	7	3	5	6	2
G13	5	7	5	1	7	3	5	6	2
G14	5	7	5	1	7	3	5	6	2
G15	7	5	3	1	7	3	5	3	2
G16	7	5	3	1	7	5	5	3	2
G17	7	5	3	1	7	7	5	3	2
G18	7	5	5	1	7	5	5	6	2
G19	7	3	3	1	7	5	5	5	2
G20	7	3	3	1	7	5	5	5	1
G21	5	3	3	1	7	3	5	6	2
G22	5	3	3	1	5	5	5	6	2
G23	5	5	3	1	7	5	5	3	2
G24	5	5	3	1	7	3	5	6	2
G25	7	7	5	1	7	3	5	6	2
G26	5	5	5	1	7	5	6	5	2
G27	5	3	3	1	7	5	6	6	2
G28	7	3	3	1	7	1	6	3	2
G29	5	5	5	1	7	3	6	4	2
G30	5	3	5	1	7	5	5	6	2
G31	5	3	3	1	7	1	6	3	2
G32	5	7	5	1	7	1	6	6	1
G33	5	7	5	1	7	3	6	6	2
G34	5	7	7	1	3	7	5	6	2
G35	5	5	5	1	7	3	6	3	2
G36	5	5	7	1	7	3	6	7	2
G37	5	5	7	1	7	3	6	6	2

G38	5	5	7	1	7	3	6	6	2
G39	7	7	7	1	3	3	5	6	2
G40	5	5	3	1	7	3	6	3	2
G41	5	7	5	1	7	1	6	6	2
G42	3	3	5	1	7	3	5	3	2
G43	3	3	5	1	3	3	5	10	2
G44	5	5	5	1	7	1	5	6	2
G45	5	3	5	1	7	1	5	6	2
G46	5	3	5	1	7	1	5	6	2
G47	5	5	5	1	3	3	6	8	2
G48	3	3	3	1	7	3	6	8	2
G49	3	3	3	1	7	3	6	3	2
G50	7	3	3	1	7	3	6	6	2
G51	7	3	3	1	7	3	6	7	1
G52	7	3	3	1	7	3	6	3	2
G53	5	3	3	1	7	3	6	6	2
G54	3	7	5	1	3	3	6	3	2
G55	3	3	7	1	5	5	5	9	1
G56	3	3	5	1	5	3	5	3	2
G57	7	3	3	1	7	5	5	8	2
G58	7	7	3	1	7	5	4	8	2
G59	7	7	5	1	7	5	5	8	2
G60	5	5	5	1	7	5	5	6	2
G61	5	5	5	1	7	3	6	3	2
G62	3	3	3	1	5	3	6	3	1
G63	5	3	3	1	5	5	5	6	2
G64	3	5	5	1	7	3	3	3	2
G65	5	3	3	1	5	1	6	6	2
G66	5	5	5	1	5	3	6	3	2
G67	5	3	3	1	5	1	6	6	2
G68	3	3	3	1	7	5	5	5	2
G69	3	3	3	9	7	3	6	3	2
G70	5	5	3	1	5	5	5	8	1
G71	7	5	3	1	5	7	5	9	2
G72	5	3	3	1	7	5	3	3	2
G73	7	7	5	1	3	3	5	7	1
G74	7	7	5	1	3	3	5	3	2
G75	7	5	5	1	3	5	4	6	2
G76	5	3	5	1	5	7	5	6	2
G77	5	7	5	1	5	5	7	8	1

LA: Leaf Attitude; 3:Semi erect, 5: horizontal, 7: semi-dropping, **LL**: Leaf length; 3: Short, 5: medium, 7: long, LW: **Leaf width**; 3: Narrow, 5: medium, 7: broad, **L**: Leaflets; 1: present, 9: absente, **NF**: Number of flowers; 3: 3-5 pieces, 5: 6-10 pieces, 7: more than 10, **TR**: Time of ripening; 1: Very early, 3: early, 5: medium, 7: late, 9: very late, **FC**: Fruit color; 1: Orange, 2: yellow, 3: pink, 4: light red, 5: red, 6: dark red, 7:Zebra, **FLS**: Fruit shape in longitudinal section: 3: Circular, 4: rectangular, 5: cylindrical, 6: elliptic, 7: heart-shaped, 8: obovate, 9: ovate, 10: pear-shaped, **FCS**: Fruit cross section; 1: Not round, 2: round

Some yield parameters of fruits belonging to cocktail tomato genotypes were also examined. The average fruit weight of all genotypes was measured as 25.5 g. The highest fruit weights from the G66, G26, G52 were 44.0 g, 43.3 g, 43.2 g, respectively; The lowest values were measured in the G1, G4, and G24 (13.3 g, 12 g, 11.4 g, respectively). The average fruit size was found to be 37.55 mm. Among the genotypes, G28, G61, G35 were found to have the highest fruit size (57.1 mm, 49.5 mm, 46.7 mm). The lowest values were measured in G31, G72, and G76 as 29.5 mm, 28.9 mm, 28.1 mm, respectively. The fruit width average was found to be 35.12 mm. G41 (42.1 mm) and G38 (42) gave the highest values in terms of fruit width, while genotypes G71 (26.5 mm) and G58 (22.03 mm) gave the lowest values. Pericarp thickness was the highest in the G67 (6.03mm), G39

(5.53mm), and G34 (5.15mm), while the lowest in the G66 (1.78mm) and G58 (1.39mm). The average amount of water-soluble dry matter was found to be 6.15. Highest Brix values were determined in G39, G47, and G55 (9.10, 9, 9 Brix, respectively). G56, G71, and G23, which had the lowest Brix values produced the 4, 3.9, and 3 Brix, respectively. When the carpel numbers were examined, it was found that the G12, G16, G26, G33, G38, G40, and G45 had 3 carpels, while the other genotypes had 2 carpels (Table 3).

Table 3. Fruit measurements of cocktail tomato lines

Genotypes	AFW	FS	FW	PT	BRIX	CN
G1	13,33	34,80	30,09	3,14	6,80	2
G2	28,50	30,48	36,94	3,43	5,60	2
G3	14,15	34,84	32,46	2,68	5,10	2
G4	12,00	39,15	35,23	4,42	7,10	2
G5	28,50	42,76	30,94	3,33	6,80	2
G6	26,13	37,53	37,64	2,92	7,30	2
G7	30,25	41,31	39,78	4,94	4,90	2
G8	21,71	37,34	31,67	3,22	6,00	2
G9	17,11	37,36	34,06	2,96	5,70	2
G10	23,00	33,94	34,82	3,47	6,40	2
G11	26,11	39,85	34,96	3,13	6,10	2
G12	18,18	33,94	34,82	3,47	5,80	3
G13	18,33	39,85	34,96	3,13	6,00	2
G14	25,67	35,10	34,95	4,29	4,50	2
G15	23,60	36,36	34,78	4,16	7,40	2
G16	27,55	36,06	35,12	2,27	6,30	3
G17	14,38	34,62	34,04	2,10	5,50	2
G18	31,25	32,40	32,25	4,07	6,50	2
G19	16,25	32,35	34,26	3,66	7,40	2
G20	26,43	31,15	30,19	2,44	5,30	2
G21	27,14	43,56	37,73	3,05	6,40	2
G22	33,33	39,53	30,84	2,67	6,00	2
G23	37,00	38,22	35,74	2,16	3,00	2
G24	11,44	38,49	39,40	4,03	4,50	2
G25	28,89	37,73	40,65	3,76	8,40	2
G26	43,33	42,05	38,20	2,43	4,50	3
G27	23,50	35,53	33,75	2,31	7,10	2
G28	24,38	57,05	39,46	4,12	7,30	2
G29	29,00	35,56	34,21	4,34	6,00	2
G30	21,25	33,87	33,12	3,26	5,90	2
G31	23,64	29,54	31,36	2,67	8,60	2
G32	37,45	41,41	36,61	3,36	6,20	2
G33	20,63	32,92	33,75	2,96	6,02	3
G34	28,33	41,86	41,81	5,15	7,20	2
G35	30,00	46,68	40,28	4,85	6,80	2
G36	30,22	36,71	37,27	2,95	5,50	2
G37	39,00	37,58	41,10	3,45	5,70	2
G38	36,75	38,18	42,00	4,91	5,40	3
G39	27,78	39,00	41,18	5,53	9,10	2
G40	20,70	40,71	39,81	4,25	6,60	3
G41	26,00	37,87	42,12	3,68	4,90	2
G42	33,44	36,36	36,02	2,72	6,00	2
G43	18,90	37,09	39,77	4,39	5,40	2
G44	15,20	36,58	30,02	3,34	5,50	2
G45	16,91	33,68	36,40	3,09	5,80	3
G46	19,09	33,12	33,35	2,39	7,30	2
G47	14,86	40,40	38,31	3,38	9,00	2
G48	20,06	36,24	34,00	3,21	7,00	2

G49	27,22	37,11	31,82	3,29	6,50	2
G50	28,30	38,72	26,87	2,52	5,50	2
G51	37,43	37,97	31,40	3,54	6,40	2
G52	43,27	35,21	38,58	4,52	5,80	2
G53	21,18	42,75	36,32	2,75	6,20	2
G54	26,40	41,63	36,81	3,03	7,00	2
G55	15,92	41,26	39,67	4,12	9,00	2
G56	31,50	33,19	31,36	2,55	4,10	2
G57	33,38	38,81	37,70	3,85	6,10	2
G58	31,00	34,75	22,03	1,39	5,40	2
G59	19,33	36,49	38,25	4,44	6,10	2
G60	37,25	38,72	39,74	4,17	7,30	2
G61	32,80	49,47	37,76	4,10	7,30	2
G62	27,22	38,92	26,69	2,27	6,30	2
G63	20,50	43,63	37,13	3,78	6,40	2
G64	29,37	37,97	35,38	2,46	4,60	2
G65	31,92	33,62	32,33	3,09	4,20	2
G66	44,00	34,42	31,58	1,78	5,70	2
G67	28,00	41,25	38,45	6,03	6,90	2
G68	15,44	40,09	41,36	3,30	5,00	2
G69	19,92	31,22	30,96	2,24	5,10	2
G70	20,86	39,05	33,08	2,72	5,20	2
G71	22,44	38,63	26,55	2,13	3,90	2
G72	27,29	28,98	40,45	2,33	8,10	2
G73	16,86	39,79	31,96	3,49	6,00	2
G74	23,14	40,99	31,00	4,57	5,50	2
G75	24,71	34,93	32,04	2,99	7,00	2
G76	27,18	28,09	29,35	3,01	5,80	2
G77	19,13	34,80	35,49	3,01	5,80	2

AFW: Average Fruit Weight (gr/fruit), **FS:** Fruit Size (mm), **FW**: Fruit Width (mm), **PT**: Pericarp Thickness (mm), **BRIX**: Water Soluble Dry Matter (Brix), **CN**: Carpel Number (piece)

Table 4. PCA results obtained from fruit measurements of tomato lines.

	PCA1	**PCA2**	**PCA3**
Eigen Value	2,526	1,9	1,525
Variance%	16,84	12,66	10,169
Total Variance %	**16,84**	**29,508**	**39,676**
Eigenvectors			
AFW	0,05665	0,18526	0,29289
FS	0,33722	0,16973	-0,18577
FW	0,46797	0,17644	0,06163
PT	0,47579	0,08559	-0,17071
BRIX	0,22945	0,01588	-0,39781
CN	0,07494	0,12381	0,46184
FLS	0,12708	-0,43882	-0,13247
FCS	0,00652	0,23855	0,27847
LA	-0,03946	-0,21764	0,03991
LL	0,27288	-0,31605	0,35984
LW	0,41838	-0,20126	0,25155
L	-0,17798	0,2528	-0,27153
NF	-0,17189	0,33594	0,31414
TR	-0,15433	-0,42059	0,07527
FC	0,16473	0,30322	-0,08773

AFW: Average Fruit Weight, **FS:** Fruit Size, **FW**: Fruit Width, **PT**: Pericarp Thickness, **BRIX**: Water Soluble Dry Matter, **CN**: Carpel Number, **LA**: Leaf Attitude, **LL**: Leaf length, **LW**: Leaf width, **L**: Leaflets, **NF**: Number of flowers, **TR**: Time of ripening, **FC**: Fruit color, **FLS**: Fruit shape in longitudinal section, **FCS**: Fruit cross-section

Principal component analysis (PCA) was applied to the measurements and observations taken through the statistics program. When the obtained data were examined, it was seen that the study was explained in 6 components with a rate of 63%.

As a result of the principal component analysis, the first component (PC1) explained the study with a rate of 16.8%. According to the first component, pericarp thickness, fruit width and leaf width were the highest positively explained parameters. While the second component (PC2) explained the study with a rate of 12.6%, the number of flowers and fruit color was the highest positively explained parameters, and the fruit longitudinal section was the highest parameter in the negative direction. The third component (PC3) explained the study at a rate of 10.2%. Looking at this component, the highest positively explained parameters were carpel number and leaf length, while the highest negatively explained parameter was Brix (Table 4).

Gbadamosi et al. (2020) conducted a study in which morphological and SSR markers were used to determine the genetic diversity among tomato genotypes in Nigeria. In the principal component analysis they made using the data they obtained, the researchers stated that the study in 10 components was explained. Among these components, it was reported that the study was explained with a high rate of 80% in the first 3 components. According to PCA analysis, fruit yield, average fruit weight, number of days until first flowering and first fruit set and plant height, number of branches, and number of fruits per cluster show the highest discrimination potential.

In a study, it was tried to determine the best screening method for salt tolerance in tomato genotypes. The results of this study showed that the principal component analysis (PCA) technique can be used as a tool for selection and discrimination against salt stress in tomato genotypes (Sivakumar et al., 2020). By using principal component analysis and different methods, 324 tomato pure lines were classified based on their agronomic properties. According to the principal component analysis of 17 agronomic features among the parameters in the study, variables were grouped into six main components. These six basic components made up 68.35% of the total genetic variation and the study was explained at this rate (Jin et al., 2019).
In another study on tomatoes, the profile of water-soluble metabolites and mineral nutrients were tried to be determined to evaluate the effects of pesticides and organic and chemical fertilizers on tomato fruit quality. The data obtained in this study were evaluated by subjecting them to principal

component analysis. As a result of the study, it was seen that the total variation was explained in the first two main components at a rate of 88.06%. Nutrient contents are generally separated between organic and chemical fertilizer applications by both main components 1 (PC1) and PC2 (Watanabe et al., 2015).

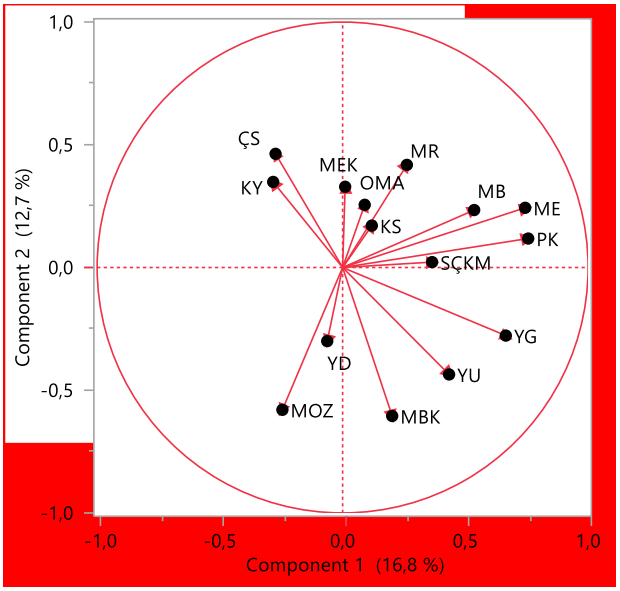

Figure 1. Loading plot graph obtained from PC1 and PC2 as a result of PCA made from fruit characteristics of cocktail tomato lines. (**YD**: **LA**: Leaf Attitude, **YU**: **LL**: Leaf length, **YG**: **LW**: Leaf width, **KS**: **CN**: Carpel Number, **ÇS**: **NF**: Number of flowers **MOZ**: **TR**: Time of ripening, **MR**: **FC**: Fruit color, **MBK**: **FLS**: Fruit shape in longitudinal section, **MEK**: **FCS**: Fruit cross-section **OMA**: **AFW**: Average Fruit Weight, **MB: FS:** Fruit Size, **ME**: **FW**: Fruit Width, **PK**: **PT**: Pericarp Thickness, **SÇKM**: **BRIX**: Water Soluble Dry Matter, **YAKY**: **L**: Leaflets

Using PC1 and PC2 components, a loading plot chart was drawn to examine the relationship between yield and morphological properties (Figure 1). If the angle value between the vectors is less than 90 degrees, it means that there is a positive relationship between the vectors, and if it is more than 90 degrees a negative relationship. If the angle between vectors is 90°, it has been reported that there is no significant relationship (Yavuz et al., 2020; Seymen, 2021). When Figure 1 was examined, it was found that the highest positive correlation was between Brix, fruit width, fruit length, and pericarp thickness. On the other hand, the highest negative correlation was found between leaf length and leaflet.

Lovelli et al., (2017) conducted a study to understand how different water constraint techniques can affect tomato properties. This study was planned for two years and applied different statistical techniques to the results obtained from the study. When the loading plot chart drawn with two different components was examined in the study, it was observed that there was a high positive correlation between the dry matter content of tomatoes and soluble solids in both years.

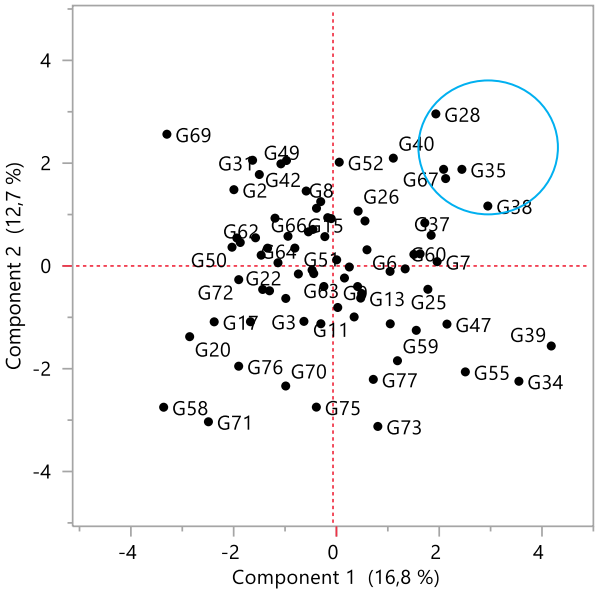

Figure 2. Score plot graph obtained from PC1 and PC2 as a result of PCA made from fruit characteristics of tomato lines

Score plot charts were created to evaluate 77 tomato genotypes using PC1 and PC2 components. When Figure 2 is examined, the genotypes that are located in the positive region of PC1 and PC2 and numbered G28, G35, G38, G67, and G40 in terms of fruit size, fruit width, and pericarp thickness emerged as the genotypes with the best results (Figure 2).

Conclusion

The morphological and agronomic properties of 77 genotypes included in the study using cocktail tomato pure lines were evaluated, and the relationships between these characteristics were interpreted. As a result of the study, it was revealed that there are some differences in morphological characteristics obtained from plants and fruits. According to the PCA, the study was explained in 63% of 6 components. With the help of the graphics drawn with these components, it was determined that there is a positive correlation between Brix, fruit width, fruit length, and pericarp thickness. G28, G35, G38, G67, and G40 inbred lines, located in the positive zone between PC1 and PC2, were found to be able to be used in breeding studies considering the consumer demands. The hybrid cocktail tomatoes to be obtained using these genotypes should be taken to trials in larger areas, and the variety of candidates showing sufficient performance should be brought into agriculture. Also, it was determined that the differences between tomato genotypes can be revealed by using principal component analysis and this analysis can be used safely in morphological and agronomic characterization studies.

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ANTIOXIDANT AND IMMUNOSTIMULANT EFFECTS OF SOME MEDICINAL AND AROMATIC PLANTS

Ugur TEMIZ[1*], Ergin OZTURK[2]

[1]Amasya University, Suluova Vocational School, Department of Veterinary, 05500, Amasya, Turkey
[2]Ondokuz Mayis University, Faculty of Agriculture, Department of Animal Science, 55139, Samsun, Turkey
*Corresponding author: ugur.temiz@amasya.edu.tr.

ABSTRACT

Medicinal and aromatic plants, their extracts and essential oils are considered as alternative feed additives to antibiotics in animal nutrition. It has been determined that aromatic herbs and essential oils obtained from them increase the amount and activity of enzymes in the digestive system, improve the microbial flora in the intestine, strengthen the immune system and increase the shelf life of the products due to their antioxidant effect. It is stated that essential oils have positive effects on feed consumption, feed utilization, improvement of carcass quality, decreasing mortality and increasing productivity. Aromatic plants and essential oils derived from them are also used as an antimicrobial preservative in many industrial sectors such as medicine, food and cosmetics. It is also recommended by many researchers because of its "antioxidant activities" that counteract the effects of free radicals. In this review, antioxidant and immunostimulant effects on livestock of aromatic plants and their essential oil components were evaluated.

Keywords: Animal nutrition, Medicinal and aromatic plant, Antioxidant, Immunostimulant.

INTRODUCTION

With the prohibition of the use of antibiotics as performance enhancers in livestock rations since 2006, research on human and environmentally friendly alternative additives (probiotics, organic acids, plant extracts, plant essential oils and various herbs) that can replace antibiotics has intensified. One of the most interesting alternative feed additives recently, is aromatic plants and essential oils extracted from them. These alternative feed additives, essential oils, which are generally referred to as phytobiotics, can be used alone or in combination with other feed additives to produce economical and reliable animal products (Ricroch, 2016; Cheng, 2018). It is stated that

the use of essential oils and extracts obtained from medicinal and aromatic plants in animal nutrition prevents pathogenic microorganisms from settling in the digestive system, increases the effects of digestive enzymes, shows antioxidant properties that prevent free radical formation, strengthens the immune system, improves the feed utilization and the flavor of the feed (Botsoglou et al., 2004; Ghasemi et al., 2014; Arpášová et al., 2015; Diaz and Sanchez, 2015). In this review, the antioxidant and immunostimulant effects of aromatic plants and their essential oil components on livestock were evaluated.

1. Essential oils

Essential oils are aromatic oily compounds obtained from different parts of plants (flowers, buds, seeds, leaves, branches, bark, wood, fruit and roots). Essential oils are obtained from the leaves, flowers, shells, seeds and roots of plants by the method of water vapor distillation or extraction, generally in liquid form at room temperature, easily crystallize, and are mostly colorless or light yellow (Raut and Karuppayil, 2014; Akdag and Ozturk, 2019). Essential oils are complex structures formed by the combination of various compounds in different concentrations and different chemical structures (Al-Kassıe, 2009).

Most essential oils, structurally classified as alcohol, ester and aldehyde derivatives of phenylpropanoids and terpenoids, are terpenoids (Isoprenoids), mostly monoterpenes and sesquiterpenes. They also include diterpenes, low molecular weight aliphatic hydrocarbons, acids, alcohols, aldehydes, acyclic esters or lactones, nitrogen and sulfur-containing compounds as exception, coumarins and homologs of phenylpropanoids (Evren and Tekguler, 2011). Essential oils obtained from plants have been found to have no health hazards when consumed by humans and animals, and these substances are classified as safe additives in terms of chemical structure (FDA, 2004; Qiao, 2018).

2. Usage of essential oils as antioxidants

Antioxidants are used to prevent or prolong the oxidation of oils and fatty acids. The presence of phenolic OH groups acting as hydrogen donors to peroxide radicals released during the first step of lipid oxidation reduces the formation of hydroxy peroxide. The antioxidant effect of phenolic compounds is due to their properties such as scavenging free radicals, forming compounds with metal ions (metal chelating) and preventing or reducing the formation of singlet (single) oxygen (Farag et al., 1989).

In the past, synthetic antioxidants such as butyratet hyroxyanol, butyratet hyroksitoluen, butyratet hyroxyanol or butyratet hyroksinetolvenol were used as feed additives (Nakatani, 2000; Luna et al., 2010). However, in some studies conducted on mice, it has been found that butyrate hyroxytoluene and butyratet hyroxyanol synthetic antioxidants have tumor and carcinogenic effects on various organs in the body (Lindenschmidt et al., 1986; Kahl and Kappus, 1993; Yanishlieva et al., 1999). When these damages of synthetic antioxidants emerged in terms of human health, producers turned to phytogenic plants containing phenolic terpenes. Among the phytogenic plants, especially thyme, rosemary and thymol, which are in the labiate family, stand out due to their antioxidant properties (Cuppet and Hall,1998; Wojdyło et al., 2007; Windisch et al., 2008). In recent years, studies on the potential antioxidant effects of plant extracts and essential oils obtained from them have gained momentum and positive results have been obtained (Tavarez, 2011; Hashemipour et al., 2013).

3. Usage of essential oils as immunostimulant

The active ingredients of plants can activate various complements of the immune system, such as lysozyme, complement, B and T lymphocytes, natural killer cells and phagocytosis. In this context, plants and their by-products can be preferred to boost the immune system. Plants contain phenolic, polyphenolic, alkaloid, quinone, terpenoid, lectin and polypeptide compounds. Many of these herbs are shown as highly effective alternatives to antibiotics, chemicals, vaccines and other synthetic compounds (Esin B, 2017).

Essential oils, alone or as a mixture with other feed additives, are considered as alternative feed additives to produce economical and reliable animal products. It has been reported that aromatic plants and essential oils obtained from them can be used as feed additives in animal nutrition due to the strengthening of the immune system, increase of appetite, stimulation of digestion, antimicrobial and antioxidant properties if IgG and IgA production is increased (Wallace et al., 2010).

The most important functions of essential oils, also known as etherial oils, are their antiseptic, antioxidant, digestive stimulant, antimicrobial and enzymatic properties (Griggs and Jacob, 2005; Arpášová et al., 2015). Substances such as linalool, limonene, 1,8-cineol and carvacrol isolated from essential oils of thyme, coriander, cumin, lavender and orange peel can be shown as an example of such kind of natural antimicrobial agents (Alcicek, 2009). Recent studies show that thyme, clove and cinnamon are the most effective essential oils in this regard. For example, thyme

essential oil is the best known and most widely used essential oil due to its antibacterial effect. Active ingredients such as carvacrol and thymol are effective on Escherichia coli and many pathogenic microorganisms (Da Silveira et al., 2014). Therefore, with the use of essential oil as a feed additive; Many benefits can be achieved such as high body weight gain, better feed utilization, inhibiting intestinal pathogen microorganisms, increasing the activity of digestive enzymes, increasing the secretion in digestive juices, producing quality meat due to stimulation of protein synthesis and creating a healthy and clean environment by binding ammonia (Purchiaroni et al., 2013).

CONCLUSION AND RECOMMENDATIONS

There has been a significant increase in studies for the development of alternative feed additives due to the risk of residue and cross-resistance using antibiotics as growth factors in animal nutrition. However, it is possible to say that phytobiotics and the essential oils obtained from them can be used as an alternative to antibiotics due to their antioxidant activities and immunostumulant effects in animal nutrition. Studies on the determination of doses for the use of essential oils in rations separately and in combination, their interactions with each other, technologies for incorporating mixed foods, and their effects on animal organisms and products are needed.

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ESSENTIAL OILS AS NATURAL ADDITIVES

Ugur TEMIZ[1], Ergin OZTURK[2]

[1]Amasya University, Suluova Vocational School, Department of Veterinary, 05500, Amasya, Turkey
[2]Ondokuz Mayis University, Faculty of Agriculture, Department of Animal Science, 55139, Samsun, Turkey
Corresponding author e-mail: ugur.temiz@amasya.edu.tr.

ABSTRACT

With the prohibiton of the use of antibiotics as a growth enhancing feed additive in animal nutrition in the Europan Union, the search for alternative products regulate growth, use of feed and regulate digestive system health. In this context, researchers have searched for natural and safe additives that can be alternative to antibiotics in recent years. Concern and data about synthetic additives are harmful to human health has caused natural additives to be preferred in this sector. In recent studies, the fact that natural additives as antioxidans have immunity-enhancing effects on the defense system, and consumers have turned to organic and natural product consumption, have highlighted natural additives as an alternative. Plants and essential oils derived from them come to the fore with their various microbial activities, and in many countries; herbal extracts are considered as one of the effective solutions. It has been proven that essential oils obtained from plants have no health hazards when consumed by humans and animals, and it has been stated that these additives are suitable for usage in animal nutrition. In this study, the facilities of using essential oils as natural feed additives in animal nutrition were evaluated.

Keywords: Animal nutrition, Essential oils, Natural additives

INTRODUCTION

With the prohibition of the use of antibiotics as performance enhancers in livestock rations since 2006, new feed additives that can be an alternative to antibiotics as a growth factor and minimize losses in animal nutrition have started to be researched with new legal regulations. One of the most interesting alternative feed additives recently, is aromatic plants and essential oils extracted from them. Vegetable essential oils can be used alone or in a mixture with other feed additives to produce economical and reliable animal products (Ricroch, 2016; Cheng, 2018). These

natural feed additives used in animal nutrition are aimed to improve feed utilization, reduce the negative effects on human health, and increase the quantity and quality of the product obtained from animals. It is stated that the use of essential oils and extracts obtained from medicinal and aromatic plants in animal feed suppresses the development of pathogenic microorganisms in the gastro intestinal system, increases the effects of digestive enzymes, strengthens the immune system, improves the feed utilization and the flavor of the feed (Ghasemi et al., 2014; Diaz and Sanchez, 2015). In this study, the possibilities of using essential oils as natural feed additives in animal nutrition were evaluated.

1. Essential oils

Essential oils are aromatic oily compounds obtained from different parts of plants (flowers, buds, seeds, leaves, branches, bark, wood, fruit and roots). Essential oils are obtained from the leaves, flowers, shells, seeds and roots of plants by the method of water vapor distillation or extraction, generally in liquid form at room temperature, easily crystallize, and are mostly colorless or light yellow (Raut and Karuppayil, 2014; Akdag and Ozturk, 2019).

Essential oils, also called "etherial oils", are a mixture of plants' secondary metabolites and are studied in two chemical groups called terpenoids and phenylproponoids. Terpenoids constitute the largest group of plant active ingredients and monoterpenoids and sesquiterpenoids are the most important components of Terpenoids (Patra and Saxena, 2010). Thymol and carvacrol in thyme, limonene in orange, pinene in bay and menthol in mint are the most important examples that can be given to terpenoids. Anethole in fennel, eugenol in cinnamon, cinnamaldehyde in cinnamon and silverberry can be shown as an example for phenylpropanoids (Nerio et al., 2010; Patra and Saxena, 2010; Patra, 2011; Sahan, 2012).

Essential oils obtained from plants have been found to have no health hazards when consumed by humans and animals, and these substances are classified as safe additives in terms of chemical structure (FDA, 2004; Qiao, 2018).

2. Usage of essential oils as a growth promoter in livestock

Vegetable extracts that do not leave any residue in animals and do not contain any risk to human health and essential oils obtained from them are the most emphasized substances used in animal nutrition (Bilgin and Kocabaglı, 2010). Despite the limited number of controlled studies on the effects of phytobiotics on livestock, there are extensive reports on the positive effects of adding

these additives to the diet (Du et al., 2015; Pirgozliev et al., 2015; Peng et al., 2016). On the other hand, in recent years, it has been determined in vitro that essential oils activate the digestive system, increase enzyme production and thus improve body weight, ensure feed utilization and improve carcass yield, and also make many essential oils inhibit both bacterial and fungal pathogens (Cabuk et al., 2006; Jerzsele et al., 2012; Turan et al., 2012; Peng et al., 2016).

3. Usage of essential oils as antimicrobial agents in livestock

It is known that essential oils obtained from medicinal and aromatic plants have antibacterial, antiviral, antiparasitic properties, and have bactericidal and fungicidal effects against various microorganisms. Substances such as linalool, limonene, 1,8-cineol and carvacrol isolated from essential oils of thyme, coriander, cumin, lavender and orange peel can be shown as an example of such kind of natural antimicrobial agents (Alcicek, 2009). Recent studies show that thyme, clove and cinnamon are the most effective essential oils in this regard. For example, thyme essential oil is the most widely known and widely used essential oil due to its antibacterial effect. Active ingredients such as carvacrol and thymol in thyme essential oil are effective on Escherichia coli and many pathogenic microorganisms (Da Silveira et al., 2014). These effects are reported to occur due to the lipophilic properties of oils and the presence of a series of terpenoid and phonolic compounds in their chemical structure (Demirtas et al., 2011; Onenc and Acıkgoz, 2011). Therefore, with the use of essential oil as a feed additive; many benefits can be achieved such as high body weight gain, better feed utilization, inhibiting intestinal pathogen microorganisms, increasing the activity of digestive enzymes, increasing the secretion in digestive juices, producing quality meat due to stimulation of protein synthesis and creating a healthy and clean environment by binding ammonia (Purchiaroni et al., 2013).

CONCLUSION AND RECOMMENDATIONS

After the use of antibiotics as growth factors in animal nutrition is banned due to the risk of residue and cross resistance, essential oils, which are most interestingly focused on, are considered as alternative feed additives to produce economical and safe animal products, either alone or as a mixture with other feed additives. Studies on the determination of doses for the use of essential oils in rations separately and in combination, their interactions with each other, technologies for incorporating mixed foods, and their effects on animal organisms and products are needed.

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THE EFFECT OF SEAWINE FERTILIZER ON THE DEVELOPMENT OF SPINACH AND LETTUCE PLANT

Ummahan ÇETİN KARACA* İrfan YARIMOĞLU*

*Selçuk University, Faculty of Agriculture, Department of Soil Science and Plant Nutrition, Konya, Turkey (ucetin@selcuk.edu.tr; irfanata422@hotmail.com)

ABSTRACT

In this study, the effects of seaweed manure applied in increasing doses in greenhouse conditions on the development of spinach and lettuce plants and some yield components were investigated. Trial coincidence plots were carried out in 2 different types of plants (spinach, lettuce), seaweed manure, four different doses (0, 0.1, 0.2, 0.5 %) and 3 repeats according to the trial pattern. When the spinach and lettuce plant has completed its 60-day development, it was harvested, plant growth and some yield elements (plant upper part and root length, plant and root age and dry weights) were determined. The application of seaweed manure to soil in increasing doses supported the development of the plant in both plant varieties and showed differences according to the increasing doses. These differences were found statistically significant and insignificant depending on plant variety, doses and some yield factors. According to the research results; The effect of seaweed manure fertilizer applied in increasing doses on the root length, upper age and dry weight of spinach plant was found statistically significant. The application of seaweed manure in lettuce plant, on the other hand, was determined to be important on the plant's upper parts and root length, and the effect of the plant on wet and dry weight.

Keywords: Spinach, lettuce, seaweed manure, soil

1. INTRODUCTION

The fastest and most effective way to increase productivity in agricultural production has been chemical fertilizer applications and very successful results have been obtained from these applications. However, long-term and excessive chemical fertilizer applications have brought various problems, such as adversely affecting various properties of soils and polluting groundwater etc (Liu et al., 2010; Shan et al., 2015).

When seaweed products stay in the soil for a long time, they easily break down under natural conditions and produce plenty of nitrogen (N) and calcium (Ca). They also contain trace elements such as magnesium (Mg), manganese (Mn), boron (B), iron (Fe), zinc (Zn), copper (Cu) and cobalt (Co). All these effects of seaweed; It is derived from compounds such as macro and microelements (N, Ca, Mg, Mn, B, B, Fe, Zn, Cu, Co), plant growth regulators (auxins, cytokinins, gibberellins, abscisic acid) and betaines (Hong et al., 1995).

The effect of liquid algae extract (Kelpak) on the growth and nutrient content of lettuce has been examined and it has been noted that Kelpak increases the product amount and the amount of Ca, K, Mg in leaves (Grouch et al., 1990). Verkleij (1992) reported that the application of 100-1000 times diluted seaweed extract before harvesting in peaches extends the storage life, and soaking banana and mango fruits in diluted commercial seaweed solution increases the ripening rate.

As a result of the application of Goemar GA 14, an extract of Ascophyllum nodosum, to spinach plant in the form of a spray; It was determined that the amount of fresh weight in spinach increased (Gassan et al., 1992). Allwright (1992) reported in his study on wheat that the plant height and dry weight ratio increased with the application of seaweed extracts from leaves and soil.

Demirkaya, (2010), in the study, the possibilities of using seaweed extract in osmotic conditioning applications on pepper (Capsicum annuum L.) and onion (Allium cepa L.) seeds were investigated. Osmotic conditioning applications with seaweed extract increased the germination percentage in onion and pepper seeds and shortened the average germination time.

In recent years, the use of commercial liquid fertilizers with organic content has become widespread in order to ensure earliness and diversity in greenhouse cultivation. Nowadays, seaweeds are used in many countries either as a liquid extract or by mixing them directly into the soil. When they are mixed directly into the soil; It is aimed to preserve soil fertility for a long time by improving the soil structure. For many years, some sea algae that were naturally thrown ashore by the seas were used as fertilizers in the fields (Güner and Aysel, 1996).

In this study, it was aimed to determine the effects of seaweed fertilizer, an organic fertilizer, on yield and quality in lettuce and spinach cultivation.

2. MATERIAL AND METHOD

In the experiment conducted under greenhouse conditions, a soil sample with a silty loam texture was used. As the seaweed fertilizer, a solid fertilizer named proton obtained from DRT fertilizer company was used. In the experiment, 4 kg of soil was placed in the pots on the basis of oven dry weight and the doses of seaweed fertilizer were applied as 0-0.1-0.2-0.5 %. Fertilizer doses were added to the soil with planting. After adding the seaweed fertilizer to the soil in the specified doses, spinach and lettuce seeds were planted in pots and irrigation was carried out with pure water. After the spinach (Matador) and lettuce (Yedikule 5701) plants germinated and developed, 4 plants were left in each pot.

Spinach and lettuce plants were harvested at the end of 60 days trial period and necessary measurements were made. Plant and root lengths were measured in plants. Then, the wet weights of the upper parts and roots of the plants were determined by weighing. The plant and root samples, whose wet weights were taken, were dried in an oven at 70°C for 48 hours and oven dry weights were determined. The data obtained from the greenhouse experiment, which was established according to the randomized plot trial design, were subjected to variance analysis according to the Minitab 16 statistical program, and the significant treatments according to the F test were grouped in Duncan multiple comparison test (Düzgüneş et al., 1987).

3. RESEARCH RESULTS AND DISCUSSION

Some of the physical and chemical properties of the soil sample used in the greenhouse experiment are given below.

Table 1. Some physical and chemical properties of the soil sample used in the greenhouse experiment.

Properties	**Value**	**Properties**	**Value**
Texture class	Silty loam	Ca $mgkg^{-1}$	7533
pH (1:2.5)	8.25	Mg $mgkg^{-1}$	826
EC (1:5) dSm^{-1}	0.31	Mn $mgkg^{-1}$	8.55
$CaCO_3$ (%)	24.32	Zn $mgkg^{-1}$	1.08
O.M. (%)	2.03	B $mgkg^{-1}$	2.24
NH_4 +NO_3-N $mgkg^{-1}$	10.7	Cu $mgkg^{-1}$	1.21
P $mgkg^{-1}$	23	Fe $mgkg^{-1}$	1.94
K $mgkg^{-1}$	525		

Some chemical properties of seaweed fertilizer (alginic acid) used in the study are given in Table 2.

As can be seen from Table 2, the seaweed fertilizer used in the experiment is rich in organic matter, its pH is alkaline, and is in the extremely salty class in terms of salinity. This fertilizer contains 1.5% alginic acid.

Table 2. Some chemical properties of seaweed fertilizer used in the experiment.

Properties	**% w/w**	**Macro N.**	**% w/w**	**Micro N.**	**mgkg^{-1}**
O. M.	45	N	2	Fe	200
pH	9-11	P	3	Cu	6
EC (dSm^{-1})	44.6	K	10	Mn	12
Protein	6-8	Ca	0.2	Zn	100
Karbonhidratlar	35-50	S	1.5	B	100
Alginik asit	1.5	Mg	0.5	Mo	4
Mannitol	4-7	Na	1.8		

3.1. Research Results of the Spinach Plant

In the study, 0-0.1-0.2 % and 0.5 % application doses of seaweed fertilizer were added to pots containing 4 kg of soil on the basis of oven dry weight. Spinach and lettuce plants were grown in these pots after the growing environment was prepared. The plants in question were harvested after 60 days and necessary measurements were made. According to the research results; The effect of seaweed fertilizer applied in different doses on the plant length of spinach showed differences, and these differences were statistically insignificant. The highest plant height was 11.42 cm with 0.1 % seaweed applied plant in the pot. The lowest plant height was determined as 0.5 % in the seaweed applied plant.

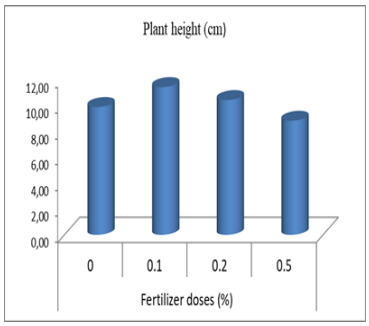

Figure 1

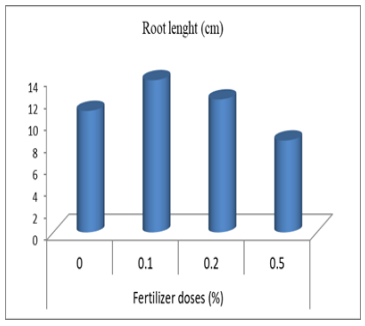

Figure 2

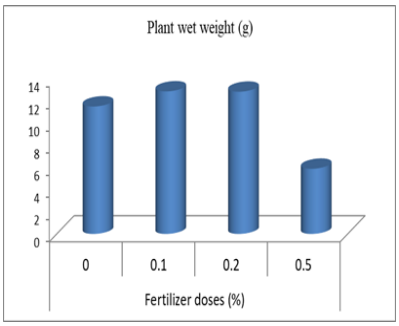

Figure 3

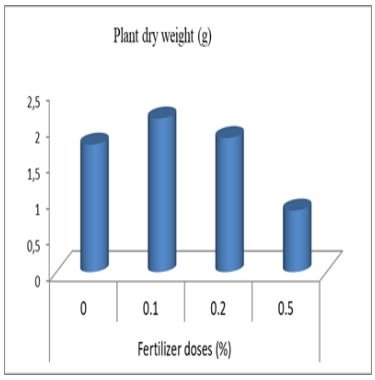

Figure 4

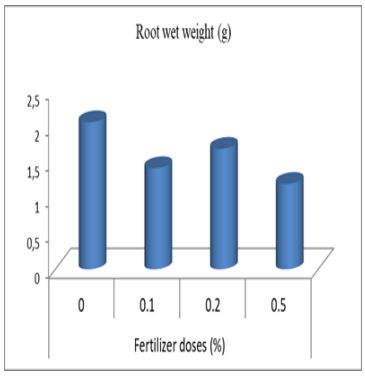

Figure 5

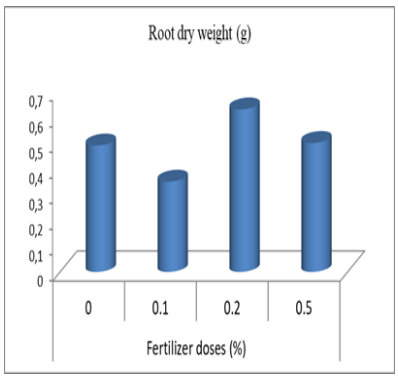

Figure 6

Figure 1, 2, 3, 4, 5 and 6. The effect of seaweed fertilizer applied in increasing doses on plant height, root length, plant wet weight, dry weight, root wet and dry weight of spinach plant.

According to the results of the research, the effect of seaweed fertilizer applied in increasing doses on the root length of spinach showed differences as shown in Figure 2, and these differences were found statistically significant ($p < 0.05$).

In the study in question, the root lengths of spinach plant varied between 13.83-8.35 cm, and the highest root length was determined with 13.83 cm with 0.1 % seaweed fertilizer. The lowest root length was determined as 8.35 and 0.5 % in seaweed applied plants. There was no effect of increasing the seaweed fertilizer dose on the root length of the spinach plant (Figure 2).

In this study, in which the effect of increasing doses of seaweed fertilizer on some yield elements of spinach plant was investigated, the effect of fertilizer doses on the wet weight of the spinach plant showed differences (Figure 3). As can be seen from Figure 3, the plant wet weights of the spinach plant ranged from 12.86 to 5.88 g, and these changes were statistically significant ($p < 0.01$). In addition, the highest wet weight of the spinach plant was observed with 12.86 and the plant in the

pot applied with 0.1 % seaweed fertilizer. It was determined that the wet weight of the spinach plant in the pot without seaweed fertilizer was higher than the plant in the pot with 0.5 % seaweed fertilizer.

According to the results of the study, the effect of seaweed fertilizer applied in different doses on the dry weight of spinach in spinach showed differences, and these differences were statistically significant ($p < 0.01$). Dry weight values of spinach plants in pots applied with increasing doses of seaweed fertilizer were determined to be between 2.12 and 0.85 g (Figure 4). As can be seen from Figure 4, the highest dry weight of spinach plant was observed in the plant in the pot applied with 0.1 % seaweed fertilizer with 2.12 g. The lowest dry weight of the plant was determined in the potted plant with 0.5 % seaweed fertilizer.

On the other hand, the effect of the doses of seaweed fertilizer applied in increasing doses on the root wet weight of the spinach plant showed differences. In the study, it was determined that the root wet weight values of the spinach plant varied between 2.05-1.19 g (Figure 5). According to the data obtained from the study, the effect of seaweed fertilizer applied in increasing doses on the root wet weight of spinach plant was found to be statistically insignificant. In the experiment, it was determined that the root wet weight of the spinach plant in the pot without seaweed was higher than the plants treated with 0.1-0.2 % and 0.5 % seaweed fertilizer (Figure 5). In addition, the spinach plant, which has the lowest root wet weight, was observed at 0.5 % in the pot in which seaweed fertilizer was applied.

According to the results of the research, the effect of seaweed fertilizer applied in increasing doses on the dry weight of the spinach plant showed differences, and these differences were statistically insignificant (Figure 6).

As can be seen in Figure 6, root dry weight of spinach plant varies between 0.63-0.35 g. According to the data obtained, when the root dry weight values of spinach plant were examined, the highest root dry weight was observed in the plant with 0.2 % seaweed fertilizer with 0.64 g, while the lowest root dry weight was determined in the plant in the pot with 0.1% seaweed.

3.2. Research Results of Lettuce Plant

According to the results of the research, the effect of seaweed fertilizer applied in increasing doses on plant height in lettuce showed differences as seen in Figure 7, and these differences were found statistically significant ($p < 0.01$). In the study in question, the plant heights of lettuce plant varied

between 14.5-11.7 cm, and the highest plant height was 14.5 cm with a 0.5 % dose of seaweed. The lowest plant height was determined with 11.6 cm in the potted plant without seaweed fertilizer. Seaweed fertilizer applied in increasing doses to the plant height of the lettuce plant was effective. Generally, as the fertilizer dosage increased, the height of the lettuce plant increased (Figure 7). The dried seaweed biofertilizer significantly increased leaf height of lettuce over the control and this might be due to the release of enough nitrogenous compounds for lettuce growth, mostly nitrates and ammonium, which can be readily taken up by vascular plants (Rogers and Burns 1994). Absorbed nitrogen in turn increases leaf height through stem elongation brought about by cell division and expansion (Havalin et al. 2010).

According to the results of the research, the effect of seaweed fertilizer applied in increasing doses on the plant root length in lettuce showed differences as seen in Figure 8, and these differences were found statistically significant ($p < 0.05$). In the study in question, the root lengths of the lettuce plant varied between 9.08-7.17 cm and the highest plant root length was observed in the pot applied with 0.1 % seaweed fertilizer with 9.08 cm, while the lowest plant root length was 7.17 cm and 0.5 % in the plant in the pot with seaweed fertilizer applied.

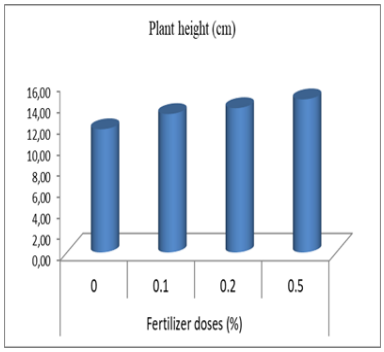

Figure 7

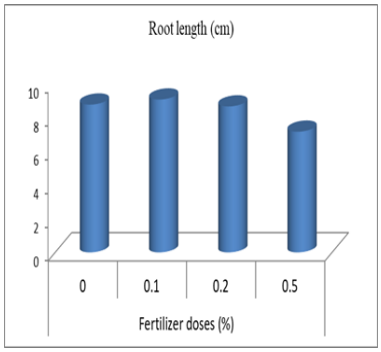

Figure 8

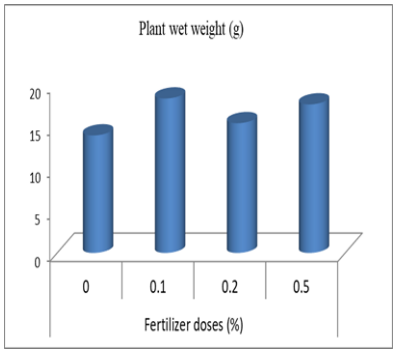

Figure 9

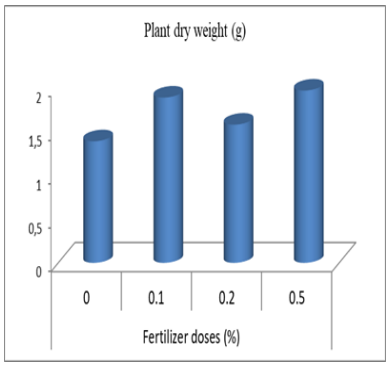

Figure 10

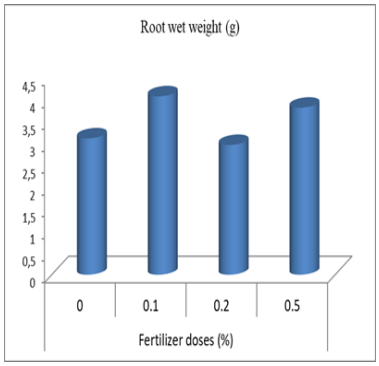

Figure 11

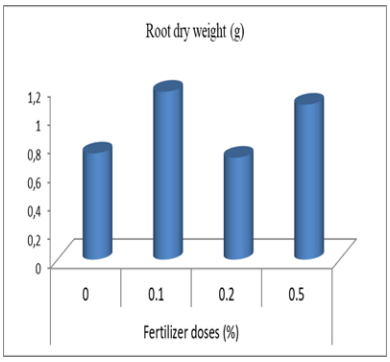

Figure 12

Figure 7, 8, 9, 10, 11 and 12. The effect of seaweed fertilizer applied in increasing doses on plant height, root length, plant wet weight, dry weight, root wet and dry weight of lettuce plant.

According to the results of the research, the effect of seaweed fertilizer applied in different doses on the plant age weight in lettuce showed differences, and these differences were found to be

statistically significant ($p < 0.05$). It was determined that the wet weight values of the lettuce plant in pots applied with increasing doses of seaweed fertilizer were between 18.33-13.95 g. As can be seen from Figure 17, the highest wet weight was observed with 18.33 g and 0.1 % in the plant in the pot where seaweed fertilizer was applied. The lowest plant wet weight was determined with 13.95 g in the potted lettuce plant without seaweed fertilizer.

According to the results of the research, the effect of seaweed fertilizer applied in different doses on the plant root age weight in lettuce showed differences and these differences were found to be statistically insignificant.

Root wet weight values of lettuce plants in pots where increased doses of seaweed fertilizer were applied were determined to be between 4.07-2.96 g. As can be seen from Figure 11, the highest plant root wet weight was observed in the potted plant with 4.07 g and 0.1 % dose of seaweed fertilizer, while the lowest plant root wet weight was found in the plant in the pot applied with 0.2 % seaweed fertilizer with 2.96 g (Figure 11).

On the other hand, the effect of seaweed fertilizer applied in increasing doses on dry weight of lettuce showed differences, and these differences were statistically significant ($p < 0.05$). In the research, it was determined that the upper part dry weight values of lettuce plant varied between 1.97-1.40 g (Figure 9). As can be seen in Figure 9, the highest dry weight of the plant was observed with 1.97 g and the plant in the pot with 0.5 % dose of seaweed fertilizer, while the lowest plant dry weight was observed with 1.40 g in the potted plant without seaweed fertilizer. The dose of seaweed fertilizer was effective on the dry weight of the lettuce plant.

According to the results of the research, the effect of seaweed fertilizer applied in increasing doses on the dry weight of the lettuce plant showed differences, and these differences were statistically insignificant (Figure 10). As can be seen from Figure 10, root dry weights of lettuce plant vary between 1.17-0.71 g. According to the data obtained, when the root dry weight values of the lettuce plant were examined, the highest plant root dry weight was observed in the plant in the pot with a dose of 1.17 g and 0.1 % seaweed fertilizer, while the lowest plant root dry weight of the lettuce plant was 0.71 g and 0.2 % seaweed fertilizer. It was observed in the potted plant applied (Figure 10).

4. CONCLUSION

Increase in the use of chemical fertilizers and environmental pollution; It has begun to pose a life-threatening threat to all living things with the deterioration of natural balance and food chains. As a result, they have started to prefer agricultural products produced by methods that do not cause toxic effects on humans and do not destroy nature. It is known that in agriculture and especially in biological agriculture, seaweed is used in many regions of the world to increase yield and quality, to regulate plant growth, to increase resistance to diseases and pests, to improve soil structure and for animal husbandry.

In the research, it has been observed that the application of seaweed fertilizer applied in increasing doses generally supports the development of the plant depending on the doses to develop better vegetative components in spinach and lettuce plants. This development affected the root length, wet and dry weight of the upper parts of the spinach plant. In the lettuce plant, the application of seaweed fertilizer to the soil has been determined to be significant on the plant upper parts and root length, and the plant's wet and dry weight.

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DETERMINATION OF THE RELATIONSHIPS BETWEEN SOME MORPHOLOGICAL CHARACTERISTICS BY PRINCIPAL COMPONENT ANALYSES IN PINTO BEAN

Yeşim DAL[a]*, Necibe KAYAK[b], Ünal KAL[a], Gülbanu KIYMACI[b], Münevver AĞCA[b], Neslihan ISSI[b], Arif Selim ARICI[b], Musa SEYMEN[a], Önder TÜRKMEN[a], Ertan Sait KURTAR[a]

a: Horticulture Department of Agriculture Faculty, Selçuk University, Konya-Turkey
b: Horticultural Departments, Graduate School of Natural Sciences, University, Konya-Turkey
* **Corresponding author:** dalyesim@gmail.com

Abtract

This study was carried out to determine the morphological characteristics of 36 pinto bean genotypes (*Phaseolus vulgaris* L. var. *pinto*.). Morphological diversity in pinto bean genotypes was determined by examining the parameters of the UPOV criteria in plant, fruit and productivity. The results of the plant, fruit and yield obtained were subjected to PCA analysis. The study was explained with a high rate of 77.28% in 5 components with using of PCA (Principal component analysis). The highest positive correlation was found between seed width and seed height. On the other hand, the highest negative correlation was found between grain color L and a values. When PC1 and PC2 were evaluated together, the G3, which showed important results in terms of agro-morphology, emerged as a promising hybrid line. Genotypes showed high variation in terms of agro-morphological characteristics, and differences were determined in yield and some genotypes were found promising lines.

Keywords: Agronomic, kidney beans, morphology, PCA

Introduction

Bean (*Phaseolus vulgaris* L.) is an important species that is highly self-pollinated and grown in extremely large areas in the world and in our country (Ulukapı and Onus, 2012; Akbulut et al., 2013; Dursun, 1999; Maras et al., 2008; Yeken et al., 2018). There are nearly 230 species of the Phaseolus genus, but about 20 of them are of economic importance. The most important types among these are; *P. lunatus var. lunatus, P. acutifolius, P. coccineous and P. vulgaris* (2n = 22). (Bliss, 1981; Bliss and Brown, 1983). Kidney Beans; It is a type of vegetable that can be evaluated in different ways, including fresh broad beans, unripe fresh and dried grains (Balkaya and Odabaş, 2004). In ranking the countries engaged in the production of beans in the world, China ranked first with 9.8 million tonnes, Indonesia second with 939 thousand tons, India third with 715 thousand

tons, Turkey with 581 thousand tons, ranks 4th among the most important producers (FAO, 2018). In the FAOSTAT data, the production amount of kidney beans (*Phaseolus vulgaris* L. *var. pinto*) was not evaluated separately, it was evaluated within the bean data.

Pinto beans have a very high nutritional value in terms of human nutrition, with high amounts of protein (20-25%), carbohydrates (50-60%), especially mineral substances (Potassium, Phosphorus, Calcium, Magnesium, Sulfur, Iron and Manganese) (Rehman et al., 2001; Reyes- Moreno ve Paredes-Lopez, 1993; Sözen et al., 2014; Tan, 2002). Beans are especially rich in iron, containing between 50 and 150 mg Fe kg−1(Geil and Anderson 1994; Welch et al., 2000; Cejas et al., 2013; Broughton et al., 2003; Çavuşoğlu and Akçin 2007). Beans are also a rich source of essential vitamins (A, D, E and K) and minerals, soluble fiber, starch and phytochemicals, and are also reported to have low fat content (Ülker and Ceyhan, 2008; Zargar et al.,2016).

The purpose of the characterization of plant genetic resources is primarily to reveal genetic variation between seed samples or populations. Turkey is not included in the bean gene center. But due to the wide geographic diffusion of this crop, distributed in very different climatic environments, divergent criteria of selection for well-adjusted characters were utilized by producers from different regions (Piergiovanni et al., 2006; Akbulut et al., 2013). Knowing the variations in cultivated species is very important for the implementation of plant breeding programs(Blis, 1981b). Variation in the genetic evaluation of a quantitative trait in vegetable breeding is of great importance. Variation in the genetic evaluation of a quantitative trait in vegetable breeding is of great importance. The partial sizes of these variations with each other help in identifying the genetic characteristics of the population (Yıldırım, 1985). Many of the traits that are directly affected by natural and artificial selection usually show quantitative variation. Studies on quantitative properties are of great importance as they determine the economic use of germplasm. For this reason, in the evaluation of gene resources inbreeding, it is necessary to examine agronomic characteristics together with genetic characteristics (Singh, 2001; Escribano et al., 1998).

In a study conducted in Konya conditions, a total of 8 commercial varieties, Nadide, Romano Massay, Sarıkız, Nova, Bourgondia, Gina, and Goffora, were used to determine the yield and some quality elements of some dwarf green bean varieties. Yield and yield factors differed significantly among the varieties, the highest yield was obtained from Sarıkız (1551 kg/da) and the lowest yield from Bourgondia (605 kg/da). Sarıkız genotype ranked first in yield per plant and the number of pods per plant (Seymen et al., 2010). Besides, it is necessary to determine the varieties suitable for ecological conditions, apart from the cultural applications to increase the yield (Pekşen, 2005; Anlarsal et al., 2000).

Ulukapı and Onus (2014) tried to identify suitable bean genotypes that can be used in breeding programs in their study. Therefore, Turkey had 36 items of fresh bean genotypes were collected from different regions. Then they made the morphological characterization of these genotypes. They evaluated the morphological characters of bean genotypes they collected according to UPOV criteria. Then they made the statistical analysis of the obtained data. At the end of the study, they concluded that the variation between some bean genotypes was not high and that the first three characters could be used to explain 50% of the variation between genotypes. According to the

dendrogram they obtained, they stated that distant genotypes could be an important source of variance and could be used in possible breeding programs.

This study was carried out to determine the agro-morphological characteristics of 36 kidney beans genotypes (*Phaseolus vulgaris* L. *var. pinto*.), which were determined to be suitable for fresh consumption and have hope. The results obtained in yield, fruit and plant characteristics were subjected to PCA analysis. Thus, by determining important parameters, it is aimed to reveal productive genotypes with high fruit quality. Thus, it is aimed to create the starting material for the kidney bean breeding program that is planned to be made later.

2-Material and Method

The research was conducted at the Selcuk University Faculty of Agriculture application land in 2020. In the study, 36 pinto bean genotypes determined to be suitable for consumption were used. When the climatic data of the research year were examined, the average temperature in June-September was 18-20 ° C and it was found suitable for bean cultivation. The trial random blocks were set up with 3 replications according to the trial pattern. It was also established with 10 plants per recurrence. The study was started on 28.05.2020 by sowing seeds at 20x100 cm distances. After sowing, it was irrigated with drip irrigation and during the vegetation period, cultural practice such as hoeing, throat filling, fertilization, disease, and pest management were carried out regularly. The first harvest was made on 20.08.2020 and the harvests were terminated on 27.09.2020.

In genotypes; the number of pods per plant (pieces), average pod weight (gr), pod height (cm), pod width (cm), pod thickness (mm), beak length (mm), seed length (mm), 1000 grain weight, The morphological characteristics of the hybrid lines were determined according to the International Union for the Protection of New Plant Varieties (UPOV) characteristics such as seed number, seed width (mm), seed height (mm) and L, a and b values existing in the color measurement scale.

3. Results and Discussion

In the study, as a result of the characterization studies performed on 36 kidney bean genotypes, the differences between them were evaluated according to the UPOV parameters.

Average of kidney bean genotypes according to the parameters taken; number of pods per plant (15.06 pieces), plant weight (4.94 g), pod height (13 mm), pod width (11.35mm), pod wall thickness (0.53 mm), beak length (10, 85), seed number (6.03 pcs), thousand-grain weight (515 g), seed length (14 mm), seed width (8.3 mm), seed height (6.58), and L (69.95)), a (6.82) and b (13.46).

Plant, fruit and seed characteristics measurements obtained in kidney beans genotypes were subjected to PCA. In the studies conducted, it is stated that more than 25% of the first two component should be explained in order to use PCA analysis (Mohammadi ve Prasanna, 2003; Seymen et al., 2019). As a result of PCA, 25.78% of the first component (PC1) study were explained, and pod height, pod width, seed length, seed width and "a" parameters were the highest positive parameters. The second component (PC2) explained 20.4% of the study, seed length, seed height, "L" and "a" were the highest parameters explained in the positive direction, and the number of seeds was the highest parameter in the negative direction. The third component (PC3), on the

other hand, explained 12.7% of the study, and the number of pods per plant, thousand grain weight and beak length were the highest positively explained parameters, and the average pod weight and "b" value were the highest parameters explained in the negative direction (Table 1).

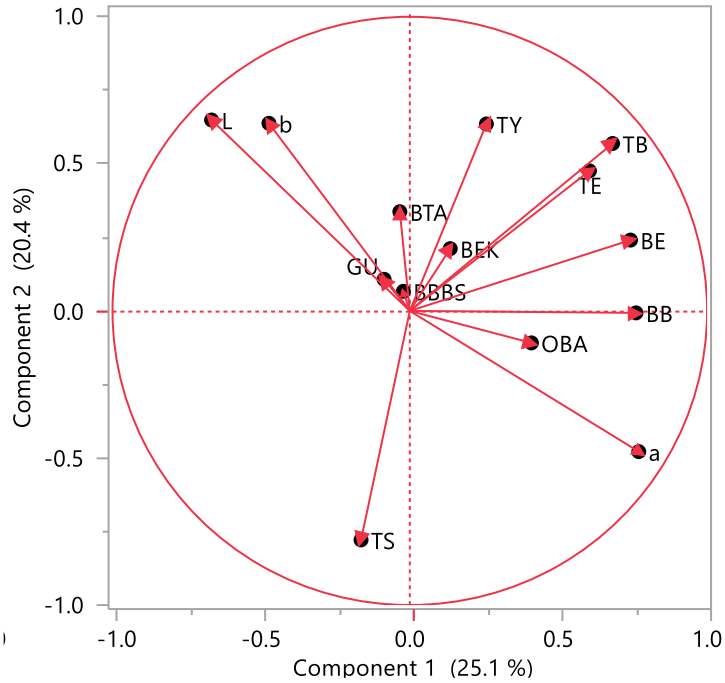
Table 1: PCA results obtained from plant, fruit and seed measurements of kidney bean variety candidates

	PC1	PC2	PC3
Eigen value	3.51	2.86	1.77
Variance%	25.78	20.43	12.65
Total variance%	25.78	46.21	58.86
Eigenvectors			
BBPP	-0.0115	0.03943	0.54464
ABBW	0.21835	-0.06429	-0.32445
BBH	0.40604	-0.00397	-0.16659
BEW	0.39616	0.14232	0.16089
BET	0.07254	0.12511	-0.1649
BL	-0.04613	0.06346	0.38091
TS	-0.08757	-0.46025	-0.07807
TGW	-0.01787	0.19931	0.447
LS	0.36408	0.33644	-0.02969
SW	0.32255	0.28143	0.10081
SH	0.13748	0.3757	-0.13323
L	-0.35584	0.38361	-0.15598
a	0.41101	-0.28283	-0.0735
b	-0.25289	0.37699	-0.32823

BBPP: broad bean per plant ABBW: average broad bean weight BBH: broad bean height BEW: broad bean width BET: broad bean thickness
BL: beak length TS: number of seeds TGW: thousand grain weight LS: length of seeds SW: seed width SH: seed height L*a*b

By using PC1 and PC2 components, a loading plot chart was created to examine the mutual relationship between yield, fruit and seed characteristics (Figure 1). It has been reported that there is a positive relationship if the vectors in the figure are smaller than 90 degrees, there is a negative relationship if they are greater than 90 degrees, and if the angle between the vectors is 90 degrees, there is no significant relationship (Yan and Kang, 2003; Yavuz et al., 2020). When the figure was examined, the highest positive correlation was found between seed length and seed width. On the other hand, the highest negative correlation was found between "L" and "a".

Figure 1. Loading plot graph obtained from PC1 and PC2 as a result of PCA made from fruit characteristics of Kidney Bean Genotypes



BBPP: broad bean per plant ABBW: average broad bean weight BBH: broad bean height BEW: broad bean width BET: broad bean thickness BL: beak length TS: number of seeds TGW: thousand grain weight LS: length of seeds SW: seed width SH: seed height L*a*b

A score plot graph was created to evaluate 36 kidney bean genotypes by using PC1 and PC2 components (Figure 2). When the figure was examined, when PC1 and PC2 were examined, the genotypes with G1, G3, G5, G14, G17 appeared as the best results in terms of seed width, seed length and pod width parameters. In terms of the number of seeds of the genotype numbered G6, the genotype numbered G10 showed an important result with the "a" value, which gives the red / green ratio in the color scale.

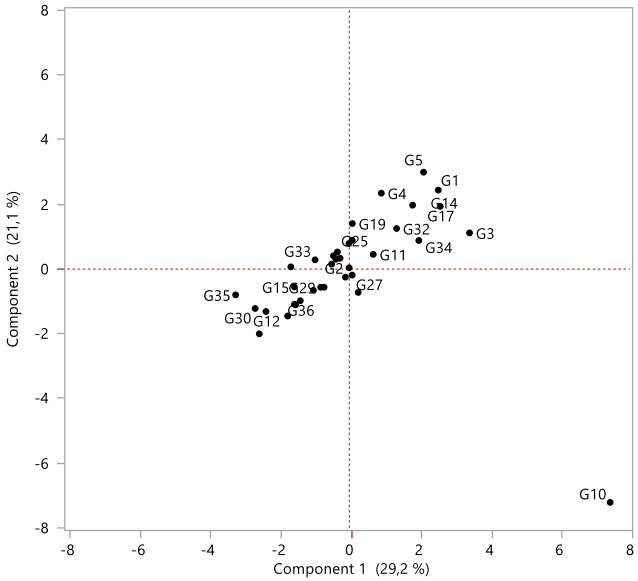


Figure 2. Score plot graphic obtained from PC1 and PC2 as a result of PCA made from fruit characteristics of kidney bean genotypes

4. Conclusion

In our study, morphological and agronomic data of 36 genotypes were examined. As a result of the PCA analysis performed to determine the relationship between traits and genotypes examined using these data, some differences were found in plant, fruit and seed characteristics. As a result of the study, genotypes numbered G1, G3, G5, G14 and G17, located in the positive region of PC1 and PC2 and showing important results, were determined as promising genotypes in terms of the characteristics examined. It is thought that the determined genotypes have important gene resources for future breeding efforts and will make significant contributions to the development of new varieties.

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SOME PHYSICAL AND MECHANICAL PROPERTIES AND WORKABILITY OF SOILS IN A SARAYKÖY RESEARCH AND APPLICATION STATION

Zeynep Demir

Soil Fertilizer and Water Resources Central Research Institute, Ankara, Turkey
zdemir06@yahoo.com

Abstract

The aim of this study was to investigate selected mechanical and physical soil properties of Sarayköy Research and Application Station field such as bulk density, field capacity, penetration resistance, relative saturation, Atterberg limits (liquid limit, LL; plastic limit, PL; plasticity index, PI), activity of clays, consistency index and suitable moisture contents for soil workability in the clay textured soil. Soil samples were taken from 0-20 cm depth in 2017. Clay content of soil in the Research and Application Station field ranged between 40.80 and 54.80%. Mean field capacity (FC), bulk density and penetration resistance values of soils were identified as 39.91%, 1.19 g cm^{-3} and 1.20 MPa, respectively. Atterberg limits ranged between 69.90 and 79.60% for LL, between 31.70 and 35.60% for PL and between 38.20 and 46.10% for PI. Liquid limit significantly correlated with plastic limit (0.466^{*}), plasticity index (0.832^{**}), field capacity (0.338^{*}), and relative saturation (0.680^{**}). Consistency index values of soils were significantly correlated with field capacity (-0.491^{*}). Penetration resistance values showed significantly correlations with field capacity (-0.645^{**}), bulk density (-0.614^{*}) and relative saturation (-0.605^{*}). Moisture contents for soil workability were 43.86, 33.34 and 27.03%, reference to consistency index values of 0.75, 1.0 and 1.15, respectively. According to LL and plasticity index values, the soils in the field of Sarayköy Research and Application Station were classified within high plastic inorganic clays group. Ic values at field capacity ranged between 0.79 and 0.92 with an average of 0.84. Thus, it was concluded that soil cultivation at field capacity would not have structural deformation in the soils of the field. According to the results obtained, lower and upper moisture limits for suitable cultivation of the soils in Sarayköy Research and Application Station field were recommended 27.03 and 39.91%, respectively.

Key words: Clay, field capacity, soil cultivation, Atterberg limits, consistency index, soil workability,

INTRODUCTION

The optimum soil water content (OWC) for tillage is described as the moisture content for which the greatest rate of small aggregates is obtained in tillage or the minimum quantities of large aggregates is obtained with least soil structural deterioration. Dexter and Bird (2001) determined that the range of the OWC for tillage is limited with a lower tillage limit and an upper tillage limit, with the OWC between them. Braunack and Dexter (1989) reported that the workable range is significant since a fine seedbed has better agronomical characteristics when compared to a coarse cloddy one. Soil workability is described as easy workability of the soil during tillage operations. Soil workability has an effect on timing of tillage and so the suitability of production. if a fine tilth can be produced with no smearing, the soil is identified as workable (Rounsevell, 1993). The concept of soil workability is associated with the OWC (Mosaddeghi et al., 2009). Soil-implement

interactions are related to workability. It is required to eliminate plastic deformation of the soil in tillage since it results in smearing and clodding of soil. For instance, seedbed preparation, basic tillage and tillage applications have been optimized and realized at various depths based on the purpose of tillage (Koolen and Kuipers, 1983). Therefore, the conditions of different tillage procedures may vary for the soil water status, and the conditions of tillage and associated field traffic for the field moisture status as well (Mueller et al., 2011). The capability of estimating the timing of optimum soil workability is based on knowledge of the extent and structure of variability in primary soil physical properties (Kværnø et al., 2007). Mechanical and physical characteristics of fine-grained (cohesive) soils are considerably dependent on the moisture content. Soil consistency signifies the soil's resistance to deformation under mechanical forces. According to Atterberg (1911), there are three consistency limits including plastic limit (PL) and liquid limit (LL) for cohesive soils based on gravimetric water content. While the plastic limit is the border between plastic and semisolid states, liquid limit distinguishes plastic state from liquid state (McBride, 2008). Moisture ranges in which certain mechanical behaviors indices consistency indexes. Soil mechanical behavior is irreversible/plastic by making no crack after loading in the plastic range as quantified by plasticity index (Keller and Dexter, 2012).

The Atterberg limits show the moisture content in which the consistence of a cohesive soil is transformed from a plastic state into a liquid state, and the misture content at which different cohesive soils have an almost equal undrained shear strength, which is 1.7–2.7 kPa at the liquid limit and about 100 times higher at the plastic limit. It is also valid for the amount of water at the Atterberg limits and for the other soil physical characteristics and based on mainly compositional factors, like the type of minerals, the quantity of each mineral, the pore-water composition and the size distribution and shapes of the particles (Mitchell, 1993). This suggests that there must be the completely described relationships between the Atterberg limits and the other soil characteristics. Several researchers have determined valid relationships between the amount of moisture at the LL, the PL and some physical characteristics. But, the findings were greatly different and were valid in most cases only for the examined soils. The Atterberg limits and consistency indices are employed to classify cohesive soils. They are also used to get information for interpretation of some soil physical and mechanical characteristics like compressibility, shear strength, swelling and shrinkage potentials (Seybold et al., 2008). In addition, the moisture limits are important for infrastructure treatment. Furthermore, these limits are useful to classify soils concerning tillage practices, compaction and soil-machine interactions (Campbell, 2001), OWC for tillage (Keller et al., 2007). Tillage changes soil structure, and if the soil is too wet during tillage, the soil structure will be adversely affected. A method that could be utilized to predict the maximum gravimetric soil moisture content for optimum tillage would be useful for prevention of soil structural damage (Mueller et al., 2003). The aim of this study was to examine selected mechanical and physical soil properties of Sarayköy Research and Application Station field such as bulk density, field capacity, penetration resistance, relative saturation, Atterberg limits, activity of clays, consistency index and suitable moisture contents for soil workability in the clay textured soil.

Material and Methods

Soils were taken from 0 to 20 cm depth of 15 different points in the Sarayköy Research and Application Station field, Ankara, Turkey in 2017. Soil pH values were measured with a pH meter and electrical conductivity (EC) values were measured with an EC-meter (Richard, 1954). Soil organic matter (OM) contents were identified with the use of Modified Walkley-Black method (Kacar, 1994). Soil particle size distribution was determined by using Bouyoucos hydrometer method (Richards, 1954). Bulk density (BD) was carried out with the cylinder method (Black, 1965).

Field capacity (FC) was identified with the aid a pressure plate (Tüzüner, 1990). Soil gravimetric moisture content (W, g H_2O g^{-1} soil at the sampling time) was identified by drying soil samples at 105 °C for 24 h. Volumetric water content (θ) was estimated from the following equation 1 (Hillel, 1982);

$\theta = W \times BD$ ..... (1)

Total porosity (F) (Hillel, 1982) was estimated using the following equation 2:

$F = 1 - (BD/2.65)$……..……..……(2)

Then, volumetric water content (θ) was divided by total F to get relative saturation (RS). A standard cone penetrometer at 20 cm soil depth was used to determine soil penetration resistance (PR) (Bradford, 1986).

According to Black (1965) identified LL (Liquid limit), (PL) plastic limit and (PI) plasticity index of the soils. Eq. 3 was used to calculate the index of consistency (Ic) at any given soil water content (W) or FC (Baumgartl, 2002);

$Ic = (LL - W) / PI$.....(3)

Eq. 4 (Baumgartl, 2002) was used to calculate the activity of clays (A):

$A = PI / (\%\ clay\ content)$.....(4)

Correlations between the investigated parameters were tested with the use of Pearson correlation method (SPSS 19.0, SPSS Inc., 2011).

Selected soil characteristics are provided in Table 1. The soils in the field of Sarayköy Research and Application Station were clay in texture, slightly alkaline with insufficient organic carbon, none saline (Soil Survey Staff, 2014). Clay content of the soils ranged between 40.80 and 54.80% with an average of 47.89%.

Table 1. Some characteristics of the soils

	Maximum	Minimum	Mean	Std. Deviation
Clay, %	54.80	40.80	47.89	3.63
Silt, %	37.10	25.40	30.89	3.27
Sand, %	25.60	16.30	21.22	3.16
pH	7.95	7.71	7.84	0.09
EC, dS m^{-1}	1.43	0.87	1.10	0.17
OM, %	0.81	0.31	0.51	0.14

pH: soil reaction, EC: electrical conductivity, OM: organic matter

Results and Discussion

Descriptive statistics for selected mechanical and physical soil characteristics in 0-20 cm soil depth and correlations among them are given in Table 2 and 3. BD of the soils ranged between 1.10 and 1.29 g cm^{-3}. Soil Qual. Staff (1999) found that an ideal soil BD to root growth is less than 1.10 g

cm^{-3} in the clay textured soil. Average bulk density of the soils was 1.19 g cm^{-3}. The findings show that soils in the Sarayköy Research and Application Station field have a potential risk for compaction if they are cultivated under unsuitable water contents. PR were between 0.88 and 1.73 MPa with an average of 1.20 MPa. PR gave a significant correlations with bulk density (-0.614*), field capacity (-0.645**) and relative saturation (-0.605*). The soil factors that affect PR are soil water status, BD, compaction episodes and soil depth (Whitmore et al., 2011). Costantini (1996) reported that soil penetration resistance was negatively correlated with soil moisture content and positively correlated with bulk density. In present study, increasing BD values caused lower PR. Increasing BD of clay soils could explaine higher relative saturation values at similar gravimetric water contents. In addition to, the bulk density values had significant positive correlation with RS (0.613*). Soils in greater BD since too wet according to the soils in lower BD. Campbell and O'Sullivan (1991) reported that relationships between soil water content, PR and BD for the cultivated soils were similar to those reported. Soil water contents may have a important impact on PR. In dry soil conditions PR is much higher than wet conditions because soil moisture content acts as a lubricant for soil particles. Moreover, dry soils resist compaction because of their interparticle forces, internal friction, including water films, bonding with temporary cements and fibres of OM (Vaz et al., 2011). In present study, increasing soil water content in field capacity and relative saturation lead to reduces in PR.

Table 2. Selected mechanical and physical characteristics of the soils.

	Maximum	Minimum	Mean	Std. Deviation
BD, g cm^{-3}	1.29	1.10	1.19	0.06
PR, MPa	1.73	0.88	1.20	0.28
FC, %	41.90	38.11	39.91	1.03
RS, %	72.92	51.76	60.75	5.46
LL, %	79.60	69.90	75.41	2.48
PL, %	35.60	31.70	33.34	1.38
PI, %	46.10	38.20	42.07	2.20
Ic (at FC)	0.92	0.79	0.84	0.04
A	1.13	0.77	0.88	0.10

BD: bulk density, PR: penetration resistance, FC: field capacity, RS: relative saturation, LL: liquid limit, PL: plastic limit, PI: plasticity index, Ic: consistency index, A: activity of clays

The size of the PI is related to the maximum possible bound moisture content of a certain mass of soil particles (Husein et al., 1999). Mapfumo and Chanasyk (1998) reported that a plasticity index > 17 indicates high plasticity of a soil, whereas 7 < plasticity index < 17 indicates medium plasticity and plasticity index < 7 indicates low plasticity. In this study, Atterberg limits varied between 69.90 and 79.60% for LL, between 31.70 and 35.60% for PL and between 38.20 and 46.10% for PI. According to LL and plasticity index values, the soils in the field of Sarayköy Research and Application Station were classified within high plastic inorganic clays group. Soils of the Sarayköy Research and Application Station field exhibited high plasticity and thus highly prone to compaction. Liquid limit significantly correlated with plastic limit (0.466*), plasticity index (0.832**), relative saturation (0.680**) and field capacity (0.338*). The PI is an important parameter for classification, characterization and prediction of the engineering behavior of fine soils. On the other hand, some researchers have determined the relationship between in situ soil moisture content and Atterberg limits, the liquidity index, which is an indicator of soil hardness under natural conditions (Rashid et al., 2014). Some researchers reported that the Atterberg limits

are in general effected by many soil characteristics (Stanchi et al., 2015; Gülser and Candemir, 2004 and 2006; Gülser et al., 2008 and 2009). Ic values were significantly correlated with FC (-0.491*). Activity index value characterizes the relationship between the clay content and plasticity index. Skempton (1953) determined activity index values of 1.5–7.0 for montmorillonite, 0.5–1.2 for palygorskite, 0.5–1.2 for illite and 0.3–0.5 for kaolinite. In addition to, Baumgartl (2002) classified soils based on A values as: active soils (smectite) for A values of >1.25; normal soils (illite) for A values of between 0.75 - 1.25; inactive soils (kaolinite) for A values of <0.75). In present study, activity index varied between 0.77 and 1.13 with an average of 0.88.

Dexter and Bird (2001) reported that the soil workability status is related to the water content at the lower PL according to Atterberg. AG Boden (1994) reported that the primary advantage of the concept of consistency is the opportunity to reliably check the soil behavior in the field. Ic describes consistency condition of a soil at any given soil water content. Baumgartl (2002) reported that if this value is becoming 0, soil is in liquid formation (liquid limit at index of consistency =0), If Ic value is becoming 1.0, soil is in plastic formation (plastic limit at index of consistency =1.0). In present study, the index of consistency were identified using the soil water contents at field capacity. Optimum workable moisture content range for agricultural use is present when the soil is stiff and has a compression strength of >100 kPa and Ic values between 0.75 and 1.00 (Baumgartl, 2002). If a soil is cultivated when index of consistency is less than 0.75, soil structural deformation will occur. In this study, Ic values at field capacity ranged between 0.79 and 0.92 with an average of 0.84. Thus, it was concluded that soil cultivation at field capacity would not have structural deformation in clay soils of the field. On the contrary, field capacity for clay textured soils lies in the danger zone for cultivation and soil workability of the soils at or near field capacity would cause severe compaction (Mapfumo and Chanasyk, 1998).

Table 3. Pearson correlation coefficient between soil parameters

	PR	FC	RS	LL	PL	PI	Ic	A
BD	-0.614*	0.556*	0.613*	0.395	0.383	0.204	0.058	0.324
PR		-0.645**	-0.605*	-0.462	-0.225	-0.378	0.070	-0.558*
FC			0.266	0.338*	-0.011	0.387	-0.491*	0.530*
RS				0.680**	0.370	0.533*	0.297	0.414
LL					0.466*	0.832**	0.402	0.674**
PL						0.103	0.846**	0.020
PI							-0.079	0.745**
Ic								-0.118

BD: bulk density, PR: penetration resistance, FC: field capacity, RS: relative saturation, LL: liquid limit, PL: plastic limit, PI: plasticity index, Ic: consistency index, A: activity of clays

Mueller et al. (2003) reported that soil structure damage is prevented when tillage occurs at the OWC for tillage. The consistency limits are important to estimate the optimum workable moisture content range and compressibility for tillage (Zong et al., 2016) and agricultural water management (Smedema, 1993). Thus, Dexter and Bird (2001) reported the OWC for tillage of a soil to be at the inflection point of the water retention curve which also coincided with 0.9 of the moisture content at the lower PL. Similarly, Mueller et al. (2003) reported Ic of 1.15 and 90% of PL as the maximum soil moisture content for optimum tillage of cohesive soils. In present study, calculated soil gravimetric moisture content at Ic of 0.75, 1.0 and 1.15 and 90% of plastic limit are presented in

Table 4 and mean soil gravimetric moisture content in Figure 1. OWC range for agricultural use are between 0.75 and 1.00 of Ic (Baumgartl, 2002), it can be dangerous cultivation of the fine-grained soils near index of consistency =0.75 (43.86%) or over the field capacity (39.91%). It seems that soil moistures at index of consistency =1.0 or plastic limit (33.34%), index of consistency =1.15 (27.03%) and 0.9% of plastic limit (30.01%) are suitable for the soils cultivation. Thus, the lower moisture limit for suitable cultivation of the soils was recommended as 27.03% and the upper moisture limit was 39.91% or field capacity.

Table 4. Calculated soil moisture contents for suitable workability.

	Maximum	Minimum	Mean	Std. Deviation
W (at Ic=0.75)	46.36	41.25	43.86	1.44
W (at Ic=1.00 or PL)	35.60	31.70	33.34	1.38
W (at Ic=1.15)	29.69	25.41	27.03	1.45
W (at 0.90 PL)	32.04	28.53	30.01	1.24
W (at FC)	41.90	38.11	39.91	1.03

Ic: consistency index, PL: plastic limit, FC: field capacity, W: gravimetric moisture content

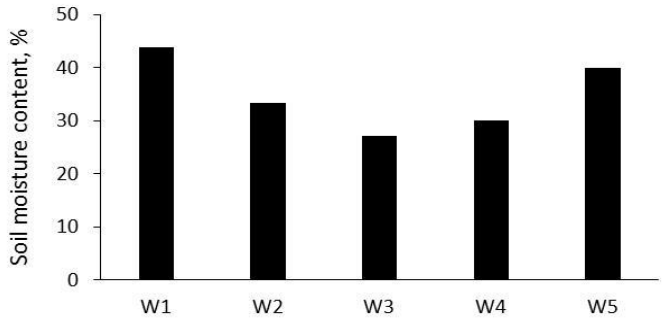

Figure 1. Soil moisture (W) at FC and different index of consistency values for suitable workability (W1 at index of consistency =0.75; W2 at index of consistency =1 or plastic limit; W3 at index of consistency =1.15; W4 at 0.9 plastic limit; W5 at FC)

CONCLUSION

This study was determined selected soil physical and mechanical characteristics of Sarayköy Research and Application Station field and suitable moisture contents for soil workability. According to liquid limit and plasticity index values, the soils in the field of Sarayköy Research and Application Station were classified within high plastic inorganic clays group. Consistency index values at field capacity ranged between 0.79 and 0.92 with an average of 0.84. Thus, it was concluded that soil cultivation at field capacity would not have structural deformation in the soils of the field. According to the results obtained, lower and upper moisture limits for suitable cultivation of the soils in Sarayköy Research and Application Station field were recommended 27.03 and 39.91%, respectively.

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ESTABLISHMENT OF A RECIRCULATING SUMP SYSTEM FOR THE CRAYFISH CULTIVATION IN IZMIR KATIP ÇELEBI UNIVERSITY

Onur KARADAL*
Department of Aquaculture, Faculty of Fisheries, İzmir Katip Çelebi Universiy, 35620, Çiğli, İzmir, Turkey
***Corresponding author:** onur.karadal@ikcu.edu.tr

Abstract

Consumption of crayfish as human food has become more common in recent years. With its rich amino acid and fatty acid content, crayfish have high protein value like other aquatic animals. Therefore, with the increasing interest in crayfish worldwide, studies on crayfish culture systems have started to be concentrated. Plastic aquariums (280 x 420 x 176 mm) with covers were provided to stock crayfish. Using U-PVC (Unplasticized Polyvinyl Chloride) pipes and fittings (elbow, ball valve, tee, union, muff, cole, cap, interior and exterior threaded adapters) and machinery equipment (submersible pump, external heater, and electromagnetic air pump) plastic aquariums were connected to each other and two closed circuit sump systems were created. Water inlets are opened to the front of the aquariums and ball valves are connected. The water collected through the pipes was filtered in a 50 x 140 x 25 cm glass aquarium (main sump) and the clean water was pumped back into the aquariums via circulation pumps. Biological sponge, filter fiber, ceramic, bio-ball and activated carbon are placed in the main sump as filter material. In addition, an external heater is connected to circulation pump outputs of the systems. An electromagnetic air pump was connected to each system and air lines were installed in all aquariums. Thus, systems that do not cause water waste, have their own filtration and aeration equipment and suitable for crayfish cultivation have been established.

Keywords: Crayfish breeding, Recirculating, Sump system, Piping, Water filtration.

INTRODUCTION

Aquaculture is the breeding, rearing, and harvesting of fish, shellfish, algae, and other organisms in all types of water environments. This production system can also identify as a method used to produce seafood, restore and rebuild natural stocks of aquatic species. It is currently estimated to account for approximately 13 percent (10.2 million t) of world fish production (FAO, 2020). Declines in capture fisheries are likely to continue at present levels. Thus, increased production by aquaculture is expected to close the future gap in fish supply. In the world aquaculture sector, the major purpose is the production of seafood, and the main aim of most facilities is income or commercial profit. While this production is applied with extensive and semi-intensive methods in most Asian and Far Eastern countries, intensive production is expected to become widespread throughout the world. Aquaculture systems range from very extensive, through semi-intensive and highly intensive to hyper-intensive. When deciding the capacity, the features of each system must be defined, as there are no clear specifications amongst these cultivation volumes.

Aquaculture varies according to the type of environment the species cultivated. The main environments are: freshwater, brackish water, and saltwater (marine) areas. The main groups of species are: finfish, such as sea bass, sea bream, trout and carp; crustacea, such as marine shrimp and freshwater crayfish; molluscs, such as mussels, oysters and clams, and seaweeds (FAO, 2020). Recently, cultivation of crustacean species has an important share in the world aquaculture production. Crayfish (order Decapoda, phylum Arthropoda) is a crustacean with the ten jointed legs

belonging the families Astacidae, Cambaridae, and Parastacidae. This animal commonly consumed as a food or kept in the aquariums as an ornamental animal by humans.

The aim of the study was to establishment a circulated freshwater system for feeding and breeding of crayfish species. However, recirculating aquaculture system (RAS) was thought to be the most appropriate method for planning this cultivation system.

MATERIALS AND METHODS

This study was carried out in Invertebrates Culture Laboratory, Faculty of Fisheries, İzmir Kâtip Çelebi University, İzmir, Turkey. Stages of the drilling water inlets and outlets can be listed as measuring the inlet / outlet holes, marking the holes, point heating with soldering iron, drilling the plastic with hand drill, remove the output piece with pliers, sanding with sandpaper (Figure 1).

Figure 1. Processes of the drilling water inlets and outlets by using different equipment.

Using 20 mm U-PVC (Unplasticized Polyvinyl Chloride) pipes and fittings (elbow, ball valve, tee, union, muff, cole, cap, interior and exterior threaded adapters) (Figure 2) and machinery equipment (submersible pump, external heater, and electromagnetic air pump) plastic aquariums were connected to each other and two closed circuit sump systems were established (Figure 3).

Figure 2. 20 mm U-PVC fittings used for the establishment of the systems.

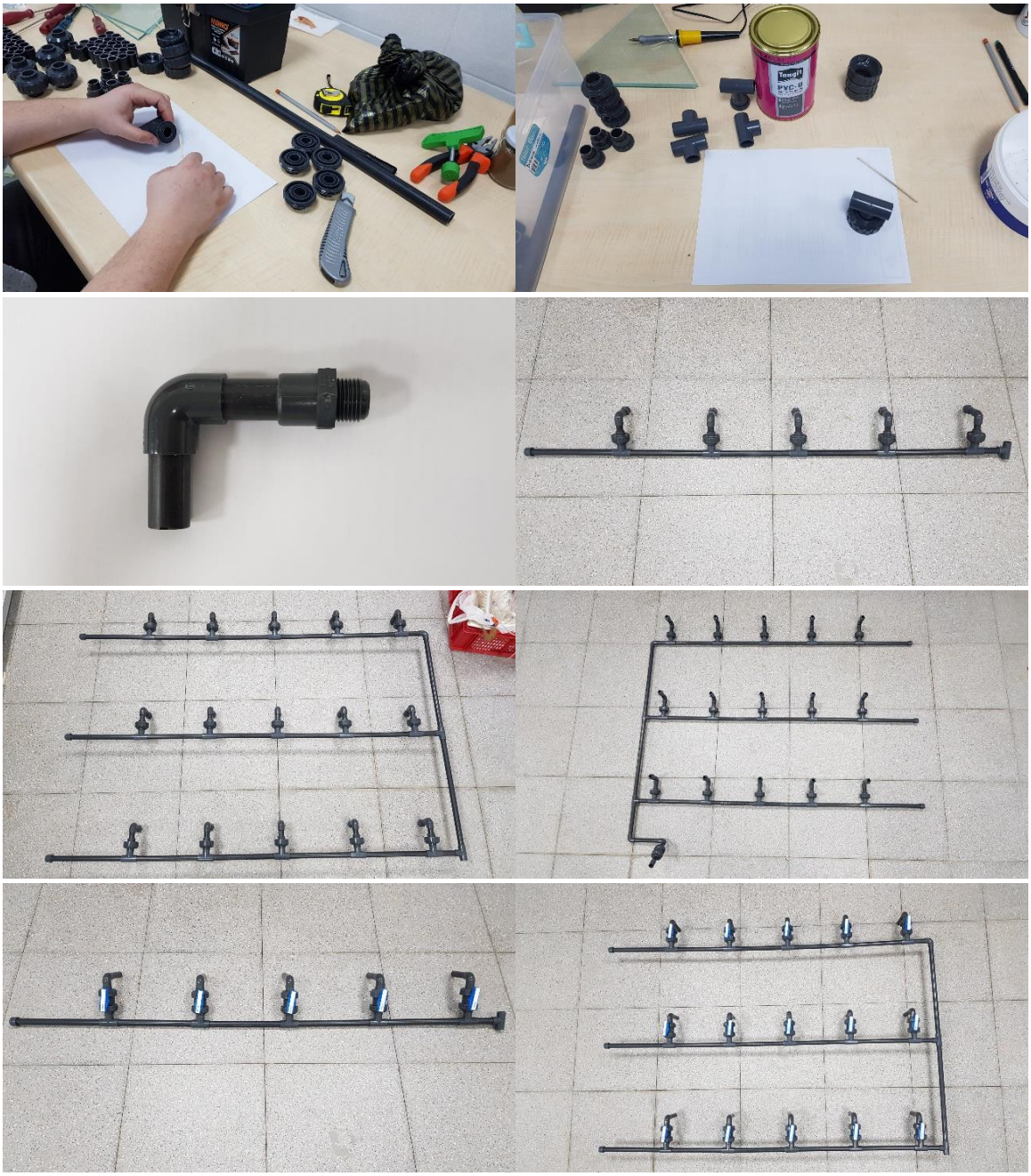

Figure 3. Unifying processes of pipes and fittings with solvent cement glue.

Details and measurements of the inlet and outlet piping structures were presented in Figure 4 and Figure 5, respectively.

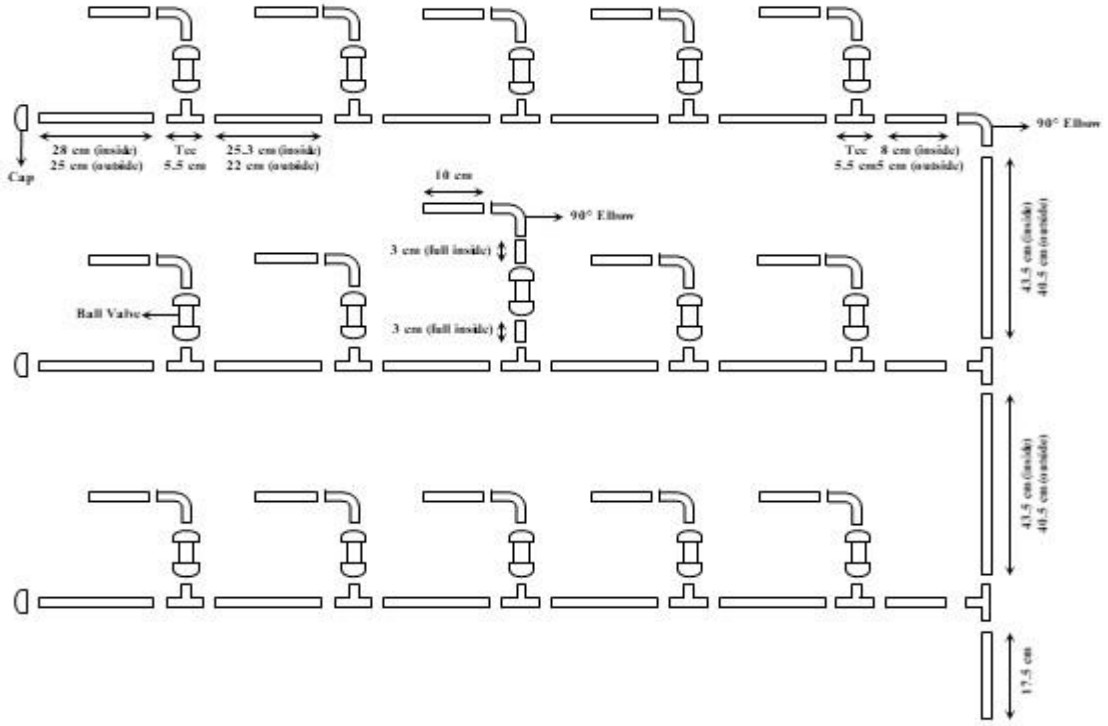

Figure 4. Establishment form and some measurements of the water inlet piping structure.

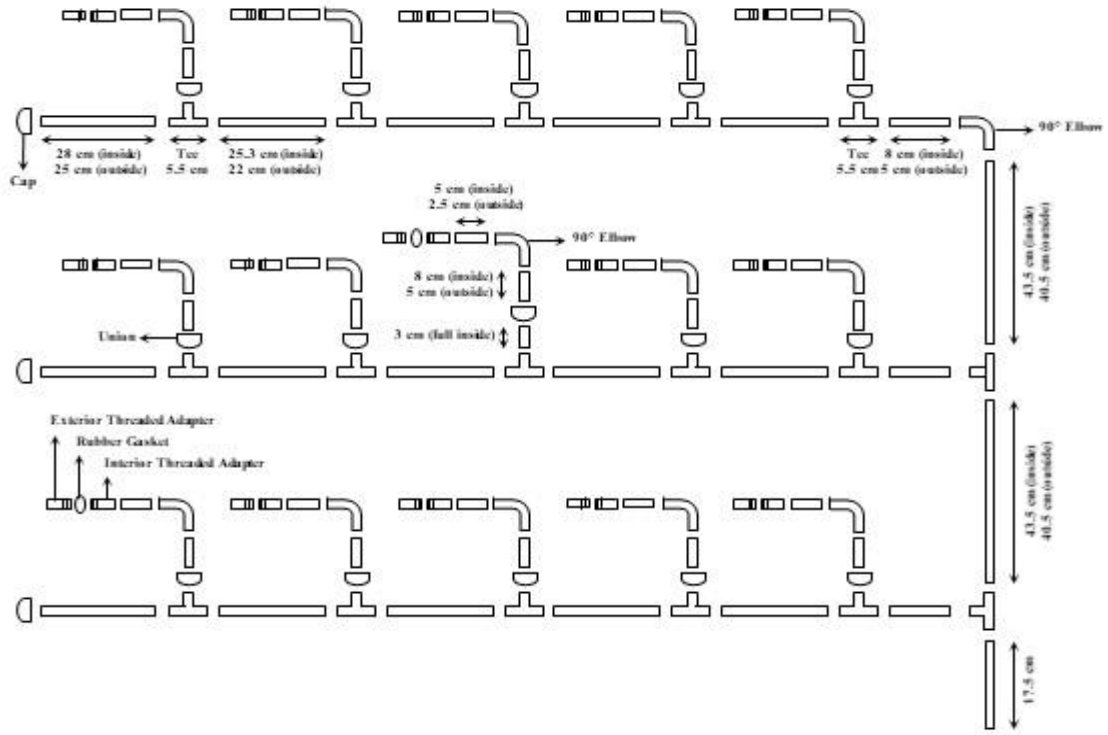

Figure 5. Establishment form and some measurements of the water outlet piping structure.

Solvent cement (Tangit) was used to stick all the pieces together. This solvent, all pressure rigid PVC glue, is suitable for the gluing of tube systems in the longitudinal direction, boots and fittings. Tangit is used for bonding connection points of pressurized pipes made of rigid PVC, such as drinking waterpipes, gas pipes, and agricultural watering pipes.

The water collected through the pipes was filtered in a 50 x 140 x 25 cm glass aquarium (main sump) and the clean water was pumped back into the aquariums via circulation pumps (Aquawing AQ6000) (Figure 6a). Biological sponge, filter fiber, ceramic, bio-ball and activated carbon are placed in the main sump as filter material. An electromagnetic air pump (Resun ACO-001) was connected to each system and air lines were installed in all aquariums (Figure 6b). In addition, an external heater (Hydor ETH 300) is connected to the circulation pump outputs of the systems (Figure 7).

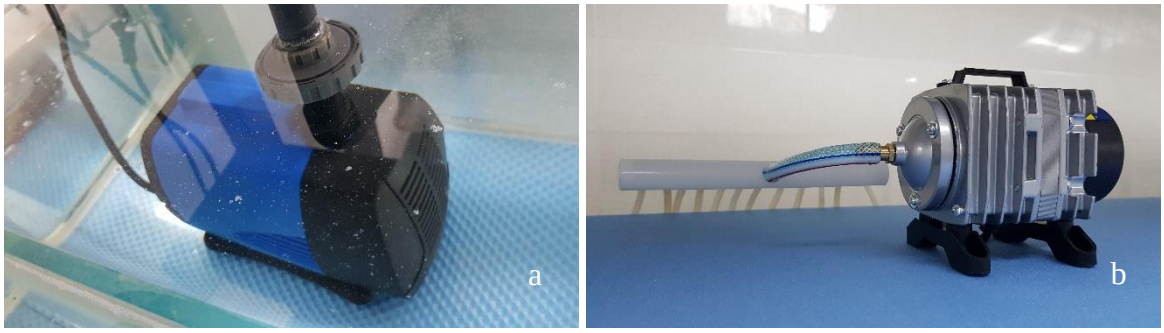

Figure 6. a) Circulation pump in main sump and b) electromagnetic air pump in the systems.

Figure 7. Connection and piping of an external heater.

RESULTS

At the end of the study, two recirculating systems were designed, as all stages were detailed in the Materials and Methods section. Thus, systems that do not cause water waste, have their own filtration and aeration equipment and suitable for crayfish cultivation have been established (Figure

8). These systems are suitable for different kinds of cultivation practices and experiments, including feeding, breeding, behaviour, diseases, etc. on crayfish species. Red swamp crayfish (*Procambarus clarkii*) were stocked to the system, after the establishment (Figure 9).

Figure 8. Full view of the established recirculating crayfish cultivation sump systems.

Figure 9. Red swamp crayfish stocked to the recirculating systems.

DISCUSSION

Aquaculture is accounted for nearly half of the whole food fish source. If culture applications not sufficiently used, recent performs can have undesirable ecological effects because of eutrophication, landscape alteration and variations in biodiversity (Tovar et al., 2000). Hence, some regulations have been presented connected to water usage and effluent discharge (Jokumesen and Svendsen, 2010). Thus, the development of land-based RAS as an alternative to traditional aquaculture areas such as open ponds and cages has become popular for providing controlled conditions (Avenue and Kong, 1995; Timmons and Ebeling, 2007). Water from the culture tank is cycled through bio-filters and reuse in the growth tank in RAS. This design offers improved control over water management, growth performance of fish, biological safety and energy utilization (Ebeling, 2000; Timmons and Ebeling, 2007; Tal et al., 2009). In these systems, aquafeed is almost the only origin of nitrogenous compounds, which are the main causes of water pollution. The solid excess is included mainly of fish evacuations and portions of uneaten feed. These solid wastages

and sludge are excreted by sedimentation or physical filtration (Chen et al., 1994; Timmons and Ebeling, 2007). If the wastages amassed properly, they can be used as fertilizer in other agriculture applications (Sharrer et al., 2007). Thus, these wastages are assessed with sustainable ways.

In conclusion, the understanding of the RAS is one of the major factor in water management in aquaculture, as this requires interaction between engineering and biology of living organisms and husbandry (Karadal, 2017). Within the above framework, most of the research has been related to enhancing eco-friendly RAS techniques. Further studies are required for searching RAS more effectively for natural balance, environmental sustainability, and improvements in production of both crayfish and other aquatic animal cultivation systems.

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SEVERAL METHODS FOR EXTENDING THE STRAWBERRY PRODUCTION SEASON

A. Lizalo[1], L. Demirsoy[1]

[1]Ondokuz Mayis University, Agriculture Faculty, Horticulture Department, Samsun

ABSTRACT

Strawberry growers in the world are faced with challenges that include decreased agricultural land availability, harsh climatic conditions, and significant competition from both domestic production and imports. In order to keep strawberry production viable, growers need to adopt strategies that minimize these challenges but on the other hand maximize the harvest period using new day-neutral varieties, low-chilling June-bearing varieties, specialized growing techniques and crop protection and forcing systems. This brief report identified production technologies that can extend the growing season for strawberry crops and result in change from a cultural risk to an opportunity for expansion of strawberry in a wider areas all over the world.

Keywords: Fragaria×ananassa, harvest season, plant material, protected cultivation, forcing

Introduction

Strawberry (*Fragaria* × *ananassa* Duch.) is an important small fruit crop grown worldwide, and its production is increasing steadily. Over 9.118.336 tons of strawberries were produced in 2018 (FAOSTAT, 2018). The biggest producer is China at 2.964.263 tons per year, which represents 30% of the world's strawberry crop. The next largest producer is the USA at 1.296.272 tons per year, and Mexico, Egypt, Turkey, Spain produce between 362.639 – 653.639 each (FAOSTAT, 2018). During the past 20-30 years, the cultivated areas, varieties and cultural techniques of strawberry production have changed considerably. The general object has been to extend season cropping options (e.g, tunnel or greenhouse production in late fall and winter, and open-field summer production) by introducing new ever-bearing varieties, low-chilling june-bearing varieties, protected culture and forcing systems. This brief review has tendency to identify the different methods of extending the strawberry season, and their effect on total yield, as also on earliness.

Plant Type and Variety Selection

Based on photoperiodic requirements for flower induction, strawberries are classified as short-day, long-day and day-neutral. Currently, most cultivated strawberries are short-day cultivars (Demirsoy et al., 2012). These are facultative short-day plants, which initiate flower in late summer and autumn in northern climates, however, when temperature is low enough (<10-15 °C) they can initiate flowers independent from photoperiod (Darrow, 1936; Guttridge, 1958). Depending on the variety, short-day strawberries generally require 8-12 hours of photo-period to initiate flowers at temperatures above 15 °C (Darrow, 1936; Ito and Saito, 1962). Short-day strawberries are particularly effective in terms of early growth (Sjulin, 2003). Day-neutral strawberries are

considered insensitive to photoperiod in flower bud initiation and bear fruit in a wide range of photoperiods (Durner, 1984; Galleta et al., 1988; Galletta and Bringhurst, 1990; Demirsoy et al., 2012). Flower bud initiation in day-neutral varieties varies depending on temperature, the ideal temperature is 18-26 °C and above 30 °C flower bud initiation is prevented (Hancock, 1999). Although most modern strawberry varieties are short-day, the use of day-neutral varieties in commercial strawberry growing increased in recent years due to their importance for extending the harvest period (Straw, 2005; Poling and Ballington, 2006; Portz and Nonnecke, 2010; Rowley et al., 2011; Demirsoy et al., 2012; Neri et al., 2012; Durner, 2018; Demirsoy et al., 2018). The day-neutrality characteristics allow the differentiation of flower buds under long days conditions during spring and summer, thus continuing fruit production during summer and autumn. Hence, day-neutrality feature plays a critical role in extending the production season of the strawberry (Shaw and Famula, 2005).

The interaction of the genotype with environmental factors is particularly important, some cultivars can not adapt to areas with different climatic conditions. Moreover, breeders are trying to develop new varieties that can adapt to different environments and production systems to cope with extremely variable climatic conditions (Dale, 2008). Around the world, many active breeding programs continuously offer a wide range of new varieties to growers. The most important current objective is to extend the harvest season. Basically, this has been fulfilled following by two approaches: using low-chilling June-bearing varieties able to bear fruit for longer periods during the winter and spring seasons, particularly suited for southern environments, but using forcing systems it can allow to grow them successfully even in northern areas, and breeding ever-bearing varieties for spring-summer production, particularly suited for northern environments (Neri et al., 2012). In central-southern areas of Europe (Italy, Spain) there is a large differentiation of cultivars used depending on conditions and market. Mezzeti et al. (2018) reported that in the more central areas (Germany), some of the most common cultivars used are ‘Clery’, ‘Joly’, ‘Alba’, ‘Asia’, ‘Garda’, ‘Eva’, ‘Romina’, ‘Sibilla’ and ‘Cristina’, and ‘Darselect’. In the more southern areas, many cultivars released from California and Florida are commonly planted (eg. ‘Florida-Fortuna’, ‘Camarosa’, ‘Monterey’, ‘Portola’) combined with other important Spanish cultivars (Sabrina Sabrosa). In Turkey the most commonly used cultivars are ‘Rubygem’, ‘Festival’, ‘Camarosa’, ‘Fortuna’, ‘Sabrina’ and ‘Sabrosa’ (short-day) for southern areas, and ‘Albion’ (day-neutral) for northern areas.

Planting Material

Knowing the plant dimension and architecture (number of inflorescences and flowers per inflorescence, and their phonological phase), yield potential and fruit ripening can be planned in a predictable way (Neri et al., 2012). Modern strawberry fruit production is based on using proper plant material. There are different plant materials used in strawberry production, such as frigo plants, tray plants, waiting beds and fresh plants. Each of this type of material provides big potential of strawberry fruit production. In the world frigo plants are predominantly used in the past ten years. They are planted in summer and they bare fruit in the spring next year. Development of new technologies of strawberry production out of season demands also other types of plant material. Strawberry tray plants are fast replacing traditional bare-rooted transplants in many parts of the world as growers recognize that container-grown plant material provides better opportunity to control critical production factors (Durner et al., 2002). The prediction is that tray plants will be

more important especially in out of season production, due to plant size, earliness, fruit quality and yield are generally higher, and risk of soil originated disease is reduced (Lareau and Lamarre, 1992; Pritts, 2002; O'Dell and Williams, 2009; Yoshida, 2013). Tray plants have cold storage properties that are better than bare-root waiting-bed plants (Lieten, 1994). There are two types of tray plants, green tray plants and cold-stored tray plants. Green tray plants are planted immediately after they are produced and the production of it takes five weeks (Bish et al. , 2002). Planting can be done from mid-summer to autumn depending on climatic conditions. Cold-stored tray plants is particularly used in soilless production systems (Duralija, 2004). The choice of cold stored plant types which are used in production out of season, have high influence on the yield and harvest during the summer period (Duralija et al., 2004). Waiting bed plants can be characterized as a heavy, extensive, multi-crowned plant, conditioned to start fruiting about 5–8 weeks after planting, depending on the cultivar, planting date, and environmental conditions after planting (Dijkstra, 1988; Jamieson, 1991), which are grown from runners and planted into a 'waiting bed' to produce a large, strong plant and have potential to extend the strawberry production season (Baumann and Daubeny, 1989). In the waiting bed phase of this system the plants were deblossomed and runners were removed to stimulate the production of a multiple crowned plant (Chercuitte et al., 1991). It is possible to extend the production period using fresh plants in early strawberry production locations. Commonly referred to as fresh dugs, are most often transplanted by hand requiring an availability of affordable labor, and are not usually available until the final week of September, which is too late for transplanting in colder regions. To establish these highly perishable fresh dugs, growers must rely on intense overhead sprinkling for one to two weeks, depending on weather and the condition of the freshly dug plants. Planting is usually performed in the late fall, in the high tunnels or in areas with cool winters for winter and early spring harvest season. Fresh dugs exposed to cooler temperatures, chilling in the nursery or both will require less time for establishment than fresh dugs produced in warmer climates (Duralija, 2004). The utilization of fresh plants is quite common in Spain and Italy. In Turkey, deficiency high elevation locations with sandy soil for producing fresh plants, very hot falls in fresh plant production areas limits using fresh planting material, and having not high temperatures during December and January prevent significantly fruit production with fresh plants (Demirsoy and Serçe, 2016).

Environmental Conditions

The location significantly affects the plant's formation, thus it is possible to program the harvest time and synchronization by changing the growing areas. The environmental conditions of the nursery place vary according to the altitude, as in the cultivation place. Plants can be propagated in conditions suitable for floral formation in the northern areas and then transplanted into the southern areas to promote the formation and development of flower organs. The altitude of the nursery location affects flower formation, flower formation occurs earlier in nurseries at higher altitudes (Savini et al., 2006), whereas long photoperiods and environments with high temperatures reduce flower formation and encourage vegetative growth. Vegetative growth is reduced in plants in tropical climates with low altitudes and high temperatures (Riyaphan et al., 2005).

The strawberry growers face climate change in present days. Thus strawberry researchers have tried to innovate cultural techniques and varieties to successfully expand the harvest season, irrespective of climate change. The photoperiod is a primary environmental factor controlling the transition from vegetative to reproductive growth in strawberries. Strawberry cultivars traditionally

have been classified into photoperiodic response groups for flowering. June bearers are defined as facultative short-day plants (Darrow, 1936), everbearers are classified as long-day plants (Darrow and Waldo, 1934), and photoperiod-insensitive varieties are defined as day-neutral (Bringhurst and Voth, 1978). Artificial light or light-proof coverings can be used to alter light availability and thus the occurrence of flower differentiation and the plant architecture (Bosc and Demené, 2009), according to the specific needs of each plant genotype. For instance, flower induction and blooming ability can be delayed by the application of long day conditions on short-day plants (Bosc et al., 2012). Heide (1977) found that stolon formation, petiole elongation, and leaf area growth were stimulated by high temperature and long days, usually with optima at 16 h and 18°C for petiole elongation and 16 h and 24°C for stolon formation. They concluded that at high latitudes temperature is as important as photoperiod in controlling flowering in the strawberry. Flower initiation in June-bearing SD strawberries may be regulated by light quality (Collins, 1966) and intensity. As an example, a reduction in light intensity (85% shading) along with the associated lower temperature can increase flower induction, but only during the period of reducing day length (Kumakura and Shishido, 1995). As well, increasing the amount of shade on the plant may induce a reduction in crown dimension (Wright and Sandrang, 1995) as well as the number of leaves and inflorescences, whereas increasing light intensity can enhance flower differentiation (Awang and Atherton, 1995). Photo-selective nets placed over the plants may select the light signal that stimulates flower initiation. In fact, the spectral composition of the irradiation appears to quantitatively affect flower bud initiation (Takeda, 2010). In particular, red and blue nets prevent flower initiation (Takeda and Newell, 2007). Light quality interacts with the responsiveness to photoperiod. Long day conditions do not delay floral initiation if the extended lighting is with red light, but do delay floral initiation with far-red or a combination of low red/far red (Vince-Prue and Guttridge, 1973). Temperature is the most important limiting factor in strawberry production in temperate areas. The ideal temperatures for strawberry growth are between 20 and 26 ˚C (Darrow and Waldo, 1934). Flower bud formation takes place in a range of optimal temperatures and can be totally (Hideo and Saito, 1962) or partially inhibited at prolonged high temperatures, higher than 26°C (Durner, 1984) or 30°C (Hideo and Saito, 1962). At tropical to equatorial latitudes, strawberries can be commercially grown only in the highlands, where temperatures are lower. In addition, natural daily fluctuation of temperatures (26.7/15.6°C day/night) induces earlier flower formation compared with a constant temperature of 21°C (Hartmann, 1947), or higher (35/25°C) day/night temperatures (Bish et al., 1996). Fluctuating temperatures can be artificially applied to reproduce natural environment in forced conditions or to manipulate flower induction (Reichart, 1973; Chabot, 1978; Durner, 1984; Bish et al., 1996) in specific climate areas. Temperatures below 15.6 °C delay flower differentiation (Darrow, 1966). Cold temperatures (below 7-10°C) effective in overcoming dormancy (chilling) may induce strong vegetative growth (Vince-Prue and Guttridge, 1973). Cold treatments can be applied to avoid the decrease in vegetative vigor in greenhouse strawberry production. Exposure to chilling to a certain extent reduces flower induction and stimulates floral differentiation (Durner and Poling, 1988), along with leaf number and runner formation (Guttridge, 1958; Porlingis and Boynton, 1961; Bailey and Rossi, 1965; Braun and Kender, 1985; Kahangi et al., 1992; Lieten et al., 1995; Tehranifar and Battey, 1996). In warm regions, chilling preceding the optimum digging date in the nursery may be advantageous for early fruit production, while extra chilling after the optimum digging date may reduce flowering (Durner and Poling, 1988). A lack of cold can be compensated by artificial lighting (Van Delm et al., 2010),

especially in the greenhouse. During prolonged cold storage (frigo plants) widely applied for programmed cultivations, sugar and starch content can decline and this is correlated with a decrease in the number of emerging inflorescences and flowers (Molot, 1973; Kinet et al., 1992; Dradi et al., 1996; Sønsteby and Hytonen, 2005) mainly below the last expanded leaf (Bosc et al., 2012). Further, the stress related to the duration of cold storage may result in earlier flowering (Lieten et al., 1995).

Forcing Culture

Forcing culture is the induction of flowering by several artificial methods (e.g., chilling, short-day) in autumn, growing of plants under a heated greenhouse to avoid the induction of dormancy and dwarfing, and kept in a nondormant status to continue harvest (Mochizuki et al., 2009). To understand the meaning of forcing culture, it is very important to comprehend the status of dormancy in strawberry plants, thus controlling dormancy is a key to realize the long-term successive harvest during winter to early summer. Dormancy of strawberry plants is induced by low temperature and short-day photoperiod is released by sufficient chilling. In spring, dormancy-broken plants produce long petioles, large leaf blades and many runners. To avoid onset of the dormancy, plants need to be heated at a minimum of 5 ºC and exposed to supplemental lighting, so they do not cease to initiate flower buds (Yano et al., 2006; Mochizuki et al., 2008). Forcing techniques are still not well known in the world. Japan is the leader in production of strawberries using forcing cultures, and it is characterized by promotion of flowering of the first inflorescence, successive flowering and harvest during the overwintering season, and environmental control for keeping on the dormant status suitable to successive flowering (Mochizuki et al., 2008). Japanese horticulturists are using several artificial methods for inducing flowering (e.g., chilling, short-day) in autumn, and plants are grown under a heated greenhouse to avoid the induction of dormancy and dwarfing, and kept in a non-dormant status to continue harvest. Fujimoto and Kimura (1970) developed forcing technique to increase early yield and to meet the demand for strawberries. Firstly, they used Hokowase cultivar which easily goes into dormancy in the winter season. For this forcing system, runner plants are raised in waiting beds until July, dug up, and then replanted in the same beds in early September. In this transplant manipulation technique called “Dankon-zurashi,” early flower-bud initiation was promoted by reducing the plant nitrogen level (Fujimoto and Kimura, 1970). In the 1980s, new techniques for flower induction, such as short-day/low-temperature treatment (8 hours of ambient light) and dark/low-temperature treatment (10-15°C), mainly for varieties ‘Nyoho’ and ‘Toyonoka’ were established and widely adopted in warmer regions with forcing culture (Furuya et al., 1988). During the past few years, in Belgium and the Netherlands the forcing culture has progressively developed by using appropriate forcing conditions and involving the plasticity of strawberry plants, the breeding of new varieties with specific acclimation properties (day-length sensitivity, chilling requirement), the technical ability of specialized farmers and the integration of the European market (Neri et al., 2012). Lately, there is a need to evaluate alternative types of strawberries (e.g., day-neutrals); alternative cultural systems (e.g., tunnel culture); or specific products (e.g., row covers) that could be used for either season extension or off-season production in strawberry cultivation.

Protection Systems

Protected cultivation systems that include “high tunnels” or “low tunnels” covered with clear plastic agricultural film produce high quality strawberries with low disease incidence through the winter in many locations (Freeman and Gnayem, 2004). Most strawberries are grown in the open, but greenhouses have become popular for season extension and off-season production in some parts of Europe (Spain; Huelva, Italy; Verona,), North Africa, Israel, Korea, Turkey and Japan, particularly in areas with mild winters (Neri et al., 2012). To protect the crop against temporary inclement weather conditions, improve yield and fruit quality, reduce incidence of insect population and weed interference, single or multiple light plastic tunnels are generally used. Low tunnels are typically only 40 to 50 cm tall and cover only one row or one bed of strawberries (Galletta and Bringhurst, 1990). Lewers et al. (2017) found that low tunnels provide 9 months season length and total yield and marketable yield under low tunnels are 188% greater and 313% greater, respectively, compared with open beds. Use of polyethylene tunnels warms the air and soil, resulting in more rapid strawberry plant growth and flowering, thereby enabling strawberry fruit to be harvested 6-8 weeks earlier than outdoor culture, and with higher total yields (Daugovish and Larson, 2008). High tunnels are most commonly used in strawberries production in order to provide earlines, season extension, practicality and protection from unfavorable weather conditions, including wind, hail, frost, and excessive rainfall (Demchak, 2009; Gu et al., 2017). In many countries, strawberry cultivation is done by unheated plastic tunnels, which are particularly risky because these tunnels allow considerably early blooming, and do not provide enough protection for flowers or, eventually, the plants, if the temperature falls far below 0°C (Neri et al., 2012). Growing day-neutrals in an annual raised-bed plasticulture system is viable, and planting plug plants of day-neutral cultivars in the fall, then harvesting in the spring, or planting dormant plants in the spring and harvesting through the fall is possible (Kadir et al., 2006), however, the primary benefit of high tunnels for strawberry may have been reliability of production rather than a yield increase (Demchak, 2009). Rana and Gu (2020) reported that organic and off-season day-neutral strawberries produced in low tunels inside high tunnels have higher prices than the conventional, field-grown strawberries. Rowley et al. (2011) found that high tunnels could be used to improve summer production of spring-planted day-neutral cultivars and extend production into late fall, as well as use a low tunnels inside high tunnels were shown to provide more hours of optimal growing conditions for strawberry plants in the early spring and late fall, but management of the low tunnels to maintain optimum temperatures proved difficult. However, the use of protection systems in combination with day neutral cultivars and additional temperature management strategies, gives an option for growers that may help economically strawberry production for extending season, thus making commercial strawberry production an option, where it might not have been viable in the past (Rowley et al., 2010).

Summary

Traditionally, production season for strawberries is only four to six weeks. In recent years, researchers evaluated new types of varieties, show that planting different types of strawberries, using different plant material, growing them under protected systems and favorable conditions increase the length of the season and strawberry yield considerably. Utilizing different season extension methods in strawberry production, growers can achieve high yield, high selling price,

quality and nice looking fruits also, and fresh strawberry fruits are available to the consumers throughout the whole year as a source of nutrients.

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SUMMER-FALL STRAWBERRY PRODUCTION WITH DAY NEUTRAL STRAWBERRIES

A. Lizalo[1], L. Demirsoy[1]

[1]Ondokuz Mayis University, Agriculture Faculty, Horticulture Department, Samsun

ABSTRACT

The main strawberry fruit production period is from April to June. But there is also increased interest in producing fresh strawberry fruit during summer and autumn periods. Fruit produced from July to November has the greatest market value. Day neutral plants are established in the early spring, come into production near the end of the june bearing production season, and continue to fruit through the summer and fall months. Thus, recently growers have attempted summer-fall production with day neutral cultivars. But growers face problems in the selection of appropriate planting time, planting material, variety and cultural practices, as well as the management of summer temperatures in summer-autumn strawberry production with day neutrals, as it is a new method yet. The objective of this review is to investigate appropriate management practices for successfull summer-fall strawberry production with day neutral strawberries and to evaluate economic efficiency of it.

Keywords: Fragaria x ananassa, summer-fall production, day neutral, planting time

Introduction

Based on photoperiodic requirements for flower induction, strawberries are classified as short day, long day and day neutral. Currently, most cultivated strawberries are short day cultivars (Hancock, 1999; Demirsoy et al., 2012). Day neutral cultivars are the natural choice for out of season production because they do not require specific photoperiodic conditions for floral bud initiation (Hamann and Poling, 1996) as long as temperatures are moderate below 30/26 °C day/night (Castro et al, 2015). In the past decades, utilization of day neutral cultivars has received considerable attention in commercial strawberry growing because of their providing opportunities to produce fresh strawberry fruits during summer and autumn periods (Ballington et al., 2008; Voca et al., 2009). Day neutral plants are established in the early spring, come into production near the end of the june bearing production season, and continue to fruit through the summer and fall months (Pritts and Dale, 1989). Previous research has tended to focus on june bearing varieties because of their commercial dominance. Using day neutrals in commercial strawberry production started to become common just after the first successful introgression of day neutrality into commercial octoploid strawberries in 1980's (Bringhurst and Voth, 1984). For this reason, research on day neutrals has been relatively limited, especially on the summer production system with day neutrals as it is new (Ballington et al., 2008; Lantz et al., 2009; Portz and Nonnecke, 2010; Lantz et al., 2010; Rowley et al., 2011; Demirsoy et al., 2018; Gude et al., 2018;). Success in summer-fall strawberry production has been inconsistent due to the lack of systematic evaluation of appropriate conditioning treatments for specific cultivars. Hence, growers have a dilemma about the exact time of planting, planting material, management practices, the choice of cultivar, and high summer temperature management. By using proper management techniques, strawberry growers can readily produce summer-fall crop and represent an uprising market that offers the potential for growers to diversify and remain competitiv. The focus of this brief is to evaluate the effect of management practices such as planting time, planting material, flower removal application, cultivar selection

(environmental physiology and photoperiodic responses), temperature management, and also protected cultivation on summer-fall production of day neutral strawberries and also to evaluate economic efficiency of summer-fall strawberry production.

Planting Time and Planting Material

There are several reports available in the literature indicating that strawberries can be planted at different times of the year depending on variety, location and climates (Galletta and Bringhurst, 1990; Sharma and Sharma, 2004). According to Gafke et al. (1993), using low-quality plant material leads to a high loss of yield and is impossible to compensate for. Recently, growers and researchers have attempted to produce strawberries in summer and autumn in highland areas using day neutral and short day cultivars (Lee et al., 2007; Ruan et al., 2009). Day neutral plants can be planted in the fall time for winter production with tray plants and in late winter or early spring for summer-autumn production with frigo plants. Plants start to grow at 4-5 ℃, which is why recommended to plant as early as possible in order to achieve maximum yields. This early growth allows day neutral varieties to reach high yield capacity before high summer temperatures start to limit flower initiation (Rowley et al., 2010). Demirsoy et al. (2018) found that late planting (7-8 June) wıth bare rooted plants of day-neutral cultivars for summer-fall crop production had negative effect on fruit yield. In recent periods there is an increase in interest in planting day neutral strawberries in early spring (Popovic, 2019). Early spring planting gives an opportunity to fruit harvest during summer-fall time and next spring season surely. Technologically and economically method is to plant strawberry plants as early as possible in spring, because within the first two months of planting, strawberries start to bear fruit and continue bearing through late fall (Straw, 2005; Poling and Ballington, 2006; Portz and Nonnecke, 2010; Rowley et al., 2011; Durner, 2018; Demirsoy et al., 2018). Combination of day neutral cultivar and everbearing cultivar with spring planting and plug material not only can realize even fruit supply but also can fulfill both fresh consumption and processing purposes in summer and autumn season (Ruan, et al., 2013). High prices of the out – off season production can pay of investment. This period for planting is limited (low yield) for june bearing cultivars, because of their flowering physiology based on flower initiation under short day and cooler temperature conditions. The first-year yield directly depends on the category of planting material used. Furthermore, higher profitability and productivity of strawberries are being taken with staggered planting (Wang et al., 1998, Hancock, 1999, Neri et al., 2012, Lieten 2013). To achieve a high percentage of yield, it is recommended to use tray plants or bare rooted plants (A+ category of frigo plants). Summer replanting with plug plants did not increase fall yields (Rowley et al., 2011). Potted fresh transplants are not recommended, as they are only available late in the planting period, and are more expensive and less productive for summer-fall production. Ruan et al., (2011) investigated the effect of cultivar, planting date, planting material, and yield performance of frozen (−2.2°C) bare root plants, potted frozen bare root plants, and potted fresh plants on fruit productivity of ‘Albion’ and ‘San Andreas’ planted on four dates: 30 Apr., 15 May, 30 May, and 15 Jun. Both cultivars performed well in summer and autumn production, although marketable fruit yield for ‘San Andreas’ was significantly greater than that of ‘Albion’.

Cultivar Potential

Day neutral strawberries insensitive to the length of the photoperiod can give fruit in a short period of 3-4 months (Galletta and Bringhurst, 1990), and continue to flower as long as temperatures are between 4 and 29 ˚C (Durner et al., 1984). Thus they are suitable for winter and summer-fall production, in areas with hot winters and cool summers, respectively (Galletta and Bringhurst, 1990). The present day neutral strawberries have negative aspects such as not being

suitable to the continental climates (Dale et al., 2000). Likewise, day neutrals are not being well-adapted to places where the temperature difference between day and night is low and the cultivars suffer from high summer temperatures in continental climates (Durner et al., 1984). To grow day neutral cultivars during summer, temperatures should be less than 30˚C. These cultivars have reduced yields and produce small, soft fruits in the middle of the summer (Draper et al., 1981), but day neutral cultivars have a lower temperature threshold of growth and continue to grow to produce fruit going into the winter months (Durner et al., 1984). Recent studies have specific objectives to quantify the summer-fall benefits of utilizing spring-planting for increased summer-fall production. Fall-planted june bearing cultivars in an annual hill production system has proven effective for focusing fruit production in the early spring (Poling, 1993; Black et al., 2002; Stevens et al., 2011), but length of fruiting season is limited by photoperiod and temperature (Durner et al., 1984). Since 1986's, the breeding program of California University has released a new day neutral cultivars: 'Diamante','Aromas', 'Albion', 'Sweet Ann', 'San Andreas', 'Seascape', 'Everest', 'Monterey', 'Portola', 'Triumph' with the primary objectives of production efficiency, fruit quality, harvest efficiency, environmental tolerance and extending fruit production through the summer and fall months (Shaw, 2004). Mezzeti et al. (2018) reported that in Northern and Central European countries still the most common cultivar remains 'Elsanta', a quite old cultivar with a high interest for the fruit quality. In central-southern areas of Europe (Italy and Spain) there is a large differentiation in the type of cultivars used depending on conditions and market. In the more central areas (Germany) some of the most commonly used everbearing cultivars are 'Clery', 'Joly','Alba' and 'Darselect'. Everbearing cultivars are also widespread in some cultivation areas of Europe, and currently a few are showing increased interest in different European areas, such as 'Murano', 'Eve Delight', 'Malga' (Mezzeti et al., 2018). In recent years, there have been a few reports on strawberry production systems that would potentially allow growers to achieve extended cropping with day neutral strawberries in the summer (Straw, 2005). In Tennessee, Straw (2005) has investigated the potential of fall fruiting of two day neutral strawberry cultivars ('Everest' and 'Seascape') along with 'Sweet Charlie' (short day), at the Plateau Experiment Station near Crossville, but problems were encountered with wildlife feeding on plants as well heavy and frequent rainfalls at harvest and anthracnose fruit rot. Ballington et al. (2008) reported that the day neutral cultivars 'Albion' and 'Seascape' had excellent flavor and produced high yields. Shaw and Larson (2006, 2009) even reported fruit yields of 2.42 and 3.29 kg/plant for 'Albion' and 'San Andreas', respectively, during a six-month harvest from April to October. Ruan et al. (2011) found that cultivars 'Albion' and 'San Andreas' during summer and fall fruiting season produced 521.0 g/plant for 'Albion', and 618.3 g/plant for 'San Andreas', respectively.

Flower Removal

The effect of flowering on vegetative growth in strawberries has long been a source of contention among investigators. Theoretically, flower removal after planting would allow the plant to establish well before fruit production begins. Flower trusses should be removed for 2-3 weeks after dormant field-planted plants begin to flower in order to allow the plant to establish and have leaf surface to support later fruit production. Otherwise the plant's vigor will suffer, total fruit production will be reduced, and the plant will be less able to withstand attacks by diseases or insects. Flower removal would also provide advantage to delay fruit production to target a certain market (Dale and Pritts, 1989). In day neutral strawberries, the first flowers are generally removed to stimulate the plants to achieve sufficient size for fruiting. The rest of flowers have potential for bearing fruit 1-2 seasons (Rubinstein, 2015). Pritts and Worden (1988) reported the highest season fruit yields in day neutral plants that had been deblossomed just after planting. Nishizawa ve Shishido (1998) found that amount of dry matter was increased in the plants from which flowers

were removed. Lantz et al. (2009) reported that producers do not need to remove flowers after the plug plants are planted in spring (it should be noted that flowers were removed when plug plants were at the nursery). Demirsoy et al. (2018) investigated the effects of flower removal practices (30, 60, 90 days after planting) on the total summer-fall fruit production for two day neutral cultivars Albion and Sweet Ann, and found that flower removal did not affect yield and fruit size in the tried cultivars. However, they were observed that the plant growth parameters were low in the plants non-flower removed, which indicated that in the perennial growing, flower removing would be beneficial for plant vigor and yield. Forney and Breen (1985) compared the vegetative growth and dry matter distribution in the plants deblossomed and having fruit-bearing in Brighton, a day neutral variety, and found that fruit is the biggest source that prevents the formation of stolon and crown during development. On the other hand, removing flowers seemed to encourage stolon, crown and leaf development. Portz and Nonecke (2010) conducted a study with spring-planted bare rooted, day neutral cultivars ('Albion', 'Seascape' and Tribute') to compare the production practices of removing flowers and runners after planting (May 7) on total fruit production, average berry size, and plant biomass. The results stated that the yield and fruit number were the highest in 'Tribute' in which only flowers were removed until 31 July, while the highest yield was obtained in runner and flower removal application until 31 July in 'Albion'. Howerever, all the above research have been implemented mostly in the distant past with old cultivars and standard cultivation methods, therefore there is a need for more researches utilizing new cultivars and modern cultivating systems to find out the exact effect of flower removal on plant growth, yields and the final on the profit.

Temperature Management

Heat stress is a challenge for growers in strawberry production mostly because it reduces vegetative growth and root growth of strawberries (Hellman and Travis, 1988; Fukuda and Matsumoto, 1988), fruit weight (Kumakura and Shishido, 1994), fruit size (Wang and Camp, 2000), Heat stress affects all stages of reproductive growth from flower bud initiation through flower development (Guttridge, 1985; Durner and Poling, 1988), pollination and fertilization (Ledesma and Sugiyama, 2005), achene to fruit development (Darrow, 1966; Dana, 1980; Renquist et al., 1982; Kumakura, and Shishido, 1994; Miura et al., 1994; Ledesma et al., 2008; Mackenzie and Chandler, 2009). Chen (2013) investigated the effect of temperature on fruit and achene characteristics of day neutral strawberries. The results suggested that fruit became smaller as weather became hotter and in the same way heat negatively affected fruit size and weight by reducing the number and size of the various components in fruit development from flower bud initiation to ripe fruit. High temperatures above 30 °C reduce overall plant growth (Hellman and Travis, 1988). Flower number is reduced by temperatures above 20°C (Heide, 1977; Miura et al., 1994; Ledesma et al., 2008). Lower yields were found in june bearing strawberries when exposed to high temperatures over 35°C (Hellman and Travis, 1988). Ledesma et al. (2008) reported that in 'Nyoho' and 'Toyonoka', there were fewer inflorescences and flowers when the cultivars were grown at 30/25°C day/night temperature after the stage of visible flower buds than at 23/18°C. Kadir et al. (2006) found that june bearing plants in a high tunnel produced crops 5 weeks before open-field production, and From December to February, average minimum and maximum crown temperatures under the high tunnel is 5 and 12 °C warmer than those of the field crowns, respectively. In contrast to june bearers, the prolonged season of the everbearers causes vegetative growth and fruiting to coincide (Camacaro et al., 2002), so the influence of the environment on the balance of assimilate partitioning between vegetative and reproductive growth is of particular importance for optimized long-season production (Wagstaffe and Battey, 2006). There are some recommended production practices for summer-fall strawberry production. Thus, growing systems may not be able to prevent heat stress completely on a commercial scale, but improved materials (e.g. heat reducing polythenes) and

targeted crop husbandry techniques based on a more precise knowledge of the causes of heat stress could decrease its severity, providing scope for future improvements (Wagstaffe and Battey, 2006). Shadecloth was shown to decrease temperature by as much as 4 ˚C during the hot summer months, thus providing more optimal growing conditions for strawberry plants (Rowley, 2011). Gude et al. (2018) investigated the utility of evaporative cooling in the high tunnels for summer-fall production with day neutral cultivars and found that the use of evaporative cooling did not affect fruit weight or gray mold incidence on strawberry fruit. Lantz et al. (2009) compared fruit production and fruit size in the plants grown on aluminized, white and black plastic mulch, and reported that no significant difference was found in fruit production and fruit size between the colors of plastic mulch, but production in August was significantly higher with alumnized mulch, which is important for growers trying to produce a consistent crop throughout the summer months. There are few studies that compare strawberry cultivars in terms of their performance at high temperatures. Use of the heat-tolerant cultivars and developing heat-tolerant genotypes are the most effective ways of avoiding heat damage. Mookerjee et al. (2013) stated that heat-tolerant remontant genotypes can be used to breed cultivars better adapted to hot summer conditions. Kesici et al. (2013) reported that the cultivars 'Elsanta', 'R. Hope' and 'Camarosa' were determined as relatively heat-tolerant, while 'Whitney', 'Fern', 'Festival', and the 'CG3' were relatively heat-sensitive among the 15 strawberry cultivars evaluated.

High Tunnel Cultivation

Where tunnels are used, rain damage is eliminated, pest severity is reduced, the crop is earlier, weed control can be simplified and the season can be extended in the fall and early spring or winter (Lantz et al., 2010). High tunnels can substantially improve marketable yields, shelf life, and extend the harvest season for strawberry fruit (Kadir and Carey, 2004; Salame-Donoso et al., 2010; Belasco et al., 2013). Extending the production season later into the summer and fall would require day neutral cultivars and additional temperature management strategies. Protected system allows the use of bare root plants in spring since soil preparation can be completed at any time inside of the tunnel. High tunnels alone effectively buffered against low temperature extremes in the early spring and late fall, providing as much as a 4.2 ˚C temperature increase compared with the outside (Rowley et al., 2011). The high tunnel provided a net return of $1,943.57 or $15,548.56 per hectare assuming eight high tunnels per hectare (Curtis et al. 2014). A proper ventilation system is critical for achieving an optimal growing environment during the summer period of the year. Replacing high-tunnel plastic with shade cloth during the warmest summer months is another method for passive manipulation of growing temperatures. In reference to the fall and spring production option (double-cropping) with conditioned plugs (Fernandez and Ballington, 2003), Straw (2005) observed that ''recovering production costs in the fall'' may be an important way to reduce risks associated with annual strawberry plasticulture production. With the additional heat units from the tunnel, early planting of bare root plants will start producing at about the same time as outdoor plug plants planted later in the spring (Lantz et al., 2010). Rowley et al. (2011) found that high tunnels could be used to improve summer production of spring-planted day neutral cultivars and extend production into late fall. Rowley et al. (2011) likewise reported that economic analysis indicated that growing spring-planted day neutral strawberries in high tunnels was marginally profitable, whereas field production at high altitude locations would be a money-losing enterprise. Ruan et al. (2013) reported that summer-fall day neutral cultivars in high tunnel showed high contents of total soluble solid and sugars, and the highest sugars/acids ratio, at similar levels as everbearing cultivars. Gude et al. (2018) investigated the feasibility of spring-planted six day neutral strawberry cultivars in a high tunnel production system and based on the crop productivity found that this production system has the potential to extend the season for strawberry growers. However, the plasticulture system

requires improvements and changes in planting dates and materials to achieve high fruit yields and quality.

Economic Analyses

Typically, the price received for spring strawberries is less than half that received for summer-fall berries. Consumers are willing to pay price premiums for local strawberries at direct markets, especially when available outside of the normal season, providing growers the opportunity to garner higher prices (Foord, 2004; Curtis, 2014; Curtis et al., 2014). Higher market prices for strawberries produce a positive economic result in terms of increased family farm profits, and also result in better utilization of resources and labor. However, cost per plant of day neutral varieties might be 20-50% higher than for june bearing varieties (Lantz et al., 2010). Management of strawberries for summer-fall production is intensive and there is the likelihood of encountering a number of production difficulties, as the harvest takes longer, labor expenses, heat, pest, irrigation and fertilizing managment. Njavro and Duralija (2006) reported that the highest investment cost is for planting material. Rowley et al. (2011) found that the use of low-cost high tunnels converted a spring-planted day neutral strawberry system from a money-losing to marginally profitable enterprise. Gude et al. (2018) reported that growing day neutral strawberry in high tunnels in the central United States is feasible and highlights the importance of proper cultivar selection. At the same time Lantz et al. (2010) reported that in the eastern United States, spring-planted, in-ground raised bed, plasticulture is the most reliable and economical method to produce a day neutral crop without taking extraordinary measures. In North Carolina, there is not yet developed an actual budget for summer season day neutral strawberry production costs and returns. In the inner part of Turkey and the Black Sea region, day neutral cultivars (especially Albion) have been used for summer-fall production in the last 3-5 years, but information or results about yield and economic viability do not exist yet. According to Demchaket al., (2005) in the case of spring planting, for 27 months, investments with labor costs for harvesting are at the level of € 42,600 and revenues at the level of € 80,000 (profit € 37,400 / 27 months = € 1,385 / month). Land = 4 decares; Labor = land preparation: 4-6 hours, Establishment: 60-65 hours, Production: 55-60 hours, Custom harvest labor (mature): $4,000-$6,000; Capital = Land preparation: $300-$400, Strawberry plants: $900-$4,000, Mulch: $180-$300 per year, Fuel, repairs, maintenance, and depreciation of machinery: $10-600 per year. Anywise, utilizing summer-fall crop production system creates potential for significant profit.

Summary

Strawberry plants, due to their size and architecture can be grown throughout the year in as many innovative cultural systems as possible or as many as financially feasible. There are many reasons for growers to switch to summer-fall production, such as more profitable production (quicker refund on investments, 350-450 gram/plant^{-1} (12-15t/ha) in the first year, 800-1200 gram/plant^{-1} (35-45t/ha) in the second year (Popovic, 2019), bearing starts in eight weeks after planting, fewer pests (plants are exposed to viruses, bacteria and pathogenic fungi for a shorter period), better labor use, better land utilization, and off-season markets available. Day neutral production costs are similar to costs of june bearing production for either system, with the exceptions that plant costs and fertilizer costs are somewhat higher, harvest container and labor costs should be higher due to higher yields (only if berries are sold as already picked), and timing of some operations is different.

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CURRENT PROBLEMS OF LAND MARKET AND LAND RELATIONS IN UKRAINE

V. Artemov, T. Movchan

V. Artemov, Ph.D., ORCID ID: https://orcid.org/0000-0001-9121-1062
T. Movchan, Ph.D., ORCID ID: https://orcid.org/0000-0002-8914-2632
Odesa State Agrarian University, Ukraine
Department of Land Management and Cadastre
Faculty of Engineering and Economics
65012 Odesa Ukraine

ABSTRACT

The main problems of modern land relations are investigated in the article. The foreign experience of reforming the land market has been generalized, which has made it possible to identify proposals for improving the effective institutional framework of land legislation. The subject field of the state policy on the land market in Ukraine is formulated. Monitoring of land market based on information in the State Register of rights to immovable property and its results publication is proposed. It is determined the factors, on which public administration should be based in the field of land ownership. Problematic issues of land reform implementation are presented. The necessity of transfer of state-owned lands outside settlements to communal property of village, settlement, city councils is substantiated. It is proved that the economic mechanism of land relations regulation in Ukraine requires a thorough rethinking and renewal of efficient land policy economic regulations.

Keywords: land policy**,** reform, land legislation, monitoring, land ownership, regulatory mechanism.

INTRODUCTION

In Ukraine, the issues of current interest of market relations regulations are reforms in the field of land tenure, land use. The process of land market formation has become more complicated in recent years due to consumption attitudes towards it, inefficient and irrational use of land resources. Despite the fact that Ukrainian chernozems are the most fertile soils in the world, and agricultural lands are mostly used in economic circulation, it is not possible to form an effective landowner, turn land resources into a major factor of economic growth, reduce social tensions in rural areas, increase living conditions in rural areas, improve the environment, etc. The unresolved social, legal, organizational and economic problems of land use are due to the lack of a balanced public policy. It should apply successful experience of developed countries, where regulatory policy priority is to ensure rural development, it is worth to summarize the international experience in reforming the land market that allows to define the key stages of the institutional framework of land legislation improvement.

RESEARCH METHODS

The theoretical basis of these studies is a dialectical method of cognition of economic phenomena and processes in their continuous development and relationship. To achieve this goal are used the following methods: dialectical logic and abstract - in a synthesis of theoretical and methodological provisions for state regulation of land use, reform; monographic - in highlighting the views of scientists, who worked on the studied problems, and in studying the development of the land market, domestic and foreign experience. The information base of the study was the data of the State Geocadastre, normative and legislative documents of Ukraine regarding effective land market state regulations.

RESEARCH RESULTS

Land issues were always important and urgent, as the effective land use in any country was and remains a key issue for agricultural sector development. There is a need to create an effective mechanism for land transformation, which would be carried out on the basis of scientific substantiation and practical testing, stimulate the effective use and preservation of land.

Our country uses outdated methods and techniques in the field of land relations, legal problems hinder the development of the land market, hinder the development of the industry and are an obstacle to attracting investors to Ukraine.

Scientists believe that the level of development of land relations is insufficient, the issues of efficient use of land resources and mechanisms of land market regulation need research.

The protracted process of land reform has a long history of development and, unfortunately, has not ensured the formation of an effective landowner, land user [2]. It is due to the complexity of solving organizational and technical problems and differences between legal documents governing the development of land relations. There is a need for a clearer definition of the place and role of the state in the formation of new land relations, development of mechanisms for the implementation of various forms of ownership of agricultural land, widespread introduction of mortgage mechanisms, addressing land ownership issues and creating favorable conditions for citizens to exercise private land ownership, etc.

The deepening market reforms in the process of land reform requires further legal amendments to harmonize economic, environmental and social targets as well as the construction of the algorithm based on the settlement of the system of ecological and economic principles. Relevant regulatory changes should become a continuous process of quantitative, qualitative and substantive changes in all institutions of land relations.

The state, at the expense of its own financial and land resources, must participate in the land market turnover, thus influencing the supply and demand, and hence the market pricing, without restricting the rights and freedoms of other market participants [4]. State regulation of the land market should be considered as a set of goals, strategies, forms and methods of implementing a balanced and balanced state policy to ensure efficient use of natural resources of the country and the transformation of land resources, agricultural production into Ukraine's economic growth program.

Reforming the latest land relations implies that land in Ukraine can be sold only at electronic land auctions; it will be mandatory to register the land price during the transaction; the ban on the transfer of agricultural property rights from one person to another is envisaged; Citizens of Ukraine, state and legal entities registered in Ukraine will be able to purchase land. There are also restrictions on the area of agricultural land, which can be leased and owned by one person, it can not exceed 35% of the area of land in the community, not more than 15% of the region and not more than 0,5% of the country. Recognition of land market turnover should improve the forms of management, methodology and techniques of land pricing, economic management mechanism, attracting investment through land mortgages and intersectoral regulation of the agro-industrial complex of Ukraine.

This leads to rethinking and the development of a new integrated system of economic controls that contribute to the formation of a new model of social relations and effectively solve the problem of the state land policy in the developed market economy, because most of the existing institutional, economical and organizational instruments are based on outdated regulatory and methodological basis.

After analyzing the current situation in the field of land management, main factors are represented, which should be the base for governance in land use and land ownership relations (Figure 1).

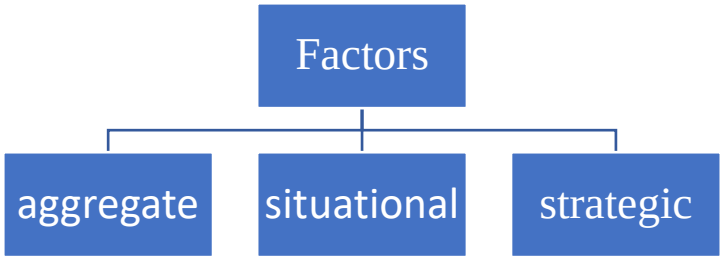

***Figure 1**. Factors on which public administration should be based in the field of land use and land ownership relations*

The table shows that public administration in the field of land use and land ownership relations includes three factors: aggregate, situational and strategic. Aggregate factor consist of land market formation within the common set of development problems of our country economy. The situational factor is to take into account the real social, political and economic situation of land ownership reforms. Strategic factor lies in the long eternity role of land resources, rather than focus on the current problems of economic development.

The issue of formation and regulation of the land market is one of the most important areas of state economic policy. It affects almost all spheres of socio-economic life - from agricultural production to the preservation of landscapes and agricultural lands. Ensuring the land market includes such components as: organizational and financial, regulatory and incentive, research and information (Fig. 2).

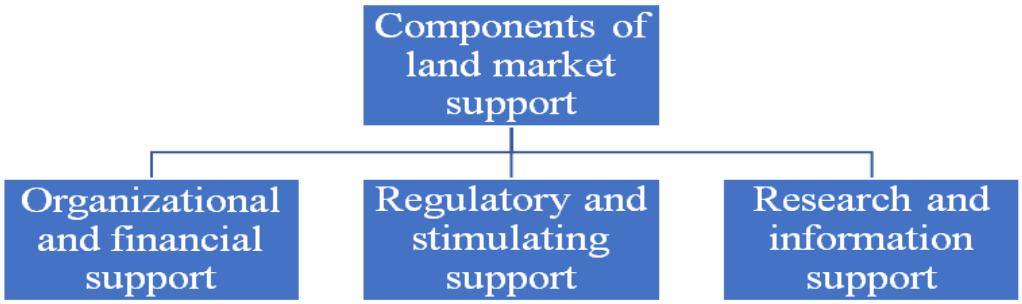

***Figure 2**. Components of land market support*

Thus, the organizational and financial support of the land market includes land auctions (auctions), directly enterprises - organizers of land auctions, insurance companies, land banks; regulatory and stimulating support of the market includes institutional and fiscal systems and regulation of land relations, state funds to stimulate activity in the land market, and research and information support of market participants includes information, consulting, land management companies, institutions, organizations, law firms higher education institutions that train specialists in the field of "Geodesy and Land Management".

Given the problems of modern land relations in Ukraine and its focus on European integration, there is a need to study foreign experience of reform in the land market, which will provide recommendations for improving the effective legal framework of land legislation in our country.

Analyzing the experience of a free land market in different countries [1], it can be noted that this is a purely individual matter of each state, because it has not always led to the same consequences and social stratification. For example, Russia has no incentive and to turn the land over vast reserves of oil and gas. Difficult social conditions in Moldova for their citizens cause lack of interest in the free movement of land, interest in land is revealed mostly by foreigners. In Georgia and Brazil, there has been self-seizure of land by peasants, which has been a problem [3]. It follows that it is not the land market that plays a key role in carrying out land reform, but the current land legislation and enforcement.

Features of state regulation of land relations in different countries are presented in table 1.

Table 1. Foreign experience in regulating land relations

Feature of public administration in the field of land use	France	Denmark	UK	Poland	Germany	Hungary	Ukraine
Land use control	+	-	+	-	-	-	-
Requirements for land turnover and size	+	-	-	+	+	+	-
Requirements for landowners and land users	-	+	-	-	+	+	-
Requirements for the formation of the land market on an economic basis	-	-	-	+	-	-	-
Legislative support	-	-	-	-	+	+	-

The table shows that in France and the United Kingdom there is a strict control over land use, because in France all land agreements are in the field of view of the state, as they are subject to registration, and in Britain virtually all land is owned by the royal family. In Ukraine, land use control and protection are not yet at the proper level, it is in its infancy.

Requirements for the circulation of land and their areas in France are subject to the permission of a special administrative committee for various transactions with land, in Poland only with the permission of local authorities landowner can sell a plot of more than 1 hectare, in Germany it was created a state treasury for the purchase of land from the peasants and selling them to more promising buyers in order to strategically divide the land for more skilled entrepreneurs. As we can see, in many European countries there have long been functioning markets for agricultural land with clearly defined legislation, among which special attention is paid to limiting the concentration of a significant amount of land in one hand. In Austria, Denmark, Germany, Norway, the acquisition of agricultural land is based on the permission of the authorities in the presence of justification for the intended use of land and certification of professional agricultural specialty of the potential landowner. In Denmark, in order to purchase a plot of land, a farmer must have lived in the area for at least eight years. This is aimed at preventing excessive concentration of land, purchase for speculation, misuse, violation of environmental requirements for land use, violation of the agrarian structure, and so on.

Requirements for landowners and land users in Denmark, Germany and Hungary are the availability of agricultural education or a certificate of professional training related to agricultural activities. This cannot be said about Ukraine, unfortunately we do not have such requirements for landowners and land users. In the UK, land can be freely purchased by any entity, including foreigners, and by purchasing the land, the owner will own it forever, subject to foreclosure.

Given the major trends in farming in the EU, it may be noted that as of 2018 the contribution of the agricultural sector into the EU GDP was 1,1%. In total about 10 million people are involved

in EU agricultural sector. In EU most farms are families, their labor force is formed by family members, the size of farms is small, the average size is 16,6 hectares and only 15% of farms are larger. And most important fact is that agriculture has a fairly high level of state financial support in the form of subsidies.

With the formation of the land market in Eastern Europe and the former Soviet Union (the Baltic states), the main objective was to develop a real and effective land owner, who would efficiently use the land without damaging its fertility and qualitative state. This led to the establishment of requirements for: mandatory residence of the owner on the land, the establishment of a maximum limit on the concentration of land resources in one hand (for example, in Poland not more than 500 hectares); availability of appropriate education. And the long transition period allowed farmers to form the necessary amount of financial resources to purchase land. Therefore, our country in the formation of the land market must first take into account the characteristics of other foreign countries and apply them in practice. For example, one can take into account the main characteristics of the land market formation, such as the protection of the interests of national agricultural producers and the harmonization of land markets and legislation within the EU, the other requirements are presented in Figure 3.

***Figure 3**. The main characteristics of the land market in Ukraine*

Effective regulation of the land market becomes possible if the market environment is sufficiently accessible to the state and it can constantly monitor the real supply and demand for land for various purposes. This will effectively forecast the dynamics of market indicators such as supply and demand, land prices for various purposes, the number of transactions in the market, the liquidity of land as an economic resource at the local, regional and national levels and more [5]. An important task is the constant analysis of the compliance of the value of land with the real purchasing power of citizens and economic entities, which will effectively prevent various negative phenomena [6].

Monitoring land market should be held by Derzhheokadastr, that fulfill collection, processing, summarization and analysis of the information about the price of real rights to land in contracts on their exclusion, and information about the market value of real rights to land according to their expert money estimation, a definition on this based on comparable prices for land for different purposes (Table 2).

Unfortunately, agricultural sector does not have stable and effective legal base, and this raises doubts in the ability of agricultural businesses make the purchase of land on which they operate. A long - term moratorium on land sales in Ukraine slowed down the development of the land market and added problems with the exchange rate, which led to the fact that in hryvnia growth in land value in Ukraine looks attractive (Fig. 4), but if you look at the same data in US dollars - the results look awful, on the contrary, indicating a fall in the value of land (see Figure 5).

Table 2.Normative monetary valuation of arable land in Ukraine

№	The name of the administrative	Information as of					
		01.07.1995		01.01.2006		01.01.2017	
		hryvnia	dollars	hryvnia	dollars	hryvnia	dollars
1	Zhytomyrska	2444	1358	6234	1247	20581	823
2	Chernigivska	2900	1611	7399	1480	24423	977
3	Mykolaivska	3130	1739	7985	1597	26360	1054
4	Zakarpatska	3132	1740	7991	1598	26378	1055
5	Luhanska	3149	1749	8034	1607	26519	1061
6	Lvivska	3161	1756	8065	1613	26622	1065
7	Odeska	3338	1854	8517	1703	28114	1125
8	IvanoFrankivska	3392	1884	8653	1731	28568	1143
9	Sumska	3494	1941	8915	1783	29427	1177
10	Volinska	3555	1975	9070	1814	29939	1198
11	Ternopilska	3567	1982	9101	1820	30039	1202
12	Rivnenska	3729	2072	9513	1903	31406	1256
13	Kyivska	3796	2109	9685	1937	31970	1279
14	Kirovogradska	3811	2117	9724	1945	32097	1284
15	Kharkivska	3860	2144	9846	1969	32506	1300
16	Dnipropetrovska	3862	2146	9854	1971	32526	1301
17	Vinnytska	3927	2182	10020	2004	33073	1323
18	Zaporizka	4018	2232	10252	2050	33838	1354
19	Chernivetska	4037	2243	10300	2060	34000	1360
20	Khmelnitsk	4096	2276	10450	2090	34496	1380
21	Kherson	4120	2289	10512	2102	34699	1388
22	Poltavska	4121	2289	10377	2075	34253	1370
23	Donetsk	4139	2299	10559	2112	34855	1394
24	Autonomous R-ka Krim	4387	2437	11193	2239	36946	1478
25	Cherkasy	4727	2626	12061	2412	39811	1592

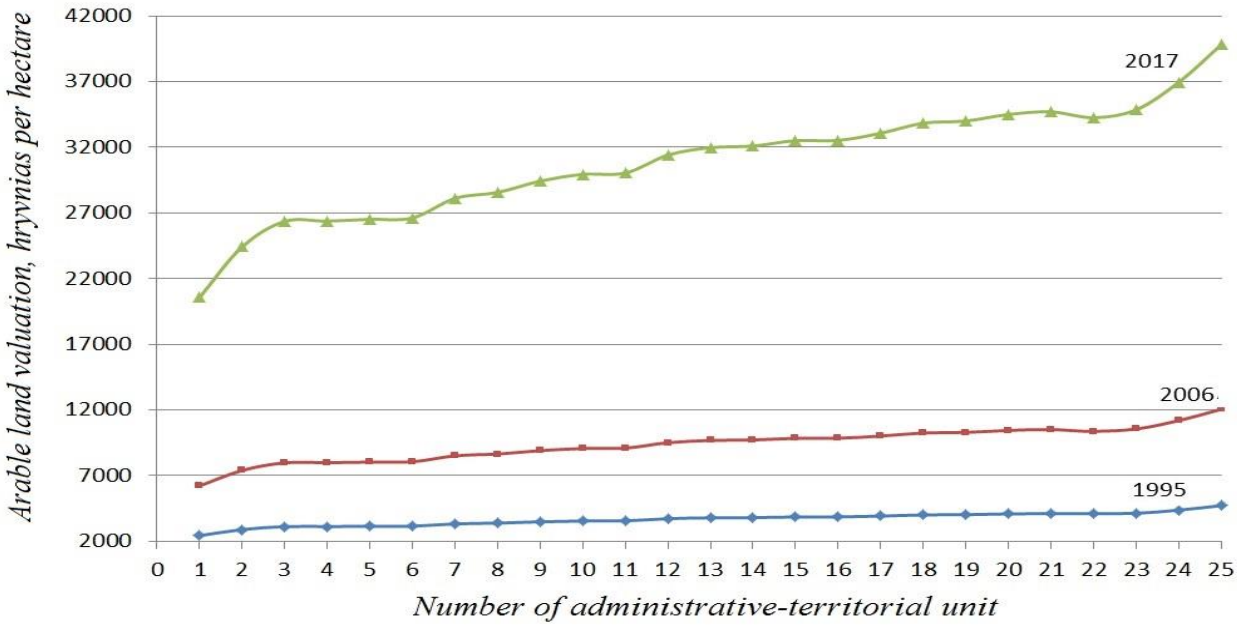

Figure 4*. The monetary valuation of arable land in Ukraine in December in hrivnas per hectare*

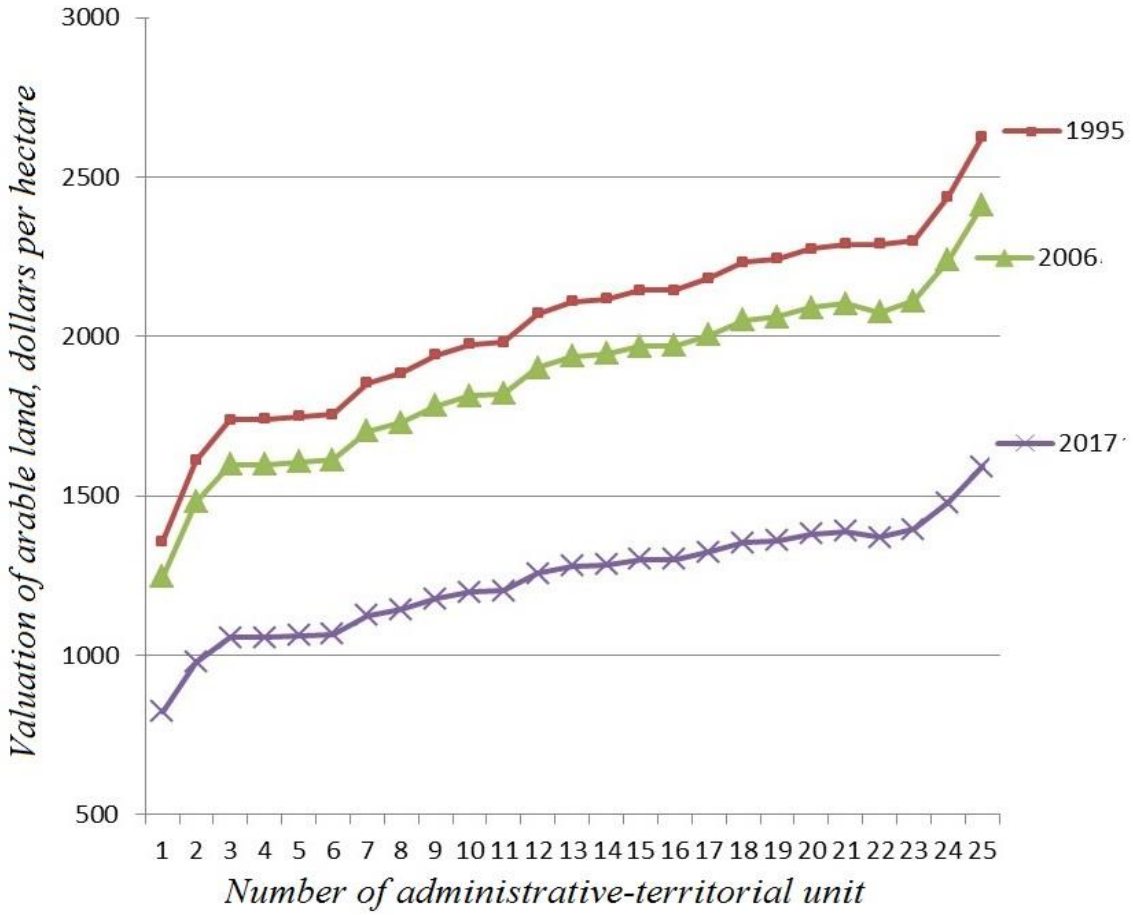

Figure 5*. The monetary estimation of arable land in a country in US dollars per hectare*

October 7, 2020 the Verkhovna Rada of Ukraine on Agrarian Policy and Land supported the draft law on amendments to the Land Code of Ukraine and other legislative acts on improving governance and deregulation in land relations (registration №2194*)*, which proposes to transfer state-owned land outside the settlements (except for lands that are needed by the state to perform its functions) to the communal property of village, settlement, city councils (from 01.01.2021). It is also proposed to cancel the institutes of state examination of land management documentation and agrochemical certification of land, to cancel the approval of land management projects for land allocation and author's supervision over the implementation of land management projects, to cancel the agreement with the Cabinet of Ministers of Ukraine on sale of non-agricultural land. With regard to restrictions, it is also proposed to exclude from the Land Code of Ukraine norms that restrict the ability of foreigners and foreign legal entities to purchase non-agricultural land plots outside settlements.

The main problematic issues of implementation of land reform in Ukraine, in our opinion, is shadow economy, inability of the authorities to objectively assess the readiness of the agricultural sector to privatization, land inventory problems associated with available transparent information on the quantity and quality of land resources, biased quantitative and qualitative characteristics of lands, their assessment, imperfection of the legal framework, lack of established requirements for the buyer.

Therefore, we believe that first of all it is necessary to assess and improve the regulatory, institutional, financial and economic, personnel conditions of the land market, which will determine the readiness of economic entities for land ownership reforms. Only after the proposed policy measures it could be expected the development of real favorable conditions for further reforms in land use and management.

CONCLUSIONS

The issue of land market state regulation in Ukraine remains relevant and requires a broad scientific and practical discussion on the content, forms and timing of implementation. We have determined that the provision of the land market includes such components as: organizational and financial, regulatory and incentive and research and information. The main factors on which public administration should be based in the sphere of land ownership relations have been formed and include three categories: aggregate, situational and strategic. The necessity of transfer of state-owned lands outside settlements to communal property of village, settlement, city councils is substantiated. It is proved that the economic mechanism of land relations regulation in Ukraine needs a thorough rethinking and updating of an effective system of economic regulators of land policy. Agricultural sector does not have stable and effective legal base, and this raises doubts in the ability of agricultural businesses make the purchase of land on which they operate.

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MATHEMATICAL METHODS FOR EVALUATING THE EFFECTIVENESS OF ADVERTISING IN AGRICULTURAL PRODUCTION

O. Danilenko, L. Smolenskya, T. Movchan

O. Danilenko, L. Smolenskya, Senior Lecturer
T. Movchan, Ph.D., ORCID ID: https://orcid.org/0000-0002-8914-2632
Odesa State Agrarian University, Ukraine
Department of Land Management and Cadastre
Faculty of Engineering and Economics
65012 Odesa Ukraine

ABSTRACT

Successful financial activity of agricultural enterprises significantly depends on their advertising campaign. The article investigates the method of assessing the effectiveness of advertising in agricultural production as a type of psychological impact on the consciousness and behavior of potential consumers. It is noted that different models of influence are used in the process of developing modern agricultural advertising products. The system of the main factors influencing efficiency of advertising in the agrarian sphere, their ways of calculation and the economic meaning are considered. Article provides examples of usage the mathematical methods for assessing the effectiveness of advertising in agricultural production, which provide opportunities to timely use tools to improve the effectiveness of advertising levers in the activities of agricultural enterprises.

Keywords: psychological influence, economic effect, models, logistic curve, agrarian sphere, quadratic dependence, differential equation.

INTRODUCTION

Advertising is considered as a highly effective means of competition of agricultural enterprises in market conditions. After all, the advertising company and the new requirements for the work of agro-industrial enterprises significantly affect the results of their successful activities, which cause significant changes in the management mechanism, forms of ownership, the nature of relations between producers and consumers in the organization of advertising.

Examining the practical functioning of agricultural enterprises, we can note the lack of an effective mechanism for advertising, focused on ensuring the competitiveness of the enterprise.

Given this, there is a need to study the agricultural market, forecast development, analysis of marketing activities of enterprises and the formation of reserves for growth of their profitability by increasing the effectiveness of advertising in the system of marketing activities in an unstable business environment.

RESEARCH METHODS

In studying the advertising activities of agricultural enterprises and its means of interaction with the market environment, a systematic approach and methods of synthesis and mathematical statistics were used.

RESULTS AND DISCUSSION

The term "advertising" can mean advertising as a product or as a process of manufacturing this product. Advertising as a product is a form of presenting information about a particular manufacturer's products. It is a separate tool of marketing communications, the purpose of which is

to establish links between consumers and producers of goods. Basic principles of advertising: creating, maintaining and deepening the image of the company and its products; motivating the buyer to buy the product; increasing the market segment of goods produced by the enterprise.

In order for advertising communication to achieve its goal, it is necessary to ensure the conditions for its effectiveness. Efficiency is determined by a system of indicators: sales of goods, net profit, production cost ratio, rate of return on invested capital, and so on. In modern market conditions, the efficiency of agricultural enterprises involves the use of a set of marketing tools, including advertising communications, and it is worth focusing on the effectiveness of advertising as an important condition for competitiveness of enterprises.

The process of advertising influence is constantly changing and requires appropriate scientific evaluation. The lack of an effective methodology for assessing the effectiveness of advertising encourages the study of new diverse approaches to optimize the process of advertising impact, to consider it in both dynamic and static conditions. The above mentioned necessitates the study. The mechanism of formation of advertising activity of agricultural enterprises in the context of ensuring their competitiveness in an unstable market environment is the object of study.

The purpose of advertising appeal - to ensure the stages of effectiveness of advertising. In the case that the advertiser independently develops an advertising appeal and conducts an advertising campaign, the structure of the advertising process will consist of the following stages:

- research of goods and services of the enterprise, competitors, buyers and sellers;
- definition and development of the purposes of advertising communication which should proceed from the general purposes of the enterprise;
- development of the budget of the advertising campaign;
- defining the concept of the advertising campaign;
- choice of means of advertising;
- specification of tasks;
- choice of forms of advertising appeals;
- development of a business plan for an advertising campaign;
- creation of advertising appeals;
- placement of advertising appeals;
- control over the course of the advertising campaign (measuring effectiveness) and adjustment as needed;

The effectiveness of advertising is influenced by factors of direct and indirect action, the most important of which are the objectivity of advertising messages, the specifics of the market of advertised goods, advertising opportunities, national characteristics of the target audience, the amount allocated for advertising activities. Thus, advertising in the agricultural sector has a significant impact on increasing sales, providing information about agricultural products, their promotion, increasing demand, turnover and production. It is an integral and active part of a comprehensive system of marketing activities of enterprises, the level of development of which is determined by the quality and effectiveness of advertising campaigns in accordance with the requirements of the modern market.

Advertising stimulates the development of economic processes, revives the market, increases agricultural output, consumer demand and reduces the unit cost. Thus, the increase in demand leads to increased production and cheaper products, market saturation, increased corporate profits, increased contributions to the state budget, higher wages, job creation, strengthening the socio-economic situation in the country. It should be noted that advertising in the agricultural sector stimulates the satisfaction of new needs of buyers, and this gives a new impetus to production, determines the direction and pace of its development [1]. Examining in detail the advertising activities of agricultural enterprises and studying the scientific works of scientists, we can conclude that it consists in creating an advertising product, bringing it to potential buyers so that they

understand what exactly the product, service or idea is positively different from similar , and the manufacturer was able to turn this innovation into capital [2].

Of course, advertising services are an expensive procedure, they require significant investment, and if advertising measures are not stimulated financially, not supported, then the sale of products, agricultural production will be slowed down, higher costs per unit of production will be determined.

Advertising strategy in agricultural production as a type of psychological impact on the consciousness and behavior of potential consumers, should take into account a set of factors, which are presented in Figure 1.

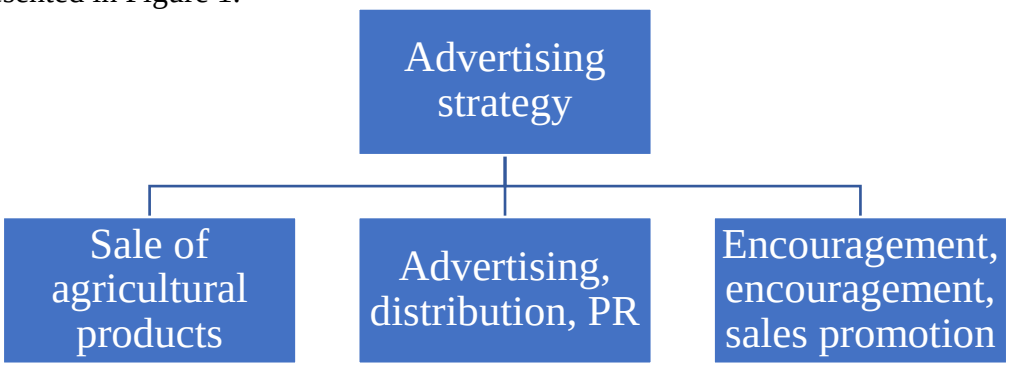

Fig. 1. Factors of advertising strategy of agricultural enterprises

The process of forming the advertising strategy of agricultural enterprises covers all the main communication tools, therefore advertising should be considered as a tool for implementing the marketing and business strategy of farmers. The integration of marketing communications (advertising, public relations, sales promotion, direct sales, sponsorship, direct marketing, merchandising) is necessary, as they must all be aimed at achieving one goal. Advertising communication should have the features of a logical process, timely delivery of messages to the consumer, to form his support and love for the brand of agricultural products. All this will increase the profitability of enterprises, increase the effectiveness of advertising.

In order to increase market share and increase the price of products, agricultural enterprises have the opportunity to increase the value of their own brand. It is worth noting that advertising should be large-scale, long-term and continuous for its effectiveness, the interest of a wide range of consumers, constantly updating and attracting new audiences, otherwise you can quickly lose everything.

And the implementation of these requirements is very much in need of funding, avoidance of unnecessary costs, planning and implementation of the advertising budget, real and meaningful justification of the required level of costs for the promotion and sale of advertising agricultural products.

Analyzing the methods of advertising, we often see advertising products on national TV channels, in supermarkets, in crowded places, in markets. Advertising messages for the target group of consumers must take into account a set of competitive advantages that are important for the selected audience (product quality, nutritional properties, wide range, attractive packaging, high quality guarantees). It is necessary to stimulate intermediaries, to encourage working staff to improve service to build a reputation for high quality healthy agricultural products, which has no competition.

Studying consumers in our country, we can state their traits such as nationalism, practicality, principles, values, love of work on earth, distrust of others or new, friendliness, solidarity, friendliness, you can take into account when developing advertising campaigns, their psychological characteristics and ability perception of advertised information.

Thus, for planning and decision-making on advertising, the main attention should be paid to market analysis and motivation of consumer behavior regarding the choice of products offered. The organization of marketing will ensure the rational management of production and marketing activities of agricultural enterprises, the development of market relations and, above all, the

orientation of the market of agricultural products to consumer demand, which is one of the main conditions for effective development of agro-industrial production.

The effectiveness of the company's advertising activities determines its level and compliance with modern market conditions. Analysis of recent research shows that the successful financial performance of enterprises depends significantly on their advertising company [3, p.623]. The effectiveness of the use of advertising technologies in different years was paid attention to the following scientists: F. Kotler, KL Keller, J. Daly, T. Ambler.

Term “economic efficiency” is interpret by authors as the ratio of the company's costs for advertising for a specific period of time to the results obtained from advertising. To assess the effectiveness of advertising traditionally use a system of indicators:

1. The increase in sales obtained under the influence of advertising over a period of time:

$$V_{\partial o \partial} = (V_{c2} - V_{c1}) \times D \qquad (1)$$

where, V_{c1}, V_{c2} - the average daily turnover before and after advertising,
D - the period during which determine the increase in turnover.

2. Economic effect of advertising:

$$E_p = V_{\partial o \partial} - (B_p + B_n) \qquad (2)$$

where B_p - advertising costs, B_n - additional costs associated with sales growth.

3. Profitability of advertising (%):

$$P_p = \frac{\Pi}{B_p} \times 100 \qquad (3)$$

where Π - the profit received as a result of advertising of the goods.

4. The ratio of sales per 1 monetary unit of advertising costs:

$$K_p = \frac{V_p}{B_p} \qquad (4)$$

where V_p - the volume of sales of goods after advertising.

5. Coefficient of advertising costs per 1 monetary unit of sales volume:

$$K_p = \frac{B_p}{V_p} \qquad (5)$$

6. Coefficient of efficiency of expenses for advertising:

$$K_к = \frac{V_1}{B_{p1}} \times \frac{V_2}{B_{p2}} \qquad (6)$$

where V_1 V_2 - the volume of sales of goods of the 1st and 2nd firms for a specific period.

In order to develop methods of using mathematical methods to assess the effectiveness of advertising, as additional, as the company does not always have the necessary data to calculate the above indicators, we will continue our research. The concept of advertising effectiveness includes the content of such factors as economic, psychological and social effects. It is advisable to use differential equations to measure the communicative effectiveness of advertising.

Authors consider the task that [7, p.547] enterprises sell products ***B***, about which at time ***t*** of the number of potential buyers ***N*** knows only x buyers. Suppose further that to accelerate the sale of products ***B*** were provided advertisements on radio and television. The following product information is disseminated to customers through communication with each other.

We will assume that after advertisements the rate of change in the number of consumers who already know about the product ***B*** is proportional to both the number of buyers who know about the product and the number of buyers who did not know about it.

Assuming that the time is counted after the advertisements, when $\frac{N}{\gamma}$ men are informed about the product, we come to a differential equation with separable variables.

$$\frac{dx}{dt} = kx(N - x) \qquad (7)$$

with initial conditions $x = \frac{N}{\gamma}$, if t=0.

In equation (7), the coefficient k - is the coefficient of proportionality.

We give equation (7) in the form:

$$\frac{dx}{x(N - x)} = kdt$$

From here we get

$$\int \frac{dx}{x(N-x)} = k \int dt + c, \text{ or}$$

$$\frac{1}{N} \int \left(\frac{1}{x} + \frac{1}{N-x}\right) dx = k \int dt + c.$$

After integration we will have

$$\frac{1}{\mathrm{N}} (\ln|\mathrm{x}| - \ln|\mathrm{N} - \mathrm{x}|) = kt + c$$

$$\frac{1}{\mathrm{N}} \ln \frac{\mathrm{x}}{\mathrm{N} - \mathrm{x}} = kt + c$$

Assuming Nc = c_1, we arrive at the equality:

$$\frac{x}{N-x} = Ae^{Nkt}, \text{ where } A = e^{c_1}$$

If we solve the last equation with respect to ***x***, then we obtain the relation

$$x = N \frac{Ae^{Nkt}}{Ae^{Nkt}+1} = \frac{N}{1+Pe^{-Nkt}}, \text{ where } P = \frac{1}{A}.$$

In the economic literature, this equation is called the equation of the logistics curve.

If we take into account the initial conditions, we obtain the equation:

$$\frac{N}{\gamma} = \frac{N}{1+Pe^{-Nk*0}}, \text{ where } P = \gamma - 1$$

$$\text{or} \quad x = \frac{N}{1+(\gamma-1)e^{-Nkt}} \qquad (8)$$

A similar equation reduces, in part, the problem of the distribution of technological innovations. One way to measure the commercial effectiveness of advertising is to compare sales with advertising costs for previous periods.

Authors consider the task [7, p.512]: in the researched agricultural enterprise (which develops advertising of its agricultural products) there are data on advertising costs ***x*** (UAH units) and sales volumes of agricultural products ***y*** (UAH units). The initial data are presented in table 1.

Table 1. Initial data on the cost of advertising and sales

Advertising costs (x) i, (UAH per unit)	1	2	3	4	5
Sales volumes (yi), (UAH per unit)	1,6	4,0	7,4	12,0	18,0

Assuming that there is a quadratic dependence between the variables ***x*** and ***y***, which has the following form: $y = ax^2 + bx + c$, it is necessary to find the values of the parameters ***a, b, c*** by the method of least squares, for this we perform calculations, and their results are given in table 2 .

Table 2

The results of calculations

i	x_i	y_i	x_i^2	x_i^3	x_i^4	$x_i y_i$	$x_i^2 y_i$
1	1	1.6	1	1	1	1,6	1.6
2	2	4,0	4	8	16	8,0	16,0
3	3	7,4	9	27	81	22.2	66,6
4	4	12,0	16	64	256	48,0	196,0
5	5	18,0	25	125	625	90,0	450,0
∑	15	43,0	55	225	979	169,8	680,2

The parameters are found from the system of normal equations, which are presented below (9)

$$\begin{cases} a\sum_{i=1}^{n} x_i^4 + b\sum_{i=1}^{n} x_i^3 + c\sum_{i=1}^{n} x_i^2 = \sum_{i=1}^{n} x_i^2 y_i \\ a\sum_{i=1}^{n} x_i^3 + b\sum_{i=1}^{n} x_i^2 + c\sum_{i=1}^{n} x_i = \sum_{i=1}^{n} x_i y_i \\ a\sum_{i=1}^{n} x_i^2 + b\sum_{i=1}^{n} x_i + cn = \sum_{i=1}^{n} y_i \end{cases} \quad (9)$$

$$\begin{cases} 979a + 225b + 55c = 680{,}2 \\ 225a + 55b + 15c = 169{,}8 \\ 55a + 15b + 5c = 49{,}0 \end{cases}$$

The solution of this problem is as follows: ***a = 0,3, b = 0,18, c = 5,06***.. Thus, the dependence we are looking for has the form $y = 0.3x^2 + 0.18x + 5.06$. The obtained model, while maintaining the trends, can be used in the study of ensuring the effectiveness of advertising in agricultural production to develop practical recommendations for improving the effectiveness of advertising. The considered mathematical methods can be used for an estimation of advertising activity that gives the chance to take timely measures for increase of its efficiency.

We will compile an algorithm for analyzing the effectiveness of advertising and present in Figure 2.

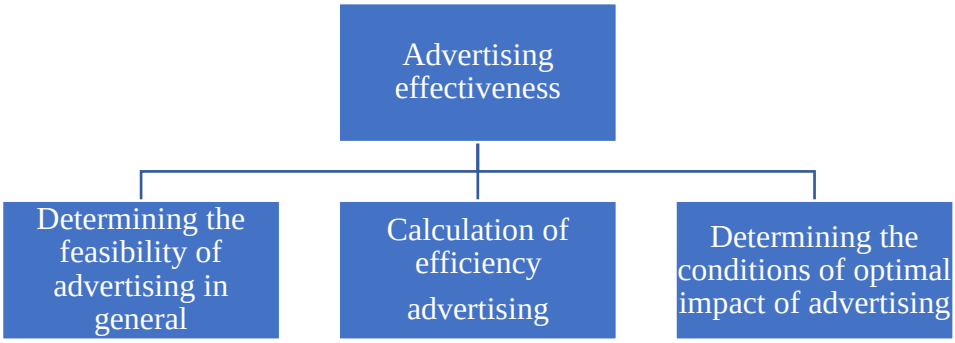

Fig. 2. Algorithm for analyzing the effectiveness of advertising

The above algorithm contains components - the main factors influencing the effectiveness of advertising in the agricultural sector. Determining the feasibility of advertising in general - their main factor - economic indicators; calculation of the effectiveness of the advertising event - mathematical methods; determining the conditions for the optimal impact of advertising - social and psychological components.

CONCLUSION

Based on the results of research, we can conclude that the most important basis for advertising of agricultural enterprises are the specifics of the agricultural market, opportunities for advertising, features of a wide range of consumers, the effectiveness of advertising, the amount allocated for advertising activities.

All these measures require large financial costs for advertising and production of the advertising product, as well as the development of special measures aimed at improving their marketing activities and increase the competitiveness of agricultural products in the face of increased competition and shortage of raw materials.

The system of main components, factors influencing the effectiveness of advertising in the agricultural sector, their methods of calculation and economic content are considered. It is proved that decisions in the field of advertising are made in conditions of certain risk and uncertainty. The considered methods provide an opportunity to predict the impact of advertising in the agricultural sector. Achieved goal - to identify a set of conditions and factors that affect the effectiveness of advertising in agricultural production.

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FUTURE OF AGRICULTURAL LAND MONITORING IN THE CONTEXT OF CLIMATE CHANGE - UNMANNED AERIAL VEHICLES

D. Bulysheva1, O. Varfolomeyeva1, O. Panasyuk1

Odesa State Agrarian University 65012 Odesa Ukraine

ABSTRACT

Climate change is a major global problem that threatens the existence of both humanity and biodiversity on Earth. In connection with the abovementioned, research proves the indisputable relevance of monitoring studies of erosion processes, control of plant growth phases, pests and soil conditions, crop yield forecasting, identification of unused and irrationally used land. As object of research agricultural lands as complex systems that require constant monitoring of their condition are defined. The subject of research is the processes of topographic and geodetic support for the monitoring of agricultural lands. The aim of the study is to develop proposals for improving integrated monitoring of agricultural lands, taking into account the use of unmanned aerial vehicles (UAVs) as the main tool for aerial photography. Methods of topographic and geodetic support of monitoring of agricultural lands and stages of assessment and forecasting of a qualitative condition of agricultural lands are investigated. The relevance of the UAV's use for monitoring the development of agricultural land has been proven. It has been determined that the use of UAVs is many times more efficient from different points of view. The advantages of using UAVs in monitoring the state of the agricultural sector are shown - accuracy, mobility, high efficiency, environmental safety, relatively low cost. Possibilities as a result of UAV's application in the agricultural sector of the country are identified.

Keywords: Monitoring of agricultural lands, unmanned aerial vehicles, climate change, topographic and geodetic works, UAV data processing.

INTRODUCTION

Climate change is a major global problem that threatens the existence of both humanity and biodiversity on Earth. The main cause of global warming is growing concentration of greenhouse gases generated by human activities: industry, transport, agriculture, fossil fuel combustion and forest fires. Given the corresponding trend, the world is currently on a trajectory that corresponds to an increase in temperature by about + 4 ° C by 2100.

Over the past 50 years, the cultivated area in the world has increased by 12%. During the same period, the area of irrigated land has doubled. This, first of all, explains the net increase in the area under crops. At the same time, the volume of agricultural production increased by 2.5–3 times due to a significant increase in the yield of major agricultural crops. By 2050, food production is projected to increase by almost 70% globally and by almost 100% in developing countries [1]. Growing demand for food, along with competing demand for agricultural products in other areas of its use, will create unprecedented pressure on many agricultural production systems around the world. These "risk systems" face increasing competition for land and water resources and are often constrained by unsustainable agricultural practices. Therefore, they require close attention to themselves, as well as implementation of specific actions to correct the introduction of new technological processes while monitoring the state of the resources.

The object of research is defined agricultural lands as complex systems that require constant monitoring of their condition. The subject of research is the processes of topographic and geodetic support for the monitoring of agricultural lands. The aim of the study is to develop proposals for improving integrated monitoring of agricultural lands, taking into account the use of unmanned aerial vehicles (UAVs) as the main tool for aerial photography.

To solve the problems of agricultural lands monitoring, modern methods and means of receiving, storing, processing and presenting of various information are required. As well as means of information exchange are needed. They include methods for collecting a significant amount of

data on a variety of indicators from large areas. Then it is necessary to present the collected data in digital form suitable for use in information, including geographic information systems. These systems should integrate spatial geographic data, aerial and satellite imagery and thematic data on a variety of agricultural parameters presented in cartographic and tabular forms. Such systems can be used to display large amounts of information on a screen or hard copy in user-friendly forms. It is possible to obtain a secondary derived cartographic material of analytical properties by superimposing received and collected data on the collected information (such as soil quality, irrigation conditions, meteorological information, phytosanitary observations, field agricultural research data, satellite monitoring data, etc.) On its basis, one can judge the degree of development of plant crops in a given area and at a certain time. This is perhaps the most optimal way to monitor the state of vegetation cover, crops and pastures, as well as their productivity, identify degradation of crops or soil, predict the yield, etc.

The advantage of monitoring as an integral tracking system is quite obvious, since soil and agrochemical studies are often carried out on the basis of unilateral programs that provide for a limited set of studied parameters and the use of different methodological and methodological approaches.

The relevance of the research topic is caused by the need:

- creation of electronic maps of fields;
- inventory and detailing of agricultural land;
- control of the volume and quality of agricultural work;
- operational monitoring of the state of crops;
- yield forecast;
- environmental monitoring;
- fire safety;
- other broad opportunities that open up when using UAVs in the agricultural sector of the country, especially in the context of the development of precision farming technology.

RESULTS AND DISCUSSION

The best method for monitoring the condition of lands is photogrammetric method using unmanned aerial vehicles with small-format cameras or medium-format air cameras. Unmanned aerial vehicle (UAV, drone) is an aircraft designed to perform a flight without a pilot on board, the flight control of which is controlled by a special station located outside the aircraft, or in automatic mode.

Small unmanned aerial vehicles are composed of several objects, which can be divided into 2 groups: onboard radio-electronic equipment, structural mechanical parts.

Considering onboard radio electronic equipment - there are many different UAVs, but each of them must have: autopilot, sensors, navigation system, link, energy source, propulsion system.

When working with a UAV, the operator does not require special piloting skills and lengthy training, due to the complete automation of the complex control. One or two employees are enough to carry out regular surveys of territories.

Up-to-date information on the implementation of certain unmanned aerial vehicles is provided on the official electronic resources of manufacturers and distributors of unmanned aerial vehicles such as DJI, Smart Drones, People's Drone, and others. Sufficient attention has been paid to the general theoretical issues of UAV use in the military, law enforcement and economic sectors, but the problem of integrating the use of unmanned aerial vehicles in the field of monitoring the state of agricultural land requires further research.

Obtaining and using for research purposes aerial photographs of UAVs has become possible since the early 1990s due to the advent of digital cameras, the characteristics of which have made the opportunity for replacement of small-format aerial cameras. The popularity of UAVs is due to easy maneuverability, mobility, efficiency, low cost and the ability to use the payload to obtain ultra-high resolution spatial data. Aerial photography can be divided into manufactured by means of manned vehicles controlled by long-range UAVs and micro UAVs. Compared to other aerospace data, UAV images have ultra-high spatial resolution and high efficiency, but cover relatively small areas. The altitude and focal length of the camera determine the scale (m) of the resulting image.

The areas of UAVs' use are quite wide - from emergency forecasting, state border control, road monitoring - to atmospheric and meteorological observations, prevention of unauthorized deforestation and poaching in national parks and reserves [2]. They can be used for operational or round-the-clock monitoring

of the state of technological objects, highways and railways, agricultural territories, airports and seaports, pipelines, etc.

Japan can be considered a "pioneer" in the use of unmanned aerial vehicles in agriculture. Back in the 1990s, Yamaha produced small R-50 and R-Max remote-controlled helicopters [3]. The latter was presented on the international market, and since 2015 is used in the United States for spraying vineyards. It can lift up to 28 kg of payload into the air, fly at speeds of up to 105 km / h and be in flight for up to one hour, but the main thing is to perform more accurate and economical spraying. Now according to mass media till the end of 2020, agricultural drone producer Tevel Aerobotics Technologies will complete $ 20 million funding round to launch a commercial project to launch fruit-harvesting drones. Tevel Aerobotics Technologies is developing autonomous drones equipped with one-meter mechanical claws that can pick fruit or be used for thinning and pruning trees in gardens. Tevel Aerobotics' drones are equipped with capabilities that allow them to identify fruit types and ripeness.

In recent years, such cameras are placed on agricultural drones. The images obtained with their help allow to reveal problems of growth of plants even before they become visible to the naked eye.

Based on field images in different ranges, specialized software packages analyze the volumes of nitrogen uptake in the soil, calculate the soil vegetation index and the normalized vegetation index. All this allows you to more accurately dose fertilizers, reducing their consumption and pollution of water bodies by flushing from the fields.

According to AUVSI (International Association of Unmanned Systems) [4], precision farming and public safety are the two most popular applications for commercial drones today. Together, these two segments make up about 90% of the total civilian drone market. AUVSI forecasts that annual sales of drones for agricultural use will be up to 150 thousand by 2025. Earlier, the association used a more conservative estimate of 100 thousand units.

The use of drones, Big Data techniques and artificial intelligence technologies is becoming interconnected in agriculture. This combination allows field monitoring and maintenance of equipment much faster and with lower resource costs. Electronic maps, automatically created based on aerial photography are more accurate than manual measurements and satellite images [5]. They show more clearly the existing shortcomings of land use, giving the opportunity to focus on problem areas.

Powerful forecasting tools based on neural networks allow to pre-select the optimal strategy for all agricultural work, reduce costs and increase yields per hectare. In Japan, China, United States and a number of European countries, these are already current transformations of the agricultural sector.

UAV surveys allow quickly and accurately assess the area of agricultural land, and constant monitoring makes it possible to assess crop germination, control crop quality and identify cases of theft and damage to crops. All these data will help to respond quickly to changes in the state of crops, make timely decisions and, ultimately, increase the efficiency of agriculture.

In addition to high cost-effectiveness (dozens of times cheaper), UAVs have additional advantages over traditional aerial and space imaging:

- small height of survey - it is possible to carry out surveying at heights from 10 to 200 meters for receiving ultrahigh resolution (units and tens of centimeters) on the terrain;
- accuracy - the ability to take detailed pictures of small objects and small areas where it is completely unprofitable or technically impossible to do in other ways, for example, in urban areas;
- mobility - no aerodromes or specially prepared runways are required, UAVs are easily transported by cars (or carried manually), there is no complicated procedure for permits and flight approvals;
- high efficiency - the whole cycle, from the departure to the surveying and getting the results, takes several hours;
- ecological cleanliness of flights - low-power petrol or silent electric motors are used, practically zero loading on environment is provided [6].

It should be noted that the use of UAV survey data allows to create three-dimensional models of the area with high accuracy, which, of course, should be used as part of a comprehensive methodology for monitoring agricultural lands. Therefore, the technique of monitoring aerial photography materials allows to obtain high measurement accuracy and can be implemented using inexpensive equipment for aerial photography and widespread digital photogrammetric systems for processing aerial photography materials.

It is most appropriate to monitor the use of the photogrammetric method, which allows to determine the position and state of agricultural territories.

Agricultural land monitoring includes systematic observations of:

- the state and use of crop rotation fields, agricultural landfills and contours, as well as the parameters of soil fertility and development of soil degradation processes (changes in the reaction of the soil environment, the content of organic matter and nutrients, destruction of the soil structure, salinization, alkalinization, waterlogging, development of water and wind erosion, soil pollution with pesticides, heavy metals, radionuclides, industrial, household and other wastes, changes in other soil properties);

- changes in the state of the vegetation cover on arable land, fallow lands, hayfields and pastures (changes in the species composition, crop structure, types and quality of vegetation, the degree of resistance to anthropogenic loads).

When conducting the state monitoring of agricultural land, the following tasks are solved:

- timely identification of changes in the state of agricultural lands, assessment of these changes, forecast and development of recommendations for increasing their fertility, preventing and eliminating the consequences of negative processes;

- obtaining data on the basis of a systematic survey of soil fertility and observations of the quality condition and effective use of agricultural land as the main resource for agricultural activity using the geographical referencing of agricultural landfills and contours;

- monitoring of the state of agricultural land vegetation;

- maintaining a register of soil fertility of agricultural lands and recording their condition;

- formation of state information resources on agricultural lands in order to analyze, predict and develop state policy in the field of land relations (in terms of agricultural lands) and the effective use of such lands in agriculture, as well as use in statistical practice;

- providing access for legal entities and individuals to information on the state of agricultural land;

- participation in international programs (ensuring the fulfillment of international obligations).

Assessment and forecasting of the qualitative state of agricultural land with subsequent spatial-structural modeling of the predicted state of the study area consists in the sequence of operations which executors must perform:

1. Study of long-term dynamics of agricultural lands' state.
2. Parametrization of the qualitative and quantitative characteristics of the study area's state.
3. Assessment of the current state of agricultural land.
4. GIS modeling.
5. Continuous monitoring of the potential development of agricultural land.

Analyzing the data processing process, it should be noted that in general, the process of adaptation of any remote sensing data obtained from the air consists of the stages of pre-processing, photogrammetric processing and subsequent decoding. However, each type of survey has its own characteristics (Fig. 1).

As a result of the above actions, the technology of obtaining a digital terrain model is reduced to creating a polygonal model in software packages for photogrammetric processing (Agisoft Photoscan, Pix4D, UAVMaster), which is connected to ground reference points. Then the cloud of dense points and polygonal models are edited and processed in geographic information software packages, which create a digital terrain model.

Thus, we consider it appropriate given the accuracy, mobility and an economic point of view recommend to use aerial photography during monitoring the condition of agricultural land by UAVs with subsequent processing of aerial photographs and construction (if necessary) of a digital terrain model or topographic plan.

Aerial photography in agriculture is one of the most important sources of information when carrying out land work. UAV technology allows you to record and monitor the state of agricultural land, which consists of monitoring and optimization of water consumption, calculation of the optimal amount of fertilizers and chemicals applied, creation of an electronic map of the fields, forecast of the yield of agricultural crops, planning the laying of drainage systems etc.

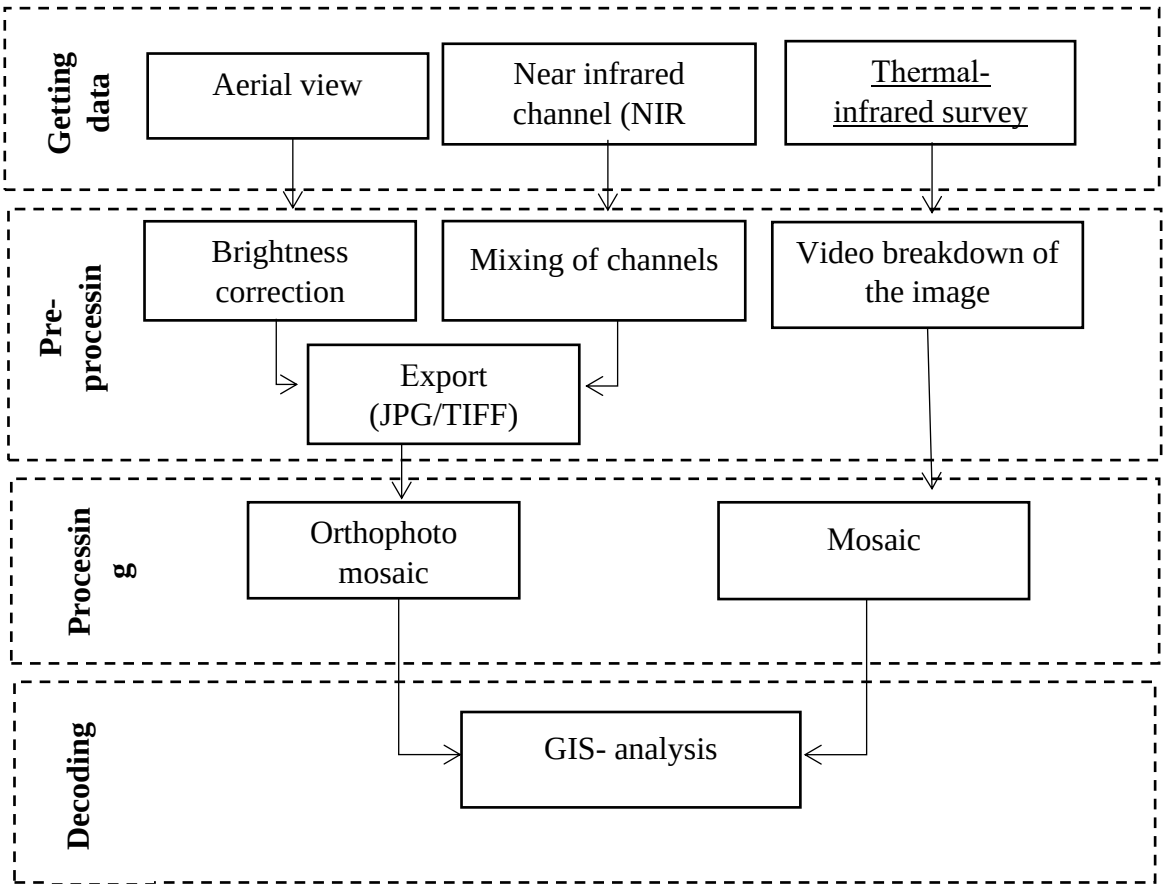

Figure: 1. Scheme of processing tribute from the UAV

With the help of unmanned aerial vehicles, it is possible to determine the terrain, the size of the fields, the boundaries of water bodies (lakes, rivers, swamps) and roads. Using this technology, stakeholders can get images to analyze the state of the sowing, its density and uniformity. The use of multispectral imaging allows to detect changes in a culture during its growth. The data obtained show the development and growth of plants in the visible near infrared spectrum. Based on the change in the tonality and color of the spectrum, it is possible to draw a conclusion about which part of the sown area requires this or that additive.

The use of UAVs for agriculture helps to solve the following tasks:

- creation and updating maps and plans of cultivated land in electronic form;
- accounting of agricultural land;
- sowing planning for production sites;
- control of the volume and quality of field work;
- conducting operational monitoring of the state of crops;
- assessment of crop germination;
- crop yield forecast;
- quality control of harvesting;
- economic assessment;
- monitoring of erosion conditions;
- construction of maps of vegetation indices etc.

One of the advantages of UAVs used in agriculture is the acquisition of images in two formats. The first is with real color reproduction, the second is in the near infrared range.

Thanks to the images with artificial infrared colors, experts calculate the NDVI (NormalizedDifferenceVegetationIndex) vegetation index, which allows to:

- quantify the state of vegetation (both in the entire field and in its individual areas);
- calculate the yield;
- identify cultures;

- assess the germination and growth of plants;
- analyze the productivity of land.

It has already become obvious that aerial photography from UAVs has the following advantages over space and traditional:

- relatively low flight altitude (allows surveying at altitudes from 50 to 3700 m);
- high resolution on the territory (the smallest details of the relief and objects can be seen, even a centimeter in size);
- ability to create panoramic images (satellite and traditional aerial photography do not have this opportunity);
- detailed shooting of small objects is possible;
- technology of aerial photography from UAVs allows aerial photography of small objects and small areas where it is unprofitable to do it with other types of aerial photography, and in some cases it is technically impossible;
- ability to choose weather conditions and time of day for aerial photography;
- efficiency (the whole cycle from start of surveying to obtaining the final results takes several hours within one day);
- low cost (much cheaper than traditional methods of aerial photography);
- environmental safety (an electric motor is used for operation, this ensures practical noiselessness and environmental friendliness of flights).

Such devices are a modern information and control tool with broad functionality for stakeholders in agricultural sector. The use of UAVs for monitoring agricultural land will optimize information components related to cultivated areas. On the basis of the accumulated information, an optimal strategy for managing the production processes of field cultivation can be built.

CONCLUSION

Nowadays the study of the state of agricultural lands is acquiring special relevance, since the indicators of their qualitative state are low (soil degradation, deterioration of fertility, low organic matter content etc.).

Of great importance are the issues of land protection and their rational use, systematic monitoring of the state of land for the timely detection of changes, their assessment, prevention and elimination of the consequences of negative processes.

Very important monitoring criterion is to obtain and improve methods for collecting information on agricultural land for the purpose of real increasing production efficiency in terms of living standards, quality and standard of living, economic security and especially food security of the population.

State regulation of such complex processes makes it possible to resolve many contradictions in conditions of socio-economic, scientific& technical, intellectual&informational crisis of society, especially it can help the sphere of organization and management of agricultural production.

As a result of the research, it was determinated, that unmanned aerial vehicles can be used to perform the following tasks: creation and updating maps and plans of cultivated land in electronic form; accounting of agricultural land; planning of sowing operations by production sites; control of the volume and quality of field work; conducting operational monitoring of the state of crops; assessment of the germination of agricultural crops; forecast of crop yields; quality control of the harvest; economic assessment; monitoring of erosion conditions; building maps of vegetation indices.

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OPTIMIZATION OF THE STRUCTURE AND COMPOSITION OF TECHNOLOGICAL COMPLEXES FOR HARVESTING GRAIN CROPS BY ENERGY COSTS

D.A. Domuschi*, P.I. Osadchuk **

Department of Agroengineering, Odessa State Agrarian University, Odessa, Ukraine
E-mails: * d.domuschi@ukr.net; ** petrosadchuk@ukr.net
*Corresponding author: d.domuschi@ukr.net;

ABSTRACT

A model has been developed for optimizing the structure and composition of technology of technological complexes for harvesting grain crops by energy costs, taking into account the likely nature of their interaction. The problems of technical re-equipment of agricultural producers are being solved by the introduction of energy-saving technologies for growing and harvesting grain crops.

Keywords: technological complex, grain crops, structure and composition, harvester, transport, harvesting, energy consumption, optimization criterion, energy saving, model, probable state.

INTRODUCTION

The technologies of plant production that we inherited from the past are costly. In order to achieve the greatest efficiency of agricultural production, it is necessary to introduce energy-saving technologies. Nowadays is a market economy with its fierce competition. If we continue to advance traditional consumption technologies, it will soon be that the expected result (increase in productivity, gross output, quality and lower cost of production), we will never receive. Crop production is one of the most profitable types of agricultural business – 110% profitability may be the norm for crop production. Norm but not the limit. Production costs "eats" a significant portion of the profit under the traditional model of plant growing. Successful producer is the one who collects the best harvest at the lowest cost (Kravchuk and Miller, 2009).

THE STATEMENT OF THE PROBLEM

For agriculture in Ukraine there is a problem of increasing the efficiency of energy use. All technologies of agricultural production are estimated by economic indicators (given costs, profitability, etc.) and labor costs. However, in modern conditions, this is not enough, since these indicators have significant fluctuations and are determined by the pricing policy. Therefore, technological processes and complexes of machines are estimated taking into account energy costs for the production of each type of agricultural products. This enables us to evaluate both the applied and new technologies as well as their prospects from the point of view of the specific energy consumption per unit of cultivated products (D. Domuschi, pers. commun.).

ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

An analysis of the current state of mechanization of harvesting of grain crops in Ukraine reveals its low efficiency. The statistical data indicate a constant tendency of reducing the total number of combines in the fleet, increasing the share of defective machines, aging of the fleet, and increasing the average load on the combine, increasing the time of harvesting and loss of grain from falling off (Dumenko and Boyko, 2011).

Ukraine is lagging behind the leading countries of the world 3-6 times in terms of technical maintenance of harvesting operations, and on providing grain per capita we are at the level of the beginning of the last century. The livestock dropped almost twice, which drastically reduced the need for fodder grain and roughage (straw). Orders for new equipment dropped below the expected level, which led to a reduction in its industrial production. The role of state mechanisms of agricultural management has further weakened, the form of equipment leasing changed, and the volume of use of various harvesting technologies deformed towards the less-operational, less resource-intensive and productive technologies in terms of gross collections of grain. Almost ceased the existence of industrial seed production. However, machine and

tractor stations (MTS)'s role in the harvest campaign has increased slightly, and import of foreign machinery has increased (Dumenko, 2010a).

In many documents and materials of the state and regional level, the position of grain production and technical support to the agro industrial complex (including harvesting of grain) in Ukraine is assessed as critical (Dumenko, 2010b).

The development of a promising strategy for the development of mechanization of harvesting of grain crops concerns a class of problems of forecasting the development of macro systems, whose functioning depends on the interaction of the set of external and internal factors. Modernization or creation the new resource intensive grain harvesting equipment according to its purpose and scale of production cannot be considered in isolation from the general state of agro industrial complex, the effectiveness of mechanisms of state policy and social order for agricultural products (Kravchuk and Miller, 2009).

The comparative technical and economic assessment of modern combines shows that domestic technology, which is much cheaper than other foreign machinery, in terms of complex specific indicators of the technical level is slightly inferior to it. Significant lag is still observed for reliability, design and comfort (Enakiev et al., 2016).

PURPOSE OF RESEARCHES

Improving the efficiency of the use of machine-transport complexes (MTC) in harvesting grain cereal crops by reducing material and energy costs.

MATERIALS AND METHODS

The main indicator characterizing the efficiency of machine-transport systems and takes into account, to a large extent, the agronomic and structural factors, are the energy costs per unit of work. Energy analysis allows assessing existing and planned systems, their prospects in terms of energy efficiency and opens up the possibility of purposefully developing new and improving existing systems. In the study of the work of machinery of harvesting machine-transport complexes, the main criterion for assessing the efficiency of their work, taking into account the results of studies, is the minimum total energy consumption for harvesting grain crops per unit area ΣE, MJ/ha is the function of the purpose of this research (D. Domuschi, pers. commun.):

$$\sum \mathrm{E} = \frac{\left[\sum_{i=1}^{m}\sum_{j=1}^{n}\sum_{k=1}^{l} X_{ijk}\, E_{IJ} + \sum_{i=1}^{m}\sum_{k=1}^{l} X_{ijk} E_l + \sum_{l=1}^{t} X_{ijk} Q_S\, E_{cf}\right]}{\Omega} \rightarrow \min \qquad (1)$$

where X_{ijk} – the volume of work performed by all means of the i-th type on the j- th production process in the kth period, ha;

E_{ij} – total energy consumption by type i on the j-th process, MJ/ha;

E_l – the cost of living labor, MJ/ha;

Q_S –standard rate of fuel consumption per unit area, kg/ha;

E_{cf} – energy equivalent of complex fuel, MJ/kg;

Ω – the volume of performed works, ha.

The optimum structure and composition of the harvesting machine-transport complexes, the way of organization of maintenance and maintenance in different conditions is determined by the minimum target function (1) with allowable yield losses. When minimizing the purpose of the function, one must adhere to a number of restrictions:

1. All estimated unknown values should be positive:

$$X_{ijk}>0; \quad i=1,2,...,m; \quad j= 1,2,...,n; \quad k= 1,2,...l. \qquad (2)$$

2. The volume of work on each of the production processes Ωi must be performed completely in the established agro technical terms, that is:

$$\sum_{j=1}^{n} \sum_{k=1}^{l} x_{ijk} = \Omega_i \qquad (3)$$

The summation of "K" here goes within those periods from l_1 to l_2, during which agrotechnics foresee the implementation of the i - th process.

3. The costs of live labor should ensure the implementation of the volume of the

i-th production process and the K-th period in the established agro technical terms:

$$\sum_{J=1}^{n}\sum_{k=1}^{l} E_l < n_i \quad (4)$$

where n_i - the number of employees available to the farm for this type of work, people

4. The fuel consumption Q_j should not exceed the normative values Q_S:

$Q_j < Q_S$. Total (total) energy consumption by means of j-th type is determined by the formula:

$$E_{ij} = \left[\frac{\alpha_{tm} W_t}{100}\right]\frac{A_t+R_t}{L_t} + \left[\frac{\alpha_{wm} W_w}{100}\right]\frac{A_w+R_w}{L_w}, \quad (5)$$

where α_{tm}, α_{wm} – energy unit of weight according to traction and working machine, MJ/kg;

W_t,W_w – weight of traction and working machines, kg;

A_t, A_w – norms of depreciation for traction and working machines, percent;

R_t, R_w – rates of deductions for repair and maintenance according to traction and working machines, percent;

L_t, L_w – annual load of traction and working machines, hour.

Expenditures of live labour energy E_l, MJ/ha:

$$E_l = \frac{(n_m\alpha_m+n_a\alpha_a)}{P_e} \quad (6)$$

where n_m, $n_д$ – the number of main and auxiliary workers participating in the MTC, people;

α_m, α_a – corresponding energy equivalents of labor costs, MJ/people-year ;

P_e – operating efficiency MTC, ha/hour.

Direct energy consumption of fuel E_{cf}, MJ/ha:

$$E_{cf} = \alpha_{cf}Q_{cf}, \quad (7)$$

where α_{cf} – energy equivalent of fuel consumption, MJ/kg;

Q_{cf} – fuel consumption per unit area, kg/ha.

When comparing MTC in grain harvesting, it is necessary to identify differentially the coefficients of energy cost efficiency:

– coefficient of energy efficiency of costs of technological means $K_{eт}$:

$$K_{eт}=E^p_{ij}/E^b_{ij} \quad (8)$$

– coefficient of energy efficiency of labor costs K_{el}:

$$K_{el}= E^p_l/E^b_l \quad (9)$$

– coefficient of energy efficiency of direct energy consumption K_{ed}:

$$K_{ed}= E^p_{cf} / E^b_{cf} \quad (10)$$

– coefficient of energy efficiency of expenses when applying the proposed complex in comparison with the base one K_{ee}:

$$K_{ee} = \frac{E^p_{ij}+E^p_l+E^p_{cf}}{E^b_{ij}+E^b_l+E^b_{cf}} \quad (11)$$

The calculation of the comparative economic effect from the introduction of the recommended MTC per unit area was determined by the formula:

$$E_{ra} = \sum E_b - \sum E_p, \quad (12)$$

where $\sum E_b$, $\sum E_p$ - total energy costs in the base and projected composition of the MTC.

RESULT OF RESERCH

In order to calculate the comparative estimation of energy costs for the basic and projected machine-transport systems, the following technologies of harvesting of grain crops were used: direct harvesting without straw shredding and separate harvesting. For these technologies, according to the methodology of the Ukrainian Research Institute for the Productivity of the Agro-Industrial Complex of the Ministry of Agrarian Policy of Ukraine "Norms for the Cost of Living and In determined Labor for the Production of Grain Crops", technological maps were developed for harvesting winter wheat. All technologies were developed for such production conditions: growing area - 1300 hectares; yield of main products - 4,6 t/ha; yields of by-products - 4,6 t/ha. Normative crop losses of 3%; harvesting time at full ripeness of grain - 7 days (Vitvytskyy et al., 2010).

In the direct combine harvesting, the Don-1500B harvesters were used for harvesting - twelve units. The grain was transported by trucks CamAZ-55102 with trailers GBK-8527 in quantity - 12 units. Each harvester was serviced by a personal vehicle. Straw - non-grain products were pulled to the edge of the field with the unit T-150K-05-09 +VTU-10 - 8 units and transported for tricking the unit - MTZ-80 + 2PTS-4-887A - 24 units. Straw throwing - unit YUMZ-6AKL + PF-0,5B - 8 units.

At separate collection, the ratio of the area of harvesting in a separate and direct way - 40% and 60%. To mow down the rolls and the selection of rolls, four combines - Don-1500B, harvester ZBH-6, pick-up - PL-150 in quantity - 4 units were used. Direct harvesting - Don-1500B - 8 units, vehicles - CamAZ-55102 + GBK-8527- 8 units. Straw is pushed to the edge of the field and drowned at the edge of the field. Quantity and composition of aggregates, as in the first technology. The energy assessment of the efficiency of the MTC was determined for the recommended and existing on-farm options for the availability of equipment and organization of the process of harvesting. Comparative analysis of the energy intensity of a unit of production - 1 t grain grains of cereals of the basic and recommended variants is determined by the formula 1. The results of calculations for the energy performance of the MTC are summarized in table 1.

Table1 Comprehensive energy intensity of harvesting and transport operations

Energy expenditure	Basic equipment MTC		The proposed equipment warehouse MTC		Energy equivalent	Total energy costs, MJ/t	
	Energy facilities	Working machines	Energy facilities	Working machines		Options	
						Base	Offered
On the main means: Combine, MJ / kg	SC-5M		Don-1500B		86,4	1600,6	1002,2
Needle, MJ / kg	SC-5M	ZBN-5	Don-1500B	ZBN-6A	75,4	113,1	74,0
Pick up trailer, MJ/ kg	SC-5M	Pick-up - PL-150	Don-1500B	Pick-up - PL-150	75,4	33,5	21,0
Vehicles, MJ / kg	GAZ-53B	-	CamAZ-55102	GKB - 8527	86,4	756,0	593,2
Tractors	MTZ-80	2PTS-4-887	T-150K-05-09	VTU -10	86,4	680,4	419,3
	YUMZ-6L	PF-0,5	MTZ-800	PF-0,5	75,4	593,8	453,2
On the reverse side means: Fuel and lubricants, MJ /kg	-	-	-	-	52,8	274,6	256,0
Living labor MJ/ human year: combiner	-	-	-	-	1,90	1,23	0,67
tractor driver	-	-	-	-	1,26	0,41	0,22
the driver	-	-	-	-	1,50	0,54	0,30
auxiliary staff	-	-	-	-	0,60	0,10	0,10
Total:						**4054,3**	**2820,5**

Comparison of options by the end result shows that the recommended variant is more effective than the base one. The magnitude of the effect is 4054,3–2820,5 = 1233,8 MJ/t. A differentiated assessment of comparable harvesting machine-transport complexes for specific labor costs and material and energy resources is given in table 2.

Table 2 Differentiated assessment of machine - transport complexes

Name indicators	Unit measurement	Marking	Options	
			basic ones	projecting
Energy efficiency factor, including cost:	-	$К_{ее}$	1,00	0,74
- the technical facilities	-	$К_{ет}$	1,00	0,76
- live labor	-	$К_{el}$	1,00	0,54
- direct energy	-	$К_{ed}$	1,00	0,93
Combine harvest performance	ha / hours	$Р_{teh}$	1,76	2,20

CONCLUSIONS

1. The model of estimation of energy costs of equipment of harvesting machine-transport complexes is developed, which allows optimizing the structure and composition of harvesting machines and vehicles taking into account the probable nature of their interaction.
2. Differential consideration of material and energy expenditures makes it possible to assess in large measure the need for material and energy resources to collect the entire volume of planned products and compare this demand with the actual availability, so the recommended variant of the composition of MTC is more efficient than the base at 1233,8 MJ/t.
3. The recommended composition of machinery of transport systems will increase the efficiency of the process of harvesting grain cereal crops with the energy consumption of technical equipment by 24%, live labor - 46%, fuel and lubricants - 7%, and overall efficiency by 26,0%.

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INCREASING THE RELIABILITY OF COMBINES FOR HARVESTING GRAIN CROPS BY METHODS OF RESERVE SUBSTITUTION

D.A. Domuschi*, A.D. Ustuyanov**
Department of Agroengineering, Odessa State Agrarian University, Odessa, Ukraine

E-mails: * d.domuschi@ukr.net; **a.ustuaynov61@ukr.net

*Corresponding author: d.domuschi@ukr.net;

ABSTRACT
The results of experimental studies to ensure the operability of combine harvesters for harvesting grain crops are presented. The reliability indicators of the aggregates, assemblies and parts of combine harvesters are determined, and the methods of spare parts reservation at different storage levels are justified.
Key words: combine harvester, reliability, operability, operating time to failure, average time to eliminate failure, spare parts, different levels of storage.

INTRODUCTION

The main requirements for equipment are its reliability and efficiency. Regarding agricultural machinery, these requirements are no less important, and in terms of reliability, they are higher than in industry. Insufficient reliability of agricultural machinery affects the efficiency of its use and is the cause of significant losses of agricultural products both during cultivation and, especially, during harvesting.

THE STATEMENT OF THE PROBLEM

More than half of the failures of the harvesters for technical reasons associated with the replacement of parts, components or assemblies, which are failured. Recovery time after failures depends on how quickly the service for the eliminations of failures and delivery of parts and components that have failed works. It is necessary to clarify the nomenclature and places of the deployment of spare parts including the possibility both group work harvesting machines (combines) within technological systems, and a single work.

ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

Providing of harvesters' operability during exploitation seen in many studies (Dumenko, 2010a,b; Dumenko and Boyko, 2011; Sidorchuk and Skibchik, 2013) etc. Machine builders allow methodological errors in the design requirements and standards of machines' reliability. They give rationing of faultless work of aggregates without the 1st group of complexity, the part of which is 51-66% of the total. As a result, unreasonably, the faultless work of aggregates increases by 50-65%. Besides, work of units as a whole, significance of works, necessity of observance of optimum agrotechnical terms of their performance are not considered (D. Domuschi, pers. commun.).

In studies (Sidorchuk et al., 2011a,b) indicates that the terms of machine's work is possible, not only between probable failures, but also between scheduled maintenance. Studies indicate that in the structure of monetary costs for the operation and repair of combine harvesters, the cost of spare parts is 50-60% (Skibchik and Dnes, 2017). Late delivery of spare parts during the harvest period leads to an increase in downtime of the combine harvester fleet, delaying the start of repairs. The study notes that total downtime combine harvesters, which constitute 32-35% of the time, the downtime for technical reasons accounts for 17-20% (Enakiev et al., 2016). Thus, 60% of failures for technical reasons associated with the replacement part or unit. Thus, the ability to eliminate the failure of harvesting machines in a timely manner is associated with the presence of a spare part in the service system. The analysis shows that the elimination of 70% of failures requires the replacement of a part, assembly or unit that has failed, and the length of time to eliminate failures is mainly due to the time delivery of spare parts for combines.

The problem of organizing the technical service of complex agricultural machinery is given much

attention in economically developed countries. Maintenance (simple operations) of combines is carried out by farmers or in repair shops. Combines are repaired by farmers, dealers and manufacturers. In the United States and some European countries, the volume of repairs performed on farms is growing (D. Domuschi, pers. commun.).

In the same works it is noted that in case of breakdown of the important mechanism during working season the new detail is delivered by the emergency supply system within 8-24 h, for this purpose even air transport is used. Special service during harvesting is compulsory and sometimes around the clock.

The analysis of works on this issue showed that the available research on the reliability of modern harvesting machines requires further development in relation to specific production conditions. The research does not provide complete recommendations for the organization of delivery of spare parts from different levels of storage to the failed harvesting machine.

PURPOSE OF RESEARCHES

Improving the operability of combine harvesters - combines by reducing downtime for technical reasons with the demand for spare parts, determining their nomenclature and storage locations.

MATERIALS AND METHODS

Duration of harvesting crops depends on the availability, reliability and technical condition of harvesting machinery.

Expanding and deepening of harvesting machines' maintenance due to the increasing in its complexity, that require additional costs that are so "price" achieved by increasing reliability.

Research of the process of detection and elimination of failures of the combine harvester fleet should be carried out on such indicators as:

-number of cases of failures during harvesting;

-the complexity of restoring the efficiency of machines;

-losses of working hours caused by the removal of faults;

-expenses on elimination of failures grouped by the most important positions, components and units with the reservation of spare parts.

Optimal concentration and distribution of spare parts for various levels of storage depends on many factors: the nature and quantity of the resulting failures, the number of working combines, distances to storage, spending on storage, and shipping and eliminating failures and others.

Two types of failures are considered in the model of occurrence of failures of harvesting machines. The first is associated with various disabilities in the manufacture and repair the second associated with random factors (hitting foreign objects, shaking and so on.). The probability of the first type of failure is subject to Weibull's law, the second - the exponent, and the probability of all failures is defined as:

$$P(t)=P_1(t) \cdot P_2(t), \quad (1)$$

where: $P_1(t)$ – probability of first type failures;

$P_2(t)$ – the probability of the second kind of failures.

In conducting multivariate correlation analysis performance combine harvesters identified the following relationship:

$$y=700{,}648-32{,}456x_1+1{,}654x_{12}+8{,}99x_2+0{,}212x_{22}-12{,}850x_3-16{,}007x_4, \quad (2)$$

where: y – seasonal developments combine, physical, ha;

x_1– life harvester, year;

x_2– experience combiner specialty, year;

x_3– refusal quantity;

x_4– average recovery time, hours.

As seen from this relationship a great impact on productivity within the combine harvester affects the life of the combine, the number of failures and average recovery time.

RESULTS OF RESEARCHES

Research aimed at improving efficiency of harvesting machines, conducted in Belgorod - Dniester district of Odessa region. Productivity and balance of time changing of combines are investigated in (D. Domuschi, pers. commun., 2016) and the results of experimental studies to assess the reliability of combines Don – 1500B presented in (D. Domuschi, pers. commun.,2017).

Studies show that the harvest of a platform - pick-up and wedge belts account for 88,2% of all failures

that require replacement parts that failed. These are the main components that are objectified also assigned combine's reliability (table 1).

Table 1 Research of combines Don - 1500B on efficiency (refusal of the demand for spare parts)

Units, units, details	Number of faults	Percent of total	Work on a refusal (average), hours	Refresh time (average) hours*
Header	315	25,0	20,8	2,6/1,6
Thresher	39	3,1	337,8	7,4/4,8
Electrical	49	3,9	268,5	7,2/4,7
Hydraulic	15	1,2	877,2	6,8/4,5
Chassis	3	0,2	4336,0	9,8/7,1
Bearings	40	3,2	328,9	8,2/5,5
Driving	98	7,7	134,2	9,4/6,7
Chains	2	0,2	6579,0	2,4/1,6
Platform – wagons	699	55,5	9,4	1,7/0,9
Total	1260	100,0	10,4	3,2/2,0

** In numerator – the total time spent on the restoration of failure, the denominator – the time spent on the delivery of spare parts*

Failure of the first group of complexity is about time. Average bounce complexity in different groups of nodes and aggregates revealed that most failures of Group I accounted for such units as the platform - up (65,1%) and Reapers (28,1%) (table 2).

This replacement is performed mainly small size of parts that can be easily removed and installed. The concentration of such parts in the vicinity of working combines will significantly reduce the recovery time of disability.

Failures II of complexity combine distributed more evenly than failure I and III group complexity. Most failures accounted for electrical equipment – 29,1%, bearings – 24,2%, Driving –20,6% and thresher – 15,2% (table 2). During the season of to combine accounts for 0,5 - 1,0 waiver for one part or one unit used to eliminate denial II of complexity. Because spare parts to address these failures is advisable to store in warehouses brigades (divisions) or households. The bulk of refusals III of complexity (56%) are in the thresher. In reaper, hydraulic system and a chassis-fence have 12%, and electrical and pick – 4% (table 2). Given the fact that the refusal Group III difficulty arises in the combine about 2 - 3 seasons of spare parts to address these failures appropriate to keep in storage at the district level. This will reduce the number of reserve parts and reduce the cost of storage.

Table 2 Results distribution failures harvester Don-1500B (refusal by groups of complexity of the demand for spare parts)

Units, units, details	The number of failures pieces	Average bounce on groups of complexity					
		I group		II group		III group	
		pieces	interest	pieces	interest	pieces	interest
Header	315	301	28,1	11	6,7	3	12,0
Thresher	39	–	–	25	15,2	14	56,0
Electrical	49	–	–	48	29,1	1	4,0
Hydraulic	15	6	0,6	6	3,6	3	12,0
Chassis	3	–	–	–	–	3	12,0
Bearings	40	–	–	40	24,2	–	–
Driving	98	64	6,0	34	20,6	–	–
Chains	2	2	0,2	–	–	–	–
Platform – wagons	699	697	65,1	1	0,6	1	4,0
Total	1260	1070	100,0	165	100,0	25	100,0

When using harvesters are of the failure to eliminate that do not require a long downtime, as easy to remove damaged parts of the car, but serviceable - easily. These include segments fingers, rays, strips, hoses, belts and other. To determine the list of spare parts that limit the reliability of the harvesting method of weighting coefficients were determined by flow parameters failures and their significance.

CONCLUSIONS

Simple harvesting machines technology systems for technical reasons can reduce by reservation of spare parts to correct failures of various groups of complexity. Parts advisable to keep at various levels: the processor; in mobile technological complex warehouses; in warehouse – team (department) sector, district and regional level. Reservations parts to reduce the duration of 2–8 days harvesting, grain losses are reduced from 3,0 to 12,0 kg / ha. Implementation harvesting in optimal agronomic conditions only in terms of South steppe zone of Ukraine will increase cereal yields by an average of 10–20%.

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BIOCHEMICAL EFFECTS ON THE FLAVOR OF FERMENTED SAUSAGE

H. Sen Arslan[1], H.S. Olcay[2], E. Alagoz[3], A. Yaldiz Cabi[3], I. Celik[3], C. Saricoban[3]

[1]Department of Food Engineering, Karamanoglu Mehmetbey University, Karaman, TURKEY

[2]Department of Food Engineering, Istanbul Aydin University, Istanbul, TURKEY

[3]Department of Food Engineering, Selcuk University, Konya, TURKEY

Abstract

Flavor is a complex feeling phenomenon involving taste, odor and textural responses and the flavor chemistry of foods. Flavor chemistry of foods is the subject of different researches in fermented products. Fermented meat products generally have a flavor resulting from the chemical changes and ingredients that occur during the fermentation and drying processes. Flavor formation in dried meat products is quite complex because there are many reasons that affect this situation such as smoking, salting, the use of nitrate and nitrite and components resulting from them, spices, various bacterial ferments and enzymes found in meat. Hydrolysis of proteins, carbohydrates and fats play an important role in the flavor formation in fermented meat products. The accumulation of carbonyl components during fat hydrolysis and its relation to the role of bacteria in chemical changes is remarkable. Glycolysis, proteolysis, lipolysis and lipid oxidation play an important role in the flavor development of various ingredients. During glycolysis, pH affects the formation of aroma by ionizing the carboxyl groups of amino acids. Proteolysis during ripening and significant increases in the concentrations of amino acids and peptides in fermented sausage have a significant effect on flavor formation. As a result of lipolysis, the formation of cholesterol as a result of the release of short chains consisting of neutral and phospholipids and chemical changes during the ripening of fermented sausages affect the formation of flavor. In this study, information about the biochemical effects on the flavor of fermented sausages will be given.

Keywords: Fermented meat, Flavour, Ingredients, Lipolysis, Proteolysis.

1. INTRODUCTION

Flavor; it is one of the quality criterias that determine the prefer of food by consumers. The flavor of fermented meat products is mainly formed during the fermentation stage in the production process. However, a series of complex reactions such as glycolysis, proteolysis, lipolysis, and lipid oxidation and hydrolysis of proteins, carbohydrates and fats that occur during production also play a role in flavor formation. Flavor formation in dried meats is quite complex because there are many reasons that affect this situation, such as smoking, salting, the use of nitrate and nitrite and their decomposition components, spices, various bacterial ferments and enzymes found in meat (Nurmi and Niinivaara, 1964). Chemical phenomena occur as a result of the breakdown of fat, carbohydrate and proteins by the activity of microbials and endogenous meat enzymes.

It is believed that four major processes of great importance such as glycolysis, proteolysis, lipolysis and lipid oxidation, which will be described in the following context, play an important role in the flavor development of the various ingredients. Similar end products can go through multiple processes; therefore, a certain amount of change may occur.

2. GLYCOLYSIS

Raw meat used in making fermented sausage contains L-lactic acid, glucose and phosphoryl glycolytic intermediates. The added carbohydrate as an ingredient, along with some of the glucose and phosphoryl intermediates, is used as an energy source for use by the non-identical flora of the meat or starter cultures if used. More lactic acid accumulates due to the fermentative metabolism of lactic acid bacteria, which is noted to have the production of both (L-) and (D-) isomers from carbohydrates (Lücke, 1986).

In a study carried out, Belgian type cold smoked fermented sausages stored for forty days; it was found that there is an inverse relation between lactate production and hexose use. It has been found that the lactate production amount, which is three times the initial level, is related to the amount of added carbohydrate and that lactate can be produced from amino acid metabolism up to 10% (De Ketelaere et al., 1974).

Acetic acid is another acid commonly and significantly found in fermented sausages and believed to be of microbial origin. Studies on fermented sausages found that short-chain organic acids have similar concentrations (De Ketelaere et al., 1974). There is one exception that Cervelatwurst, studied by Langner (1969), contains almost five times as much acetic acid. Ordónez et al. (1989), it was found that there was a relationship between the types of bacteria used to inoculate the Salchichon type sausage mixture and the amount of acetic acid production in the experimental fermented sausages. Lactic acid, hexose and amino acid are thought to be important acetate sources. However, most lactic acid bacteria found in fermented sausages can also produce acetate with pentoses from ATP and lactate (Kandler, 1983).

Regardless of their source, it is often suggested that lactate and acetate are an important contributor to the acid aroma and taste of fermented sausages. These flavours are perhaps more characteristic in Northern European fermented sausages, and particularly in rapidly fermented ones, compared to the traditionally slower fermented Southern European fermented sausages (Demeyer et al., 1986; Langner, 1969; Lücke, 1986). While the relationship between acid flavours and the two acids seems plausible, and the amount of acetic acid is well above the flavor threshold range levels established in aqueous and lipid systems, there is little evidence to directly prove this point (Forss, 1972). Demeyer et al. (1974) claimed that excessive acid production leads to an unwanted sour, tingling and astringent taste, although Burcharles acidity associated with excessive amounts of D-lactic acid.

In addition to these direct effects, it can be thought that lactate plays an important role in the development of the textural properties of fermented sausages, which is another factor in the general evaluation of taste, although lactate is the most important factor in pH reduction and has an effect on soluble protein (Dwivedi and Brockmann, 1975). In addition, the effect of pH on the ionization of amino acid carboxyl groups and its effects on aroma should not be forgotten (Demeyer et al., 1979).

It is known that other acids have been reported in various combinations with various acids and their measured concentrations are 100-1000 times less than that of acetic acid. Considering the low odor and taste threshold levels of many of these acids, the possibility of these compounds to play a role in the development of aroma in some products is unthinkable (Halvarson, 1973). C4 and C5 acids have particularly characteristic odours and low threshold series. The source of these acids is unknown, but monocarboxylic acids bound to five carbon atoms are microbial metabolites by transamination or deamination corresponding to α-keto acid, followed by all of the subsequent decarboxylation (Dainty and Hibbard, 1983).

3. PROTEOLYSIS

The effect of pH on the extract of meat protein and the texture of fermented sausages is mentioned in the following stage. In the study by De Ketelaere et al. (1974), it is clear that there are significant reductions in the proportion of total protein that can be extracted as sarcoplasmic or myofibrillar protein using standard methods. The extractability of these two fractions; change from one product to another, with the degree of loss during maturation or more affected by the procedures applied (Astiasaran et al., 1990; de Fernando and Fox, 1991; Pezacki and Pezacka, 1983).

Researchers have proven all confirmatory data based on one or more measurements of undissolved protein nitrogen, an amino nitrogen in peptides and amino acids, ammonia, or persistent amino acids (Cantoni et al., 1974; Dierick et al., 1974; Langner, 1969; Reuter et al., 1968; Sajber et al., 1971). Dierick et al. (1974) found that increases in α-amino nitrogen in free amino acids and peptides are clear evidence of ammonia and a number of specific amino acids. Given the wide variety of product formulations, temperatures and ripening periods, smoking or air-drying times, the differences in kinetics and the scope of the process will be different. Although it has been found that ammonia rather than free amino acid is produced earlier and faster in Cervelatwurst sausages, it has been observed that the production of free amino acids in the described Belgian products is faster than the production of ammonia and peptides (Roncalés et al., 1989).

Alongside these findings, total protein-free nitrogen values increase by a factor of two, with a reasonable degree of homogeneity across various studies, with individual amino acid concentrations ranging from two to twelve-fold. Similar amino acids, including valine, leucine, isoleucine, phenylalanine and methionine, have been noted to be among those showing the greatest increase in concentration (Dierick et al., 1974). Direct proof of proteolysis was obtained using SDS-PAGE (sodium dodecyl sulphate-polyacrylamide gel electrophoresis) in two studies. The data showing the cleavage of myosin, actin, and troponin T, which are components of myofibril, have been observed in both studies and the shape of the smaller molecular weight peptides obtained is quite reminiscent of peptides produced by meat cathepsins (de Fernando and Fox, 1991; Verplaetse et al., 1989). Verplaetse et al. (1989) found that the production of these products was at pH 4.8-5 and announced that the maturation temperature at 15-20°C was optimum for such enzyme activity. They argued that this process could be seen as a continuation of the meat conditioning process.

The question of the relative importance of microbial and non-microbial activities in proteolysis has often been addressed, but it is interesting that it is still considered unresolved. Data from studies using different bacteria initially added to the sausage mix or the inclusion of antibiotics to suppress the microbial growth point plays an important role for microorganisms that are stated to have the most necessary activity (Sajber et al., 1971). De Masi et al. (1990) show a greater increase in non-protein nitrogen in fermented products inoculated with *Pediococcus* than in unfermented

controls. As the highest concentration increase, it is expressed that the amount of amino acids shown above has a characteristic bitter taste (Reuter et al., 1968).

Thanks to its contribution to the pH increases observed during the drying of many fermented products, ammonia can ionize the sensory properties of compounds. The emphasis on ammonia production and the further metabolism of amino acids is evidence of a long drying phase (Demeyer et al., 1979).

Histamine, tyramine tryptamine, cadaverine, putrescine diaminopropane and diphenylmethylamine, which are called biologically active or pressor amines, are well known in fermented sausages. Such components typically occur in meat by the amino acid decarboxylation of certain lactic acid bacteria (Lois et al., 1987).

The formation of gamma-aminobutyric acid from glutamic acid observed in some products probably occurs by the same mechanism and may result in glutamic acid being used as a less effective flavor enhancer than expected, according to the authors. The amines of putrescine, consisting only of arginine, and cadaverine, consisting of lysine, do not have any sensory properties. However, it is questionable whether the quantities produced, typically no more than 300 μg/g sausage, are sufficient to affect the taste or smell (Dierick et al., 1974; Langner, 1972).

4. LIPOLYSIS

The release of short chains from neutral and phospholipids and the formation of cholesterol have been for a long time a central topic in the study of chemical changes in fermented sausages during ripening (Cantoni et al., 1966; Cerise, 1973; Demeyer et al., 1974; Fernández and Rodríguez, 1991; Nurmi and Niinivaara, 1964; Roncalés et al., 1989). An increase of free fatty acid levels up to approximately 5% of the total fatty acid amount is normal. For example, according to the data from the Belgian study on fermented sausage, the concentration of free acid at the beginning of the production process has been reported to increase, whereas it peaked before the maturity period ended (Demeyer et al., 1974). Demeyer et al. (1974) also reported that as the amount of free acids increased, the amount esterified as triglycerides decreased, while the amount of di- and monoglycerides increased. Cantoni et al. (1966) stated that longer storage could also lead to acid formation, and reported that there was no measurable change in the phospholipid fatty acid content.

In the study carried out by Demeyer et al. (1974), it is stated that the spreading rate of free acids increases as linoleic acid>oleic acid>stearic acid>palmitic acid, respectively. Regarding lipolysis substances, it seems to be a general consensus about the use of different bacterial cultures as inoculums and the incidental finding of the number of lipolytic bacteria that plays an important role in the increase of free fatty acids. It is thought that micrococcal bacteria are active like moulds and yeasts in some products, particularly (Lucke and Hechelman, 1986). However, the role of meat enzymes also cannot be ignored (Dobbertin et al., 1975).

In studies conducted on possible sensory consequences of the accumulation of free fatty acids, it has been reported that the oleic and linoleic acids are odourless (Forss, 1972). What is most important for taste is generally considered, but unsaturated acids in particular act as precursors of small molecular-weight compounds with highly characteristic flavor properties.

5. LIPID OXIDATION

Cerise (1973), in their study on pork salami, provides direct evidence that the acid concentration increases initially, while in stages after maturity there is a decrease in some long-chain acids, including oleic acid. The researchers specifically identified the C12 acid as alpha-butenyl-beta-keto octanoic acid and the C11 component as alpha, alpha dimethyl- or alpha-ethyl undecanoic acid. They also found out that the decrease in oleic acid concentration corresponds to a proportional increase in a range of other acids with carbonyl groups. A series of aliphatic straight-chain components (C9-C20) and two-methyl derivatives (C8-C13) with unregistered functional groups have also been found with cyclic ketone, dodecane, tetradecane, tridecadiene, and tetradecadien. These types of components occur in the final stage of the autoxidation of unsaturated fatty acids (Mottram, 1991). Cerise (1973) found that the peroxides, the first final product of autoxidative reactions in which the oleic acid level also increased on the first days of maturation, rapidly formed. There was a rapid and excessive decrease in peroxides, whereas oleic acid levels decreased slower. More evidence than interpreted as indicative of oxidative changes for lipid components during maturation was obtained using methods such as peroxide values, TBA numbers, benzidine number for aldehydes, and spectrophotometric and chromatographic determination of total and single carbonyls (Cantoni et al., 1966; Demeyer et al., 1974; Halvarson, 1973; Langner, 1969; Nagy et al., 1989; Walhroos and Niinivaara, 1969).

It has been reported that concentrations of acetaldehyde, pentanal, 2-butanone, 2-pentanone, and diacetyl components which are recorded by Cantoni et al. (1966) increased, but 3 methyl butanal decreased. Langner (1972) found increases in 2-hexanal, methanal, ethanal, 2-propanone, and 2,3 butanedione and commented on general measures taken by referencing to the use of a carbonyl index in quality control. Later, in a study carried out on a number of commercial products, particularly Salami and Cervelatwurst, Langner (1972) recorded a lot of carbonyl and showed that the maximum flavoured sausages had the highest carbonyl levels between six and twelve carbon atoms. Although ethanal, propanal, and 2-prapanone are found as the predominant carbonyl in Swedish fermented meat products, since their concentrations are less altered during the ripening of either air-dried or smoked products, they have little effect on the possible flavor (Halvarson, 1973). These products have a taste threshold of between 5 and 60 ppb and their flavours are variedly defined as fresh, metallic, sweet, and fatty (Forss, 1972). In terms of known antioxidative properties of fume components such as phenols, it is interpreted that the negative effect of fumigation in the formation of these components is consistent with the formation of carbonyl by autoxidative processes. Halvarson (1973) emphasized that the concentrations of C6 and C7 carbonyls decreased during the maturation of air-dried products, whereas the C6 component increased and C7 decreased in smoked products.

6. CONCLUSION

There are many factors affecting the taste of fermented sausages. These factors generally include the aroma components that occur during the production process, substances such as spices, curing agents, and some chemical changes. Compounds formed by starter cultures during fermentation contribute to the aroma of meat by improving its sensory and biochemical properties. Besides, flavor improves with the activation of endogenous enzymes in meat under suitable conditions. In addition to all these, a number of chemical and biochemical reactions such as glycolysis, lipolysis, proteolysis, lipid oxidation, and hydrolysis of carbohydrates, fats and proteins are responsible for the aroma formation in fermented meat products.

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NOVEL METHODS USED IN MEAT TENDERIZATION

E. Alagoz[1], C. Saricoban[1], K. Unal[1]

[1]Department of Food Engineering, Selcuk University, Konya, TURKEY

Abstract

Tenderness is one of the most important features of meat and meat products that considerably affects its consumer acceptability. The process of tenderness that occurs naturally as a result of a series of biochemical changes during pre-rigor and post-rigor stages in fresh meat after slaughter, including pre-slaughter, can be accelerated and made more effective by various treatments. For this process, some methods have been applied for years such as electrical stimulation, tenderstretch, marination, aging. However, new technological methods have become popular to improve the meat quality and to increase the consumer demands, in recent years. These methods include such as high-pressure processing, hydrodynamic-pressure, shockwaves, pulsed electric field, ultrasonics. This review has been prepared to give information about the biochemical changes in the process of meat tenderness, new technologies used in meat tenderness and the advantages and disadvantages of these technologies.

Keywords: Beef, Meat quality, New technology, Tenderness.

1. INTRODUCTION

Quality and flavour in various meat and meat products are always important according to consumer demands and the desire for this is increasing day by day. Flavour, taste, tenderness and juiciness are the main textural and sensory properties that determine the desired quality of meat (Aaslyng and Meinert, 2017; Grunert et al., 2004; Picard and Gagaoua, 2017). The presence of these features in most meat products makes it easier to buy them again by consumers.

Many factors affect the tenderness of meat. These include factors such as the type, size and age of the animal, feeding the animal before slaughter, treatment and medicines, storage conditions of the carcass after slaughter, electric shock applied to the carcass, hanging the carcass, ageing of the meat and packaging (Channon et al., 2016; Channon et al., 2016; Hocquette et al., 2014; McMillin, 2008; Purchas, 2007; Strydom and Rosenvold, 2014; Thompson et al., 2006). However, the main constituent of meat tenderness has been affected by some factors such as the amount and solubility of the connective tissue of the meat, the shortening of sarcomere lengths during rigor, and post-mortem proteolysis that occurs between calpains and myofibrillar and their associated proteins (Marsh and Leet, 1966; Purslow, 1994). Keeping for a period of time in controlled refrigerated conditions of the carcass obtained after slaughtering the animal for meat tenderness has been used as a traditional method for many years. However, although this method provides positive contributions to the texture and flavour of the meat, it may also cause negative effects such as drip loss and cooking loss in the meat due to the long process.

In recent years, many new technological methods have been applied in the industry in order to minimize the negativities that may occur with the loss of area, time, labour and energy and to ensure more efficient and quality meat production.

2. CHANGES IN FRESH MEAT BY SLAUGHTER

In a few hours after slaughter, the rigor mortis naturally begins in the carcass. Rigor mortis is a indication of death defined as the irreversible loss of extensibility or become stiff of the muscles as a result of a series of chemical changes (Warner et al., 2017). As it is known, oxygen is transported to the muscles through the blood (haemoglobin) and as a result of the removal of the blood with the slaughter of the animal, anaerobic metabolism begins for the production of ATP in the muscles. When the amount of ATP reaches low levels, the extensibility of the muscles begins to diverge considerably from the original. As a result of glycolysis, glycogen which is stored in the muscles, turns into lactic acid in an anaerobic environment with some enzymatic activities and lactic acid reaches a final concentration of 5–6 mmol/g of tissue. With the lactic acid formed, the pH begins to decrease and protein denaturation begins with the effect of acidity in normal conditions (Warner, 2016).

When the animal is slaughtered, the tenderness is at the highest level (pH: 7.00-7.30). The tenderness decreases as the pH value decreases slowly. The tenderness increases with rise above 6.1 of the final pH whereas the water holding capacity increases and consequently the cooking losses are reduced. In addition, sarcomere shortening is prevented to some extent and/or proteases can show more activity at pH values close to neutral (Yu and Lee, 1986). At the isoelectric pH (pH: 5.20-5.50) reached as a result of rigor mortis at muscle, the water holding capacity and tenderness of the meat are at the lowest level.

Proteolytic enzymes, as well as glycolysis, are also responsible for the tenderness of meat. Some of these proteolytic enzymes are enzymes that exist in the natural structure of meat such as calpain, caspase, chymotrypsin, cathepsin, calcium-activated proteases. These enzymes contribute to the tenderness of meat by breaking down proteins at different pH ranges with the slaughter of the animal.

3. AVAILABLE TECHNIQUES USED FOR MEAT TENDERIZATION

In order to increase the tenderness which decreases to a certain level after cutting, techniques such as the use of exogenous enzymes, marination, salting and electrical stimulation as well as traditional ageing can be applied.

3.1. Traditional ageing

It is based on the principle of keeping carcasses or divided muscles in cold stores for a certain time/temperature norm after slaughter. In this technique, the tenderness of the meat increases slightly as a result of glycolysis, proteolytic activity and some microbial activities.

3.2. Use of exogenous enzymes

While enzymes in the natural structure of meat generally act against myofibrillar proteins, exogenous enzymes can affect both myofibrillar and connective tissue proteins (Sullivan and Calkins, 2010). For this purpose, some plant, bacterial and fungal proteases are used.

Plant proteases: Papain, Ficin, Bromelain, Actinidin

Bacterial proteases: *B. subtilis*-subtilisin and neutral protease

Alkalophilic *Bacillus* sp.-alkaline elastase

Fungal proteases: Aspartic proteases from *A. oryzae*

Rhizopus sp. Proteases

3.3. Marinating and salting

The process of keeping the meat generally in fruit or vegetable juices with low pH for a certain time and temperature is defined as marination. When meat proteins are exposed to high acidity, they partially break down and become tenderization. For this purpose, liquids such as onion juice, vinegar and milk are generally used. Meat can be made tenderize by salting fresh meat and keeping it for a certain period of time.

3.4. Electrical stimulation

It accelerates glycolysis after slaughter and this case ensures that the meat pH reaches the isoelectric point before the muscle temperature drops sufficiently. However, it accelerates the tenderization of meat by increasing the rate of proteolysis and physically affecting muscle fibers (Hwang et al., 2003; Lang et al., 2016). It can also increase the tenderness of meat by disrupting the membranes of lysosomes and releasing cathepsins at low pH and high temperature (Dutson and Pearson, 1985).

4. NOVEL TECHNIQUES FOR MEAT TENDERIZATION

The new techniques used to make meat more tender with minimal effect on the nutritious and sensory properties of meat are as follows;

- High pressure processing/High hydrostatic pressure processing
- Hydrodynamic pressure processing/Shockwaves
- Pulsed electric field
- Ultrasound
- Smartstretch

4.1. High Pressure Processing

High pressure processing (HPP) is a non-heat technique that increases the quality and shelf life of food products. HPP applied after slaughter increases the calcium level in the muscle and causes intense muscle contractions, resulting rapid drop in post rigor glycolysis and in pH (Okamoto et al.,1995). However, it affects protein conformation and molecular bonds. It has been reported that these effects can cause to deteriorate of the myofibrillar structure with high pressure and thus increase tenderness (Sikes and Warner, 2016). However, Ratcliff et al. (1977) reported that the effect of pressure-temperature application on connective tissue proteins had limited while myofibrillar proteins was affecting.

The effects of HHP on meat tenderness have changed depending on the rigor mortis process, pressure, temperature and their combination. Sun and Holley (2010) reported that high temperature (40 to 80°C) application was also required with HHP for tenderising in post-rigor process. Unlike traditional applications, HPP is not affected by product and equipment size, so application time is minimized and provides convenience from laboratory findings to commercial applications.

4.2. Hydrodynamic Pressure Processing

Another way to tenderising meat by applying pressure is hydrodynamic pressure process (HDP) or shock waves, which are the instantaneous development of pressure waves. Shock waves spread in liquid mediums at speeds greater than the speed of sound. Since most of the meat consists of water, the applied waves ensure tenderness by affect the muscle proteins in the meat (Bolumar et al., 2013). In addition, it has been reported in various studies that HDP increases the tenderness of fresh meats and has no effect on microbial and chemical stability (Bowker et al., 2010; Claus et al., 2001; Moeller et al., 1999; Solomon et al., 1997).

The tenderness developed with the use of HDP in different type of animal meats varies between 25-75%. This change in tenderness rates depends on the use of fresh or frozen/thawed meat, the specific conditions of the process, the initial tenderness, the process after slaughter, and storage (Solomon et al., 2004; Solomon et al., 2008; Solomon et al., 2011). It has been reported that HDP does not affect the colour, pH, flavor components and drip loss of fresh meat, while being suitable for tenderising meat in a short time with low costs (Bolumar and Toepfl, 2016; Bowker et al., 2008; Ha et al., 2017).

4.3. Pulsed Electric Field

Pulsed Electric Field (PEF) application is based on the principle that the product is exposed to a certain electric field force for a very short time. It actualizes in a very short time and at low temperature compared to traditional techniques. In addition, it differs from other traditional methods by having different parameters for each muscle. Meat must be in post-mortem maturation period for PEF application to have maximum effect. PEF application in this process affects calcium release and calpain activation (Bekhit et al., 2016; Bekhit et al., 2014; Carne et al., 2015a, 2015b, 2015c; Warner et al., 2017). It also affects muscles structurally, enables cathepsins to be released from lysosomes and helps meat to become tenderising by accelerating glycolysis (Bhat et al., 2019; Warner et al., 2017). The effect of PEF application on meat tenderness may vary depending on the electric field strength, the structure of the muscles and whether the meat is in ripening period.

4.4. Ultrasound

Ultrasound is a type of energy produced by sound waves with vibration frequency above the audible limit (20 kHz) for humans. In ultrasound application, electrical energy transforms into vibration energy, and cavitation occurs. The cavitation energy is generated by ultrasound application on meat affects the meat chemically, physically or biologically (Peña-Gonzalez et al., 2019). Mechanical actions that occur during the ultrasound application physically affect the myofibrillar proteins in the structure of the meat. In addition, with the application of this technology, the activation of enzymes that help ripening in meat, and the release of Ca into the medium and the chemical changes in the pre-rigor meat facilitate the tenderization (Got et al., 1999;

Roncalés et al., 1993). The effect of ultrasound application on the tenderness depends on the frequency density and application time, and the pre- or post-rigor condition of the meat.

4.5. Smartstretch

Smartstretch is a technology used to reduce hardening during rigor, based on the principle of stretching the muscles. As well as the entire carcass, only a certain number of hot-boned muscles are affected by this technology. In this technology, the hot-boned muscle is placed in a flexible sheath, this sheath is placed in an airtight chamber, and force is applied perpendicular to the muscle fibers (Warner et al., 2017). Since the Smartstretch process is not applied to the entire carcass, it provides profit in terms of space, time and energy, and facilitates the control of the portion shape of the meat for consumers.

5. CONCLUSION

Many traditional and innovative applications have been used for meat tenderization. New technologies have been developed. Technologies such as HPP and PEF are more eco-friendly applications as they produce small amounts of CO_2. Although most of the new technologies have positive results, some difficulties are also available in their use in the food industry. These disadvantages include such as excess the installation costs of most of them, the need for personnel training, the optimization of the working conditions of the machines. More research is required to fully bring these technologies to the meat industry.

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SOME FLEECE QUALITY TRAITS OF BAFRA SHEEP

Emine DUMAN[1], Evren ERDEM[2], Serkan ERAT[2], Bora ÖZARSLAN[2], Mehmet NACİ OKTAY[2]

[1]Karakeçili Directorate of District Agriculture And Forestry, Kırıkkale, Turkey

[2]Kırıkkale University, Faculty of Veterinary Medicine, Department of Animal Breeding and Husbandry , Kırıkkale, Turkey

Abstract

The study material were consisted of 32 male and female Bafra sheep, which were 10 and 24 months of age. A total of 96 fibre samples were taken from three regions of the body (wither, chest, rump) separately from each animal to determine the fleece quality traits. Least squares mean of fibre diameter, fibre elongation, fibre tenacity, and fibre proportion for 10 and 24 months of age Bafra sheep were defined as 31.26 and 31.24 μm, 37.04 and 38.37 %, 15.92 and 22.95 cN/tex, 67.33 and 67.49 %, respectively. Fibre diameter, fibre elongation, fibre tenacity, and fibre proportion traits were affected by sex ($P<0.001$). Fibre diameter, fibre tenacity, fibre elongation and fibre proportion of the females were significantly higher than those of the males. The effects of body region on fibre diameter ($P < 0.05$), fibre tenacity ($P < 0.05$) and fibre proportion ($P<0.001$) were statically significant. According to the research results, compared to other Turkey indigenous sheep breeds, we concluded that the fleece of Bafra breed has a moderate quality in terms of fibre diameter and it is well quality in terms of fibre proportion. By making selection studies in the Bafra race, high-quality wool (fibre diameter 30 μm and below) herds can be created that can be used in the fabric industry.

Keywords: Bafra, Fleece, Fleece Quality Traits

INTRODUCTION

Sheep (37 276 050 head) constitute about 76.89 % of the total Turkey population of small ruminants (48 481 479 head), and the fleece production was 42 823 tons in 2010, and its increased 70 588 tons in 2019 in Turkey (TUİK, 2020). Breeds of sheep in Turkey is quite a big difference in terms of cultivated area. While some sheep breeds are bred (Akkaraman, Morkaraman, Awassi) in a very wide region, it is seen that some breeds are bred in certain regions (Chios). Meat and milk yield is important in the production of the Kıvırcık breed and its hybrids, which is raised in the Aegean and Marmara regions. Milk yield is of primary importance in the Awassi breed, which is raised in Southeastern Anatolia. In the Central and Eastern Anatolia regions, low combined yield indigenous sheep breeds (Akkaraman, Morkaraman) are raised to obtain meat, milk, and the fleece (Akçapınar, 2000). Sheep fleece is preferred in the clothing and

apparel industry (Dellal et al.2000; Koyuncu et al.,1996). It's desirable to use thin (low fibre diameter) and high-strength (high fibre tenacity) fibers in the textile industry. Nowadays, the polyester fiber in the weaving industry has begun to replace the fleece. The use of organic materials such as cotton and wool fibres in the clothing industry is important for health. The most preferred in the apparel industry sheep wool known for elastic and strong due to the structure of the fibre, and also feel-soft, and it allow air and heat exchange (Eser et al., 2016; Woolmark, 2020). Previous studies have examined fleece quality traits of indigenous sheep breeds (Atasoy et al., 2003; Erişir and Özbey 2005; Ünal et al., 2003; Ünal et al., 2004; Yüceer et al., 2003), however very little information about the fleece quality traits of Bafra sheep (Akdağ et al.,2011) which is bred for the purpose of meat and milk yield. Therefore, the objective of this study was to determine the fleece quality traits of Bafra sheep.

MATERIALS AND METHODS

The study material consisted of 32 male and female Bafra sheep (16 male and 16 female), which were 10 and 24 months of age. A total of 96 fibre samples were taken from three regions of the body (wither, chest, rump) separately from each animal to determine the fleece quality traits. Fleece traits (fibre diameter, fibre tenacity, fibre proportion) were determined at Livestock Central Research Institute, wool and mohair laboratory. For fibre length and diameter analysis, an USTER OFDA 100 instrument was used. For the tenacity and elongation analyses, a Fafegraph HR + ME single fibre tensile tester instrument was used. Fibre proportion expressed as Fibre proportion (%) = [Clean mohair weight + (clean mohair weight x 0.14) / total weight of mohair] x 100 (ASTM, 1997;Qi et al.,1994; I.W.T.O., 1995; Erdem et al., 2019).

Statistical Analysis

Data were tested for normality of distribution using the box-plot test and for homogeneity of variance using Levene's test. Fleece traits were determined by (GLM) General Linear model and the significance of the difference between means was determined Tukey test which was conforming to the normal curve of distribution SPSS statistical package program was used in the calculations (SPSS 2001, Alpar 2014).

RESULTS

The fleece traits of Bafra sheep were summarized in Table 1. Least squares mean of fibre diameter, fibre elongation, fibre tenacity, and fibre proportion for 10 and 24 months of age Bafra sheep were defined as 31.26 and 31.24 μm, 37.04 and 38.37 %, 15.92 and 22.95 cN/tex, 67.33 and 67.49 %, respectively. Although all fleece traits of Bafra sheep were not affected by age ($P>0.05$), fibre diameter, fibre elongation, fibre tenacity, and fibre proportion traits were affected by sex

(P<0.001). Least squares means of fibre diameter, fibre elongation, fibre tenacity, and fibre proportion for male and female Bafra sheep were 27.13 and 35.19 µm, 35.62 and 39.85 %, 17.10 and 26.56 cN/tex, 62.32 and 71.64 %. Fibre diameter, fibre tenacity, fibre elongation and fibre proportion of the females were significantly higher than those of the males. The effects of body region on fibre diameter (P<0.05), fibre tenacity (P<0.05) and fibre proportion (P<0.001) were statically significant. Least squares means of fibre diameter, fibre elongation, fibre tenacity, and fibre proportion for wither, chest, and rump regions were 30.50 µm, % 37.54, 22.46 cN/tex and % 64.11, 30.55 µm, % 38.77 , 20.24 cN/tex and % 69.54, 32.75 µm, % 36.80, 24.31 cN/tex and %68.29. Fibre diameter and fibre tenacity of the rump region were significantly higher than that of wither and chest regions (P< 0.05; P<0.01).

DISCUSSION

The least square mean value of fibre diameter determined in Bafra females in the study (35.19 µm) has taken a value between the diameter value determined in Chios females (28.12 µm) (Çörekçi and Evrim, 2002) and the fibre diameter values determined in the Karayaka breed females (38.52 µm, 39.10 µm and 40.36 µm) (Ünal et al.,2004; Atasoy et al.,2003; Akdağ et al., 2011). This mean value (35.19 µm) lower than the Awassi (36.00 µm) (Tabba et al.2001), Morkaraman (36.32 µm) (Küçük et al., 2000), Karagül (39.11 µm) (Küçük et al., 2000) breeds, similar to Acıpayam breed (35.60) µm) (Yüceer et al., 2010), and higher than the Akkraman (elite females) (28.63µm) (Garip et al., 2010), İmroz (31.40 µm) (Çörekçi and Evrim, 2000), Hamdani (34.20 µm) (Küçük et al., 2000) , Dağlıç (31.49) (Demir et al., 2001 µm), Karakaş (30.13 µm) (Karakuş et al. 2005) and Norduz (32.24 µm) (Karakuş et al. 2005) breeds. The least square means of elasticity (39.85%) determined in Bafra breed females was higher than the elasticity mean value (29.33%) found in Karayaka females (Ünal et al. 2004) and Chios x Morkaraman F_1 (30.78%) (Erişir and Özbey, 2005). Fibre proportion mean value (65.62%) determined in the samples taken from the Bafra males in the study was lower than the value reported for the Karayaka males (68.90%) (Koyuncu et al., 1999). It has been stated that the most important trait in determining the quality of fleece is fibre diameter, and the more homogenous (uniformity for fibre diameter) the fibres that constitute the fleece samples in terms of fibre diameter, the easier and better it is processed in the weaving industry and it gives less waste (Akçapınar, 2000). In the present study, least squares mean of wither, chest, and rump fibre diameter were found as 30.50 µm, 30.55 µm and 32.75 µm, and the fibre diamater mean value of the rump region was higher than the wither and chest regions. Akçapınar 2000 reported that breed diversity, age, sex, feeding, weather conditions, body regions, housing, diseases, number of offspring and milking have an effect on fibre diameter, and the back part of the body has thicker fibre diameter than the front part. In all qualities (thinness, elasticity, strength and efficiency) females received higher values than males. In all fleece quality traits of females

(fibre diameter, *fibre tenacity, fibre elongation and fibre proportion*) were higher than males. When other studies were examined, it was reported that female fleece diameter values were higher in Norduz females than Norduz males, however, the same study reported that the sex effect was not statically significant (Yılmaz and Denk, 2014).

Table 1. Some quality traits of fleece in Bafra breed ($X \pm S_X$).

Age (month)	Sex	Body region	Fibre diameter (µm)	Fibre elongation (%)	Fibre tenacity (cN/tex)	Fibre proportion (%)
10	Male	Wither	28.20±0.80	33.74±0.84	16.92±1.59	47.18±4.23
		Chest	26.51±1.09	37.90±0.70	17.53±1.89	59.12±2.25
		Rump	28.68±0.91	33.82±0.85	19.49±1.41	66.12±2.18
		Mean	27.80±0.55	35.15±0.86	17.96±0.95	57.58±2.52
	Female	Wither	33.63±0.83	42.47±0.79	27.14±2.08	72.64±2.37
		Chest	34.24±1.81	37.93±0.90	21.88±3.38	76.06±1.14
		Rump	37.04±1.13	36.30±1.02	27.52±1.79	72.80±3.13
		Mean	34.88±0.80	39.01±0.94	25.44±1.51	73.83±1.34
24	Male	Wither	25.50±0.66	33.43±0.76	17.22±5.38	64.19±2.51
		Chest	25.88±0.63	37.22±0.70	13.65±0.56	69.49±1.38
		Rump	27.74±0.96	37.60±0.74	17.30±2.04	63.00±3.72
		Mean	26.37±0.47	36.09±0.96	15.92±1.30	65.62±1.62
	Female	Wither	34.04±1.32	40.52±0.84	25.19±2.45	66.39±2.65
		Chest	34.97±2.01	42.04±0.83	26.26±3.25	70.89±2.17
		Rump	37.47±1.32	39.41±0.95	31.45±2.53	70.44±1.49
		Mean	35.49±0.92	40.66±0.89	27.63±1.63	69.36 ±1.24
Grand Mean						
10			31.26±0.71	37.04±0.69	15.92±1.30	67.33±1.80
24			31.24±0.87	38.37±0.73	22.95±1.43	67.49±1.05
	Male		27.13±0.38	35.62±0.79	17.10±0.78	62.32±1.53
	Female		35.19±0.61	39.85±0.65	26.56±1.11	71.64±0.96
		Wither	30.50±0.79^{b}	37.54±1.02	22.46±1.48^{ab}	64.11±2.16^{b}
		Chest	30.55±1.06^{b}	38.77±0.77	20.24±1.54^{b}	69.54±1.36^{a}
		Rump	32.75±0.99^{a}	36.80±0.79	24.31±1.43^{a}	68.29±1.57^{a}
P						
Age			n.s.	n.s.	n.s.	n.s.
Sex			***	***	***	***
Body region			*	n.s.	*	**

***: P < 0.001; **: P < 0.01; *: P < 0.05; n.s. (non-significant); a,b: a-c: means within a column with different letters are significantly different (p<0.05)

CONCLUSION

The fibre diameter mean value of Bafra breed fleece was lower than some indigenous breeds (Morkaraman, Awassi, Karagül), similar to Acıpayam race, and its higher than indigenous breeds (Akkaraman, Dağlıç, Imroz, Hamdani, Norduz). The fibre proportion mean value was lower than Dağlıç breed and higher than many indigenous breeds (Akkaraman, Anatolian Merino, Norduz and Karakaş). *According to the research results，* compared to other Turkey indigenous sheep breeds, we concluded that the fleece of Bafra breed has a moderate quality in terms of fibre diameter and it is well quality in terms of fibre proportion. By making selection studies in the Bafra race, high-quality wool (fibre diameter 30 μm and below) herds can be created that can be used in the fabric industry. Since Bafra is a breed known for its high fertility and meat quality traits, it is possible to investigate the development opportunities of meat-fleece combined type genotype in the breed.

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INFLUENCE OF AGROCLIMATIC CONDITIONS OF THE SOUTHERN UKRAINE ON THE GENERAL PHYTOSANITARY STATE OF THE MAJOR FARM CROPS

GALINA BALAN

Candidate of Agricultural Sciences, Associate Professor of Plant Protection, Genetics, and Breeding,

Odessa State Agrarian University, 13 Panteleymonovskaya Str., Odessa, 65012, Ukraine

fitoizr@gmail.com

Abstract

The analysis of the phytosanitary state of the main agricultural crops cultivated in the southern steppe of Ukraine was carried out. The main diseases were determined and the species composition of pathogens was clarified. The extent and development of the pathogens in the field against the natural infectious background was assessed. The dominant species were identified. The contributing factors to the development and spread of diseases were analyzed.

Keywords: sunflower, soybean, pea, corn, cereals, diseases, pathogens, species composition, extent and development degree.

Introduction

Ukraine is one of the leading European countries in the cultivation and export of agricultural products. Important crops are legumes, sunflower, and corn. The leading place among the measures aimed at achieving the potential yield of agricultural crops belongs to the integrated system of protection against a number of diseases and pests. This system is based on the operative analysis of the phytosanitary condition of crops to timely implement the necessary protection measures. It is essential to annually monitor the spread and intensity of major diseases. The species composition of pathogens and their ratio is constantly changing due to different genetic resistance of varieties against pathogens, climatic conditions, and increased imports of soybean seeds, which is a real prerequisite for the import of a number of dangerous quarantine pathogens. Among the crops grown in Ukraine, sunflower, corn, and legumes are gaining importance. A characteristic feature of the agricultural development in recent years is non-compliance with the crop processing technologies, reducing the use of pesticides, and violation of agricultural culture. This leads to changes in the ecological state not only for the cultivated plants, but also for pests, and negatively affects the phytosanitary processes in agrocenoses. In addition, the phytosanitary situation is complicated in terms of the global warming, leading to mass reproduction of pests and some mycopathogens.

Sunflower is an important export crop for Ukraine, which is widely used in the food industry and other sectors of the economy. With rational cultivation technologies and favorable agro-climatic conditions, the yield of sunflower reaches 30 dt/ha. Sunflower yields are significantly affected by such negative factors as the development of diseases, pests, and weeds. At the present stage of production, the average yield of sunflower is at the level of 20-22 dt/ha. This is due to the sowing of insufficient quality seed material, non-compliance with the cultivation technologies, different genetic resistance of varieties to phytopathogens, climatic conditions, etc. [1, 2].

Soybeans rank first in the world among the legumes. It is sown in more than 40 countries on an area of 42 million hectares. In the future, Ukraine plans to sow 2 million hectares with this crop. Soybean oil is one of the major oils in the world production of vegetable oils. It is used in the food, textile, and chemical industries. Though the cake and meal are more valuable than oil. The infectious diseases that affect the vegetative plants and beans have a significant negative impact on the plants and soybean yields [1, 3].

Pea is an important legume, the grain of which is an integral part of human nutrition, as well as the feed for farm animals. From the agrotechnical perspective, the pea improves the fertility of the soil, and it is especially important in case of short supply organic and mineral fertilizers. In the range of legumes for gross grain harvest, peas occupy up to 25 %. The potential yield of the modern varieties of peas in Ukraine is 3,0-5,5 t/ha, but it is limited by the development of harmful organisms [1, 4].

Corn is an ancient bread plant that the Old World learned about relatively recently—only about 500 years ago. For Ukraine, corn is an important fodder crop as well. Due to it, the food industry and animal husbandry are provided with plant products for fresh use and processing, with the concentrated feed, silage, and green mass. The fulfillment of the potential productivity of corn is often limited by the development of infectious diseases. The diseases are detected and develop in corn not only during the growing season of plants, but also during the storage of cobs and grains. The degree of plant damage and harmfulness of the diseases depend on the biological characteristics of pathogens, hybrid composition, weather conditions, agricultural techniques, as well as the protection measures used [1, 5].

An important stage that allows to achieve the potential yield of crops is a comprehensive system of protection against diseases, pests, and weeds as well the timely implementation of the necessary measures. The timeliness of protective measures is based on rapid information on the phytosanitary condition of crops. The analysis of the phytosanitary condition allows to determine the species composition of pathogens, the prevalence and intensity of disease in the dynamics. Depending on the varietal composition of plants and agro-climatic conditions of a particular growing season, the epiphytothiological indicators of diseases change, and some of them may become very dangerous and become widespread [2, 3, 4, 5].

In Ukraine, various varieties and hybrids of **sunflower** of domestic and foreign production, different groups of maturity, different groups of resistance to herbicides are grown. Under favorable weather conditions and with a proper agricultural background, the sunflower yield can reach over 30 dt/ha. But in the absence of crop rotations and agronomic measures, with lack of funds for mineral fertilizers and chemicals for crop treatment against pests, the yields are significantly lower. An important reason for the decline in yield of sunflower in the areas of cultivation is the spreading dangerous diseases such as white (*Whetzelinia sclerotiorum (dBy) Korf. et Dumont*.) and gray *(Botrytis cinerea Fr*.) rot, downy mildew (*Plasmopara helianthi Novot. f. Helianthi Nova*), rust (*Puccinia helianthi Schw*.), verticillium (*Verticillium dahlia Kleb*.), and broomrape (*Orobanche Cumana Wallr*.). Septoria blight (*Septoria helianthi et Keel*.), alternaria blight (*Alternaria Nees*), phoma rot (*Phoma helianthi Aleks*.) as well as viral and mycoplasma diseases also occur. By 2002, a special issue in the internal and external quarantine in Ukraine was the phomopsys blight (*Phomopsis helianthi)* or dark gray stem blight which significantly impacted the sunflower [2].

In corn, one of the most harmful diseases found almost everywhere was the boil smut (*Ustilago zeae Unger*). Perhaps the most harmful is head smut (*Sorosporium reilianum McApl.f*). Sugar varieties and hybrids of corn are very susceptible to rust (*Puccinia sorghi Schw*.). The plants grown from seeds affected by cephalosporosis or blackening of vascular bundles (*Cephalosporium acremonium Cda*) do not bear fruit. The white-yellow striped spot, or sclerosporosis (*Sclerospora maydis Butler*) can cause a reduction in green mass and seeds by up to 10 %. Under the conditions of excessive moisture and elevated temperatures, especially in the late crops of corn brown spot, or helminthosporiosis (*Dlechslera turcica*) develops. The affected and infected seed remains become the sources of dry rot (*Diplodia zeae Lev*.). The fungus can stay in the remains of plants in the soil for 3-4 years. Delayed harvesting of corn causes the development of dry rot on the cobs. Very common are stem and root rot, Fusarium blight (*Fusarium gen. fungi*), charcoal rot (*Sclerotium batoticola Taub*.), white rot (*Whetzelinia sclerotinia*), and bacterial stem rot (*bacteria Pseudomonas holci*

Kendr., Erwinia carotovora pv. Carotovora Bergey et al. i Erwinia dissolvens Beorkh.). During ripening and storage, the following diseases of cobs and seeds spread: Fusarium blight (*Fusarium Lsnk*), minute leaf and grain spot (*Nigrospora oryzae Petch*), red rot (*Fusarium graminearum Schwabe*), gray mold (*Rhizopus maydis*), ear bacteriosis disease (*Bacillus merentericus*), cobs and grain mold (gray-green mold, dark mold, pink mold). In addition to these bacterial diseases, there are bacterial stem rot and heads bacteriosis, known bacterial spot (*Pseudomonas syringae pv. syringae Young et al*.), bacterial leaf mottling (*Corynebacterium michiganse pv. nedraskense Young et al*.), and bacterial wilt of maize (*Erwinia stewartii (Smith) Dye (Aplanobacter stewartii Mc.Cull.).* The latter is a quarantine object for Ukraine. Eight viral diseases of corn have been registered, most of which are common in tropical and subtropical regions. In Ukraine, only three viral diseases of corn were detected—the Siberian oats mosaic virus, the maize streak virus, and the dwarf mosaic virus (maize and sorghum redstripe virus). Among the infectious diseases of corn, the most harmful are volatile and vesicular smut, root and stem rot, and Fusarium head blight. Selection of self-pollinated lines and hybrids varieties resistant to these pathogens is the most cost-effective and environmentally safe way to combat these diseases [5, 6].

Peas and soybeans are badly damaged by pests, diseases, and weeds. In Ukraine, the potential loss of legumes from pests is about 10 million tons or 20 % of the gross grain harvest. This convincingly shows that even partial loss prevention is an important factor in increasing the productivity of legumes. The study of the phytosanitary condition of the soybean and pea crops is an extremely important task to increase their yield. To do this, it is necessary to conduct annual monitoring to identify and determine the number of major pests and diseases.

The pathogenic microflora of soybeans of the Southern Steppe of Ukraine consists mainly of the pathogens of fungal diseases, as climatic conditions, high temperature, and minimum humidity contribute to their mass spread and development. The most dangerous and common soybean disease is Fusarium blight (Fusarium oxysporum). Every year, soybean crops are increasingly affected by this disease. This is facilitated by non-compliance with crop rotation, abiotic factors, in particular early sowing in poorly aerated soil, which leads to the accumulation of soil infection and seedling death rate of up to 40 %. Since 2002, new soybean diseases have been diagnosed in the Odessa region—ash rot (*Macrophomina phaseolina (Tassi.) Goid*.) and phomopsis blight (*Diaporthe phaseolorum (Cke. et Ell) Sacc. Var. Sojae Wehm.)*. In 2002–2004, ash rot occurred only on single plants, but in the subsequent years it spread, especially during drought years, causing a crop failure of up to 20–35 %. Quite common in crops culture is anthracnose (*Colletotrichum dematium (Pers. ex Fr.) Grov var. Truncatum (Schw.) Arx*), ascochita leaf blight (*Ascochyta phaseolorum Sacc*.), false mildew (*Peronospora manshurica (Naum.) Syd*.), Septoria blight (*Septoria glycines T. Hemm*.), and verticillium (*Verticillum dahliae Kleb.*). Less common bacterial diseases of soybeans include angular (*Pseudomonas glycinea* Coerper) and pustule chocolate spot (*Xanthomonas phaseoli* var. *sojense* (Hedges) Starr et Burkh), and the viral diseases such as rugose (*Soja virus 1* Smith.) and yellow mosaic (*Phaseolus virus 2* Smith.) [4, 5, 7].

Fungal diseases of peas are very diverse. The most common of these are Fusarium blight. Fusarium blight of seeds, shoots, and young plants (*Fusarium gibbosum Appel et Wr*.). Fusarium blight of leaves (*Fusarium ssp*.). Fusarium blight of root system (*Fusarium ssp*.). Fusarium-related wilting of plants (*Fusarium oxysporum (Schl.) Snyd. et Hans*.). Fusarium blight of beans and seeds (caused byt *Fusarium* ssp.). Anthracnose (caused by *Colletotrichum dematium (Pers. et Fr.) Grov*. Truncatum (Spcw.) Arx.). Ascochytosis (caused by *Ascochyta phaseolorum Sacc. of Sphaeropsidales order*), the false powdery mildew or downy mildew (*Peronospora manshurica (Naum.) Syd. of Peronosporales order. Septoria* blight, or rusty spot (caused by *Septoria glycines T.*Hemm), verticillium (caused by *Verticillum dahliae* Kleb.). The bacterial diseases of peas are chocolate angular spot (caused by bacterium *Pseudomonas glycinea Coerper*), pustular spot (caused by *Xanthomonas phaseoli*, var. sojense (Hedges) Starr et Burkh.) [4, 5, 7].

Methodology

Aim. To analyze the phytosanitary condition of the main crops grown in the Southern Steppe of Ukraine. Determine the species composition of the pathogens, the degree of their spread and development, the dominant species, and the factors that contribute to the spread of diseases.

Materials and methods. The analysis of phytosanitary condition of soybeans and sunflowers was carried out during 2012-2019 in the field conditions of the experimental base of the Breeding and Genetic Institute, National Center for Seed Science and Variety Research of NAAS (SGI—NC NA) "Dachna" (Bilyaiv rayon, Odessa oblast). Analysis of the phytosanitary status of corn and peas for 2018-2019 was conducted in farms of Odessa oblast; the laboratory study was conducted by the Department of entomology and plant pathology of Plant Breeding and Genetics Institute and by the Department of Protection, Genetics, and Plant breeding of Agro-biotechnology Faculty of OSAU.

Agroclimatic conditions of the southern steppe of Ukraine are quite favorable for the growth and development and seed production of sunflower, soybean, pea, and corn. The experimental plots were located on a typical plain relief on the southern and ordinary chernozems. The climate is mostly warm and arid. The average annual temperature ranged from 4 to 7.7 °C. The frost-free period lasts from 170 to 210 days. The annual precipitation is 350–460 mm. The natural conditions are favorable for the development and spread of major diseases of crops, especially fungi. For the development of diseases, of great importance were the meteorological conditions during the growing season. The growing seasons (April to August) of the years of observations in the southern steppe of Ukraine were characterized by sharp temperature drops, lack of precipitation in spring, and high temperatures in summer.

The material of the study were 23 varieties and hybrids of sunflower, 35 variety samples of soy of foreign and domestic breeding from the collection of Plant Breeding and Genetics Institute, National Center of Seed Breeding of NAAS, 2 hybrids of peas, and 2 hybrids of corn from the working farms in area. The resistance of samples to the disease was evaluated on the natural infectious background. For the accumulation of soil infection, the constant crops in the fields with plant residues were used. The affection of plant disease was determined visually by conventional techniques of field experiments. During the phytopathological assessment the external visual observation with a microscope and the biological analysis were used. The visual examination revealed spots and pathological changes in organs and tissues without fungi sporification. The analysis of affected tissues was performed using anatomical method with sections of necrotic tissue and study under a binocular microscope (x2, x4) and a monocular microscope (x20, x40). This material was selected for further study using a biological method, which allowed to detect internal infection in the plant material and isolate it as a pure culture. The affected tissue was incubated for 3–8 days on a nutrient base in a moist chamber. The sunflower disease agents were determined by the spores detected. Based on the obtained results, the prevalence and intensity of sunflower disease were calculated according to the generally accepted methods [6, 7, 8, 9, 10].

Since each crop is affected by many diseases, many of which have similar symptoms, in order to avoid the recurrence of common features of similar diseases, they were considered by type of lesion [8, 9, 10, 11].

The results of research

While analyzing the degree of damage to sunflower, corn, soybean, and pea by pathogens, it should be borne in mind that the research took place in typical soils in the climatic conditions of the southern Ukraine, namely—Odessa region, characterized by deep groundwater and hot, dry summers. Among the diagnosed pathogens, fungi predominate, because even a certain minimum of moisture in the soil contributes to their active development and accumulation in the soil. The species composition of pathogens is constantly changing, which is due to a number of reasons, such as the genetic resistance of the variety to pathogens, the agro-climatic conditions of cultivation, and the pest damage. The main indicators of phytosanitary condition of sunflower, corn, soybeans, and peas are shown in Figures 1–4.

I. PHYTOSANITARY STATE OF SUNFLOWER UNDER THE CONDITIONS OF THE SOUTH OF UKRAINE

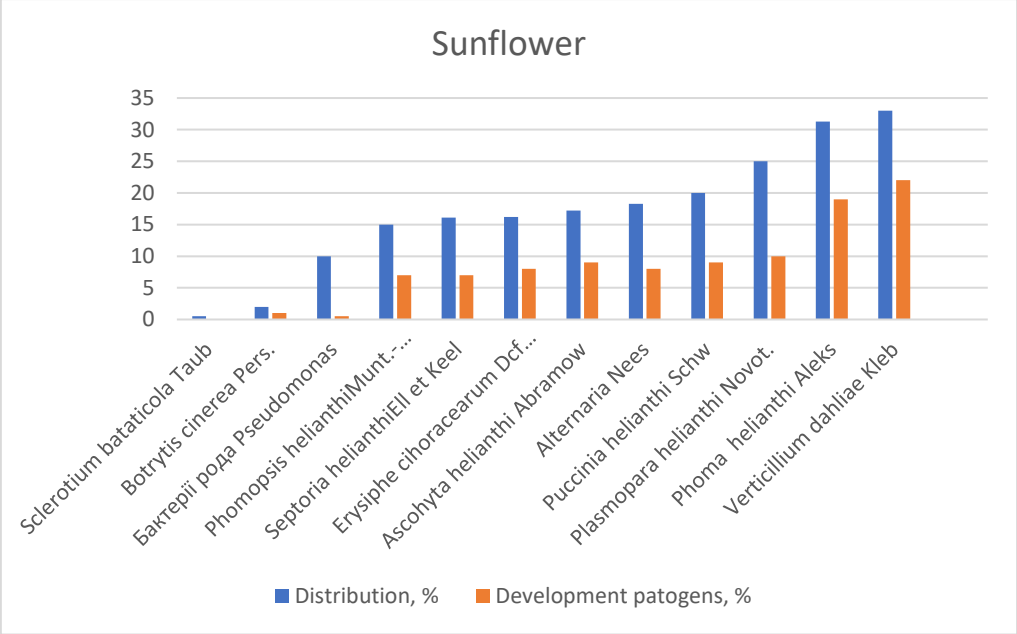

Fig. 1. Distribution and Development of Sunflower Diseases, %

As a result of the analysis of the phytosanitary state of the sunflower agrocenoses, the species composition of sunflower pathogens under the conditions of the Black Sea Steppe of Ukraine has been established. Eleven pathogens, mainly of fungal origin, have been diagnosed. During the growing season, leaf spot, phoma rot, phomopsys blight, alternaria blight, ascochita blight, and septoria blight was detected; in adult plants in the flowering and filling phase—gray rot, powdery and false mildew, and rust were detected. The development of tracheomycosis—verticillium wilt—was observed everywhere with some bacterial wilt. In the sunflower agrocenoses, the most common were the representatives of mycoflora:

Phoma helianthi Aleks, Verticillium dahliae Kleb. At the average level, the saprophytic microflora: *Ascohyta helianthi Abramow, Alternaria Nees, Septoria helianthiEll et Keel*. In few instances—*Erysiphe cihoracearum Dcf helian, Plasmopara helianthi Novot, Puccinia helianthi Schw, Phomopsis helianthi Munt.-Cwet.* Bacteria of the genus *Pseudomonas* and the basket form of *Botrytis cinerea Pers* were diagnosed in single cases.

I. PHYTOSANITARY STATE OF SOYBEAN UNDER THE CONDITIONS OF SOUTH OF UKRAINE

The analysis of phytosanitary state of soybeans under the conditions of the south of Ukraine is given in Figure 2.

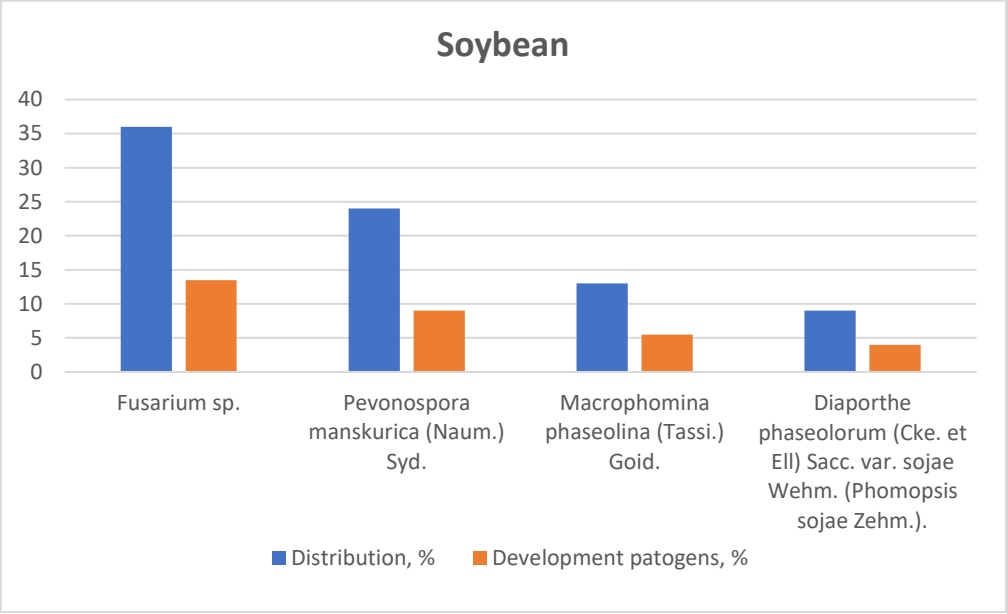

Fig. 2. Prevalence and Development of Soybean Diseases, %

While analyzing the phytosanitary state of the soybean varieties in the southern steppe of Ukraine, we determined the species composition of pathogens of their diseases. 4 main pathogens, mostly of fungal origin were diagnosed. The most common disease was Fusarium blight in young crops, the least developed was phomopsis blight. Fusarium blight of seedlings and root rot (caused by *Fusarium sp*.) were found on the sprouts with the average spread of the disease of 36.0 % at the development of 13.5 %, the maximum reached 68.8 % of the spread. False powdery mildew was diagnosed on plants in the flowering phase (peronosporosis caused by *Peronospora manskurica (Naum.)*), which affected 24.0 % of plants with the development of 9.0 %. In the ripening phase of beans, ash rot (caused by *Macrophomina phaseolina (Tassi.)*

Goid) was determined at the level of 13.0 % with prevalence with a development of 5.5 %. On the formed beans, phomopsis (stem and bean burns) (caused by *Diaporthe phaseolorum (Cke. et Ell) Sacc. var. sojae Wehm. (conidial stage Phomopsis sojae Zehm.)* was determined, which affected 9.0 % of plants with the development of 4.0 %.

III. PHYTOSANITARY STATE OF CORN UNDER THE CONDITIONS OF THE SOUTH OF UKRAINE

The analysis of phytosanitary state of corn under the conditions of the south of Ukraine is given in.

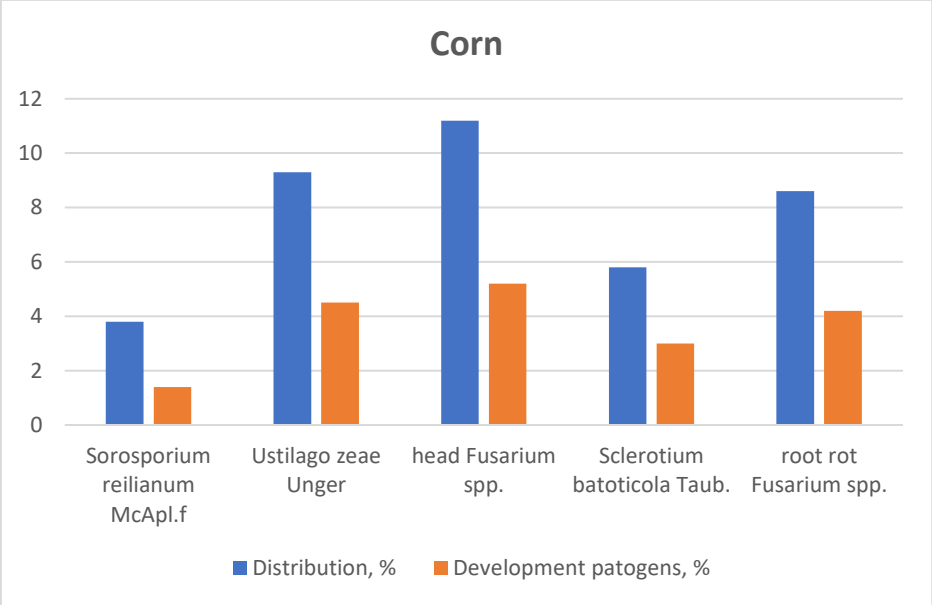

Fig. 3. Prevalence and Development of Corn Diseases, %

The main diseases identified in corn were volatile and vesicular smut on heads, which turned them into a black mass of teliospores. Their prevalence was 3.8–6.9 % of volatile smut and 9.3–10.2 % of vesicular smut. Fusarium head blight was detected in 11.2–12.6 % of cases. Stem rot (charcoal rot) was observed in 5.8– 8.1 % of plants, root rot (fusarium rot) in 8.6–13.8 % of plants. In the table, it is clear that “Kremen 200SV” hybrid is more susceptible to all common diseases than “Odeskiy 346MV” hybrid.

IV. PHYTOSANITARY STATE OF PEA UNDER THE CONDITIONS OF SOUTH OF UKRAINE

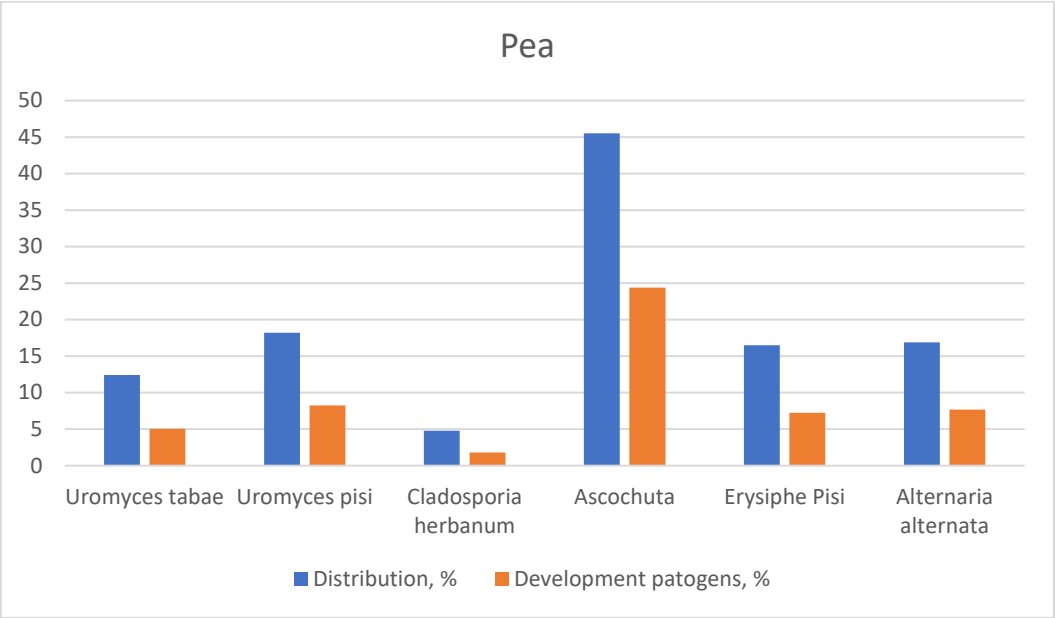

Fig. 4. Prevalence and Development of Pea Diseases, %

Summarizing the research data of 2018–2019, we can identify the trends in the spread and development of diseases. Comparing the varieties "Intensivny 92" and "Pelushka", we can conclude that there are no differences in the species composition of the diseases: 6 pathogens were identified, mainly of fungal origin. On both varieties during the study, massively development of ascochitosis (45.5–55.4 %) was observed with the extent of 24.4–28.65 %.

At the average level of prevalence was the pea rust (18.2–21.2 %) with the development of 8.25–9.9 %. Powdery mildew had a distribution of 16.5–21.55 % with the development of 7.25–9.6 %. Alternaria was observed in 16,9–18,9 % of samples with the development of 7,7–7,95 %. Legume rust was observed in 12.4–11.35 % of samples with the development of 5.05–4.8 %.

The lowest development was in olive mold (4.8 %) with the development of 1.8–1.95 %.

Comparing the varieties with each other, we observe a tendency to higher development of diseases in the variety "Pelushka" than in the variety "Intensivny 92". Comparing the prevalence of ascochitosis in the varieties, we observe a lower rate in the variety "Intensivny 92" (45.5 %) than in the variety "Pelushka" (55.4 %). The development, respectively, was 24.4 % in "Intensivny 92" and 28.7 % in "Pelushka".

Conclusions

The pathogenic microflora of the southern steppe of Ukraine consists mainly of the pathogens of fungal diseases, as climatic conditions, high temperature, and minimum humidity contribute to their mass spread and development. The most common in the **sunflower agrocenoses** were phoma rot (*Phoma helianthi Aleks*), verticillium (Verticillium dahliae Kleb), ascochita blight (*Ascohyta helianthi Abramow*), alternaria blight (*Alternaria Nees*), Septoria blight (*Septoria helianthi et Keel.*), also there were mildew (*Erysiphe cihoracearum Dcf helian*), false mildew (Plasmopara helianthi Novot), rust (*Puccinia helianthi Schw*), and

phomopsis blight (*Phomopsis helianthi Munt.-Cwet*). Bacteria of the genus Pseudomonas and the basket form of Botrytis cinerea Pers were diagnosed in single cases.

In the soybean agrocenoses, there were diagnosed 4 pathogens, mainly of fungal origin: fusarium germination and root rot (*Fusarium* sp.), downy dew (*Pevonospora manskurica* (Naum.)), ash rot (*Macrophomina phaseolina* (Tassi.) Goid), phomopsys (burns of stems and beans) (*Diaporthe phaseolorum (Cke. et Ell) Sacc. var. sojae Wehm. (conidial stage Rhomopsis sojae Zehm*.).

In the corn agrocenoses, there were identified five pathogens, mainly of fungal etiology such as: fusarium head blight (fungi of the genus *Fusarium*), boil smut (*Ustilago zeae Unger*), root rot (fungi of the genus *Fusarium*), stem rot (*Sclerotium batoticola Taub*.), and volatile smut (*Sorosporium reilianum McApl.).*

In the pea agrocenoses, there were identified ascochita leaf blight (*Ascochyta phaseolorum Sacc*.), pea rust (*Uromyces pisi*), powdery mildew (*Erysiphe pisi*), alternaria blight (*Alternaria alternata*), bean rust (*Uromyces fabae*), and olive mold (*Cladosporia herbanum).*

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THE EFFECT OF FEEDING BEES ON THEIR VIABILITY AND EGG LAYING BY THE QUEEN BEES

K. Khamid, A. Kitaeva, T. Pushkar

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Odesa State Agrarian University
Mykolaiv National Agrarian University

The peculiarities of formation of productive qualities of bee families of Carpathian and Ukrainian steppe breeds under different conditions of wintering and use of honey plants, as well as different composition of fodder during autumn and spring feeding are established. It is proved that the productivity of bees and the quality of honey is positively affected by feeding them honey candy with the addition of quail eggs and sugar syrup with the addition of citric acid and a suspension of microalgae "Live Chlorella".
Keywords: bees, feeding, development, stimulation, queen bee

Introduction. The productivity and survival of the bee family is influenced by such factors as: external - climate, weather, pathogens, enemies and pests of bees, human economic activity (including the use of pesticides, herbicides) and internal - the bee family, its strength, breed, line.

According to Bogdanov A.V. [1], Verigina I.P. [2], Papchenko O.V. [3] and others, increasing the number of bees in the family in the spring is extremely important in preparing it for pollination, use productive honey harvests, rebuilding of honeycombs, creation of large fodder stocks for the period of unfavorable weather in summer and winter, as well as in autumn for raising young bees, which will have to winter and raise several generations of bees in the spring of next year.

The growth of young bees for the winter depends on how intensively and for how long the queen bees will lay eggs during August and September. Derived from them bees retain the highest viability, they die a little in winter. After a cleaning flight in the spring, they can raise young bees, which gives impetus to prepare the family for the spring honey harvest [4, 5].

Increasing the number of bees in the family in the spring is extremely important in preparing it for pollination, the use of productive honey harvests, rebuilding hives, creating large forage reserves for adverse weather in summer and winter, as well as in autumn to increase young bees, which will have to winter and grow several generations of bees in the spring of next year [2, 3, 5].

The strength and development of bee colonies in the spring, especially those that weakened after the winter, is not sufficient for the effective use of the first honey harvest in Ukraine. One of the ways to effectively stimulate bee colonies to development is the use of carbohydrate and protein fertilizers. Therefore, the aim of the work was to study the development of bee colonies in the spring and summer with the use of top dressing.

Materials and methods. Materials were obtained as a result of observations and research conducted in 2014 - 2018 in the homestead apiaries of Mykolaiv, Odessa, Vinnytsia regions, as well as in the laboratory of technological and special measures for the prevention of bee diseases at the NSC "Institute of Beekeeping. P.I. Prokopovych "in Kyiv. The object of research were bee families of Ukrainian steppe and Carpathian breeds of bees. The priority in the research was the development of reliable technology through different types of feeding, improving the productive qualities of bee families of different breeds.

For the study, experimental and control groups of bees were formed by the method of selection of analogous families, identical in breed, age of the uterus, method of keeping, use of honey base. The peculiarities of the reproductive function of queen bees, the development of bee colonies after wintering and their productivity were determined, a comparative assessment was made during the period of egg laying by bee queens and brood rearing, development and productivity of bee colonies by different methods of their feeding.

To determine the effectiveness of different types of feeding bees were formed into four groups of families (table 1).

Table 1

Scheme of spring stimulating feeding of bees

Groups	Feeding composition
I – control	Sugar syrup (70%) (1 liter of water + 2 kg of sugar)
II – experimental	Sugar syrup (70%) with the addition of 2 g of citric acid
III – experimental	Honey candy with the addition of quail eggs (1 kg of honey dough + 3 quail eggs)
IV – experimental	Sugar syrup (70%) with the addition of a suspension of microalgae "Live Chlorella" (750 ml of syrup + 250 ml of suspension)

Group I - control, family care was carried out according to standard methods. After wintering, bee colonies were inspected, fed, and nests replenished by adding light honeycomb or light brown honeycombs.

Group II - experimental. Citric acid was added to sugar syrup, which consisted of one part water and two parts finely ground sugar).

Group III - experimental. Quail eggs were added to the honey dough at the rate of 3 eggs per 1 kg of dough.

Group IV - experimental. Sugar syrup with a suspension of microalgae "Live Chlorella" was served through a drink at the rate of 1 liter of suspension per family. Feeding of bees took place through drinking troughs.

Sugar syrup was given to bee colonies in the form of syrup in liter jars with special lids-feeders. Honey candy with quail eggs was made by hand, mixing in a bowl until a homogeneous mass of pleasant aroma and color. Bee colonies were given in the form of pancakes in gauze.

Research results. An important role in assessing bee colonies is an indicator of their winter hardiness. For the development of profitable beekeeping in the south of Ukraine, importance is attached to the study of winter hardiness of bee colonies, as their preservation in the winter depends on the spring development and productivity of the apiary. Therefore, we set ourselves the task of preparing only strong bee families for the winter. To do this, in late September and early October, increased in the experiment of young bees, through the use of different types of feeding. The survival of bees in winter depends on the hereditary characteristics of the bee family, its health, autumn bee growth, feed quality, breed and other factors. Studies have shown that both breeds have good indicators of survival after winter. Some differences were that Carpathian bees overwintered better in the winter, and Ukrainian steppe - in the wild.

According to results of the carried-out researches on winter hardiness of bees it is visible that at wintering in the Mykolaiv area of bee families of Carpathian breed on freedom at top-dressing with sugar syrup safety decreased by 10% on indicators of two years. When using quail eggs, the

preservation of both in the winter and in the wild had no significant differences, except for wintering in the wild in the period 2015-2016. The decrease in the survival of bee colonies in the wild during this period was 10% compared to the survival in the winter. Feeding bees with citric acid, contributed to their increased preservation in the wintering area by 10%.

In the Odessa region wintering of bees of Ukrainian steppe breed in the wild and wintering and feeding with sugar syrup and candy with quail eggs, the difference in their safety was not observed, and when using citric acid, the safety of bees in wintering was less by 10% in 2014- 2016

Also analyzing the data of wintering of bee families of Ukrainian breed in the wild and in the wintering ground on the first apiary, their safety was different. Thus, when kept in the wild and fed with sugar syrup, the preservation of bees in the wild is less than in the wintering area by 10% during the experimental periods. When fed quail eggs, the safety of bees kept free in the period 2014-2015 was the same, and in the period 2015-2017 was lower by 10%. When fed with citric acid, the survival of bees during the winter in the wild in 2014-2016 was lower by 10% compared to the winter in the winter. In the period 2016-2017, no significant differences in the preservation of bees depending on wintering conditions were observed.

In the second apiary, the difference in the conservation of bees in the wild for the period 2015-2016 was smaller by 10% compared to wintering in the winter. When feeding quail eggs, the difference was not observed. When fed with citric acid, the survival of bees in the wild by periods was lower by 10% compared with the content of bees in wintering grounds.

Regarding Vinnytsia region, the data show that the survival of bee families of the Carpathian breed in the winter of 2014-2015 was better when fed quail eggs and prevailed by 10% safety when fed sugar syrup and 5% when fed citric acid. A similar result was obtained during the winter of 2016-2017. The preservation of bee colonies was the same as the feeding of quail eggs and citric acid and the safety of bees feeding with sugar syrup prevailed by 5 - 10%.

Thus, for the better preservation of bee colonies, according to the results of research, there was feeding honey dough with quail eggs.

It was also established that the environmental conditions and feeding contributed to the largest number of breeding bees of the Carpathian breed with queens of the second year per family in the Mykolaiv region by 2506 pieces or 3.17%, and in the Vinnytsia region - by 1288 units or 2.95%.

The results of the studies indicate a different effect of the suspension of microalgae "Live Chlorella" on the productivity of bees. (Table 2-4).

Table 2

Average daily laying of eggs by queen bees of the second year of hatching on apiaries of the Mykolaiv area, (n = 5), piece.

Egg laying period, days of the month	Apiary		The ratio of II to I apiaries, %
	I	II	
	Feeding		
	Ss (70%)	Ss (70%) + Ch	
from 15.04. to 25.04	515±31.3	580±38.7	11,21
from 26.04 to 05.05	830±35.1	980±35.3	15,31
from 06.05 to 15.05	1685±32.9	1730±31.6	2,61
In average	1010±33.1	1096±35.2	9,71

Table 2 shows that for the first decade the average daily egg laying by the queen bees when fed with a suspension of microalgae "Live Chlorella" increases by 11,21%, for the second decade by 15.31%, and for the last study period by 2.61%. On average, the laying of eggs by the queen bees of the Carpathian breed for the studied periods is higher by 9,71%.

Table 3

Average daily laying of eggs by queen bees of the second year of hatching on apiaries of the Odesa area, (n = 5), piece.

Egg laying period, days of the month	Apiary		The ratio of II to I apiaries, %
	I	II	
	Feeding		
	Ss (70%)	Ss (70%) + Ch	
from 15.04. to 25.04	620±30.2	690±39.9	10.15
from 26.04 to 05.05	1100±34.7	1250±35.1	12.00
from 06.05 to 15.05	1910±31.9	2080±30.7	8.18
In average	1210±32.3	1340±35.2	10.11

Table 3 shows that for the first decade the average daily egg laying by the queen bees when fed with a suspension of microalgae "Live Chlorella" increases by 10.15%, for the second decade by 12.00%, and for the last study period by 8.18%. On average, the laying of eggs by the queen bees of the Carpathian breed for the studied periods is higher by 10.11%.

Table 4

Average daily laying of eggs by queen bees of the second year of hatching on apiaries of the Vinnytsia area, (n = 5), piece.

Egg laying period, days of the month	Apiary		The ratio of II to I apiaries, %
	I	II	
	Feeding		
	Ss (70%)	Ss (70%) + Ch	
from 15.04. to 25.04	695±32.6	710±37.9	2.12
from 26.04 to 05.05	1130±36.7	1310±35.4	13.75
from 06.05 to 15.05	1845±33.9	1905±36.1	3.15
In average	1223±34.4	1308±36.5	6.34

From table 4 it is seen that for the first decade the average daily egg laying by the queen bees when fed with a suspension of microalgae "Live Chlorella" increases by 2.12%, for the second decade by 13.75%, and for the last study period by 3.15%. On average, the laying of eggs by the queen bees of the Carpathian breed for the studied periods is higher by 6.34%.

Therefore, we can conclude that feeding bees with sugar syrup with a suspension of microalgae "Live Chlorella" in all studied apiaries on average increases egg laying by the queen

bees by 6.34%. Uteri of the Carpathian breed increase egg laying by an average of 202 pieces. or by 18.3%, Ukrainian steppe - by 230 pieces. or 20.4%

In the spring, bees need to develop normally before the start of the active period. Protein fertilizers are effective in early spring and late summer, especially when there is no pollen bribe and perga stocks in the hive. The absence of a natural bribe of protein feed allowed the queen bees to use a suspension of microalgae "Live Chlorella".

Chlorella contains more than 60% protein, so it served to accumulate protein feed and improve the condition of families after wintering and faster increase in family strength, as well as stimulate accelerated egg laying by queens.

The results of determining the rate of exposure to the suspension of microalgae "Live chlorella" and its effect on the life expectancy of bees are shown in table 4.

Table 4.

Influence of feeding different concentrations of suspension of microalgae "Live chlorella" on life expectancy of bees (beginning of feeding 9.07)

A variant of the experiment	Death of bees on the date of the experiment,%					
	9.07-15.07	16.07-22.07	23.07-29.07	30.07-5.08	6.08-12.08	13.08-19.08
Option 1. Control (keeping bees on the syrup cooked on tap water)	7,39	8,88	24,12 ±2,21	48,3	71,68	87,4
Option 2. Double feeding of the suspension of microalgae "Live Chlorella" in 10% concentration (keeping bees in syrup prepared in tap water)	10,12 ±3,13	11,51 ±3,88	25,6 ±6,86	41,61 ±4,37 *	53,98 ±4,65 *	70,4 ±0,32 **
Option 3. Double feeding of a suspension of microalgae "Live Chlorella" in 5% concentration (keeping bees in syrup prepared in tap water)	12,28 ±3,27	13,59 ±2,01 *	30,58 ±1,71 ***	43,47 ±2,76 ***	57,7 ±4,16 ***	71,94 ±3,50 ***
Option 4. Double feeding of the suspension of microalgae "Live Chlorella" in 1% concentration (keeping bees in syrup prepared in tap water)	5,07 ±1,53	8,79 ±1,38 *	25,4 ±3,35 *	35,72 ±6,38	51,77 ±8,87	64,22 ±11,13
Option 5. Double feeding of the deactivated suspension of microalgae "Live Chlorella" in 5% concentration (keeping bees on the syrup prepared on tap water)	4,18 ±1,12	7,21 ±2,84	26,56 ±6,65	44,04 ±8,24	51,69 ±8,84	64 ±8,17 *

Note. *p>0,95; **p>0,99; ***p>0,999

Live chlorella microalgae suspension contains a wide range of micro-macronutrients, vitamins and a significant amount of protein. Therefore, its introduction into the feed for bee feeding enriches its protein and energy value.

The lifespan of flying bees with such feeding with the content of different concentrations of the suspension of microalgae "Live Chlorella" when kept in separate hives in a thermostat at a temperature of 34-35°C, is different.

The lowest mortality of flying bees was observed when fed with sugar syrup prepared in tap water with the addition of 1% suspension of microalgae "Living Chlorella" compared to higher concentrations in syrup.

Characteristically, the feeding of bees with sugar syrup with the same concentration of the suspension of the microalgae "Living Chlorella" bee mortality increased with increasing duration of the experiment. Thus, double feeding of the suspension of microalgae "Live Chlorella" 1% concentration in sugar syrup prepared on tap water mortality of flying bees increased from 5.07 ± 1.53% in the first 7 days to 64.22 ± 11.13% at the end experiment for 42 days. A similar trend of increasing bee mortality was in the variants of the experiment with a higher concentration of the suspension of microalgae "Live Chlorella". Thus, at the 5% concentration of the suspension of microalgae "Live Chlorella" the increase in mortality was from 12.28 ± 3.27 to 71.94%, and the 10% concentration, respectively, from 10.12 ± 3.13 to 70.4 ± 0.32%.

This increase in the mortality of flying bees probably occurred because the protein - energy - enriched sugar syrup in the first half of the experiment helped to increase the viability of bees through active eating of food. Re-feeding of the same concentration of the suspension of microalgae "Live Chlorella" in sugar syrup led to the accumulation of protein in the body of bees. And since excessive protein nutrition leads to loss of appetite and reduced food intake, the bees began to eat less food without feeling hungry.

They became sluggish, passive, which contributed to the death of more of them. There was a natural selection. Stronger, stronger and more viable individuals survived. The higher mortality of bees was also facilitated by the short duration of the experiment, which was probably insufficient to adapt to the excessive intake of protein substances in their body. Mortality of flying bees was also observed at increased concentrations from 1 to 10% of the suspension of microalgae "Live Chlorella" in sugar syrup when feeding bees.

As a result, the body dies without feeling hungry. At the same time the strongest and viable individuals survive. Lower mortality of bees at feeding of the deactivated suspension of microalgae "Live chlorella" is caused by smaller activity of its components.

Conclusions

1. Preservation of Carpathian bees after wintering in the wild when fed honey candy with the addition of quail eggs averaged 95.85%, sugar syrup with citric acid - 91.85%, sugar syrup - 85.4%, and wintering in the winter - 97.5, 95.85; 90.4% respectively.

2. It is revealed that feeding of bee families of Carpathian breed with suspension of microalgae "Live chlorella" on homestead apiaries increases average daily laying of eggs by a queen bees by 11.1% on average (P> 0,99), in comparison with the Ukrainian steppe breed in the conditions of the Mykolaiv area, in Odesa oblast, in Ukrainian bee steppe breeds, these indicators were 11.3% (P> 0.99), respectively, and in homestead apiaries of Vinnytsia oblast - by 7.1%.

3. The death of flying bees during two feedings of the suspension of microalgae "Live Chlorella" of 1% concentration with sugar syrup increases from 5.07 ± 1.53% to 64.22 ± 11.13% in 42 days, in 5% - from 12.28 ± 3.27% to 71.94%, and 10% - from 10.12 ± 3.13% to 70.4 ± 0.32% (P> 0.999).

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THE EFFECT OF ABSORBENTS AND WATER-SOLUBLE COMPLEX CHELATED FERTILIZERS IN DIFFERENT PLANTING METHODS ON THE DEVELOPMENT OF GRAPE PLANTS IN THE SOUTH OF UKRAINE

E. Khrenovskov, Y. Savchuk

Department of Horticulture, Viticulture, Biology and Chemistry, Agrobiotechnology faculty, Odessa State Agrarian University, Odessa, Ukraine

Abstract The article presents data on the action of absorbents and water-soluble complex fertilizers with microelements in the form of chelates, as well as their interaction on the growth and development of technical grapes in the south of Ukraine. As a result of research, they have been shown to have a positive effect on the development of vegetative mass (increase in length, diameter of shoots and number of leaves), root system and improvement of quantitative and qualitative indicators, if productivity of grape plantations.

Keywords: Grapes, «Maximarin» absorbent, chelate fertilizers «Biochelate» and «Poly-feed», root system, leaf, bunches, harvest.

INTRODUCTION

Grapes are a perennial plant and, accordingly, throughout life grows and bears fruit in one place. Therefore, in order to obtain high and stable yields of grapes, the grapes at each stage of its development must meet all the conditions for plant life.

First of all, the longevity, productivity and profitability of vineyards depends on what measures will be taken when planting vines and the plant's need for environmental factors is met. One of such factors for plant development is nutrient and water regime. In addition, it is very important that water and nutrients (in easily digestible form) are in the soil in the area of the absorbing roots.

Most of the vineyards are located in the south of Ukraine, and one of the important reserves for high yields of grapes here is irrigation, as of all the factors influencing the growth, development and fruiting of grapes, moisture is the limiting in this area. Irrigation improves the conditions for root nutrition of plants and creates the necessary conditions for high plant productivity. [1 ,2]

That is, to create full-fledged vineyards with high productivity and good crop quality, sufficient growth force and longevity of plantations, it is necessary to carry out all work related to planting grapes in a high quality and timely manner.

PURPOSE The purpose of our research is to study both the individual effects of absorbents and in combination with water-soluble complex fertilizers with trace elements in the form of chelates on the survival, growth and development of individual organs of grapes and shrubs as a whole in different ways of planting industrial grapes. conditions of the south of Ukraine.

MATERIALS AND METHODS OF RESEARCH

Field experiments are carried out in "Agro-Koblevo" of the Berezansky region of the

Nikolaev area, Ukraine. The object of research is the grape variety Bastardo Magaratsky, which is grafted on the rootstock Riparia x Rupestris 101-14. The scheme of planting plants 3x1.0 m.

The experiments are carried out according to the following scheme:

Variant 1 - control (soaking the bushes in water and planting them under a water drill); variant 2 - coating the roots with «MaxiMarin» gel and planting them under a hydraulic drill; variant 3 - planting seedlings with two «MaxiMarin» tablets under a hydraulic drill; variant 4 - soaking the seedlings in "Biochelate" and coating the roots with «MaxiMarin» gel and planting them under a hydraulic drill; variant 5 - soaking the seedlings in "Biochelate" and planting them under a hydraulic drill with two «MaxiMarin» tablets; variant 6 - soaking the seedlings in "Poly-feed" and coating the roots with «MaxiMarin» gel and planting them under a hydraulic drill; variant 7 - soaking the seedlings in "Poly-feed" and planting them under a drill with two «MaxiMarin» tablets; variant 8- soaking the seedlings in "Poly-feed" and planting them under a hydraulic drill; variant 9 - soaking the seedlings in "Biochelate" and planting them under a hydraulic drill.

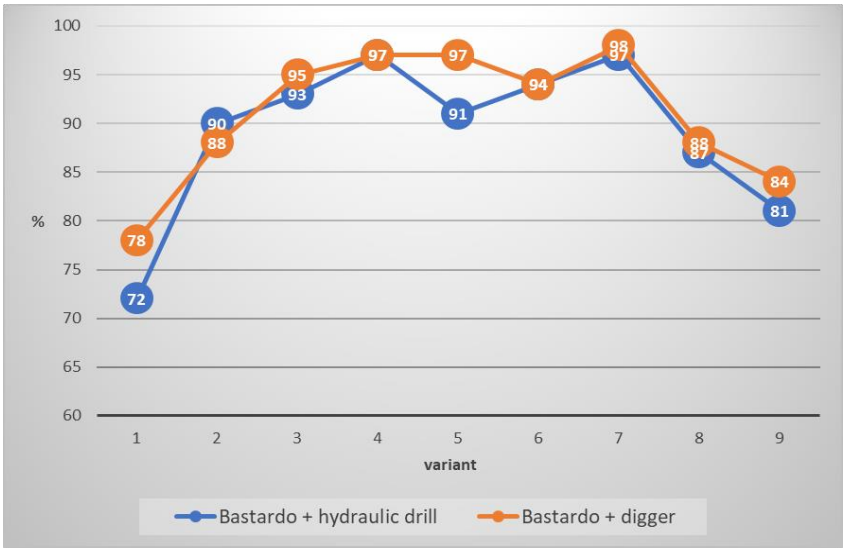
The second experiment is laid down in the same sequence as the first, only the prepared plants were planted under a digger, not under a hydraulic drill, and accordingly left a larger root system.

The research was based on generally accepted research methods in viticulture and the results were processed mathematically using analysis of variance. [3 ,4, 5]

RESULTS AND DISCUSSION

As a result of research, we found that absorbents "MaxiMarin" both in gel form and in tablet form, both in pure form and when used together with water-soluble complex fertilizers with microelements in the form of chelates "Poly-Feed" and "Biochelate" really affects the survival of the grape plant, which confirms the data of graph 1. Namely, due to the retention of moisture and its return to the plant at the right time, which leads to better survival of grapes and improved plant use of micronutrients present in chelated fertilizers.

Thus, analyzing the percentage of survival in the experiment on the variety Bastardo Magaratsky planted under a hydraulic drill, the highest percentage of survival was observed in those variants where we used absorbents in combination with water-soluble complex fertilizers with microelements in the form of chelates and ranged from 91 to 97%. Slightly lower values in the variants with the use of separate absorbents, both in the form of tablets and in the form of gel - 93 and 90%, respectively. Even lower rates in the variants where we separately used water-soluble complex fertilizers with microelements in the form of chelates and were in "Poly-Feed" - 87%, and in "Biochelate" - 81%. The lowest survival rate of 72% was in control.



Graph 1. Survival of grape seedlings

An almost similar situation occurred in the experiment on the variety Bastardo Magaratsky planted under the digger, only here the percentage of survival of grape plants was slightly higher than the experiment on the variety Bastardo Magaratsky planted under the drill.

As for the effect of absorbents "MaxiMarin" and water-soluble complex fertilizers with microelements in the form of chelates "Poly-Feed" and "Biochelate" on the development of biometric indicators of grapes (leaf apparatus, shoot development), there is also a positive effect of these drugs, especially their joint use. Which indicates that satisfying the plant at the right time with moisture and mineral nutrition, in turn, will lead to better growth and development of aboveground organs. Exceedances are quite significant and reliable, as evidenced by statistical calculations (tables 1 and 2).

The root system as well as the leaf is of great importance in plant life. One of its functions is to provide the aboveground part of the bush with water and minerals. Many scientists have proven the participation of the root system in regulating the growth and development of the aboveground part of the bush. In our studies, absorbents and chelating fertilizers had a good effect on the underground part of the vine, in particular on a stronger development of the root system, which in turn led to better drought overcoming the grape plant.

Table 1

Influence of absorbents and water-soluble complex fertilizers with microelements in the form of chelates at planting of saplings under a hydrodrill on biometric indicators of bushes of grapes of the Bastardo Magaratsky grade

Variant	Amount of leaves, pcs.	Leaf blade diameter, cm	Leaf area surface of the bush, cm^2	Shoot length, cm	Diameter of a shoot, cm	Annual growth rate, cm^3
Variant 1.	15,26	5,82	405,42	28,38	0,23	1,17
Variant 2.	17,66	7,78	840,77	46,05	0,41	6,32
Variant 3.	19,13	7,25	788,46	44,32	0,43	6,58
Variant 4.	14,66	7,27	607,02	39,22	0,29	2,64
Variant 5.	20,00	6,44	651,50	38,15	0,38	4,41
Variant 6.	21,13	7,95	1047,67	53,60	0,46	9,16
Variant 7.	16,60	7,09	652,52	40,57	0,36	4,21
Variant 8.	15,60	7,47	679,56	41,83	0,33	3,72
Variant 9.	14,33	6,53	481,99	28,03	0,26	1,51
SSD_{05}			72,60			0,95

*SSD_{05} - The smallest significant difference

Table 2

Influence of absorbents and water-soluble complex fertilizers with microelements in the form of chelates at planting of seedlings under a digger on biometric indicators of bushes of grapes of the Bastardo Magaratsky grade

Variant	Amount of leaves, pcs.	Leaf blade diameter, cm	Leaf area surface of the bush, cm^2	Shoot length, cm	Diameter of a shoot, cm	Annual growth rate, cm^3
Variant 1.	13,00	6,82	476,44	29,54	0,25	1,48
Variant 2.	13,73	7,87	664,28	40,08	0,29	2,76
Variant 3.	13,33	8,24	712,91	43,42	0,34	4,02
Variant 4.	15,53	7,45	674,19	40,39	0,37	4,41
Variant 5.	15,73	7,90	770,13	44,33	0,38	5,03
Variant 6.	17,66	7,60	826,19	48,93	0,44	7,46
Variant 7.	18,93	8,01	956,46	52,60	0,44	8,19
Variant 8.	17,26	6,87	639,36	37,00	0,36	3,88
Variant 9.	14,53	6,62	499,53	27,80	0,28	1,71
SSD_{05}			81,24			0,99

*SSD_{05} - The smallest significant difference

Investigating the development of the root system, carrying out layer-by-layer excavation of the soil, the presence of roots in plants was recorded only at a depth of 40-50 cm in the first year of vegetation (table 3). The roots found were mainly fractions with a diameter of up to 1 mm and were the bulk and a diameter of 1-3 mm, the amount of which ranged from 25 to 48.8% of the total amount of developed roots. The presence of roots with a diameter of 3-5 mm was recorded only in 3 and 6 variants.

The length of the roots in all diameters according to the variants of the experiment differed, it was the largest when using absorbents in both tablet and gel form. The combined use of absorbents with "Poly-Feed" contributed to the elongation of the roots of all fractions

Table 3

Influence of absorbents and water-soluble complex fertilizers with microelements in the form of chelates on the development of the root system of Bastardo Magaratsky grapes

Variant	The diameter of the roots	Number of roots, pcs	Root length, cm
Variant 1	up to 1 mm	13,3	4,9
	1-3 mm	4,6	7,9
	3-5 mm	-	-
Variant 2	up to 1 mm	11	6,6
	1-3 mm	9,3	9,2
	3-5 mm	-	-
Variant 3	up to 1 mm	13	5,1
	1-3 mm	11,3	10,0
	3-5 mm	0,6	7,2
Variant 4	up to 1 mm	11,0	7,2
	1-3 mm	5,3	9,9
	3-5 mm	-	-
Variant 5	up to 1 mm	10,0	6,2
	1-3 mm	8,6	9,9
	3-5 mm	-	-
Variant 6	up to 1 mm	9,6	6,9
	1-3 mm	6	12,6
	3-5 mm	1,6	6,9
Variant 7	up to 1 mm	6,3	5,6
	1-3 mm	6	9,4
	3-5 mm	-	-
Variant 8	up to 1 mm	7,6	7,3
	1-3 mm	8	8,9
	3-5 mm	-	-
Variant 9	up to 1 mm	11	6,7
	1-3 mm	6,5	8,1
	3-5 mm	-	-

The purpose of every agronomist-vine grower is to grow grapes and get the harvest of a given condition, so most of all agricultural techniques, which are used mainly to increase yields, improve crop quality and extend the life of plantations, if they are perennials. Analyzing the impact of these agricultural practices on the quantitative and qualitative indicators of yield, the highest indicators, again, were recorded in the variants using absorbents "MaxiMarin" in combination with water-soluble complex fertilizers with microelements in the form of chelates "Poly-Feed" and "Biochelate" (table 4). The analysis of qualitative indicators of harvest showed that at rather high productivity of grape plantations in our opinion, we received rather qualitative indicators of sugar content and acidity.

Table 4

Influence of absorbents and water-soluble complex fertilizers with microelements in the form of chelates on the yield and quality of Bastardo Magaratsky grapes on average in two years (2014-2015)

Variant	Years of research	Number of clusters, pcs.	Mass of grapes, gr	Yield from the bush, kg	Yield from 1 hectare		Mass concentration	
					tons	%	sugars, g/dm^3	titratable acids, g/dm^3
Variant 1	average	16,9	102,2	1,731	5,77	100,00	192	5,22
Variant 2	average	17,1	128,4	2,190	7,31	126,68	192	4,83
Variant 3	average	16,9	128,5	2,170	7,24	125,47	204	4,77
Variant 4	average	17,5	121,7	2,136	7,11	123,22	183	4,93
Variant 5	average	17,4	143,0	2,497	8,32	144,19	201	4,82
Variant 6	average	17,8	137,4	2,452	8,17	141,59	196	4,83
Variant 7	average	19,1	125,3	2,395	7,98	138,30	205	4,89
Variant 8	average	17,1	118,5	2,025	6,74	116,81	188	5,08
Variant 9	average	15,9	125,9	2,000	6,69	115,94	180	5,40

Thus, the highest yields on average for two years (2014-2015) were observed in the variants where we used absorbents "MaxiMarin" in different forms, both separately and in combination with chelating fertilizers "Biochelat" and "Poly-feed". Thus, the highest rate was observed in the variant with the use of two tablets "MaxiMarin" in combination with chelate fertilizer "Biochelate" and was 8.32 tons per hectare, which significantly exceeds the control, which was 5.77 tons, that is the experimental variant exceeded the control 1.5 times.

The mass concentration of sugars in the juice of berries, on average over two years, ranged from 180 in the variant where we used "Biochelate" and up to 205 g/dm^3 in the variants where we used absorbents, at an acidity of 4.77 to 5.40 g/dm^3, which is considered to be quite good indicators for the conditions of our zone, where we conduct the experiment.

CONCLUSIONS

Thus, based on the above and the data we obtained, we can conclude that the absorbents "MaxiMarin" in different forms of manufacture: gel, tablet, both in pure form and when used together with water-soluble complex fertilizers with microelements in the form of chelates "Poly-Feed" and "Biochelate", due to their properties, really affect the survival, growth and development of grape bushes, root system and quantitative and qualitative yields of grapes of the studied variety Bastardo Magaratsky in industrial conditions in southern Ukraine. In particular, the more intensive development of the root system, which in turn leads to better overcoming of drought by the grape plant.

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EVALUATION OF WORKING QUALITIES OF ORLOV TROTTER BREED HORSES OF DIFFERENT ORIGIN AND RESULTS OF THEIR TESTS IN THE CONDITIONS OF THE BRANCH “ODESSA HIPPODROME” SE ‘HORSE BREEDING OF UKRAINE’

S. Kosenko, V. Cheban, A. Cheban, A. Shulgina

Odessa, Ukraine
Odessa State Agrarian University
Department of Technology of Production and Processing of Livestock Products

Annotation. The current state of the breeding stock of Orlov trotters in Ukraine is studied and analyzed in the work. During the research of selection methods in farms of different forms of ownership it was found that the optimal method of breeding horses is cross lines, and crossing Orlov trotting breed with purebred riding breed does not significantly increase the liveliness and prize precocity of horses. In the Orlov trotter breed, the best indicators of liveliness belong to the offspring obtained as a result of complex inbreeding on such outstanding breeders as Pion, Fagot, Viter, Otklik, Pozyv. The crosses of the lines Barchuk × Pilot, Barchuk × Boltik, Ispolnitelny × Boltik turned out to be the most successful. The predominant number of descendants of class 2.05 was received from the stallions Prikaz (5 heads) and Otklik (4 heads). Promising lines in the reproductive composition of Orlov trotters of Ukraine are the lines of Barchuk, Pion and Pilot. Representatives of the Dibrivsky horse factory are characterized by the best indicators of an exterior.

Over the past 10 years, 7 records of the hippodrome have been set at the Odessa Hippodrome by horses of the Orlov trotter breed, 4 of which belong to the fosterlings of the Zaporizhia Horse Farm. The most progressive in terms of the number of victories in both traditional and ordinary prizes is Barchuk's line, the purposeful work of which has been carried out at the Zaporizhia Horse Plant for many years.

Keywords: horses, Orlov trotter breed, tests.

Introduction. Orlov trotter breed is a unique phenomenon not only for horse breeding in Russia or the CIS countries, but also in the world horse breeding [9]. The originality of selection and testing of horses of this breed, which has more than 200 years of history, has provided a set of valuable hereditary properties that you will not find in other trotters [1, 3]. It is this feature that allows the Orlov trotter breed to remain still popular. However, now the Orlov trotter is not experiencing the best of times. On the one hand, the breed is a symbol of domestic horse breeding, on the other - on the racetrack tests the percentage of Orlov breed is not more than 40, because the representatives of the breed by liveliness, and by precocity are much inferior to other trotter breeds - Russian trotter, American standard-breed and French [4, 7, 8].

The relevance of the topic is to develop a model for predicting possible combinations of domestic Orlov lines in order to improve the working qualities of horses during the tests at the racetrack.

The purpose of the work - by studying the genealogical structure of the Orlov trotter breed to analyze the effectiveness of the main methods of selection in farms and evaluate the main representatives of domestic lines for the quality of offspring.

Materials and methods of research. A database of horses of the Orlov trotting breed, data of primary breeding records, the results of expert evaluation of young animals and racetrack reports were the research materials.

The efficiency of purebred breeding of Orlov trotters along the lines is estimated, the efficiency of crossing of Orlov breed with purebred riding breed and formation of genealogical structure of breed is analyzed. The linear combination on the main selection traits was evaluated by comparing the analogues obtained in the corresponding selections.

According to the Instructions for grading horses [5] according to the results of broods 2017-2019 at the Odessa Hippodrome in the tested horses were determined:

- assessment of type and exterior on a 10-point grading scale;

- assessment of measurements (height at the withers, oblique length of the torso, chest girth, wrist girth);

- assessment of prize performance according to the results of tests at the racetrack during 2017-2019 in accordance with the "Rules of testing breeding horses of trotting, riding and heavy breeds at the racetracks of Ukraine" [6].

Materials of primary breeding records and databases were statistically processed in order to determine promising linear combinations in breeds while improving breeding traits. Biometric processing of quantitative features was carried out in the software environment MS Excel [2].

Results and discussion. According to the State Enterprise "Horse Breeding of Ukraine", as of January 1, 2019, the Orlov trotting breed of horses accounted for 25.2% of the total number of breeding horses. At the beginning of this year, this percentage was 23.5%, namely 424 heads.

Analyzing the genealogical structure of the Orlov trotter breed in Ukraine, we can observe a tendency to the disappearance of the lines of Uspekh, Ulov, Velbot, which 10 years ago were considered numerous. Currently, the most promising lines in the reproduction lineup are the lines of Barchuk, Pion and Pilot. The distribution of the mare composition by genealogical lines is according to the use of breeding stallions. The largest number of breeding mares belongs to the lines of Pilot (27.5%), Pion (23.9%) and Barchuk (19.9%). 8.0% of mares belong to the Ispolnitelny line, and 5.1% each to the Proliv and Boltik lines. Other lines include from 3.3 to 2.2% of mares.

When studying the performance of the offspring of breeding stallions of different lines, it was found that the best liveliness and precocity is inherent in the young of the Barchuk line (Table 1).

*Table1.*Liveliness of young of the Orlov trotter breed in the context of linear affiliation

Line	Average liveliness and the number of offspring		Liveliness of offspring at the age:							
			2 years		3 years		4 years		older age	
			n	min. sec.	n	min. sec.	n	min. sec.	n	min. sec.
of Barchuk	2.09,2 ±0,13	3	30	2.27,5 ±0,36	15	2.17,4 ±0,47	-	-	-	-
of Ispolnitelny	2.08,0 ±0,29	2	34	2.33,1 ±0,24	28	2.24,7 ±0,39	13	2.16,0 ±0,62	5	2.12,2 ±0,29
of Viter	2.07,2	1	7	2.37,0 ±0,73	2	2.17,8 ±0,55	-	-	-	-
of Otboi	2.06,8	1	16	2.38,4 ±0,65	12	2.20,6 ±0,36	8	2.16,3 ±0,57	-	-
of Pion	2.06,6 ±0,18	4	63	2.39,3 ±0,78	37	2.23,7 ±0,28	15	2.20,7 ±0,43	4	2.11,1 ±0,24
of Boltik	2.17,0	1	12	3.03,5 ±0,33	1	2.26,0	-	-	-	-
of Pilot	2.06,1 ±0,24	3	85	2.39,4 ±0,49	52	2.28,5 ±0,43	18	2.17,8 ±0,19	8	2.17,5 ±0,32

According to Table 1, the liveliness of the offspring of the Pion, Ispolnitelny and Boltik lines in older age does not exceed the liveliness of the parents. This is due to the fact that the best working quality young animals are sold abroad, not having time to reveal their own potential at racetracks in Ukraine, which negatively affects the results of selection work in domestic farms.

At the age of two and three, the best indicators of liveliness belong to the young of the Barchuk line, at the age of four to the Ispolnitelny line, and to the older age to the Pion line.

When breeding horses of the Orlov trotting breed of the modern population, special attention is paid to the exterior and expressiveness of the body type. To improve and stabilize these features, it is necessary to take into account the linear combination in the selection of parent pairs.

For this purpose, the linear combinations in the Orlov trotter breed by type and exterior were evaluated. It was found that the best average score for type and exterior had horses belonging to the lines of Voin, Otboi, Barchuk and Pilot, as well as those in which the mother belonged to the line of Viter (average expert assessment of type and exterior - 3 , 64 points) and Ispolnitelny (3.63 points).

Analyzing the linear combinations in terms of liveliness, it was found that the higher efficiency had young animals obtained from crosses of the lines Barchuk ´ Pilot, Barchuk ´ Boltyk, Ispolnitelny ´ Boltyk. Representatives of these selection options had a liveliness from 2.08 to 2.08.8 min. sec. Horses obtained from crosses of the lines Pion × Barchuk, Barchuk × Viter, Viter × Ispolnitelny had the lowest liveliness - from 2.19.0 to 2.22.2 min. sec.

The Barchuk and Ispolnitelny lines were the best in intralinear combinations: the liveliness of two-year-old offspring was 2.30.6 ± 0.67 and 2.31.7 ± 0.97 min. sec. respectively, as well as Pilot and Barchuk for the liveliness of the descendants of three years of age - 2.14.2 ± 1.14 and 2.16.3 ± 0.56min.sec. respectively. Barchuk's line was also the best in the number of descendants of class 2.10: 12.5%. Among the cross lines this indicator is the highest in the combination Ispolnitelny × Viter (23.1%); in the combinations Viter × Pion and Pion× Proliv, this figure is 16.7%.

In the study of the influence on the results of selection of Orlov trotters crossbreeding with purebred riding breed, it was found that at the age of two stallions with the highest proportion of purebred in purebred riding breed (1/8 and 1/16) prevail purebreds in liveliness by 1.3 sec. At the same time, young animals with a proportion of purebred 1/32 is inferior to the liveliness of purebred by 2.0 s, and young animals with a proportion of purebred 1/64 - by 6.0 sec. (P> 0.90) (Table 2):

Table 2

Comparative assessment of exterior and working qualities of breeding stallions of Orlov trotting breed depending on the level of proportion of purebred for purebred riding breed **(**n=56) $\overline{X} \pm S_{\overline{x}}$

Feature	Genetic groups				
		the proportion of purebred by purebred riding breed			
	purebred	1/64	1/32	1/16	1/8
1	*2*	*3*	*4*	*5*	*6*
n	26	4	8	9	9
Liveliness at the age, min.sec: 2 years	2.27,6 ±0,18	2.33,6 ±0,66	2.29,6 ±0,34	2.26,3 ±0,06	2.26,3 ±0,27
3 years	2.13,8 ±0,05	2.14,6 ±0,16	2.15,5 ±0,15	2.12,8 ±0,09	2.12,6 ±0,14
4 years	2.08,5 ±0,05	2.10,9 ±0,16	2.10,9 ±0,21	2.09,9 ±0,08	2.08,6 ±0,09
older age	2.06,3 ±0,06	2.06,7 ±0,01	2.06,8 ±0,09	2.07,5 ±0,13	2.04,8 ±0,07
Number of victories in traditional prizes	5,26 ±0,85	1,50 ±0,50	3,83 ±1,56	5,13 ±1,94	7,00 ±2,24
Number of prize places	11,27 ±1,36	7,00 ±1,96	11,86 ±2,70	14,00 ±1,66	16,78 ±2,97
Height at withers, cm	162,58 ±0,64	162,50 ±2,40	160,25 ±1,26	161,61 ±0,63	160,78 ±1,98
Oblique body length, cm	166,31 ±0,77	165,25 ±2,06	162,50 ±1,18	164,56 ±1,36	164,11 ±1,70
Chest girth, cm	184,92 ±1,04	184,00 ±3,39	179,38 ±1,16	182,67 ±1,43	184,44 ±2,01
Wrist girth, cm	21,14 ±0,20	20,75 ±0,32	20,50 ±0,25	20,83 ±0,19	20,64 ±0,30
Expert type assessment of type and exterior , point.	7,76 ±0,06	7,31 ±0,45	7,73 ±0,25	7,58 ±0,22	7,61 ±0,06

According to Table 2, stallions with a purebred proportion of purebred riding breed 1/8 and 1/16 at the age of three also have the best results of liveliness. Young animals with a purebred proportion of 1/32 are inferior to purebred horses by 1.7 sec. (P <0.90). But already at the age of four the best indicators of liveliness were found in purebred stallions - 2. 08.5 min.sec. and in horses with a proportion of purebred 1/8 - 2.08.6 min.sec. The quietest were again stallions with a proportion of purebred - 1/32 and 1/64.

Among the older stallions, the liveliest were crossbreed with the proportion of purebred for purebred riding breed 1/8 - 2.04.8 min. sec., which is 1.5 sec. higher than the liveliness of purebred stallions (P> 0.95). The lowest rate of liveliness was in stallions with a proportion of purebred 1/16, which was 1.2 sec. inferior to purebred and 2.7 sec. to animals with proportion of purebred 1/8 (P> 0.90).

In terms of the number of victories and prizes in the traditional prizes, stallions with a proportion of purebred 1/8 prevailed, and stallions with a proportion of purebred 1/64 had the worst results. Purebred stallions were inferior to crossbreed with a proportion of purebred 1/8 in the number of first places by 1.74 (P <0.90), prize - by 5.51 (P <0.95).

By all measurements, type and exterior, purebred stallions predominated: at the height at the withers - by 2.33-0.08 cm, oblique body length - 3.81-1.06 cm, chest girth - by 5.54-0,48 cm, wrist girth - by 0.64-0.31 cm, according to expert assessment of type and exterior - by 0.45-0.03 points.

Similar studies have not been performed on breeding mares, as a significant proportion of them have not been tested on the racetrack, so there are no performance indicators that can be assessed.

Thus, it was found that crossing horses of the Orlov trotting breed with purebred riding breed does not significantly increase the liveliness and precocity, while deteriorating the exterior performance - measurements and typicality. At the same time, in the absence of new nurseries and mares, it is possible to infuse blood of purebred riding breed to obtain promising crossbreeds with proportion of purebred 1/8 and 1/16.

As a result of studying the working qualities (liveliness) of trotters of the Orlov breed for the last years it is established that the average liveliness on age groups changes on years. In older horses, this figure improves almost steadily, while the liveliness of young 2-3-year-olds varies depending on the year of testing (Table 3).

Table 3

The average liveliness of Orlov trotters, which were tested at the Odessa Hippodrome during 2017-2019, head

Years of testing	Average liveliness of horses aged:						Trotters of class 2.05 and livelier
	2 years		3 years		4 years and older		
	n	хв., с	n	хв., с	n	хв., с	n
2017	66	2.30,5 ±0,49	48	2.16,8 ±0,19	21	2.11,0 ±0,23	-
2018	74	2.31,3 ±0,36	39	2.18,0 ±0,64	24	2.12,0 ±0,63	-
2019	71	2.32,4 ±0,48	52	2.18,6 ±0,27	25	2.13,3 ±0,44	-

Note: P>0,95

According to Table 3, for the last 3 years at the Odessa Hippodrome no Orlov trotters of class 2.05 were found. In total, for the period of 2009-2019, 183 heads of class 2.10 and 24 heads of class 2.05 and more agile were detected in Ukraine. The largest number of horses of class 2.05 and more agile was received from breeding stallions Prikaz (Karapet-Patoka) - 5 heads and Otklik (Otboy-Conventsia) - 4 heads, as well as from mare Kamenka (Korshun-Kvitochka) - 2 heads.

Table 4 shows the indicators of evaluation of representatives of different lines by the number of victories in the period from 2017 to 2019.

Table 4

The tests effectiveness of the Orlov trotting breed horses of different lines

Line	Number of tested, head	Effectiveness of performances in different age groups							
		2 years		3 years		4 years		older age	
		traditional prizes	ordinary prizes	traditional prizes	ordinary prizes	traditional prizes	ordinary prizes	traditional prizes	ordinary prizes
of Barchuk	112	5	47	9	62	12	75	5	55
of Ispolnitelny	9	2	29	3	34	6	49	3	19
of Viter	45	2	31	6	53	9	61	5	22
of Otboy	39	3	35	5	40	7	53	3	34
of Pion	122	4	51	8	56	10	69	5	41
of Boltik	4	-	17	1	19	1	15	-	-
of Pilot	41	3	38	4	57	6	47	3	33

According to Table 4, the most progressive in terms of the number of victories in both traditional and ordinary prizes is Barchuk's line, purposeful work with which has been conducted for many years in the Zaporozhia horse factory.

Conclusions.

1. The best performance is provided by young animals obtained from crosses of the lines Barchuk × Pilot, Barchuk × Boltik, Ispolnitelny × Boltik.

2. Crossing of horses of the Orlov trotting breed with purebred riding breed does not contribute to a significant increase in liveliness and prize precocity, while deteriorating the exterior performance - measurements and typicality.

3. At the age of two and three, the best indicators of liveliness belong to the young of the Barchuk line, at the age of four - to the Ispolnitelny line, to the older age - to the Pion line. According to the results of horse tests at the Odessa Hippodrome, Barchuk's line is the most progressive in terms of the number of victories in both traditional and ordinary prizes.

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DYNAMIC OF ENZYMES ACTIVITY ON COMPLEX THERAPY OF DOGS, SICK WITH ACUTE CATARRHAL BRONCHOPNEUMONIA

Kushnir V.Yu,

Assistant Of The Department Of Internal Diseases Of Animals And Clinical Diagnostic

Odessa State Agrarian University

Abstract. Enzymes play very important role on the metabolism. One of their key role is protection of organism against pathological factors. Also Enzymes catalyze (enhance through increased rate of chemical reaction) virtually every function in the body, from digestion to tissue repair, and from hormone function to energy production. Bronchopneumonia cause great disbalance of enzymes. Today there are a lot of methods of treatment, but they are not always effective. The purpose of our work was to compare traditional therapy and complex anthyhomotoxyc therapy.

Introduction. Enzymes play very important role on the metabolism. One of their key role is protection of organism against pathological factors. Also Enzymes catalyze (enhance through increased rate of chemical reaction) virtually every function in the body, from digestion to tissue repair, and from hormone function to energy production. Without them, these same processes would occur much too slowly to be compatible with life. Veterinarians may prescribe enzymes when they feel a particular body process needs to be supported. Commonly prescribed enzymes include combinations of lipase, amylase, protease, papain, bromelain, and cellulase [6].

Dogs, sick with catarrhal bronchopneumonia, have significant changes in the activity of enzymes. In particular, there is an increase in the activity of alkaline phosphatase, aldolase, ceruloplasmin, sialic acids, an increase in catalase number and catalase index [1,2,5,6].

Today there are a lot of methods for treatment of dogs, sick with acute catarrhal bronchopneumonia. However, these methods are not always affective and some of them have side effects. That is why more and more specialists try to use natural recourses during the treatment.

One of the methods of treatment and correction of enzymes activity is homeopathy and variety of it - complex antihomotoxic therapy. Homeopathy, as an

addition to traditional therapy, aims to use biotechnological methods for the treatment of animals.

The animal's organism is struck by the complexity of the structure and the perfection of functions. Interest in its design and laws of functioning developed in parallel with reasonable human activity and had not only positive significance. The historical time scale does not diminish the amazing importance of the way in which the evolution of our ideas about the phenomena of health and pathology has evolved - from the Hippocratic crasis, cruditas, coctio and crisis to the discovery of the molecular mechanisms of diseases in our day. One of the main tendencies of this evolution attracts attention - the natural shift of accents to a deeper level of organization of living matter - from the body, then to tissues, cells, subcellular structures and, finally, to molecules. Moreover, the growing volume of scientific information has caused the allocation of new and new scientific disciplines, the formation of scientific subsections, the formation of new departments in accordance with the real requirements of practical veterinary medicine [3,4].

It is established that all substances and information entering the cell pass through the molecular sieve filter, the extracellular space (matrix). Any sieve can be "clogged", but with the help of appropriate drainage measures its functions can be restored. In addition, immunocompetent cells are patrolled in the main substance, which perform distinctive and detoxifying functions. The picture of the basic regulation is supplemented by the circumstance that the main substance is attached to the nervous and hormonal systems. This confirms the antihomotoxic theory of H.H. Rekieweg [4].

The purpose of our work was to evaluate different methods of treatment of dogs, sick with catarrhal bronchopneumonia and to explore the dynamic of enzymes activity during the treatment.

Materials and methods. The material for the study was twenty dogs, selected according to the principle of analogs, sick with acute catarrhal bronchopneumonia. The dogs were divided into two groups of 10 animals each. Each animal was monitored for 20 days. Every day animals were subjected to clinical explorations. At the beginning and at the end of the treatment we spent the X-ray exploration. On the first, tenth and twentieth day we spent hematological and biochemical researches. Fallen animals were also subjected to pathoanatomical studies. The determination of enzymes was based on photometric analysis. Photometric analysis is one of the oldest and most common physical and chemical methods, it requires relatively simple equipment, at the same time it is characterized by high sensitivity and the ability to

determine a large number of organic substances. The discovery of ever new reagents forming colored compounds with inorganic ions and organic substances, the development of the principles of conjugate reactions makes the application of this method almost unlimited at present.

Receiver of optical radiation on the corresponding radiation fluxes. In routine laboratory practice, it is customary to designate devices that detect the absorption of light by matter, photometers, and reflection by reflective photometers.

The treatment of animals was carried out in a complex manner. Thus, in the first group we used mucaltinum 0.5 g orally twice a day up to recovery, bicillinum-3 50 thousand UA/ kg once every three days intramuscularly, dissolving in 2 ml of isotonic sodium chloride solution and vitaminum B12 1 ml once in Day subcutaneously during 10 days. In the second group we used mucaltinum 0.5 g orally twice a day up to recovery, bicillinum-3 50 thousand UA/ kg once every three days intramuscularly, dissolving in 2 ml of isotonic sodium chloride solution, intradermal leidase 32 UA with 1 ml 0,5% solution of novocaine for 3 consecutive days, then 3 times a week, traumeel lymphotropically regionally for three consecutive days, 1 ml intradermally, then every three days and phosphorus-homaccord lymphotropically regionally 1 ml every three days up to recovery.

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Results of researches. At the beginning of treatment, the animals showed characteristic signs of bronchopneumonia. Among these signs was an increase in the level of sialic acids, which indicates the inhibition of the general state of the organism. On the X-ray pictures we saw lands of inflammation, from a pigeon to a hen's egg on size, the veiling of the borders of the lungs, the blurring of the overall picture of the thoracic cavity. During the treatment the condition improved, and more

clearly it is noticeable in the group where we used complex antihomotoxic therapy (Table 1).

Table 1. Results of complex therapy

Group of animals	Number of animals	Results of treatment			
		Duration of treatment (days)	Total recovery	Came to chronic condition	Died
I	10	17-19	7(70%)	2(20%)	1(10%)
II	10	10-12	9(90%)	1(10%)	-

Also at the beginning of treatment we noticed the rise of the enzymes activity. During the treatment the normalization of enzymes activity figures was observed. Moreover, normalization of enzymes activity in the second group was a lot faster, than in the first group (table 2-3).

Table 2. Dynamic of enzymes activity of dogs of first group.

Figure	Clinically healthy animals	Dynamic of figures, n=10		
		1 day	10 day	20 day
Alkaline phosphatase, ncat/l	634,30±85,30	1096,90±6,81***	841,80±25,37*	781,80±16,73
catalase index, U.	0,69±0,13	1,19±0,14*	0,91±0,10	0,83±0,08
catalase number, ncat/l	3,88±0,58	9,89±0,42***	6,52±0,29***	4,90±0,32
ceruloplasmin, mmol/l	2,85±0,22	5,94±0,27***	4,87±0,31***	3,64±0,17**
sialic acids, mmol/l	1,59±0,04	4,54±0,20***	3,50±0,15***	2,45±0,47$^{\lozenge}$
aldolase, ncat/l	57,34±10,28	108,69±8,04***	95,68±7,34**	65,84±3,72

Note: $^{\lozenge}$ – p<0,1; * – p<0,05; ** – p<0,01; *** – p<0,001 compared with clinically healthy dogs

Table 3. Dynamic of enzymes activity of dogs of seacond group.

Figure	Clinically healthy animals	Dynamic of figures, n=10		
		1 day	10 day	20 day
Alkaline phosphatase, ncat/l	634,30±85,30	634,30±85,30	1113,60±23,54***	846,80±16,26*
catalase index, U.	0,69±0,13	0,69±0,13	1,27±0,09**	0,82±0,04
catalase number, ncat/l	3,88±0,58	3,88±0,58	9,50±0,58***	5,38±0,17***
ceruloplasmin, mmol/l	2,85±0,22	2,85±0,22	5,83±0,21***	3,98±0,10***
sialic acids, mmol/l	1,59±0,04	1,59±0,04	4,75±0,22***	2,55±0,20***
aldolase, ncat/l	57,34±10,28	57,34±10,28	110,02±5,21***	85,77±4,65*

Note: * – p<0,05; ** – p<0,01; *** – p<0,001 compared with clinically healthy dogs

Conclusions

1. Bronchopneumonia is common in dogs

2. One of the most important indicator of catarrhal bronchopneumonia is the activity of enzymes

3. complex antihomotoxic therapy with using complex antihomotoxic preparations traumel and phosphor-homaccord is more effective compared with traditional therapy

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DYNAMICS OF IgG TOXOPLASMA GONDII TITER IN BLOOD OF DOGS DURING THERAPY

M. Broshkov, V. Kusturov, A. Levchenko

Odesa State Agrarian University 65012 Odesa Ukraine

ABSTRACT

The aim was to analyze the dynamics of IgG Toxoplasma gondii titer in dogs for several years after therapy, taking into account the seasonality of the disease. Daraprim has been shown to be the most effective drug for the treatment of acute toxoplasmosis, but it has the disadvantage that it affects only endozoites and does not affect Toxoplasma gondii cysts. IgG titer was recorded by serological method (ELISA test). The study was conducted on dogs of the German Shepherd breed, in which at the initial visit to the clinic were found titers of antibodies against toxoplasmosis. The level of antibodies in the repeated study was lower than in the primary; in the third study - lower than in the primary and secondary. That is, a decrease in the level of antibodies was observed in each subsequent study. This may indicate a decrease in the activity and amount of the pathogen or the tolerance of the immune system to the antigen.

Keywords: IgG, Toxoplasma gondii, Daraprim, Sulfadiazin, toxoplasmosis treatment, dogs

INTRODUCTION

Toxoplasmosis is common in countries with different climatic and geographical conditions, due to the presence of a wide range of hosts - more than 350 species of mammals [1]. The causative agent of toxoplasmosis - Toxoplasma gondii (group of coccidia) is an intracellular obligate parasite that is able to form cysts. The pathogen belongs to the type Apicomplexa, class Sporozoa, party Coccidiida, subfamily Isosporinae, genus Toxoplasma, and species Toxoplasma gondii. Italian researchers L. Rinaldi and A. Scala prove that toxoplasmosis is widespread from Alaska to Australia [2]. According to some authors, the infected organism remains a carrier of the pathogen =all life. Most animals do not show clinical symptoms of toxoplasmosis. Clinical manifestations of toxoplasmosis are related to species and age of the animal, stage and location of the parasite [3]. Mostly in asymptomatic forms of the disease, the ambiguity of clinical manifestations in the absence of specific symptoms causes difficulties in the diagnosis of toxoplasmosis. This may be redness of the eyes, a slight runny nose, short-term diarrhea. The animal (cat) may lose some weight, has short-term loss of appetite. With the transition to a chronic form of toxoplasmosis, the symptoms disappear [3]. In dogs older than 6 years of age, toxoplasmosis manifests itself in the form of intermittent fever, anorexia, depression, indigestion, dermatitis, weight loss and lasts several months. With the defeat of the nervous system there is increased aggression and excitability, convulsions, paralysis, paresis of the hind limbs [4]. Acute toxoplasmosis has been observed in dogs that have not been vaccinated against the immunosuppressive canine distemper virus (CDV) [5,6]. Clinical manifestations of toxoplasmosis are largely associated with the state of the immune system of the macroorganism and can vary from latent to septic forms with fatal outcome. The big problem of this invasion is the lack of specific clinical manifestations in patients with normal immunoresistance. As a result, animals are either not examined for toxoplasmosis, or diagnostic errors often occur, so the attention of doctors on this problem is very important [7]. Currently, for preventive measures and for the treatment of animals from toxoplasmosis, sulfadiazine and pyrimitamine are offered [8]. However, these drugs often cause side effects.

Indications for the diagnosis of animals and humans are a complete protocol of testing for the activity of the pathogen toxoplasmosis, which includes additional determination of IgA class antibodies and DNA toxoplasma in serum by polymerase chain reaction. If the results of these tests

are negative, the patient is excluded from the risk group for the disease and does not require re-examination [10].

AIM

The aim of our study was to analyze the dynamics of the titer of IgG Toxoplasma gondii in dogs for several years after therapy.

MATERIALS AND METHODS

The study involved three dogs of the German Shepherd breed aged 4-6 years, in which at the initial visit to the clinic were found titers of antibodies against toxoplasmosis. Clinical signs: lameness (arthritis and arthrosis with deformation of cartilage tissue) (Fig. 1), skin lesions, itching, nervous system disorders (convulsions during sleep, restless behavior, bouts of aggression).

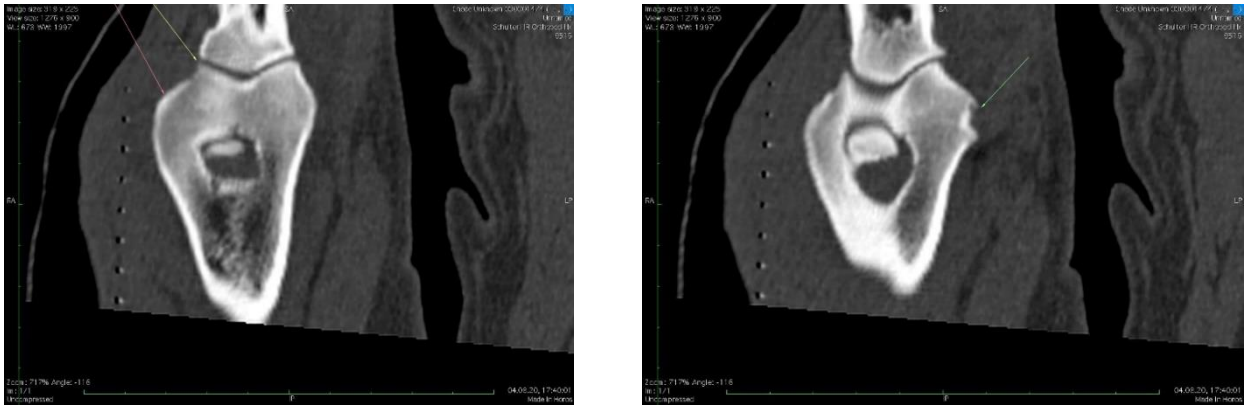

Fig. 1. Computer tomography with a quick test of cyst tissue

Animals were treated with Daraprim 2 mg / kg (active substance Pyrimethamine) once daily for 14 days, Sulfadiazin (150 mg / kg) twice daily for 14 days, Folic acid (5 mg) twice daily for 21 days. All animals that participated in the clinical experiment underwent a repeat course of therapy in connection with the restoration of the clinical picture, approximately one year later. After treatment and obtaining a clinical effect, the animal was observed with the help of monitoring studies of IgG Toxoplasma gondii. IgG titer was recorded by serological method (ELISA test) using a test system from Hema (Ukraine). Blood for the study was taken from the ulnar vein in the morning on an empty stomach.

RESULTS AND DISCUSSION

The most effective drug for the treatment of acute toxoplasmosis is Daraprim, but it affects only endozoites, which are actively multiplying and does not affect on cysts of Toxoplasma gondii. It should be noted that one of the three animals during therapy in the period from 4 to 6 days had signs of depression, refusal to feed, vomiting. This animal was additionally administered intravenous solution of reosorbilact in an amount of 200 ml and saline at a dose of 200 ml two times a day. The probable cause of this complication is an individual reaction to drugs in combination with toxins formed as a result of the death of endozoites Toxoplasma gondii.

Analyzing the graph (Fig. 2) of the results, it is seen that during the study period, IgG titers increased several times.

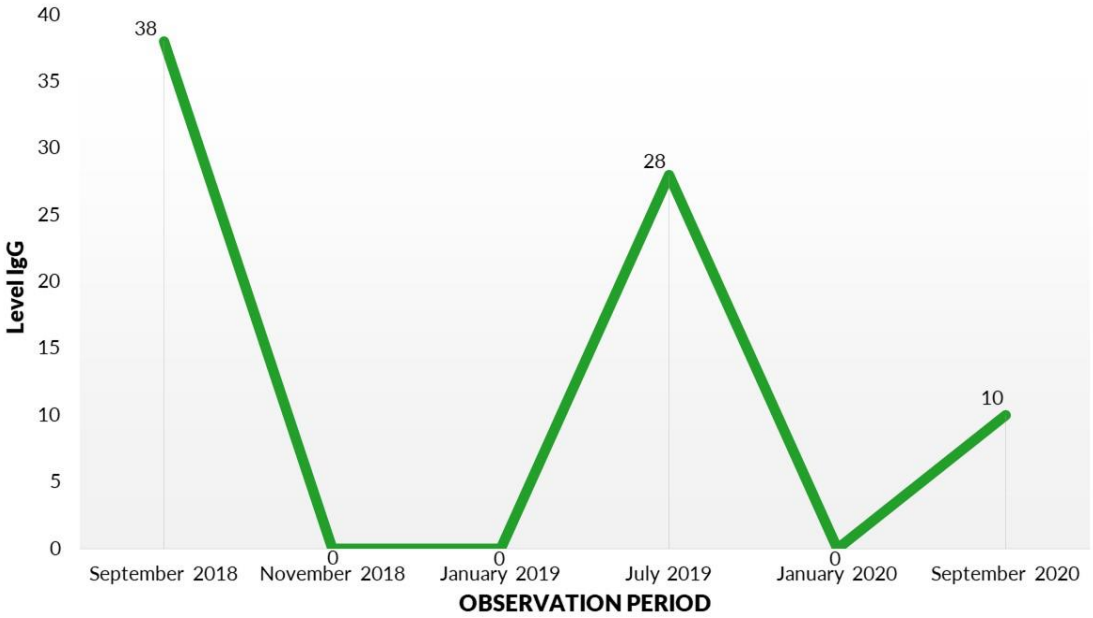

Fig 2. Dynamics of IgG titers during therapy

The increase in IgG titer is corresponded to the exacerbation of clinical signs of the disease. After therapy (November - January) a decrease in IgG titer was observed. Re-examination of serum in dogs for IgG titers of Toxoplasma gondii showed their presence. Therefore, the level of antibodies in the repeated study was lower than in the primary. The IgG titer in the third study was lower than in the primary and secondary. That is, a decrease in the level of antibodies was observed in each subsequent study, which may indicate a decrease in the activity and amount of the pathogen or the tolerance of the immune system to the antigen. It was observed a dependence that exacerbations are registered with the beginning of the autumn period of the year.

Our previous studies show that dogs have the lowest levels of cellular immunity at this time of year compared to other times of the year. At this time, the length of daylight is significantly reduced, weather conditions change: the level of solar radiation decreases, frosts begin. It is obvious that these factors lead to a pronounced immunosuppression, namely to a decrease in the number of lymphocytes on the background of reduced activity of microorganisms in the environment. In various experimental models of Toxoplasma persistence in cellular systems, Daraprim showed the effect of complete purification of cell cultures from Toxoplasma without further recurrence. Daraprim also formed three types of persistence.

In our experimental studies, re-establishment of the activity of the humoral part of the immune system against Toxoplasma gondii may indicate the need to change the treatment protocol.

CONCLUSIONS

In dogs, Toxoplasma gondii (as an intracellular parasite) retains activity and leads to clinical exacerbations, mainly in the autumn. It is likely that the autumn period of activity of the pathogen is associated with seasonal physiological depression of the immune system.

Preservation of individual foci of "dormant" intracellular forms of Toxoplasma gondii leads to reactivation of the symptoms of this disease, which in turn requires a comparative study of additional treatment protocols.

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ENGLISH IDIOMS WITH ANIMALS: THE WAYS OF THE LINGUISTIC AND CULTURAL COMPETENCE FORMATION AT ENGLISH LESSONS

Svitlana Nasakina, Anna Golubova, Iryna Shums`ka

Ukrainian and Foreign Languages Chair, Odesa State Agrarian University,
Odesa, Ukraine

Abstract

In recent decades, there has been increased interest in the study of phraseological units in different languages in various aspects. The object of this study is English idioms. The subject of this study is English idioms with animals. The article aims to specify a competence-oriented approach to professional training intended for the future specialists according to modern requirements and demands. The authors focus on idioms with animals as a means of linguistic and cultural competence formation. Special attention is given to the social and cultural competence. It is indicated that when learning English with a purpose of a professional communication of agrarian universities should be paid particular attention both to the terminology and phraseology. Competency is understood as some prescribed professional basis, which is considered to be obligatory for future specialists. The analysis considers the explicit and the implicit representations of the idioms, their symbolic meanings. The article focuses on the efficient means of idiom formation in the English language as well. The authors discuss the possibility of using idioms with the following phraseological models: adjective + noun, noun+noun, noun+verb, and forecasts further idiom-formations according to the phraseological model. The article is aimed at showing the interaction of linguistic and extra linguistic aspects within an idiom with animals, as a linguistic unit. Aspects of English phraseology are analyzed by emphasizing the important role of idioms in the cognitive processes. Working with idioms at English lessons proved to be effective for forming and developing linguistic competences as reading, writing, listening, speaking.

Keywords: culture, language, phraseology, teaching, veterinarians.

INTRODUCTION

The discipline “English for specific purposes” aims to ensure the students of agrarian universities to master the professional English language competence. Training is aimed at developing speaking, reading, writing, and translation skills. The need for the teaching of English idioms in the agrarian universities and the development of translations gave rise to the English idioms description and analysis in our research. The phraseology of language attracts the attention of linguists and language teachers from different countries. An idiom is a word or phrase that is not taken literally. As Groszler (2012, p.347) underlined, “idioms are words or phrases whose meaning cannot be inferred simply from the meaning of each of its words, but they comprise a figurative

significance which is known through common use". Animals have a special place in the life of future veterinarians, that's why animal idioms teaching English lessons would be rather interesting and useful. Some researchers think that there are both positive and negative animal idioms. According to Smith-Harris (2008), "negative animal idioms, metaphors, and euphemisms are pervasive and indicate that there is a societal permissiveness to implied cruelty toward nonhuman animals". The present paper focuses on the teaching the idioms with animals at English lessons at agrarian universities. The theoretical significance of the work is conditioned by the comprehensive approach to idioms, which enabled to consolidate the knowledge concerning the relevant aspects of the phraseology of English and Ukrainian languages. The practical value of this research is determined by the possibility of using the obtained conclusions in special courses in English for Bachelors and Masters of the Veterinarian Faculties. The practical findings of the study can serve as the basis for teaching aids.

MATERIALS AND METHODS

The research method, which includes two stages, has been presented. The first stage consisted of material collection, the frequency of certain idioms use in printed or electronic media published in English being the main criterion for this selection. The second stage consisted of the description and systematization of the data obtained using particular methods. The *descriptive method* was used in this work for inventory and taxonomy of the studied idioms. The *structural method* was used in the development of the structural classification of idioms.

ANIMAL IDIOMS

The idioms fund of each nation reflects in its many aspects of the customs and culture. There are lots of English and Ukrainian expressions based on animals and birds, and almost every animal and bird has inspired a whole range of idioms in every language, and a surprisingly varied range too. According to Oxford Dictionary of English, "idiom is a group of words established by usage as having a meaning not deducible from those of the individual words" (p.869). Idioms aren't always easy to learn and understand. As Kunin (2005) marks:

The characteristic feature for idioms is the presence of a meaning that clarifies the meaning of the components of the variable word combination, which is the prototype of an idiom, and the literal values of the components are an integral part of the value of a turnover and as a whole are its

internal form. The added value is narrower in comparison with the value of the prototype of the idiom. (p.327).

To help students go deeper into the English idioms, we must integrate our students not only with the academic knowledge but also with knowledge of idioms, proverbs, so on. Makkai (1972, p. 25) states, that "there is a view according to which everything in natural language is idiomatic; both encoding and decoding, from phonology through word formation up to syntax and semantics, including sayings, proverbs, literature, and each individual culture". There are different kinds of activities in learning idioms in English lessons. As a result of these activities, the idiomatical expressions must take their places under the name of an individual course in syllabi in agrarian universities, and especially at the veterinary faculties.

200 English and Ukrainian animal and bird idioms were selected from the English printed and electronic media. It has been established that among the animal idioms there are adjective+noun, noun+noun, verb+noun, for example, *Irish bull (English), хитрий, як лис (Ukrainian); bulls and bears (English), ні пари з уст (Ukrainian); to have a bee in one's bonnet (English), бити байдики (Ukrainian).*

To memorize animal idioms better, it is necessary to compare English and Ukrainian idioms. It must be noted, that both Ukrainian and English phraseology has a long history. We can find similar animal idioms in English and Ukrainian languages, for example, *sly as a fox* in English, and *хитрий як лис* in Ukrainian. There are differences between English and Ukrainian culture, that's why sometimes there are not equivalents between some English and Ukrainian animal idioms, for example, the English idioms *a cat can look at the king* and *cook your own goose* does not have the Ukrainian equivalent. At the same time, the Ukrainian idioms *як віл до браги, як мокра курка* does not have the English equivalent. We agree with Dragoescu (2011), that "bird idioms are sometimes metaphorically constructed as if birds were endowed with human feelings and even abilities" but think that animals in idioms are usually endowed with human abilities as well.

So, animal idioms reflect the national peculiarities and conceptions of the native speakers. In English and Ukrainian languages animal idioms belong to the lexis, which denotes the well-known animals. The most frequent animals in Ukrainian and English animal idioms are the cat, the dog, the horse.

ANIMAL IDIOMS AT ENGLISH LESSONS AT THE VETERINARY FACULTIES

Teaching English in agrarian universities has certain specifics. Teachers of English can choose the activities that will be useful for future veterinarians, agronomists, so on. There is a so-called Rule of "Four Cs" – Communication, Collaboration, Critical thinking and Creativity. In our opinion, one of the main aims of English language training in the Agrarian University is to teach communication, and critical thinking in the professional sphere. Besides, one of the important goals of mastering English by future veterinarians is forming linguistic and cultural competence, which is based on students' knowledge of the national and cultural characteristics of the country the language of which they are learning. Students need to be trained on the identification of different idioms.

Considering the content of communicative competence, it is worth noting the study of A. Kapskaya (1997), in which the author identifies the two blocks of speech skills, which essentially reflect their orientation towards the particular type of professional activity. The first block of speech skills covers mainly those that ensure the qualitative nature of speech, in particular: mastery of speech logic, intonation variability, ability to predict communicative behavior, interaction and emotional-experimental influence, mastery of speech etiquette. The second block includes the speech skills that enhance the effectiveness of the communicative process in general and social impact, in particular: the formation of the speech goal (i.e. the whole communicative process), initiating the speech process, selection and implementation of speech, adaptation of communicative skills to social and educational conditions and a specific client, the use of the results of the analysis of the communicative process, the implementation of speech management and its correction.

The theoretical and methodological analysis of the above-mentioned competencies made it possible to establish that their formation in future agricultural specialists will be effective under the following conditions. Firstly, the number of hours for a foreign language teaching has to be extended and its continuous study should be implemented. Secondly, it is necessary to create a positive microclimate, psychological comfort in an academic group at the foreign language lessons. Thirdly, the definition of the principles of learning as for the formation of foreign language speech competence should be taken into account, such as: that of communication, as well as the principle of taking into account the native language and principle of approximations (Kostyk, 2012).

The modern English textbooks for future veterinarians could, on the one hand, familiarize them with vocabulary and grammar; on the other hand, it could also present the idiomatic matrix of the language. Students need to be trained in the identification of different idioms. There are many ways in which English teachers can make their lessons memorable. At the beginning of a new topic, a set of exercises including gap-filling, multiple choices, matching, etc. is usually developed to provide a practical aid to learn animal idioms and veterinary terminology.

Let's look at the exercises which we use in English lessons. The examples below enhances the receptive knowledge of animal idioms:

Example 1.Fill in the gaps with animals from the box

Cat, bee, bull, dog

My mother was busy as a ____ making cherry jam, cooking the Ukrainian borshch, and so on. We haven`t seen our French teacher in a ___ age! Mark was like a _____ in a China shop. I was like a ___ on a hot tin roof.

It is very important to involve students in listening activities. It is known that listening is an understanding of speech, comprehension of it by a person. It also contributes to the formation of different types of speech activity. This type of speech activity makes it possible to master the rhythm and correctness of pronunciation, etc. Therefore, the training of listening is necessary when learning a foreign language.

Another useful activity is shown below:

Example 2.Listen to the English idioms. Circle T(true) or F (false)

1. Curiosity killed the dog. T/F
2. The dog days of summer are really humid and uncomfortable. T/F
3. Which came first, the chicken or the cat? T/F

We often use exercises with matching idioms in our English lessons. For example:

Example 3.Match the part of idioms in column A with the second part of the idiom in column B

Column A	Column B
What's the matter? Has the cat got your	mouse.
Don't count your	tongue?
Fight like	egg.
Kill the goose that lays the golden	a tiger.
As poor as a church	chickens.

Reviewing the training of future veterinary specialists for professional activity, it is necessary to pay attention to the speech component of this process. From the experience of teaching future veterinarians, it has been established that the most significant type of activity is speaking. Speaking allows you the opportunity to express your thoughts, convey some information to others, prove your own point of view, influence people, etc. It was found out that speech competence is the basis for the formation of communicative competence. Communicative competence is the assimilation of ethno- and socio-psychological norms, standards, stereotypes of behavior. Here is the activity we used at English lessons:

Example 4. In pairs, use idioms in the box to discuss sport on television

Proud as a peacock, a cat can look at the king, get on your high horse, fish out of water, smell a rat, have a whale of a time, a dark horse, etc.

We use authentic material to show students for what purposes the certain idiomatic structure is used in communication. For example, the English-language movie is such an authentic material. For example, it could be the movie *Black Beauty* or *The Wind in the Willows*. Makkai (1972, p. 27) states, that "language teachers are usually involved in multilingual situation in the classroom, their method of separating idioms from nonidioms has been a pedagogical one". The method of formation of speaking and writing competence of students should be chosen taking into consideration. It is advisable to teach professional speech through the lexical and grammatical language levels in the system of various communication exercises, built on the principle of speech situations. The purpose of idiomatic training in agrarian higher education institutions is to embed in the long-term memory of students the idiomatic patterns.

Much attention is paid to the writing, insofar as future agricultural specialists during their professional activities will need to fill out many reports, forms, conduct business correspondence, etc. Writing also allows to better master the rules of sentence construction, certain temporal forms, phraseology, and so on.

The students should understand that they need all the standards of literacy, their basic skills of spelling, vocabulary, punctuation, and grammar to create the message. It must be noted, that "care needs to be taken when writing idioms as many of them are only used in informal language"(Berman et al., 2011). The students will need to write concisely, accurately, and fluently. An informal letter can be selected for the writing activity. The students could be given a time limit to write the email using animal or bird idioms.

Teachers could organize some extra classes, for example, speaking clubs for students who want to improve their English. The topics for the discussion could be the following: Colour Idioms, Animal Idioms, Bird Idioms, etc.

So, the success of the professional activity of future veterinarians is connected with the use of a foreign language. In our opinion, the professional-oriented study of English for Specific Purposes plays a leading role in improving the level of English language of future veterinarians. Improvement of the basics of communication activities in veterinarians of higher agrarian educational institutions requires serious attention to aspects of mastering both idiomatic and terminology aspects, developing the ability to perceive authentic English.

CONCLUSION

Mastering the English language in the veterinary faculty is not only learning grammar and vocabulary for specific purposes but learning idioms as well. The Faculty of Veterinary Medicine of Odesa State Agrarian University carries out training of highly skilled, competitive veterinarians. The University needs to integrate European educational system, that's why Bachelors and Masters need good knowledge in English.

An idiom is an expression that cannot be understood from the meanings of its individual words but has a separate meaning of its own. The main attention of teachers is usually paid to the formation of lexical, grammatical, and speech knowledge, while the issue of idioms competence remains insufficiently developed in the methodology of teaching foreign languages for professional

purposes. Although grammar and terminology is part of the curriculum in many education programs, idiomatic exercises are often left without attention. To our mind, teaching animal idioms must be a regular feature of English language lessons at the Veterinary faculties. Though it would be overwhelming for future Masters in Veterinary to give too much theoretical information on idiomatic patterns.

Therefore, the discussion over animal idioms led us to the following conclusions: animal idioms help to understand the culture and the history of the nation, that the most frequent animals in Ukrainian and English animal idioms are cat, dog, horse. Teachers need to explain the etymology and symbolic meaning of these idioms. On the one hand, teachers have a fixed curriculum and syllabus to follow, but on the other hand, we are free to add some topics with animal idioms. Idioms can attract students' attention and make them participate more willingly and be involved in learning more actively. Students' attention to the animal idioms is drawn with the help of different exercises.

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RESEARCHING THE GEODETIC WORKS IN FORECASTING THE LEVEL OF THE BLACK SEA COASTLINE

O. Malashchuk, L.Vikulina, L. Smolenska

Odesa State Agrarian University, Odesa, Ukraine

Abstract

Black Sea coasts are important targets for preventing the adverse effects of climate change due to their sensitivity to temperature and climate changes. Also, coastal zone is of enormous economic importance to countries of Black Sea basin. Research proves that in order to prevent the negative economic and social consequences caused by the destruction of economic and natural objects located in the coastal strip, it is necessary to monitor its condition and changes in the coastline. Appropriate researches should be carried out using measurement methods that allow to obtain necessary accurate and reliable information about current and permanent changes, taking into account the need to make a long-term forecast. The object of study is the Black Sea coastline. The subject of the study is surveying observations of changes in the Black Sea coastline and their impact on the surrounding areas. The aim of the research is to develop proposals for modernizing the effectiveness of research and monitoring of coastline changes. As a result of the study, the historical stages and the current state of the network of observation points and space data of the Black Sea level study are determined; the relevance of using the photogrammetric method of forecasting changes in the Black Sea coastline on the basis of data obtained by unmanned aerial vehicles (UAV) is substantiated; the classification of UAV on various signs is formed; the advantages of UAV use for the updated topographic and geodetic support for forecasting changes in the Black Sea coastline are substantiated.

Keywords: geodetic monitoring, unmanned aerial vehicles, topographic and geodetic observations, coastline, state of the Black Sea.

INTRODUCTION

The history of observations of the Black Sea has a century and a half period. The complete bibliography of works in which various aspects of its variability are considered, includes more than 300 names. In the last 25 years, a new direction in studying the variability of the Black Sea level has been put on the agenda - the study of its fluctuations and the forecast of future changes. It is largely due to the current global rise in the oceans, resulting in flooding of low coastal areas, as well as the active reshaping of coasts with negative consequences.

Therefore, understanding the causes of rising or falling sea levels, as well as monitoring these fluctuations is of great economic importance, in particular, in the construction of shore protection and port facilities, the development of marine recreational areas and other. This problem may become even more relevant in connection with the expected acceleration of ocean level rise in the XXI century.

MATERIALS AND METHODS

The methodological basis of the work is a system of classical provisions of topographic and geodetic support of the study of territories, including scientific works of domestic and foreign scientists to determine the organizational, institutional and scientific justification of geodetic observations. In the process of research to achieve this goal the following methods of scientific knowledge were used: induction and deduction; economic-statistical and graphoanalytical methods; logical generalization, synthesis, comparison, system and spatial analysis.

RESEARCH RESULTS

Thorough observations of the Black Sea level began in the middle of the XIX century. They were conducted on level rails (footposts) installed in several ports, mainly by the Directorate of Lighthouses and Lots of the Black and Azov Seas and partly by the Port Authorities. Data from these observations have not been preserved. In the second half of the XIX century, systematic observations of fluctuations in Black Sea levels were organized, and level posts were established in the ports where the fleet was based and on the coastal lighthouses of the Hydrographic Service.

For a long time, the results of observations at these posts remained the only material on the basis of which the first scientific data on the level regime of the Black Sea was obtained. These materials were used for the practical safety of navigation, hydrographic, geodetic research and port needs.

Systematic observations were organized in 1873. The most relevant have been preserved for Ochakov (since 1874), Odesa and Sevastopol (since 1875). At the initial stage, level observations in Odesa were conducted in parallel on two upper-zero rails installed in 1874 near Richelieu, and in 1875 – near Vorontsov lighthouses. From April 1892, after the closure of the Richelieu lighthouse, observations were made only on the level rail of the Vorontsov lighthouse, where a tide gauge station was created, on which a recorder recorded the sea level.

In 1881, the corps of military topographers began systematic work on laying lines of precise leveling in the European part of Russia. These works were intended to equip the territory with a network of major altitude points necessary for mapping the country and for communication at altitude of the Baltic, Black and Azov seas. Data on the leveling of these lines was used in compiling the first in Russia "Catalog of heights of the Russian leveling network from 1871 to 1893", known as the "Rilke Catalog", named after the military surveyor who directed in those years leveling work, which formed the basis for determining and linking the average long-term levels of the Baltic, Black and Azov Seas. This allowed to perform accurate bindings of water meter posts, including the post of the Odesa port **[1]**.

In 1912, the Department of Commercial Ports of the Ministry of Trade and Industry approved the "General Program for the Development of the Hydrometeorological Service in Commercial Ports and Sea Coasts of European Russia." Previously interrupted observation posts were restored and new level posts were organized.

During the civil war of 1918-1920, the work of many level posts was interrupted, the rails were partially damaged and partially destroyed. In 1920, the Central Station of the Hydrometeorological Service of the Black and Azov Seas, located in Feodosia, carried out extensive work to restore the network of stations and its expansion in accordance with the program of 1912.

Before the Great Patriotic War (1940), the Sevastopol Department of Hydrometeorological Service opened 17 more posts and 2 posts in various parts of the Black and Azov Seas Coast – the Hydrographic Department of the Navy.

During the Great Patriotic War, many level posts were completely or partially destroyed and no observations were made. Posts located on the Caucasus coast were also affected, where surveillance, although continuing, was intermittent due to damage to the level rails during aerial bombardment. During the occupation there was a level post in Yalta. Since 1944, the network of level posts began to be restored, reconstructed and expanded. Sea level recorders were installed at many posts.

In the mid-50's, the geodetic service made a lot of work on the precise leveling of geodetic points, which allowed to bring all the benchmarks to a single system of heights and make the data comparable. Prior to that, each item had its own zero post. In 1977, the USSR's Main Elevation Base was introduced into the Baltic Altitude System, which dates back to the 1977 and is still in use.

Much work has been done in preparing the "Catalog of observations in the Black and Azov Seas" **[2]**: errors from previous observations were excluded, the data was reduced to a single altitude system. In total, in different years on the territory of the former USSR on the Black Sea there were 44 level posts, data from which survived until 1985 inclusive, summarized in **[3]**. This work contains brief information about the

posts and their height reference (benchmarks). Since 1992, the network of stations has moved to the newly independent states. In Constanta and Sulina (Romania) observations have been made since 1858, and complete series have been preserved. In Bulgaria, sea level monitoring began in 1881 (Varna), and later the stations Nessebar (1924) and Burgas (1928) were opened. On the Turkish coast during 1949-1962, observations were made in Eregli, Trabzon (1956-1983) and Samsun (1961-1983). In Turkey, the network of stations belongs to the hydrographic service of the Navy.

Currently, the network of Black Sea level monitoring points includes 30 stations. Of these, 13 belong to Ukraine, 5 – to the Russian Federation, 4 – to the Republic of Bulgaria, 3 – to Romania and the Republic of Turkey, 2 – to Georgia. Thus, on average, one station has 120 km of coastline. However, the stations are located very unevenly. The densest network on the west coast is half of all stations. The rarest network on the southern – Turkish coast (only 3 stations).

In Ukraine, 12 out of 13 stations were transferred to the State Committee for Hydrometeorology (currently the Hydrometeorology Department, which is a subdivision of the staff of the State Emergency Service of Ukraine), and one (Katsiveli village) was transferred to the National Academy of Sciences. Some information on sea level observation points in Ukraine is summarized in table. 1.

Table 3.1. Data on Black Sea level monitoring points in Ukraine

№ p / p	Item	Number of terms of observations	Availability of recorders	The beginning of observations
1	Ust-Dunaisk	4		1983
2	Primorsko	2		1951
4	Chernomorsk	4	+	1960
5	Odesa	4	+	1875
6	Jugne	4		1980
7	Ochakiv	2	+	1874
8	Horley	4		1923
9	Black Sea	3		1927
10	Evpatoria	3		1917
11	Sevastopol	4	+	1875
12	Katsiveli		++	1949
13	Yalta	3	+	1927
14	Theodosia	2	+	1912

Source: **[4]**.

Due to the destruction of footstools, no observations were made for several years in Horly, the Black Sea and Evpatoria. The unsatisfactory condition of the network was caused by the decision of a group of MedGLOSS project experts to install a tide gauge in the organization of the National Academy of Sciences of Ukraine – Experimental Department of the Marine Hydrophysical Institute in Katsiveli (Southern coast of Crimea).

Installed in 2003, the tide gauge is part of the MedGLOSS Network and operates in a mode close to real-time (online mode). So data from it is posted with a slight delay on the relevant site (medgloss.ocean.org.il). This tide gauge works in parallel with the tide float of the tide gauge, which is at a distance of about 400 m. In addition to sea level (measured by a pressure sensor), it records the sea water temperature, which is extremely important in terms of monitoring the effects of level changes. The same tide gauge is installed in Constance. The MedGLOSS network also includes Tuapse and Burgas stations, but data from them arrive in the off line mode **[4]**.

Various methods are usually used to assess the condition of the coastal strip. In the conditions of research of a coastal strip of the Black Sea it is possible to offer use of the following research methods (fig. 1).

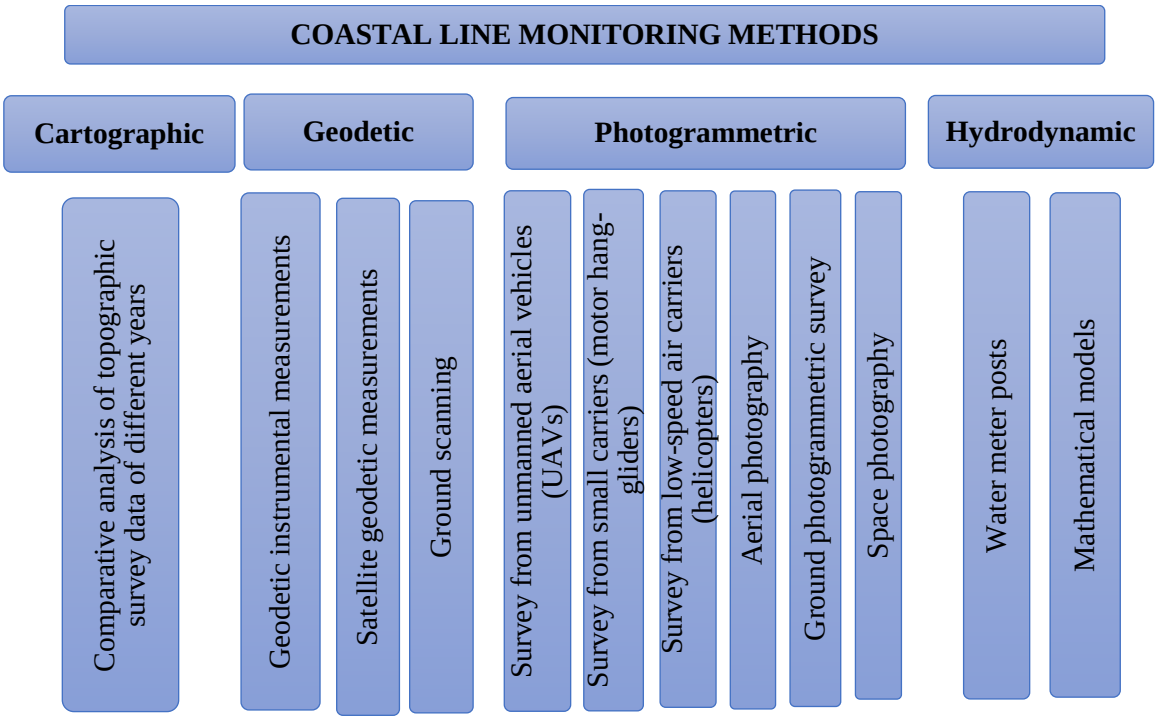

Fig. 1. Coastal line monitoring methods

The above methods have different degrees of suitability for monitoring the dynamics of the coastline.

Cartographic method

The cartographic method is suitable for studying its dynamics only in the long run, as the period of updating cartographic materials is calculated in years. The cartographic method is based on the study of maps of coastal areas created in different periods. The accuracy of obtaining information about the coastal strip in this method depends on the scale of the topographic map used, and the relevance of the information - from the time of creation of the map. The requirement for the accuracy of the map (the degree of conformity of the location of objects on the map to their location in reality) is that the objects depicted on it must maintain the accuracy of their location, geometric shape and size according to the scale of the map and its purpose. Therefore, the cartographic method is used to obtain only primary information about the state of the coastal strip. The order of renewal of cartographic materials is accounted in years and depends on many factors, because the map is essentially the product of a set of astronomical and geodetic data, remote sensing data, field observations and measurements, text sources. In this regard, this method of monitoring in itself does not meet the input parameters of the monitoring.

Geodetic method

The geodetic method is a topographic survey of the coastal strip. When surveying the coastal strip, traditional technologies for topographic surveying are used. For regular observation of the territory, it is advisable to use geodetic networks and thickening networks as a basis for repetitive measurements. Deformation marks or integrated sensors are used to study the dynamics. The geodetic method has a high accuracy, but due to the high complexity and high cost, this method should be used only for monitoring small areas of the coast.

Satellite technologies play a role of supporting other technologies. The essence of satellite technology is to use the Global Navigation Satellite System (GNSS) and computer processing system (computers and software) to obtain the coordinates and heights of points in the area. The location of the point when using satellite technology is determined by measuring the time of the signal coming from the Earth's satellites.

GPS receivers are geodetic devices that allow you to quickly perform a topographic survey of the shoreline. The results of the recordings can be recorded directly by GPS in the field, and then transmitted to

a computer in the office, and can be viewed either using software provided by the manufacturer, or in a GIS for processing. The GPS standard has an accuracy that can vary from 1 to 10 meters (X, Y) depending on the location, equipment, etc. The value (Z) is not used due to its large inaccuracy. Using multiple satellites provides better accuracy. At least four satellites must be involved **[5]**.

The advantages of GPS are that it allows executors to take measurements quickly and easily. It is an affordable tool, easy to use and relatively accurate (depending on the need, when it is not necessary to have high accuracy). The disadvantages of GPS are that this technology in some cases provides very low accuracy (10 m or more). For surveying along rocks (below) or under vegetation cover, GPS may have some limitations due to the difficulty of capturing satellites.

Photogrammetric methods include a wide range of technologies: unmanned aerial vehicles (UAVs), surveying from small carriers (motorized hang gliders), surveying from low-speed air carriers (helicopters), aerial photography, ground photogrammetric surveying, space photography, radio photography. The photogrammetric method involves the use of remote sensing data using air or space-based imaging equipment, which includes aerial photography and subsequent photogrammetric processing of the images, as well as aerial laser-location imaging. Remote sensing is the observation of the Earth's surface by aircraft and spacecraft equipped with various types of imaging equipment **[8].**

During aerial photography, the media equipped with the camera flies at a fixed height above the coastal zone. With the help of the camera, images that provide overlapping images for further stereo processing are obtained. Currently, GPS records the coordinates of each image when using UAV. Aerial photography allows to determine the geometry of the shoreline and then have access to its dynamics. An important condition is the comparison of surveying conditions, which in practice is difficult to perform. Aerial photography can be combined with digital terrain modeling, which creates augmented reality. Analyzing the data processing process, it should be noted that in general, processing of any remote sensing data obtained from the air consists of the stages of pre-processing, photogrammetric processing and subsequent decoding. However, each type of surveying has its own characteristics [9].

The photogrammetric method requires high surveying heights due to the high speeds of modern aircraft. High altitudes reduce image blur, which always occurs when surveying from a moving subject. Photogrammetric information is always relevant, but its accuracy depends on the height of the shot and the speed of the media. The photogrammetric method can be used as a supplement to the geodetic method.

Aerial surveying is a technology that uses an on-board laser scanner installed on board an aircraft or helicopter. On the carrier board, the return time of the laser pulse and the difference between the radiation time and the reflection time are calculated. The lidar covers large areas and has decimeter accuracy. Two types of onboard sensors are used: topographic and bathymetric. Topographic sensors are used to obtain models of the earth's surface. Bathymetric sensors are used to probe the water surface. Many bathymetric lidars simultaneously measure the height and depth of water, providing an aerial laser scan of the water surface. Topographic leaders record changes in the shoreline regardless of water level, vegetation boundaries or rock microerosion, all of which can be easily identified and presented for diachronic analysis. The lidar method can be used as a supplement to the photogrammetric method for capturing stationary situations and stationary objects.

Unmanned aerial vehicles (UAVs) are of two fundamentally different types: aircraft and helicopter type. Modern UAVs have the ability to carry imaging equipment that provides a spatial resolution of 2 cm at a safe flight altitude, the width of the capture band is on average 110 m, and the flight range is about 60 km. Manufacturers give a guarantee for 80 flights, respectively, during the year you can receive data every 1 to 4-5 days. This provisional permit indicator is the best of all monitoring methods available today. In terms of reasonable labor and economic costs, as well as the compliance of the input parameters of the monitoring, this method of shoreline monitoring is the best. It should be noted that the use of UAV survey data allows to create three-dimensional terrain models with high accuracy, which, of course, should be used as part of a comprehensive methodology for monitoring the dynamics of the coastline **[10].**

Space photography is used to monitor large areas. One space image can replace up to 1000 aerial photographs. With the help of space aerial photographs it is possible to obtain information about both the terrain and the state of the coastline, but to obtain information about the terrain it is necessary to use a couple of images. Analysis of the parameters of artificial satellites of the Earth, which capture the Earth's surface, shows that currently the ability to obtain images with a spatial capacity of 30 cm among the space-based imaging systems has two spacecraft (SP) - WorldView 3 and WorldView 4. The main amount of space survey data is performed with a capacity of 50-60 cm. In most cases, the height error in such data is close to

1.5-2 pixels - is 75-100 cm. The error in the plan usually is 2-3 pixels - 1-1.5 m (in the presence of a high-quality relief model and a sufficient number of reference points) **[11]**. Space survey materials are generally suitable for creating large-scale contour plans (2D), but do not provide the required accuracy of altitude for this scale. Thus, we can conclude about a fairly high accuracy, which corresponds to the input parameters of the monitoring. An important parameter of any satellite imaging system is the temporary resolution or repeatability of the same area.

Water meter measurements

The modern scientific literature describes methods and algorithms for modeling phenomena related to the oceans. Thus, the most dynamic oceanic natural phenomena, such as storm surges, are subject to modeling. The modeling is performed using various hydrodynamic models, for example, ADCIRC (ADvanced CIRCulation model for oceanic, coastal and estuarine waters), with correction for observations obtained at water meter posts. Similarly, less dynamic oceanic natural phenomena, such as coastal abrasion, can be simulated.

According to the design and method of the device there are water meter posts:

- simple, at which the height of the level is measured by a water meter rail (rail foundation, mixed (rail-foundation));
- transmitters, at which the height of the level is measured and transmitted by transmitting devices;
- automatic, at which water level fluctuations are continuously and automatically perceived by the sensor (float, manometer, etc.) **[12]**.

The choice of a particular type of water meter depends on climatic and local conditions, as well as requirements for the accuracy of the results of observations. Currently, the most modern and accurate type of water meter posts is automatic. Water metering data combined with a three-dimensional shoreline terrain model (created (and regularly updated) based on UAV aerial photography data) can have a significant impact on improving the quality of coastal abrasion forecasting in the most coastal problem areas characterized by near-coastline retreat speeds 20 m / year.

CONCLUSIONS

As a result of research on shoreline monitoring methods, we can conclude:

1. The optimal method for forecasting the level of the Black Sea coastline is the photogrammetric method using unmanned aerial vehicles with small-format cameras or medium-format air cameras.

2. The geodetic method of instrumental measurements and the method of satellite geodetic measurements correspond to the input parameters of the monitoring in terms of accuracy, but do not correspond in terms of repeatability of the survey in terms of high economic costs and use of large human resources.

3. Space survey materials can be used to monitor the long-term dynamics of sea shores. A common method for estimating coastline dynamics currently used by researchers is retrospective analysis of space images.

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HUMUS CONDITION OF CHERNOZEM SOILS IN SOUTHWEST OF UKRAINE

Olena OZHOVAN, Iryna LEONIDOVA

ODESA STATE AGRARIAN UNIVERSITY
ojovan.olena@gmail.com

Results of research for status of humus of chernozem soils in southwestern Ukraine are summarized. Geographic and genetic features of humus status of soils on the territory under study are identified. Chernozem soils under study are found to reveal a tendency, in dehumification processes, to retain their parameters being typical for soils of the chernozem-type soil-formation. Features of humus formation processes under impact of natural and man-caused factors were studied as well.

Keywords: chernozems soils, humus condition, Ukraine

AIMS

One of the global aspect of soils' degradation is their dehumification, since the contents of humus is an integral index of soils' fertility that displays an ecological and genetical status thereof. Of a special alert attention is dehumification of chernozem soils whose parameters are recognized as reference values of the superior soils quality worldwide. Making up over a half of agricultural land of Ukraine, chernozem soils hold a leading place in the natural and economic potential of the country. Agricultural exploitation of chernozems brings to depression of humus neoformation-process due to reduced income of fresh organic matter and to increased rate of its mineralization. Period of intensive dehumification takes place within first 30-60 years of chernozems' agricultural development being then followed by a period of stabilization and, possibly, accumulation of organic matter in the soil (*Laktionov, N.I. et al., 1999*). Duration of such periods differs across natural zones *(Kononova, M.M., 1963)*. There are also available some data on different rates of dehumification processes throughout the steppe zone that eventually brings to up-leveling the soils' differentiation over this territory in terms of the humus contents *(Yarmak, V. et al, 2007)*.

Quantitative changes of humus contents are known to be accompanied by changes of quality indices being of controversial character relatively to chernozems. Thus, research by V.V. Degtyaryov testifies to reduction of humine acids' contents in ordinary chernozems from the outset of agricultural use (taking a 27-year arable site as an example) as compared with virgin land; whereas further exploitation of 65-year and 120-year old plots of arable land evidences of accumulation thereof. In this case, duration of agricultural land-use doesn't affect the relative contents of fulvic acids *(Degtyaryov, V.V., 2011.)*. In studies for typical chernozems, M.V. Kapshtyk points out to increase of relative contents of humine acids alongside reduction in quantity of insoluble residue within the arable land, contrast to that with 16-year old wild brise plot *(Kapshtyk, M.V., 2009*). According to A.D. Balayev, humus contents of the southern chernozem of the 45-year old brise plot is characterized by elevated relative amount of humine and fulvic acids, contrast to that in the arable land, alongside lesser contents of the insoluble residue. However, humus contents of the typical chernozem was slightly different *(Balayev, A.D., 1986)*.

Monitoring of humus contents in soils over the territory under study has revealed its reduction within last decades to 0.35% on the average (ranging between 0.1 to 0.7% in certain areas) *(Golubchenko, V.F. et al., 2010)*. The comparative analysis with usage of data by A.I. Nabokikh (*Nabokikh, A.I., 1915*) shows that within recent 100 years, the superficial horizon of southern chernozems (within the range of the territory under study) has consecutively lost its humus contents by 25-40% (*Yarmak, V. et al., 2007)*. In this concern, an actually important task is identification of present-day zonal and local features of humus- quality indices under dehumification conditions that influence physical properties of chernozems and their ability to withstand the negative ecological factors.

METHODS

In terms of physico-geographic division of Ukraine, the territory of this present research is situated within limits of the Steppe zone. The climate of this territory is moderately continental, characteristic with insufficient humidity contents, short mild winter and lengthy hot summer. Annual sum of active temperatures makes up 2800°-3300°C, whereby the frost- free period lasts over 170-190 days. Amount of

precipitation all over the Steppe zone decreases from ~475 mm to ~350 mm from North to South, while depth of the soil wetting and thickness of soil profile decrease respectively. Therefore experts divide the Steppe land in two subzones: the North Steppe with its ordinary chernozems and the Mid-Steppe with southern chernozems. The Steppe-zone soils naturally originated on loessial bottom-bed under field grass and weed vegetation which is represented by tipchak and feather-weedle associations and which is, the further to the South the more becoming blinded due to elevation of aridity in the dry steppe climate. At present day, almost all land sites are ploughed up and used mostly for cultivating grain and forage crops. Irrigation techniques, along with other agro technical methods, are used to increase fertility of chernozems over drought-suffering territories.

Five key plot sites were arranged for the research experiment, assuming for places of their location capable of reflecting every typical geographic and genetic peculiarity of chernozems' humus-status. Features of soil formation were investigated on several key plot sites of the northern subzone (ordinary chernozems) and the southern subzone (southern chernozems, for example). Key plot sites located in Trans-Dniester area reflect facial features of soil-formation processes (for example, with ordinary micellar and carbonate chernozems). Local features of humus status were also investigated on territories brought out of irrigation in recent decades (southern chernozems) and in the area of Lower Danube super-floodplain terraces (with southern carbonate chernozems).

Research object: humus status of soils and their buffer abilities. Granulometric structure has been identified by aid of N.A. Kachinsky's techniques and interpreted via modification by S.I. Dolgov and A.I. Lichmanova *(Vadyudina, A.F.et al., 1986)*. The humus contents was identified by method of V.I. Tyurin in modification of B.A. Nikitin *(Arinushkina, E.V., 1970*), whereas humus group structure was assessed by methodology of M.M. Kononova and N.P. Belchikova *(Kononova, M.M., 1963., Kononova, M.M. et al, 1961*). Optical density was evaluated on an extract from humine acids obntained during humus contents identification *(Plotnikova, T.A.et al., 1967)*.

Rates of profile humus-accumulation coefficient (PHAC) and relative humus- accumulation coefficient (RHAC) were calculated per index of humus contents in the profile and per amount of physical clay, respectively *(Polupan, N.I. et al., 2005).*

RESULTS

Granulometric structure of soils. Characterizing the soils under study according to the contents of physical clay, authors noted the following features (see the Table below). Ordinary chernozems are represented by heavy silty loam with coarse dust filling. Dominating fractions of ordinary chernozems all over the profile are silt (with particles' size ~0.001 mm) and coarse dust (of 0.05-0.01 mm particles' size). Southern chernozems deprived of irrigation include relatively high contents of physical clay (up to 46-48%), which fact characterizes them as heavy loam soils.

Southern chernozems and southern carbonate chernozems are represented by medium loam fraction (35-42% physical clay). Unlike ordinary chernozems, southern chernozems are characterized by prevalence of coarse dust fraction all over the profile, versus contents of silt fraction. Exception hereof are southern carbonate chernozems of super-floodplain terrace of the Danube river, whereby the next prevailing fraction is fine sand (of 0.25-0.05 mm particles' size).

The most dense contents of coarse and average sand fraction (1-0.25 mm particles' size) is observed in the bulk of ordinary micellar carbonate chernozems that can affect physical properties of agro soil, promoting soil-siltation and formation of soil-crust after precipitation.

Contents of fine and medium dust (0.005-0.001 mm and 0.01-0.005 mm, respectively) in all soils under study makes up about 10%, causing siltification and deflation processes. Sum of physical clay fractions tends to increase down the profile in all soils under study, while prevalence of videlicet oozy fraction and its uniform redistribution, in the course of soil formation all over the profile, characterizes the chernozems of the territory under study with high absorbing ability.

The contents of humus in soil and its distribution across the profile. In the arable layer, the ordinary chernozems under study contain 3.6-3.8% and southern chernozems – 2.4-2.6% humus. In southern carbonate chernozems being relatively light per granulometric structure, quantity of humus makes up ~2.16%. It should be noted that today, there is no strict differentiation between chernozems of northern and southern territories of the steppe zone (in terms of humus-contents percentage manifested by A.I. Nabokikh early in the XX century (6.0-6.5% and 3.4-4.2%, respectively), which shows the present-day neglectable up-leveling of the humus-zonality importance (*Yarmak, V. et al., 2007)*. At the same time, geographical

regularity of humus distribution, i.e., reduction of the humus contents and thickness of the humus horizon from the North to the South, is still true.

Scale of humus accumulation can be estimated per total stock of humus that reflects the general contents of organic substances in soil. Chernozems under study are characterized by low amount of humus stock in a layer: 0-20 cm. Concerning ordinary chernozems, amounts of humus stock fluctuate within 85.6-89.4 ton/hectare, while making up about 68 t/hectare for southern chernozems. Poor stocks of organic substances (in a 0-20 cm layer) are typical for southern chernozems deprived of irrigation (making up about 60 t/hectare). The least value of this index is observed with southern carbonate chernozems of the Danube super-floodplain terrace (~50.4 t/hectare) that can be explained by low contents of humus in these comparatively light soils.

The soils under study are characterized by cumulative type of humus distribution in a soil profile, which is peculiar for maximum accumulation of organic matter from the surface, with gradual reduction of its contents with depth. Thickness of the humus- containing profile (H + Hp + Phk) of chernozems under study, expressed as a degree of soil- formation process- development, is considered to be of medium value (65-85 cm). Rather notable thickness of the humus-containing portion of a profile in ordinary micellar and carbonate chernozems, was noted in comparison with that of modal soils (85 cm vs 70 cm, respectively). Thickness of their humus-cumulative horizon (H) makes up about 40 cm. Concerning southern chernozems under study, depth of the humus-containing portion is associated with their geographical situation and their granulometric structure. Thus, in mid-loamy southern chernozems and southern carbonate chernozems around the Danube super-floodplain terrace, depth of the profile humus-containing portion amounts to 72-75 cm, while thickness of their humus-cumulative horizon (H) makes up 34 cm. Heavy loamy southern chernozems deprived of irrigation possess about 67 cm thickness of the humus-containing profile. A more or less thick humus horizon (up to 44 cm) and a number of medium-humus "tongues" and “lips” in the bottom portion of the humus-containing profile are characteristic indexs of irrigated soils *(Poznyak, S.P., 1997)*.

General stock of humus in a profile is defined by a soil- formation- type, whereas that in profile-limits is determined by granulometric structure, wetting and profile-thickness. Dr. N.I. Polupan considers humus as a delicate index of soil-typological and ecological memory of the soil. He suggests an idea to consider a ratio of profile humus-contents and its physical clay contents as a diagnostic index of a soil-formation type and a subtype, correspondingly *(Polupan, N.I. et al., 2005).*

Thus calculated coefficients of profile accumulation of humus (PHAC) reflect reduced intensity of a profile humus accumulation in North-South direction, which is supported by the PHAC-corresponding statistical data: from 0.051-0.052 to 0.041-0.043, respectively. It reflects factor of soil-formation and humus-accumulation zonality in a given region. Values of relative humus accumulation coefficients (RHAC), in their turn, reflect an elevation of the climatic aridity and, correspondingly, a decrease of humus accumulation in the southern portion of the steppe zone. From ordinary chernozems to southern ones, RHAC value decreases by 24% (from 0.73 to 0.53 respectively). It should be noted that in comparison with the reference values *(Polupan, N.I. et al., 2005)*, factual values of PHAC data for ordinary and southern off-irrigation chernozems, are somewhat belittled. Values of RHAC correspond to reference standards and reflect classification identity of the soils between moderately weak humus-cumulative ordinary chernozems and weakly- accumulated southern chernozems.

Qualitative structure of humus. Dynamics of humus accumulation processes in soil influences the qualitative structure of humus being estimated by the contents and a ratio of various groups of humine substances that differ in their properties, such as: humine acids, fulvic acids and an insoluble residue. Concerning the soils under study, the group structure of humus is characterized by relatively high amount of humine acids and rather low percentage of fulvic acids that is peculiar to soils of chernozem-type soil-formation *(Plotnikova, T.A., 1969).*

A relative contents of humine acids in an arable layer of ordinary and southern chernozems, on the territory under study, is ranging within 26-40% out of the general carbon amount. The least contents of humine acids is registered in southern carbonate chernozems whose mid-loamy structure causes low absorbing ability alongside an effect of coagulation which is necessary for fixing up the newly formed humine substances.

A relation between humine acids contents (C_{hac}) and fulvic acids contents (C_{fac}) characterizes the humus type, thus reflecting specifics of humification processes in different soils. The ordinary chernozems under study are characterized by fulvatic & humatic type of humus in arable layer, at the C_{hac}:C_{fac} ratio within 1.76-1.84. In humus horizon, there is observed elevation of relative contents of humine acids and rise

of Chac:Cfac ratio up to 2.02-2.21 that evidences of humatic type of the humus-formation. In relation to southern chernozems, characteristic is a gradual reduction of relative and absolute contents of humine acids down the profile and, consecutively, decrease of C_{hac}:C_{fac} ratio across the depth. The humus-cumulative horizon of southern chernozems is characterized by humatic type- humus (at C_{hac}:C_{fac} ratio ~2.27). Concerning the free-from-irrigation southern chernozems studied, as well as southern carbonate chernozems of the Danube super-floodplain terrace, humus is fulvatic & humatic type with C_{hac}:C_{fac} ratio within 1.75-1.87, gradually decreasing down the profile.

Relative contents of the insoluble residue in ordinary and southern chernozems under study is of medium value (42-59%). It should be noted that insoluble residue contents is low in off-irrigation southern chernozems at the depth below 70 cm, and in ordinary chernozems below 110 cm.

Organic residues transform into humine substances most completely in ordinary chernozems, which fact is testified to by high degree of humification (31.0-38.5) within humus-containing portion of profile. Extent of southern chernozems humification is highest (36.2-40.0%) within 0-30 cm thick top layer of the soil, whereas with depth this index decreases, making up 22.0-26.3% on the average. Exception hereof are southern carbonate chernozems of the Danube super-floodplain terrace, characterized by a mediate degree of humification, which becomes weak below the depth of 24 cm (10.1-19.5%).

Optical density of humine acids. It has been determined by indices of humus status of soils *(Orlov, D.S., 1990)* that humine acids of chernozems under study possess high and abnormally high optical density which is associated with heavily condensed aromatic nuclei and low contents of lateral aliphatic radicals in their molecules. In ordinary micellar and carbonate chernozems and in southern carbonate chernozems, optical density coefficients possess high values, such as 0.177-0.195. Abnormally high optical density coefficients (0.223-0.275) of humine acids in ordinary and southern chernozems evidence of a dense compactness of aromatic nuclei in their molecules, and point out to rather favorable conditions at formation of compound forms of humine acids in these soils.

Structure and properties of humine acids normally undergo changes in the soil profile, that is noted by numerous authors *(Kononova, M.M., 1963, Plotnikova, T.A., 1969., Podvalnaya, H., 2003)*. In soils under study, lesser values of optical density coefficients are observed in arable layers, which fact can be a consequence of fresh organic residues' accumulation and presence of chemically rather "juvenile" humine acids *(Kononova, M.M., 1963)*. Availability of more or less "mature" humine acids is observed in the lower portion of the humus-cumulative horizon, which fact is testified to by elevation of optical density coefficients. In lower portion of the soil profile were noted low indices of humine acids' optical density, probably as a result of downstream of mobile humine acids (of a simplified structure) from upper horizons. This fact was also marked out by T.A. Ponomareva in her research for southern chernozems *(Plotnikova, T.A., 1969)* that, according to M.M. Kononova, is explainable by genetic affinity between humine acids and fulvic acids, alongside probability of existence of transitional forms therebetween *(Kononova, M.M., 1956)*.

It should be noted that with depth, the humus-cumulative horizon of ordinary modal chernozems is characterized by gradual decrease in optical density of its acids. Uniform distribution of these indices within a profile is caused by humus- formation conditions favorable for: genesis of highly structurized molecules of humine acids, upgrade of hydrophobic properties and deceleration of their mobility in upper layers.

For purpose of comparison between optical properties of humine acids, there has been computed a chromaticity- coefficient based on ratios of extinction- coefficients at 465 and 665 nm wavelengths (at a rate of E4:E6). This ratio doesn't depend on carbon concentration while reflecting a degree of the condensed aromatic nuclei' input to construction of humine acids' molecules *(Kononova, M.M., 1956, Kononova, M.M., 1972)*. Abnormal structurization of molecules is observed in arable layers of ordinary modal chernozems, southern modal chernozems and off-irrigation southern chernozems, whereby the E4:E6 ratio makes up 2.8-2.9. Lesser structurization of humine acids' molecules, due to reduced interactivity of condensed aromatic neclea and, correspondingly, increase of lateral aliphatic chains, in construction of humine acids' molecules, is noted in ordinary micellar and carbonate and southern carbonate chernozems, where the increase in E4:E6 ratio makes up to 3.0-3.2. On other words, the humus in these soils is represented by juvenile, less matured humine acids.

CONCLUSIONS

Due to deficiency of organic fertilizers within recent 10-20 years, the arable horizon of chernozem soils in the southwestern Ukraine has undergone a loss of humus contents up to 0.35% on the average (ranging from 0.1 to 0.7% in certain areas). Typical contents of humus in ordinary chernozems (in the southern strip of their geographical distribution area), versus that of southern chernozems, is ranging within

3.6-3.8% and 2.4-2.9%, respectively. Thus, during the last century, the upper (arable) horizons of southern chernozems have lost ~15-30% humus contents.

At apparent up-leveling of the humus status of both ordinary and southern chernozems, there still exists a zonal character of most of specific indices that characterize some processes of humus accumulation. Thus, with decrease of the profiled humus accumulation- intensity (from 0.051-0.052 to 0.041-0.043) and coefficient of relative humus-accumulation (from 0.73 to 0.53) in southward direction, general stock of the humus, alongside the thickness of humus-containing portion of the profile, also are reducing.

The group structure of humus and optical properties of humine acids are mainly specified by local conditions, such as granulometric structure of soils, distribution of carbonates in a profile, result of irrigation. The southern carbonate and mid-loamy chernozems are characterized not only with the least contents of humus, but also with weaker extent of organic matter humification and structurization of humine acids' molecules.

General features of soils studied are: cumulative distribution of humus over the profile; humatic and fulvato-humatic type of humus(Chac:Cfac ratio within 2.02-2.27 in ordinary chernozems and within 1.76-1.84 in southern chernozems); high degree of organic matter humification (~30%); a considerably condensed status of aromatic nuclei in humine acid molecules (at E4:E6 ratio about 2.8-3.2); in this concern, typical are medium and high buffer abilities in acid and alkaline intervals, depending on degree of humus concentration, carbonate indices and granulometric structure of soils.

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Table Indices of humus status and buffer properties of chernozems in the southwest of Ukraine

Soils/Location	**Depth, cm**	**Horizon**	**Physical Clay Contents, %**	**Humus Contents, %**	**RHAC/PHAC ratio**	**Chac:Cfac ratio**	**Degree of Organic Residues Humification, %**	**E 465 0.001%**	**E4 : E6 ratio**	**pH-Index**
1	2	3	4	5	6	7	8	9	10	11
southern carbonate chernozem	0-11	H	35.73	2.16	0.58/0.041	1.87	26.9	0.177	3.2	7.15
	11-24	H	35.63	2.03		1.56	28.5	0.185	3.0	8.35
southern chernozem	0-4	H	42.32	2.62	0.64/0.051	2.27	40.0	0.223	2.8	5.70
	4-34	H	43.84	2.9		2.16	37.1	0.236	2.9	6.85
southern post- irrigated chernozem	0-10	H	46.31	2.43	0.53/0.043	1.74	36.2	0.223	2.9	6.40
	10-20	H	46.73	2.57		1.71	34.9	0.174	2.9	7.48
ordinary micellar & carbonate chernozem	0-15	H	48.5	3.64	0.73/0.050	1.84	26.5	0.195	3.0	6.60
	15-25	H	46.74	3.34		2.09	31.7	0.199	2.9	7.10
ordinary chernozem	0-10	H	52.07	3.86	0.73/0.052	1.76	31.1	0.275	2.9	5.66
	10-20	H	52.53	3.59		2.21	38.5	0.25	2.9	6.87

HYDRATION OF RAPESEED OIL USING AN ELECTROMAGNETIC FIELD.

P.I. Osadchuk

Department of Agroengineering, Odessa State Agrarian University, Odessa, Ukraine

Abstract: The prospects of using physical fields for the process of rapeseed oil purification are considered. The analysis of the existing research on the use of the processing of liquid food products by the electromagnetic field is carried out. In the context of the influence of the process of separation between two or more inhomogeneous media in the systems "liquid - liquid" and "liquid - solid". An experimental plant for the hydration of vegetable oils with processing by an electromagnetic field has been developed. Experimental studies of this process are presented, which were carried out in order to intensify and increase the release of the amount of phosphorus-containing substances, fatty acids, waxes and other related substances. The obtained results of experimental studies confirmed the positive expectations. The graphic material is presented that describes a physical experiment, the result of which is the receipt of the recommended parameters for using the electromagnetic field. Under these conditions, a high quality oil is obtained. Energy costs are reduced by intensifying the process.

Keywords: vegetable oil, electromagnetic field, hydration, phosphatides

INTRODUCTION. The content of related substances, including phosphatides, in vegetable oils varies significantly and depends on their type, as well as on the method and mode of their production.

From a physiological point of view, it is highly desirable to eat oils with a maximum phosphatide content. In practice, this cannot be done, since phosphatides easily dissolve in oils at the temperatures of their production, and then, upon cooling, are spontaneously released from them. The sediment formed quickly deteriorates due to the course of intense oxidative, enzymatic and hydrolytic processes. Taking this into account, in the process of production and processing, sunflower oil, as a rule, undergoes partial or complete refining [1, 2].

RELEVANCE. Due to the growth of consumer demand for vegetable oils in packaged and bulk form for home cooking, public and diet food networks. One of the most urgent tasks in a market economy is improving the quality and competitiveness of domestic types of vegetable oils, which have increased biological value and stability during long-term storage.

ANALYSIS OF LITERARY SOURCES. The work [3, 4] discusses a new understanding of the removal of related compounds from waste and by-products generated during the production of olive oil. The use of electromagnetic pulses for the extraction of polyphenols, fatty acids, coloring pigments, etc. is presented. However, in this case, the electromagnetic field is not used for cleaning the finished product.

In work [5], experiments are presented that showed the possibility of using pulsed electric fields for various technologies in the food industry. It is emphasized that these technologies are a valuable tool that can improve the functionality, extractability and release of valuable nutrients, as well as the bioavailability of trace elements and components in various food products. However, despite the fact that the positive effect of the use of electromagnetic fields is highlighted in the work, its use in the purification of vegetable oils is not given.

The work [6] shows the advantage of using electromagnetic fields over thermal technologies that are used in the processing of liquid food products. The main results achieved within the framework of the integrated project FP6 EU "NovelQ", which concerns the influence of electromagnetic fields on the main compounds that affect the properties associated with product quality, are summarized. However, the experiments are given for a variety of non-viscous liquids. In [7], the phenomenon of electroporation caused after the application of pulsed electric fields during the processing of food tissues is presented, which leads to an improvement in the connections between the intra- and extracellular content, which makes it possible to increase the likelihood of coagulation formation. However, these experiments were carried out with the aim of intensifying ice formation.

Based on the above experiments, it can be assumed that using an electromagnetic field, intensification of the micelle formation process will be observed when phosphatides are removed from vegetable oils. This is also confirmed in papers [8, 9, 10, 11]. Where it is shown that each stage of refining (refining) of sunflower oil is characterized by its own specific characteristic frequency of the external sinusoidal field, at which the electrical conductivity of the oil remains constant, and it is called characteristic electrical conductivity. Research on the use of electromagnetic treatment for the production of wax and wax-like substances from sunflower oil. The obtained positive results in the intensification of this process.

However, it remains relevant to conduct experiments on the effect of an electromagnetic field on the process of hydration of vegetable oils in order to remove phosphorus-absorbing substances.

PURPOSE OF RESEARCH. The purpose of the study is to determine the technological parameters of electromagnetic processing of raw materials by conducting experimental modeling of the process of hydration of vegetable oil under the influence of an electromagnetic field. This will increase the amount of phospholipid removal and intensify the hydration process.

To achieve the goal, the following tasks were set:

- to create a design of an experimental installation for processing oil by an electromagnetic field;

- to develop a methodology for determining the effective band of the electromagnetic field strength, miscella temperature and hydration time of vegetable oils;

- to carry out experimental studies with the help of which to recommend rational technological parameters of the use of the electromagnetic field during oil hydration.

EXPERIMENTAL RESULTS

Despite a number of research and development, there is still no rational way to remove a complex sludge from the oil, which forms a so-called mesh in the oil when the temperature drops, worsens the presentation of the finished product.

Studies have shown that the amount of hydrophilic phosphorus-absorbing substances in unrefined sunflower press oil reaches an average of 0.4-0.5%. The molecules of these substances consist of two parts: hydrophilic, formed by the residues of phosphoric acid and alcohol, and hydrophobic, containing long chains of residues, fatty acids.

The most common method for extracting phosphatides from oils is hydration. This process combines the treatment of oils with water or highly diluted aqueous solutions of alkalis, salts and acids. In industrial practice, various modes are used that differ from each other in the amount of the hydrating agent, its composition, etc. Most often, water is used for hydration.

Thus, due to the presence of polar groups, phosphates have an affinity for water, they have the properties of hydrophilic colloids, which suggests a positive effect of the electromagnetic field during the hydration process. Therefore, to intensify the hydration process and increase the release of the amount of phosphorus-containing substances. We have carried out research on the influence of the electromagnetic field on this process.

The experiment was as follows. For the hydration process, the standard equipment UGRM - 20.2 was used with the use of an electromagnetic installation.

It is as follows. The apparatus consists of two concentric pipes of different diameters, located one inside the other. Oil flows through the outer pipe, it is galvanized, and the inner pipe is brass or stainless.

In the inner tube, three coils are located, which form a pulsed magnetic field with polarity, which alternates between the poles of the coil and the outer tube. The centering of the inner pipe is carried out by three ribs located at an angle of 1200. The sunflower oil is supplied through the lower branch pipe, and the outlet through the upper one. The magnetization of sunflower oil occurs in a concentric annular gap between the inner and outer tubes.

Technical characteristics of the apparatus.

The electromagnetic device can operate in damp heating and unheated rooms with air humidity up to 90%.

Nominal productivity - 1.5 m3 / hour.

The nominal speed of the oil is 0.3 m / s.

The maximum magnetic field strength is 200 kA / m.

Maximum device current - 1.2 A

The maximum power consumption is 25 watts.

Dimensions: length - 750 mm.

The pipe diameter is 48 mm.

Length of branch pipes 60 mm.

Diameter of branch pipes - 1/2 "

Weight no more than 15 kg.

The impulse power supply unit is designed to operate in dry heated rooms at an air temperature of 15-35 ° C and an air humidity of no more than 80%.

Power supply voltage - 220 V.

The maximum load current is 1.2 A.

Ripple current regulation range - 2-10 Hz.

The range of regulation of the current ripple amplitude is 0.5-1 A.

Dimensions: height - 150 mm.

Width - 150 mm.

Length - 180 mm.

Weight no more than 2 kg.

When the mixture of oil and water passed through the electromagnetic installation, the intensity of the electromagnetic field changed, as well as the temperature of the miscella itself. At the same time, the time of precipitation and its weight in percentage was recorded, relative to the total amount of phosphorus-containing substances in sunflower oil.Результаты проведенных исследований приведены на рисунках 1, 2.

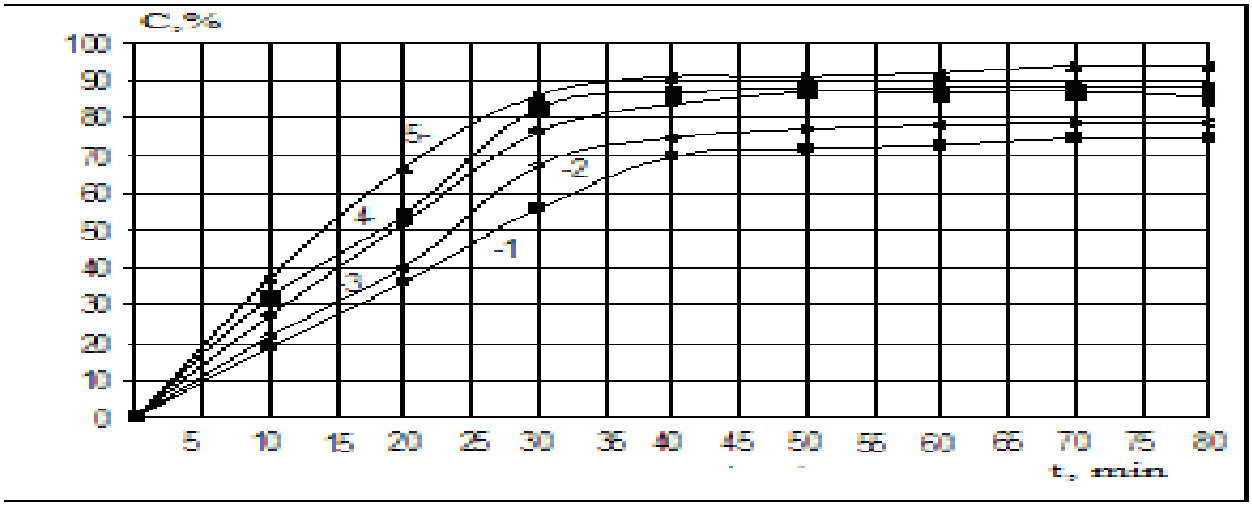

Figure: 1. Determination of the amount of removed phosphatides when the magnetic field strength changes: 1 - without an electromagnetic field, 2 - 115 kA / m; 3 - 135 kA / m; 4 - 155 kA / m; 5 - 175 kA / m.

Analyzing fig. 1 can be noted the observation of the positive effect of the influence of the electromagnetic field on the process of release of phosphorus-consuming substances. It can be seen from the family of curves that the amount of removed phosphatides without using an electromagnetic field is 15 percent less. Comparing the hydration process with a magnetic field strength from 115 kA / m to 175 kA / m, we see an increase in these indicators. However, the difference in the range of 155 - 175 kA / m is insignificant. Therefore, we determine the rational strength of the magnetic field 155 kA / m.

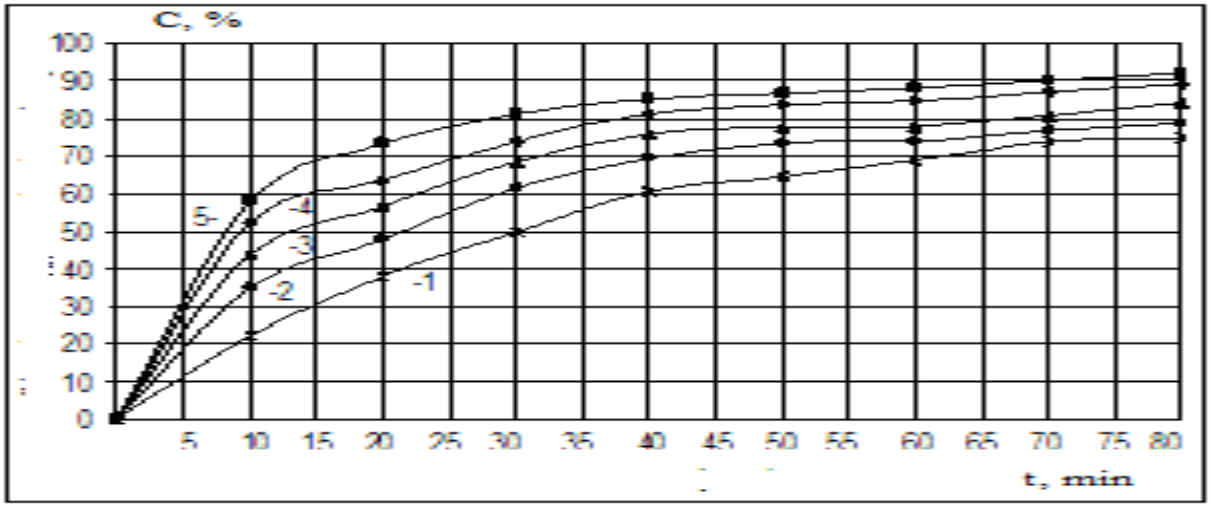

Figure: 2 Determination of the amount of sediment at a magnetic field strength of 155 kA / m, and various temperatures of the miscella: 1 - 20 ° C, 2 - 30 ° C, 3 - 40 ° C, 4 - 50 ° C, 5 - 60 ° C.

It can be seen from the family of curves in Fig. 2 that the amount of removed phosphatides with a change in the temperature of the miscella increases in direct proportion to the increase in temperature. The difference between sediment removal at minimum and maximum micelle temperatures is 15 percent. Comparing the hydration process with a miscella temperature from 20 ° C to 60 ° C at a magnetic field strength of 155 kA / m, we see an increase in the coagulation rate and the amount of sediment. However, the difference in the range from 50 ° C to 60 ° C is insignificant. Therefore, we determine the rational temperature of the miscella 55 ° C. Also, based on the obtained experimental dependencies, it is possible to determine the rational time of treatment with an electromagnetic field, which is one hour.

Figure 3 shows the percent removal of phosphotides with and without an electromagnetic field.

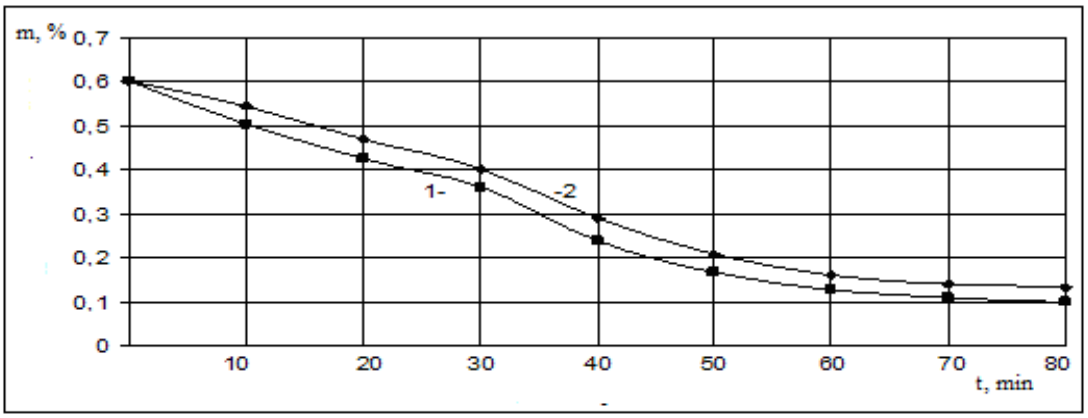

Figure 3. The number of removed phosphatides: 1- using an electromagnetic field; 2- without the use of an electromagnetic field

An intensification of the process is observed when using an electromagnetic field. The graphs show an increase in the rate and amount of phosphatide removal when using an electromagnetic field. The recommended parameters for using the electromagnetic field are the magnetic field strength of 155 kA / m, the miscella temperature is 55 oC, the rational time for the process is one hour.

CONCLUSIONS.

1. The design of an experimental installation for processing oil by an electromagnetic field has been developed.

2. The method for determining the effective band of the electromagnetic field strength, the miscella temperature and the hydration time of vegetable oils is presented;

3. The recommended technological parameters at which the intensification of the process of hydration of vegetable oils through the use of an electromagnetic field is observed.

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CLEANING SUNFLOWER OIL USING THE ULTRASONIC FIELD

P.I. Osadchuk, D.P. Domuschi

Department of Agroengineering, Odessa State Agrarian University, Odessa, Ukraine

Abstract: The options for using the ultrasonic field for primary cleaning of sunflower oil are considered. Developed an experimental installation with ultrasonic generator for purification of sunflower oil under the influence of ultrasonic field. Experimental studies of the effect of ultrasonic cavitation by changing the frequency and power of the electrical signal supplied to a magnetostrictive transmitter are presented. The technological parameters of the process of purification of sunflower oil by ultrasonic treatment have been determined.

Keywords: sunflower oil, ultrasonic field, cleaning process, magnetostrictive emitter, ultrasonic generator, ultrasonic cavitation.

INTRODUCTION

The oil and fat industry produces a wide range of fat products. The most significant part of these products are vegetable oils [5]. Compared to other foods, oils are high in calories and are primarily the main source of energy. Human energy costs are provided by fats by about 33% [5, 14].

Sunflower oil is obtained from finely ground heated sunflower seeds by pressing (squeezing) or extraction. Due to their composition, vegetable oils are physiologically active substances, and their nutritional value is determined by the content of polyunsaturated fatty acids necessary for the human body to build cells [1, 6].

BACKGROUND AND MEANS FOR SOLVING THE PROBLEM

Among the factors that form the quality of vegetable oils, there are: raw materials and production technology. The quality indicators of the oils of the same name are closely related to the degree of their purification. When assessing the quality of vegetable oil by physical and chemical indicators, the most important are: color number, acid number, mass fraction of moisture and volatile substances, mass fraction of phosphorus-containing substances [3, 7].

Organoleptic indices are significant in determining the type and raw material belonging of vegetable oils, physical indices - in identifying vegetable oils, reveal the refractive index, viscosity, pour point [13]. Oil is rejected if it has unsuitable physical and chemical parameters, the content of pesticides, heavy metals, mycotoxins, is higher than the permissible amounts. The lion's share of all quality indicators falls on the cleaning process. Therefore, the better the refined oil, the better it is [2, 4].

The use of physical methods for purifying liquids has certain advantages, which are low energy consumption, environmental friendliness, low hydraulic resistance of devices [12]. All kinds of vegetable oils, animal fats, their solutions, various petroleum products, biofuels of vegetable origin, transformer oil, etc. are among the liquids that can be purified using an ultrasonic field [9, 11].

Taking this into account, a promising direction is the improvement on the basis of existing equipment, complex oil purification. Using physical fields that provide an increase in the coagulation of related substances, as a result of which it is easier to remove them from oils and obtain a high quality finished product.

PURPOSE OF THE STUDY

The purpose of this study is to determine the recommended technological parameters for ultrasonic treatment of vegetable oils by conducting experimental modeling of the filtration process under the action of an ultrasonic field. This will make it possible to intensify the process of refining sunflower oil and obtain a high quality product.

EXPERIMENTAL PLANT FOR SUNFLOWER OIL FILTRATION USING ULTRASONIC WAVES

An experimental installation for the purification of sunflower oil using an ultrasonic field was developed and built (Fig. 1).

A magnetostrictive emitter was used as a working element for the formation of ultrasound. This installation assumes the use of appropriate equipment for the pressure filtration process. Based on the analysis of literary sources - the installations that were used earlier to conduct experiments in this direction, provided for filtration using inertial forces. This indicates the difference between the created experimental setup from other facilities that are currently used [8, 10].

The technological scheme is as follows. The apparatus consists of a primary reservoir with a valve, which is connected by a pipeline to a "cavitation chamber" (since the process of cavitation takes place in it, it was called a cavitation chamber). It has an opening for feeding raw materials, and an ultrasonic emitter is located in the middle. The so-called "ultrasonic mirror" is located in the lower part. The "cavitation chamber" is connected by a pipeline to a gear pump, which is driven through a rigid coupling with an electric motor. The pump is connected by a pipeline to a filter, which in turn is connected to the finished product reservoir.

Figure: 1. Experimental setup for the purification of sunflower oil using an ultrasonic field

Specifications:

Power supply unit (generator). Transistor. Made as a separate unit. Can be installed separately from the unit.

Designed for work in dry rooms at an air temperature of 15 - 35□C, and an air humidity of no more than 80%.

Supply voltage - 220 V.

The frequency control range is 17 - 320 kHz.

Amplitude adjustment range - 5 - 50 V.

Width - 650 mm.

Length - 350 mm.Высота - 175 мм.

Weight no more - 10 kg.

The experiments were carried out on 2 types of oil:

- obtained by hot pressing from last year's sunflower seeds;
- obtained by cold pressing from fresh sunflower seeds.

Method for the experimental determination of the parameters of ultrasonic waves

The primary tank is filled with pressed unfiltered, partially settled sunflower oil. A pre-weighed filter element is inserted into the filter. The ultrasonic generator is tuned to the desired frequency. The timer is set at the desired time. A container for the final product is being prepared. An oscilloscope for voltage measurements is turned on, which is connected to the generator output. The ultrasound emitter is also connected there.

After opening the damper, the oil enters the cavitation chamber by gravity. The ultrasonic generator is turned on and the oil is processed by ultrasonic vibrations for a specified time. An "ultrasonic mirror" reflects

and directs ultrasonic waves to improve the efficiency of the irradiation. Then the generator turns off and the electric motor turns on. Sunflower oil is pumped into the filter by a gear pump and filtered under pressure <0.2 MPa. After the filter, the oil enters the finished product tank. The filter is disassembled and the filter element is weighed.

The pump is driven by an electric motor. The electric motor runs at a predetermined frequency and is controlled by pressing a button. Reusable filter with replaceable filter element (belting - fabric).

The article presents ultrasonic cavitation during sounding of sunflower oil with a flat vibrator. Sounding takes place at a frequency of 24 kHz and a power in the vibrator of about 900 W. A black vibrator is visible in the center of the cuvette. At its end, a kind of "fog" spreads - this is ultrasonic cavitation. It can be observed for the appearance of "fog", as well as for the appearance of a characteristic hiss, the level of which increases with increasing power.

Ultrasonic cavitation with a round vibrator with a diameter of 8 mm takes place at a frequency of 43 kHz and a power in the vibrator of about 800 W.

The vibrator, the main part of which is immersed in oil, excites ultrasonic vibrations in it, which lead to liquefaction and squeezing of the liquid. The microbubbles combine (coagulate) into stable embryos, which can then be separated from the bulk (filtered).

The restructuring of the medium during ultrasonic cavitation is achieved by the adiabatic compression of voids and the formation of a low-temperature plasma mode when the cavitation microbubbles collapse.

The value of the intensity of the acoustic field in the medium substantially depends on its initial state. If the system is in a state close to thermodynamic instability (metastable state), then an external influence, even of low intensity, can bring it into a qualitatively new state.

The system goes into a state of instability when the value of any characterizing parameter (pressure, temperature) is close to critical.

This mode promotes the destruction of macromolecules of impurities, pollutants and living organisms.

The experiments were carried out in a heated room with good lighting and ventilation.

RESULTS OF STUDIES

In the course of experimental studies of the effect of ultrasound on the oil purification process, the following were determined:

- oil filtration temperature when changing the frequency of ultrasonic vibrations of the emitter, which is presented in Table 1.

Table 1: Oil filtration temperature when changing the frequency of ultrasonic vibrations of the transmitter

Ultrasound emission time, s	Ultrasonic vibration frequency, kHz				
	25	50	75	100	150
100	24	26	28	35,2	40,4
200	30	36,3	44	52,6	58
300	38,9	47	52,2	59,3	65,6
400	44,8	52	57,8	62,6	67,8
500	48,5	56	60,4	65,2	68,9
600	48,5	56,1	60,4	65,2	68,9

- the amount of sediment at an irradiator power of 1.3 kW, and different oil temperatures, which are presented in Table 2.

Table 2: Amount of precipitate separated after filtration at a feed power of 1.3 kW and a frequency of ultrasonic oscillations of the feed of 120 kHz

Filtration time, s	Oil temperature, ^{0}C				
	20	30	40	50	60
30	0,5	1,2	2	2,89	4,18
60	2	2,93	3,84	4,85	5,64
90	2,5	3,5	4,65	5,4	6,2
120	3,34	4,23	5,3	5,89	6,54
150	3,94	4,69	5,5	6,7	6,78
180	4,36	5	5,85	6,45	6,9
240	4,66	5,28	6,06	6,56	7,07
280	4,9	5,49	6,12	6,66	7,16

- the amount of sediment obtained during the filtration of oil with different intensities of the ultrasonic signal is shown in fig. 2.

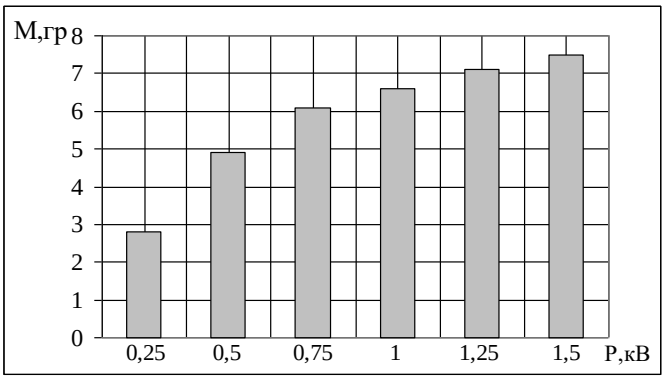

Figure: 2. Determination of the amount of sediment in 200 seconds of filtration at an oil temperature of 50 ^{0}C and changing the power of ultrasonic vibrations

- the amount of sediment for 200 seconds of filtration and the change in oil temperature is shown in fig. 3.

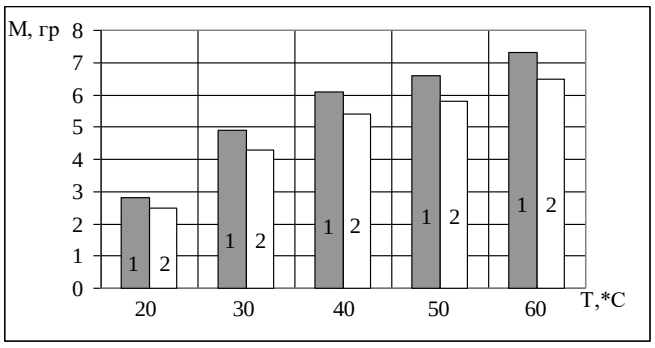

Figure: 3. Determination of the amount of sediment in 200 seconds of filtration and change in oil temperature:

1 - power of ultrasonic vibrations 1.3 kW;

2 - without the use of ultrasonic vibrations

Analyzing the obtained experimental data, the determination of the oil filtration temperature with a change in the frequency of ultrasonic vibrations, we see an increase in the oil temperature with time, with an increase in the radiation of ultrasonic waves. This can be explained by the fact that when ultrasound is

absorbed in a liquid medium, acoustic energy is converted into thermal energy. The graph shows that the heating time at an ultrasonic frequency of 24 kHz is three times longer than at 130 kHz. However, the difference in heating in the 115-130 kHz range is negligible. Therefore, we determine the rational vibration frequency of 120 kHz.

As for the determination of the amount of sediment after a certain filtration time at a certain frequency of ultrasonic vibrations, we see an increase in the amount of sediment over time with increasing temperature. So at a temperature of 20 □C, the amount of sediment obtained is one and a half times less than at a temperature of 60 □C - for the same oil filtration time. Comparative analysis of the difference in the amount of the precipitate obtained at a filtration temperature of 55 ° C without the use of ultrasonic vibrations and with its use was 10% in favor of ultrasound. With a change in the irradiation power, we also see the dependence of an increase in sediment removal with an increase in the power of ultrasonic vibrations.

With a change in the irradiation power, we also see the dependence of an increase in sediment removal with an increase in the power of ultrasonic vibrations.

In the range of 0.25-1.5 kW, the amount of sludge more than doubled. But the increase in sludge production in the ranges of 1-1.5 kW varies insignificantly, therefore, we take a rational oscillation power of 1.3 kW. Using the obtained data, taking into account certain effective parameters of exposure to ultrasonic vibrations, we take a filtration time of 200 seconds. The time taken is sufficient to remove the maximum amount of sludge with rational energy consumption.

The above experimental studies indicate that when using ultrasonic waves in the process of sunflower oil filtration, there is an increase in the amount of removed sediment and a reduction in the process time. Compared to conventional filtration, the removal of impurities by ultrasonic field treatment increased by 12%.

During the experiments, it was found that the following technological parameters for using the ultrasonic field can be recommended: the power of ultrasonic vibrations is 1.3 kW, the frequency of ultrasonic vibrations is 120 kHz, the processing time is 200 seconds, and the oil temperature is 55 55C. At the same time, an optimal effect on the removal of suspended solids is achieved and, accordingly, an intensification of the filtration process occurs.

CONCLUSION

With the help of the created experimental setup, sunflower oil is filtered using ultrasonic waves, where it is processed with a magnetostrictive emitter.

The recommended technological parameters have been determined, at which there is a decrease in filtration time and an increase in the amount of recovered accompanying substances.

Using this technology, an oil is obtained that meets the standard, without hydration and processing at low temperatures. This leads to a reduction in energy costs and equipment in the oil refining process.

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ECONOMIC EFFICIENCY OF COMPLETE FEED PRODUCTION PROVIDED THE USE OF PROTEIN AND VITAMIN SUPPLEMENTS FOR BROILER CHICKENS AGED 1-3 WEEKS 5%

Igor Fedorovych Riznychuk, Olena Kostiantynivna Kyshlaly

UDC: 636.52 /.58.085.55: 330.131.5

Igor Fedorovych Riznychuk, Candidate of Agricultural Sciences,

Associate Professor

Odessa State Agrarian University

Olena Kostiantynivna Kyshlaly, Assistant

Abstract

Feeding of young poultry was carried out with complete feed for broiler chickens aged 1-3 weeks.

The nutritional value of 1 kg of complete feed is 12.5 MJ of metabolic energy. 1 kg of compound feed contains: dry matter - 860 g, crude protein - within 230 g, lysine - not less than 14 g, methionine + cystine - 10, threonine - 9, tryptophan - 2.8, crude fat - 50, crude fiber - not more than 40, sodium - not more than 2, calcium - not less than 8 and phosphorus - 6 g.

Compound feed is balanced with the content of normalized microelements and vitamins, includes enzymes, antioxidant and adsorbent.

The basis of complete feed for broiler chickens aged 1-3 weeks are grain feed, plant protein concentrates, protein-vitamin supplement and fuz oil.

The live weight of broiler chickens at 3 weeks of age is 950 g, with an average daily gain for the period of 45 g. Feed costs for the period of feeding broiler chickens aged 1-3 weeks - 1.17 kg, feed conversion - 1.3 kg , the cost of 1 kg of live weight gain - 15 UAH.

According to the results of the research it is established that the production of complete feed with the use of protein-vitamin supplements for broiler chickens aged 1-3 weeks, 5 % and developed by us, allows to optimize the protein, amino acid, mineral and vitamin nutrition of broilers, affects on the productive qualities of animals positively, provides high efficiency of feed use, meets the requirements of intensive production, and it is characterized by positive economic efficiency.

Keywords: broiler chickens, complete feed, amino acids, calcium, phosphorus, feed conversion.

INTRODUCTION

The essential condition for the intensification of poultry industry is the organization of complete feeding, which ensures the formation of high productivity of modern poultry breeds and economic efficiency of production.

THE AIM OF THE STUDY

To study the economic efficiency of complete feed production with the use of protein and vitamin supplements for broiler chickens aged 1-3 weeks 5%.

MATERIAL AND METHODS

To solve this goal it was necessary to develop the recipe for complete feed and protein-vitamin supplement for broiler chickens aged 1-3 weeks, to weigh young animals at the daily and 21-day age, to determine the conversion of feed and the cost of 1 kg live weight gain of broiler chickens.

The research was conducted at the private enterprise Riznychuk I.F., in Ovidiopol District of Odessa Oblast.

Broiler cross ROSS 308 (ROSS 308 BROILER), norms of concentration of energy and nutrients in 1 kg of complete feed for broiler chickens, protein and vitamin supplement for broiler chickens aged 1-3 weeks 5%, complete feed for broiler chickens aged 1-3 weeks.

For the experiment, 100 heads of broiler chickens per day were selected.

Productive qualities of broiler chickens were determined by the dynamics of their live weight and average daily gains, the efficiency of feed use - by the cost of feed per 1 kg of meat poultry growth.

THE MAIN RESULTS OF THE STUDY

According to the latest developments, the feeding of young poultry was carried out with complete feed for broiler chickens aged 1-3 weeks.

The nutritional value of 1 kg of complete feed is 12.5 MJ of metabolic energy. 1 kg of compound feed contains: dry matter - 860 g, crude protein - within 230 g, lysine - not less than 14 g, methionine + cystine - 10, threonine - 9, tryptophan - 2.8, crude fat - 50, crude fiber - not more than 40, sodium - not more than 2, calcium - not less than 8 and phosphorus - 6 g.

Compound feed is balanced with the content of normalized microelements and vitamins, includes enzymes, antioxidant and adsorbent.

Complete feed for broiler chickens was made from crushed grain of cereals (wheat, barley, corn) - 58%, vegetable protein concentrates (sunflower meal, soybean meal) - 35%, soybean oil - 2% and specially designed for the production of feed 5 % protein-vitamin-mineral supplement.

1 kg of protein-vitamin supplement for broiler chickens aged 1-3 weeks contains: metabolic energy - not less than 5 MJ, dry matter - 900 g, crude protein - 220, lysine - 64, methionine + cystine - 62, threonine - 33 , tryptophan - 1, crude fat - 10, crude fiber - not more than 20, sodium - 30, calcium - not less than 130 and phosphorus - 47 g.

Protein-vitamin supplement contains plant protein concentrates, critical amino acids, calcium carbonate, monocalcium phosphate, sodium chloride, sodium bicarbonate, prebiotic and premix, which includes trace elements, vitamins, enzyme complex, antioxidant and adsorbent.

The live weight of broiler chickens at 3 weeks of age is 950 g, with an average daily gain for the period of 45 g. Feed costs for the period of feeding broiler chickens aged 1-3 weeks - 1.17 kg, feed conversion - 1.3 kg , the cost of 1 kg of live weight gain - 15 UAH.

CONCLUSIONS

According to the results of the research it is established that the production of complete feed with the use of protein-vitamin supplements for broiler chickens aged 1-3 weeks, 5% and developed by us, allows to optimize the protein, amino acid, mineral and vitamin nutrition of broilers, affects on the productive qualities of animals positively, provides high efficiency of feed use, meets the requirements of intensive production, and it is characterized by positive economic efficiency.

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SOME INDICATORS OF MILK QUALITY DEPENDING ON SANITARY AND HYGIENIC CONDITIONS OF ITS OBTAINING

Ruslan Susol, Natalia Kirovich, Valentina Yasko, Elfeel Ayman

Odessa State Agrarian University

r.susol@ukr.net or kirovich.natalya.2017@gmail.com

Key words: milk quality, probiotic agent for udder processing before milking, bacterial contamination, acidity, milk grade.

INTRODUCTION

Milk and dairy products, due to their exceptionally useful properties, are one of the popular foods of the population. To obtain high quality milk, it is necessary not only to properly feed the animals, but also to comply with sanitary and hygienic conditions, violation of which leads to high bacterial contamination of milk, which is a favorable environment for the development of microorganisms [1].

Today, Ukraine has set a clear course for its activities in the World Trade Organization (WTO). The food laws of the member countries of this organization set quite strict requirements for food producers, thus protecting the health of consumers. The legislation of the World Trade Organization promotes the production of guaranteed quality and safe food. Its characteristic feature is that control over food production must be constant throughout the production chain, ie "from farm to table". Each link in this chain must be strictly controlled by both the state and producers. Such international cooperation in the field of ensuring the proper quality and safety of milk, raw milk and dairy products is carried out through Ukraine's participation in the work of international organizations; concluding international agreements; optimization of normative documents, norms and rules with international documents, norms and rules that determine the requirements for the quality and safety of milk, raw milk and dairy products, as well as veterinary and sanitary requirements; exchange of information on measures taken to ensure the proper quality and safety of milk, raw milk and dairy products [5].

The quality of milk is determined by a significant number of factors, among which unsatisfactory sanitary and hygienic conditions for its production are prominent. At the same time, the use of antiseptics of chemical origin can harm both the health of the animal and the environment. The use of probiotics to clean the udder before milking has an interest in terms of improving the quality of milk and requires serious study.

GOAL Determination of the effect of probiotic means for cleaning the udder before milking with the disinfecting effect of prolonged action "PIP Cleaner Skin" on the quality indicators of milk in the conditions of "Druzhba" agricultural cooperative of Saratsky district of Odessa region.

MATERIAL AND METHODOLOGY

To conduct research on the study of milk quality indicators, depending on the sanitary and hygienic conditions of its production, 2 groups of cows with 15 heads in each were formed.

In group I (control) milk was obtained in compliance with sanitary and hygienic conditions adopted on the farm.

In group II (experimental), wash the udder of cows thoroughly with 0.05% PIP Skin Cleaner before milking.

Milk for research was taken from whole milk in the amount of 2 kg. 2 series of studies were conducted.

The acidity, mechanical and bacterial contamination of milk were determined in the studied samples. Based on the obtained data, a grade of milk was established in accordance with the current DSTU 3662: 2018 “Raw cow's milk. Technical conditions "[3].

RESULTS AND DISCUSSIONS

The degree of purity of milk according to the standard - is one of the main indicators that are taken into account by DSTU when purchasing milk.

Mechanical impurities that degrade the quality of milk usually include: dust, hair particles, skin flakes, food particles and litter. All these mechanical impurities are one of the main sources of contamination of milk by microorganisms. Therefore, it is necessary to clean the cows an hour before milking, wash the contaminated areas with warm water, refrain from distributing dry feed before milking, change the litter regularly. All these seemingly simple steps will help you get the highest quality milk.

Indicators of mechanical contamination of milk of the control and experimental groups are presented in table 1.

Table 1

Indicators of mechanical contamination of milk

Group	Research	Number of samples	Degree of purity according to the standard		
			I	II	III
I (control)	I	15	5	9	1
	II	15	7	8	-
	Total	30	12	17	1
II (experimental)	I	15	14	1	-
	II	15	15	-	-
	Total	30	29	1	-

Analysis of the data in Table 1 shows that the milk obtained from cows of the control group according to the standard of purity in the majority (53.33-60.00%) belongs to group II, and therefore can be attributed only to grade II according to GOST 3662: 2018. In addition, in the first series of studies, one sample in the control group had group III in purity, ie such milk belongs to the non-grade and can be used only for processing in accordance with industry recommendations approved in the prescribed manner. And only 33.33-46.67% of milk from the studied in the control group was classified as group I according to the standard of purity, and, depending on other indicators taken into account by GOST, may be higher or first grade.

In the group where sanitary and hygienic measures aimed at obtaining good quality milk were carried out, the general picture was somewhat different. Observance of sanitary and hygienic conditions allowed to receive milk only of the I and II groups according to the standard of purity: 93,33–100,00% of the investigated samples were carried to the I group, and therefore, such milk can be carried to the highest and I grades; and only 6.67% of samples - to group II.

Milk acidity is the most important biochemical indicator, which is taken into account when accepting milk on milk processing enterprises.

Since the acidity of milk is judged on its quality, it is advisable to list the main reasons that affect changes in the acidity of milk. These are, first of all,: individual and breed features of cows, character of feeding; type and level of feeding; ration and feed quality; lactation period; the state of health of cows, the system of keeping animals (care, exercise, litter, massage, udder care); cleanliness and processing of milking machines and dairy equipment; personal hygiene of service personnel, the degree of contamination of milk with mechanical impurities and bacteria; the nature

and compliance with the processes of primary processing of milk (cleaning, cooling, storage); period and storage temperature conditions.

In milk, which is in favorable conditions for the development of microorganisms, the acidity increases rapidly due to the fermentation of milk sugar and the formation of lactic acid. Technological properties of such milk decrease.

The acidity of the studied milk samples is introduced in table 2.

Table 2

The results of determining the acidity of milk

Group	Research	Number of samples	Acidity , ºT		
			16–17	18–19	20 and more
I (control)	I	15	6	8	1
	II	15	7	8	-
	Total	30	13	16	1
II (experimental)	I	15	13	2	-
	II	15	15	-	-
	Total	30	28	2	-

The data in Table 2 show that most samples of milk of the control group I have an acidity of 18–19 ºT, which is 53.33%. Therefore, such milk cannot be referred to the highest grade. In addition, 6.67% of the studied samples of the control group had an acidity of 20 or more ºT, so according to the requirements of GOST 3662: 2018 can be attributed only to grade II.

At the same time, in the second experimental group, where the planned sanitary and hygienic measures were carried out, the indicators of milk acidity were somewhat different. Thus, in the II experimental group 86.67–100.00% of milk samples had an acidity of 16–17 ºT, ie this milk can be referred to the highest grade, and 13.33% of the studied samples with an acidity of 18–19 ºT - to the first grade . In addition, none of the samples of the experimental group had milk with an acidity of 20 or more ºT.

Thus, the implementation of a set of sanitary and hygienic measures has significantly improved the quality of milk in terms of acidity.

According to GOST, milk supplied to milk processing enterprises is evaluated for microbial contamination by reductase testing.

The reductase test is an indirect indicator of bacterial contamination of unpasteurized milk and is based on the fact that bacteria that got into the milk secrete various metabolic products, namely enzymes, including reductase. Reductase by its biochemical properties, redox enzyme, is able to decoloration methylene blue. If a solution of this dye is added to milk, it discolors under the action of reductase. Decoloration of methylene blue occurs in proportion to the content of reductase. The faster the decoloration, the more microorganisms in the milk and, as a consequence, the higher the bacterial contamination.

The results of the reductase test in the studied milk samples are shown in table 3.

Table 3

Indicators of bacterial contamination of milk

Group	Research	Number of samples	Total bacterial contamination, thousand CFU / cm3		
			≤ 300	≤ 500	≤ 3000
I (control)	I	15	2	8	5
	II	15	3	5	7
	Total	30	5	13	12
II (experimental)	I	15	13	2	-
	II	15	14	1	-
	Total	30	27	3	-

As can be seen from table 3, for milk I control group, characterized by high bacterial contamination of milk. Thus, the total bacterial contamination of milk ≤ 3000 thousand CFU / cm3 had 33.33-46.67% of milk samples; 33.33–53.33% of samples had a total bacterial contamination of milk ≤ 500 thousand CFU / cm3 and only 13.33–20.00% of the studied milk samples of the control group with a total bacterial contamination of milk ≤ 300 thousand CFU / cm3.

In the studied samples of milk of the II experimental group we observe the direct opposite: 86.67–93.33% of the studied samples had a total bacterial contamination of milk ≤ 300 thousand CFU / cm3, only 6.67–13.33% - a total bacterial contamination of milk ≤ 500 thousand CFU / cm3 and none of the studied samples had a total bacterial contamination of milk ≤ 3000 thousand CFU / cm3.

Thus, the test for reductase showed significant bacterial contamination of milk of the I (control) group, obtained on the farm SVC "Druzhba". This is due to contamination of milk with manure, particles of feed, litter, hair residues, etc., which was possible as a result of violation of zoohygienic conditions for milk production. By implementing the proposed sanitary and hygienic measures in production, it is possible to significantly improve the quality of milk in terms of sanitary and hygienic indicators.

Based on the requirements of DSTU 3662: 2018 "Raw cow's milk.Technical conditions" and the results of studies of mechanical contamination, acidity and reductase test were determined by the grades of milk, which are shown in table 4.

Table 4

Grade distribution of milk

Group	Research	Number of samples	Grades			
			Highest	I	II	Non- grade
I (control)	I	15	2	3	9	1
	II	15	3	4	8	-
	Total	30	5	7	17	1
II (experimental)	I	15	13	1	1	-
	II	15	14	1	-	-
	Total	30	27	2	1	-

The data in Table 4 show that the main amount of milk obtained in the first control group was grade II (53.33-60.00%); milk of the highest grade for the studied period was 13.33–20.00%, I grade - 20.00–26.67%, and the share of non-grade milk among all the studied samples of the control group was 6.67%.

When using the set of proposed sanitary and hygienic measures, the quality of milk has significantly improved. Thus, the milk of the highest grade in the II experimental group for the study period was 86.67-93.33% of all studied samples; Grade I - 6.67% and only one sample in the first series of studies was classified as Grade II. There was no non-grade milk in the samples of this group at all.

CONCLUSIONS

1. The use of probiotic means for cleaning the udder before milking "PIP Skin Cleaner" measures can improve the quality of milk in terms of mechanical contamination: the amount of milk in I group of purity in the control group is 40.00%, against 96.67% in the experimental group.

2. The milk's acidity of the II experimental group was lower (16–17 ° T - 93.33%; 18–19 ° T - 6.67%), compared with the control group I (16–17 ° T - 43.33%); 18–19 ° T - 53.33%; 20 ° T and more - 3.33%).

3. Milk of the control group had worse indicators of bacterial contamination compared to the experimental group: the number of samples with total bacterial contamination ≤ 300 thousand CFU / cm3 in group I reached 16.67% against 90.00% in group II.

4. Carrying out a set of sanitary and hygienic measures on the use of "PIP Skin Cleaner" significantly improves the quality of milk according to the requirements of the current standard of Ukraine: of all milk milked during the study period, 90.00% was of the highest grade, 6.67% - grade I and only 3.33% - grade II; in the control group, the values were 16.67%, 23.33%, 56.67% and 3.33% of milk, respectively.

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PROSPECTS FOR THE UTILISATION OF PIGSKIN OBTAINED FROM PIGS OF DIFFERENT BREED-OF-ORIGIN IN UKRAINE

R.L. Susol, A.V. Tatsiy

Odesa State Agrarian University, Odesa city, Ukraine

Abstract

The epidermis and dermis grow with time in pigs of all studied genotypes. The highest rates of skin growth are observed during the first month of age (the surface area of dermis increases by 29.4-62.5%) and then up to four months of age (the surface area of dermis increases by 5.3-23.0%). During subsequent stages of life, the surface area of dermis increases by 2.5-14.2% and 8.8-18.7% at 6 and 12 months of age, respectively. The absolute and relative thickness of the papillary dermis in pure-bred and hybrid pigs produced from "white" breeds (Large White and Landrace) are greater than those of pigs produced from "coloured" breeds (Pietrain and Duroc). The relative thickness of the papillary dermis increases with age in pigs of all studied genotypes. Notably, the relative thickness of the papillary dermis in pigs of different origin at the age of 120, 180 and 365 days is practically similar, which proves that both metabolism and adaptation are stabilised. Satisfactory suitability of pigskin as a raw material for the leather industry has been established, based on the morphology and main structural features of skins, obtained from pigs of the most popular breeds and genotypes – such as Large White, Landrace, Pietrain, as well as their hybrids: F_1 ½ (LW + L), F_1 ½ (P + D) and F_2 ¼ (LW + L+P+D) – which are common for commercial pig production in Ukraine.

Keywords: commercial pig, skins, popular breeds and genotypes, morphology, structural features.

Introduction

In Ukraine, there is a clear downward annual trend in numbers of all livestock species in the last 10-15 years. In particular, between 2010 to 2015, the number of pigs averaged about 7.5-8.0 million heads. The decline in the number of pigs down to 5.5-6.0 million heads since 2015 was caused by various issues associated with the spread of the African swine fever virus. In 2020, we can see a trend towards stabilisation and even increase in numbers of pigs up to earlier levels. The pig industry per se provides valuable energy foods (such as pork and back fat), as well as organic fertilisers of good quality, for the country's population. Moreover, pigskin is quite essential as a raw material for leather foot-wear and accessories industry. The leather industry is supplied with a large number of pigskins, whose utilisation has been increasing systematically due to their high availability and low cost of production. On the one hand, today, the usage of pigskin as a raw material for foot-wear manufacturing becomes increasingly popular, which is associated with its availability and relatively low cost. On the other hand, pigskin does not make a truly presentable appearance and it is predominantly used as a lining material rather than as the shell fabric. This is mainly due to the fact that pigskin is not elastic enough, it gets wet easily and tends to have a rather rough, hard surface and long-lasting odour. Besides, pig skin is not durable enough, which results in a texture full of holes in the end product.

Our research is aimed at finding out whether pigskin is currently suitable as a raw material for the leather industry, based on the morphology and main structural features of skins, obtained from pigs of the most popular breeds and genotypes – such as Large White, Landrace, Pietrain, as well as their hybrids: F_1 ½ (LW + L), F_1 ½ (P + D) and F_2 ¼ ((LW + L) + ½P) – which are common for commercial pig production in Ukraine.

Materials and methods

A research study was carried out under conditions of the pig farm of Artsyz Meat Company Ltd in Artsyz sub-region of Odesa region; the farm's production capacity is 16,000 heads of growing fattening pig stock. The conceptual experimental design is presented in Table 1.

Table 1. Experimental design.

Groups of pigs	Group description	Breed and breed-of-origin		
		sows	boars	offspring
I	Control	LW	LW	LW
II	Experimental	L	L	L
III	Experimental	P	P	P
IV	Experimental	LW	L	½ (LW + L)
V	Experimental	P	D	½ (P + D)
VI	Experimental	½ (LW + L)	½ (P + D)	¼ (LW + L+ P + D)

Note: LW – Large White breed; L – Landrace breed; P – Pietrain breed; D – Duroc breed.

We examined reproductive, fattening and carcass traits of young pigs of different origin using conventional zootechnical methods. Moreover, for the purpose of studying specific biological features of Pietrain pigs in more detail with respect to their level of adaptation and suitability of pigskin as a raw material, our task was to examine histological peculiarities of skin of Pietrain pigs as compared to those of other, the most common commercial lines and hybrids.

Samples of pigskin were collected at different age: at birth, at 30, 120, 180 and 365 days of age. All the samples were taken at one and the same anatomico-topographic site, that is, the right shoulder blade of the pig. The samples, taken using a sampling probe and standardised by size and shape, were fixed in 10% formalin.

The laboratory analysis of the skin samples was conducted at the Laboratory of Histology, Cytology and Embryology of the Petro Mohyla Black Sea National University using the equipment designed by the author and employing modified methods [4], with application of K. Zeiss optical instruments and Linvatec-2 halogen light source (USA) of 10-240 Wn.

Contrast staining in the histological preparations was undertaken using a correction filter ZhZGM 2.5x (Belarus). Microphotographs of histological sections were taken with digital camera Nikon D-60 (Austria) using a standard trinocular tube 1.6x and integrated digital exposure detector Minolta-EK (Japan). Morphometric analysis of tissue structures was performed with an integrated ocular micrometre. Reliability of the results obtained for glandular tissues was achieved through waxed reconstruction. This technique involves frozen semi-thin (15 mm) sectioning for histological spatial orientation with further synthesising 3-D images (MICAM, Belgium).

Correction of microphotographs was performed using Microsoft Office Picture manager and FastStone Image Viewer applications. The results obtained were analysed statistically using Microsoft Excel application, focusing on the calculation of standard deviations [1].

Results and discussion

According the data obtained, the epidermal layer is relatively thin, averaging 4-6% of the dermis thickness in the shoulder region. Such a tendency can be observed practically in all examined samples. This fact stems from relatively stunted hair growth, which is typical for the skin microstructure of domesticated representatives of this sub-species [3].

It has been established that hybrids, produced from Pietrain and Duroc breeds, especially tend to have thinner epidermal layer.

Macroscopically, the skin surface is made up of convoluted folds. As is seen in histological sections of skin samples of pigs representing older-age groups, cord tissues below such folds form long and narrow ridges, which are perpendicular to the surface of organs and embedded in the dermis to some extent. Such an architectonics contributes to peculiar pattern of the outer surface of the skin [2].

According to the data acquired from micrographs, the epidermis, being observed in caudal direction, includes the following layers: basal, spinous, granular and corneous; it can be observed in contrast exclusively in animals of older-age groups. It should be noted that a clear layer that can be detected around wrists is absent in the skin covering the shoulder blade of the pig.

As can be inferred from the microphotographs, the dermis lies deep to the epidermis, being separated from the latter by the basement membrane, which prevents interpenetration of adjacent layers. The dermis is well vascularised, which is associated with increased needs for thermoregulation in the absence of thick hair coat [5]. There is a large number of sebaceous glands within this layer. A distinctive feature of the dermal layer of the pigskin is that there is no division of the dermis into the papillary and reticular layers as the hair bulbs that serve as a boundary reference line are located within the hypodermis.

Since the quality of pigskins is determined by peculiarities of the dermal layer structuring, detailing of the pattern of its components is of great practical interest. By employing light optical techniques, we have discovered that elastic fibres form an extensive thin network in the dermis. They are the thinnest and locate perpendicularly to the skin surface, immediately beneath the epidermis. The analysis of histological sections enabled us to establish that in the apical layer of dermis, in the vicinity of the basement membrane, there are also elastic fibres of varying diameter, approaching in different directions. Such fibres can be often observed optically as almost homogeneous mass in the preparations of young piglet skin samples whereas in caudal direction we can observe immature elastic fibres that exhibit a moderate intensity of staining.

As follows from the micrographs (shown in Figures 1 and 2), the morphology of connective tissue that constitutes the bulk of the pig skin dermis shows the absence of distinct separation of layers. Looser upper layer gradually transforms into denser fraction wherein massive fibrous component prevails. Collagen is the main structural component of the dermis that ensures elasticity and firmness of the skin. It is worth noting that among the current variety of types of collagen, only certain types can be detected in the dermis using available light optical methods [5]. In particular, type III collagen is predominant in the post-natal skin, and its content increases during the first days of piglets' lives. According to our observations, in the skin of pigs of older-age groups, thinner fibres of type III collagen wrap around coarse fibres of type I collagen, thus determining the spatial orientation of the latter ones. Other types of collagen are amorphous and cannot form fibrils. At the micro level, they can be detected as peculiar acidophilic poorly stained cavities in between fibres.

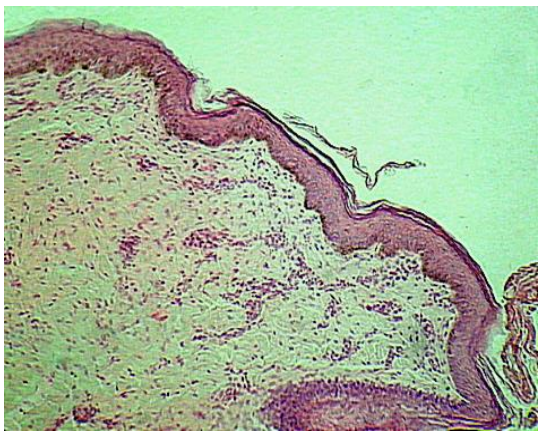

Figure 1. A sample from a Pietrain pig (30 days of age). Shoulder blade skin. Black area. Bömer's haematoxylin, counterstaining using a modified method by Tsinzerling. Correction filter ZhZGM 2.5x, X90.

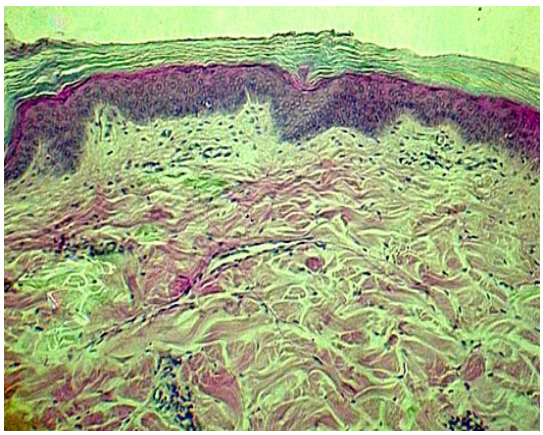

Figure 2. A sample from a Large White x Landrace pig (30 days of age). Shoulder blade skin. Bömer's haematoxylin, counterstaining using a modified method by Tsinzerling. Correction filter ZhZGM 2.5x, X90.

It has been established that collagen fibres (seldom their bunches) in the apical layer of dermis are delicate and thin; they are characterised by a relatively uniform distribution. In the medial layer, these fibres get thicker and form bundles and dense clusters. Collagen fibres in the region of shoulder blade are of better type which explains firmness and elasticity of the skin observed at this topographic region.

As has been described above, the contact between the epidermis and dermis results in the appearance of inner convoluted folds [2]. Our observations show that such folds are less prominent or absent in young pigs. It is likely due to the presence of hair coat in piglets that protects the skin from excessive mechanical shear, which is compensated by epidermal folds in pigs of older-age groups [2, 3].

Taking into consideration the existing stereotypic characteristics, there are some age- and breed-specific differences within certain histological components of the pig skin. As regards the first ones, the thickness of each layer increases with time. The dynamics of growth of organ components is shown in Table 2. The analysis of the data obtained has revealed a common biological pattern of growth: the epidermis and dermis grow with time in pigs of all studied genotypes. The highest rates of growth are observed during the first month of age (the surface area of dermis increases by 29.4-62.5%) and then up to four months of age (the surface area of dermis increases by 5.3-23.0%). During subsequent stages of life, the surface area of dermis increases by 2.5-14.2% and 8.8-18.7% at 6 and 12 months of age, respectively.

With regard to the selection and adaptive ability, the papillary layer of dermis is of research interest; the growth of this layer is indicative of higher adaptive ability, and hence higher breeding value of the pig. For instance, in our study, we have established that the absolute and relative thickness of the papillary dermis in pure-bred and hybrid pigs produced from "white" breeds (Large White and Landrace) are greater than those of pigs produced from "coloured" breeds (Pietrain and Duroc). Moreover, there is a common biological pattern, that is the relative thickness of the papillary dermis increases with age in pigs of all studied genotypes. Notably, the relative thickness of the papillary dermis in pigs of different origin at the age of 120, 180 and 365 days is practically similar, which proves that both metabolism and adaptation are stabilised.

Table 2. Age-specific peculiarities of shoulder-blade skin layers of pigs of different breed- or hybrid origin (in mcm), n = 6.

Breed/hybrid	Colour	Skin layer, mcm			
		Epidermis	Papillary dermis		Dermis
			mcm	% thickness	
At birth					
LW	white	34.0±2.27	300.0	36	830.0±16.23
L	white	31.0±1.53	284.0	35	810.0±16.23**
P	black spotted	23.0±1.26**	167.0	29	575.0±11.01
½ (LW + L)	white	30.0±2.25	278.0	37	750.0±15.26
½ (P + D)	red	24.0±2.13**	186.0	31	600.0±13.74**
¼ (LW + L + P + D)	white	26.0±1.46	218.0	34	640.0±15.83**
At 30 days of age					
LW	white	54.0±2.02	496.0	46	1079.0±24.49
L	white	51.0±2.49	472.0	45	1048.0±22.61
P	black spotted	37.0±2.91***	274.0	37	740.0±27.75**
½ (LW + L)	white	49.0±3.19	424.0	41	1035.0±28.11
½ (P + D)	red	41.0±2.14**	311.0	39	797.0±25.64***
¼ (LW + L + P + D)	white	52.0±2.13	447.2	43	1040.0±31.48
At 120 days of age					
LW	white	75.0±1.29	880.0	71	1240.0±30.55
L	white	72.0±1.13	815.0	67	1216.0±32.86
P	black spotted	51.0±2.96***	512.0	59	868.0±29.37**
½ (LW + L)	white	65.0±2.88**	767.0	64	1199.0±34.46
½ (P + D)	red	58.0±2.35***	599.0	61	982.0±30.43**
¼ (LW + L + P + D)	white	69.0±2.03*	690.0	63	1095.0±27.79**
At 180 days of age					
LW	white	81.0±3.50	890.0	69	1290.0±33.64
L	white	79.0±3.33	862.0	68	1268.0±31.40
P	black spotted	59.0±2.98***	624.0	63	991.0±28.52**
½ (LW + L)	white	76.0±3.60	843.0	68	1240.0±32.43
½ (P + D)	red	64.0±3.00**	654.0	65	1007.0±29.61**
¼ (LW + L + P + D)	white	77.0±3.48	810.0	67	1209.0±34.36*
At 365 days of age					
LW	white	85.0±4.68	1015.0	72	1410.0±37.88
L	white	83.0±3.71	966.0	70	1380.0±34.79
P	black spotted	67.0±3.32*	696.0	65	1070.0±32.46**
½ (LW + L)	white	81.0±3.54	932.0	69	1350.0±41.72
½ (P + D)	red	73.0±4.12	797.0	67	1190.0±35.80*
¼ (LW + L + P + D)	white	80.0±4.28	951.0	71	1340.0±37.14

Note: *P<0,05; **P<0,01; ***P<0,001; epidermis is the sum of smooth and wrinkled caudices.

Conclusions

The epidermis and dermis grow with time in pigs of all studied genotypes. The highest rates of skin growth are observed during the first month of age (the surface area of dermis increases by 29.4-62.5%) and then up to four months of age (the surface area of dermis increases by 5.3-23.0%). During subsequent stages of life, the surface area of dermis increases by 2.5-14.2% and 8.8-18.7% at 6 and 12 months of age, respectively.

The absolute and relative thickness of the papillary dermis in pure-bred and hybrid pigs produced from "white" breeds (Large White and Landrace) are greater than those of pigs produced from "coloured" breeds (Pietrain and Duroc).

The relative thickness of the papillary dermis increases with age in pigs of all studied genotypes. Notably, the relative thickness of the papillary dermis in pigs of different origin at the age of 120, 180 and 365 days is practically similar, which proves that both metabolism and adaptation are stabilised.

Satisfactory suitability of pigskin as a raw material for the leather industry has been established, based on the morphology and main structural features of skins, obtained from pigs of the most popular breeds and genotypes – such as Large White, Landrace, Pietrain, as well as their hybrids: F_1 ½ (LW + L), F_1 ½ (P + D) and F_2 ¼ (LW + L + P + D) – which are common for commercial pig production in Ukraine.

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EXPANSION OF TECHNOLOGICAL CAPABILITIES OF DIAGNOSTICS OF FINISHING THREAD GRINDING OPERATIONS

S.M. Uminsky, I. I. Dudarev

Cand. tech. Sciences, S.M. Uminsky, Cand. tech. Sciences, I. I. Dudarev,

Odessa, Ukraine
ymoshi@ukr.net

Abstract.

When machining lead screws, the accuracy of thread grinding is influenced by random factors, in particular, axial temperature and residual deformations of the machined parts. Therefore, for high-precision thread processing of premium lead screws, in addition to ensuring the accuracy of thread grinding, it is necessary to use a rational finishing grinding technology.

The existing methods for increasing the accuracy of finishing grinding can be conditionally divided into methods that allow to eliminate the influence of systematic components of the processing error and methods that allow taking into account the influence of a random component.

The paper proposes a method for automated grinding, which makes it possible to take into account the errors of the kinematic chains of the grinding machine. According to this method, a preliminary measurement of machine errors is made, for example, errors of movement of the working bodies of the machine, and then these errors are recorded in the memory of the numerical control system in the form of a spreadsheet, in accordance with the data of which corrective actions are developed, or the error is described functionally, and a mathematical model is fixed in the memory of the system, which reduces the amount of memory occupied. Proactive active control of temperature deformation of precision screws, produced by an automatic system, allows to stabilize temperature deformation at the level of correction setting, and thereby eliminate the random component of the accumulated error of the thread lead.

Keywords: grinding, residual stresses, solid lubricant, system.

1. Introduction.

In addition to ensuring the precision of the grinding machine, it is necessary to use rational finishing grinding technology for high-precision machining of the threads of high-quality lead screws.To increase the stability of the thread grinding technological process, modern machine models are equipped with numerical control systems that allow you to program the thread grinding working cycle. For example, screws 63x10mm with a thread length of 1200 mm after processing had a variation in the accumulated pitch error from 13 to 38 microns, although the technology and processing modes were unchanged [1]. The system of active control of the axial elongation of the screw during grinding, which is equipped with a numerically controlled machine, does not allow time to correct the technology and modes of thread grinding, since the influence of the technological transition on the value of this elongation can be detected only after the end of this technological transition.

2. Research results.

The existing methods for increasing the accuracy of finishing grinding of threads can be conditionally divided into methods that allow to eliminate the influence of systematic components of the processing error and methods that allow taking into account the influence of a random component. The first group includes methods aimed at increasing the kinematic accuracy of the grinding machine. A method is proposed for eliminating errors in the kinematic chains of the machine by using a linear displacement meter of a laser interferometer. An attempt is made to take into account (compensate) the random component of the step error. The essence of the method consists in maintaining the constancy of the ratio of the increment in the angle of rotation of the product $\Delta\varphi$ to the increment in the table displacement ΔS, ($\Delta\varphi / \Delta S = const$), taking into account the axial deformation of the screw being processed. The control action is the movement of the machine table. With multi-pass machining, it becomes necessary to take into account thermal deformations. A method for compensating the random component of the thread pitch error is proposed, which consists in the fact that before the beginning of each transition, the axial temperature deformation of the workpiece is measured (measured using the displacement sensor of the tailstock quill of the machine) and the axial temperature deformation of the lead screw of the grinding machine. At large values of axial temperature deformations, which in this method of accuracy control change arbitrarily, a decrease in the correlation coefficient between the axial temperature deformation of the part and the accumulated error of the thread pitch is observed. To achieve this goal, it is necessary to control the axial temperature deformations of the machined lead screws that arise in the grinding process. The author [3] proposed a method for controlling axial temperature deformations when grinding threads with multi-thread wheels (rough grinding) by providing the following algorithm:

$$P/V\partial = const \quad (1)$$

where P is the power of grinding, Vd is the speed of the part. The device consists of such units as the active power sensor of the grinding wheel drive electric motor, an electronic voltage transducer, and units that serve to generate a signal.

The device works as follows. In the process of processing, the active power signal is amplified and enters the electronic converter device, where the part speed signal is simultaneously received. At the output of the device, a *P/Vd* signal is generated, which is compared with the value set in the reference block. If they differ, the speed of the part is automatically corrected by increasing or decreasing the latter until the condition is met: *P/Vd =P/Vd*. This method made it possible to significantly increase the processing accuracy during the multi-thread grinding operation, but it is unacceptable for the finishing multi-pass grinding operation. The *P/Vd* criterion is an energy criterion and determines the work spent on grinding a unit of length of the workpiece processed surface, i.e. actually characterizes the amount of heat introduced into the workpiece during multi-thread grinding. In this work, it was indicated that as the cooling intensity increases, the Biot criterion, the length of the cooling zone increases), the uniqueness of the dependence of the axial temperature deformation and the specified criterion ($\Delta L = f(P / Vd)$) is violated. This dependence takes place for conditions of low-intensity heat transfer, which is quite acceptable for a multi-strand grinding scheme, since the error is formed on the width of the grinding wheel, the effect of cooling can be neglected. The article proposes a method for increasing the grinding of threads based on the diagnostics of the technological operation. The mathematical model characterizing the technical state of the technological system of multi-pass single-thread grinding of threads [1] has the following form:

$$l_{ij} = \sum_{n=1}^{\infty} \frac{4\exp(-\mu_n^2 F_{02}) B_i^2}{\mu_n^2(\mu_n^2+B_i^2)} \left\{ \frac{qLRL_p\gamma}{s\lambda}(2F_{01} + \frac{1}{4} - \frac{2}{\mu_n^2} + \frac{1}{B_i} - \sum_{n=1}^{\infty} \frac{2\exp(-\beta_n^2 F_{01})\mu_n^2}{\beta_n^2(\mu_n^2-\beta_n^2)}) + l_{0ij} + (T_в - T_c)L_p\gamma \right\} - \gamma L_p(T_в - T_c) \quad (2)$$

where l_{ij}, $l0_{ij}$ – current and initial temperature elongation of the i-ro screw blank at the j-th technological transition; *Lp, R* – length of the threaded part and radius I of the workpiece; *Foi*= $a_{τi}$ / R^2 *(i = 1,2)* – generalized Fourier variables characterizing the heating time $\tau 1 = Lp\ a / \upsilon_o\ R^2$ and cooling $\tau_2 = lcool / \upsilon_o$, *Lp, L* are the length and width of the contact of a real heat source; $\upsilon_д$, $\upsilon_0 = \upsilon_д \sin\varphi$ – circumferential and axial speeds of the workpiece; $\varphi = arctan\ (s / 2\pi R)$ – thread rise angle; *S* – thread pitch; $Bi = \alpha / \lambda\ R$ – BIO criterion; α, γ, λ, α – coefficients of heat transfer, linear expansion, thermal and thermal diffusivity;

μn, βn are the roots of the characteristic equations I_0 (μ_n) Bi-I_1 (μ_n) $\mu_n = 0$ and I1 (βn) = 0; I0, I1 – Bessel functions of the first kind of zero and first order; *Tv, Tc* – air temperature.

Equation (1) describes the mechanism of formation of the lij value during finishing grinding. However, due to the complexity of this equation, it cannot be directly used for the mathematical support of the control computer. In a limited range of variation of the variables F_{01}, F_{02} and Bi, the function lij (F_{01}, F_{02}, Bi) can be represented by a linear relationship. For example, with 9.75 • 10-5 ≤ F01 ≤ 58.5 • 10-5; 0.0679≤F02≤0.2037 and 0.1≤Bi≤1.5 equation (1) will have the form:

$$l_{ij} = a_1 \frac{P_{ij}}{n_{ij}} - a_2 \frac{P_{ij}}{n_{ij}^2} + a_3 l_{0ij} - a_4 \frac{1}{n_{ij}} \quad (3)$$

where Pij, nij - grinding power (W) and part speed (rpm) at the j-th technological transition of the i-th machined screw; as (s = 1, 2, 3,4) - coefficients determined by the following formulas:

$$a_1 = 1{,}276L_P; a_2 = 5{,}815L_P; a_3 = 1 - 9{,}702/n_{ij} a_4 = 116{,}33L_P(T_в - T_c) \quad (4)$$

To ensure the adequacy of equation (2) to the real process, an automatic correction of this equation during the operation of the technological system is proposed. The essence of this principle consists in automatic correction of the coefficients as in equation (2) based on a comparison of the measured and calculated values of lij. For this, a sensor for the axial elongation of the screw is used, and the algorithm for correcting the mathematical model [2] is based on minimizing the difference between the actually measured (Lfij) and calculated (Lpij) values of axial temperature deformation.

In [4], an algorithm for correcting the mathematical model is described, which consists in determining the additions Δap to the coefficients as, according to the formula:

$$\Delta a_p = \frac{\Delta y \frac{\partial f}{\partial a_p} \frac{1}{c_p}}{\sum_{s=1}^{k} \left(\frac{\partial f}{\partial a_s}\right)^2 \frac{1}{c_s}} \quad (5)$$

where $\Delta y = (l_{\phi ij} - l_{pij})$ is the difference between the measured and calculated values of the predicted value; f (-) is the equation by which the predicted value is calculated; c_i – weighting factors allowing to adjust the value and ratio of calculated additions Δa_s.

Taking into account formula (3), the algorithm for determining the adjusted values of the coefficients of the mathematical model (2) will have the following form:

$$a_1' = a_1 + \frac{\Delta y}{A_{c_1}} \frac{P_{i1}}{n_{ij}}; \quad a_3' = a_3 + \frac{\Delta y}{A_{c_3}} l_{0i1};$$
$$a_2' = a_2 - \frac{\Delta y}{A_{c_2}} \frac{P_{i1}}{n_{i1}^2}; \; a_4' = a_4 - \frac{\Delta y}{A_{c_4}} \frac{1}{n_{ij}}; \tag{6}$$

where $\Delta y = (l_{\phi i1} - l_{pi1})$

$$A = \left(\frac{P_{i1}}{n_{i1}}\right)^2 \frac{1}{c_1} + \left(\frac{P_{i1}}{n_{i1}^2}\right)^2 \frac{1}{c_2} + \frac{l_{0i1}^2}{c_3} + \left(\frac{1}{n_{i1}}\right)^2 \frac{1}{c_4} \tag{7}$$

As a result of the analysis of the influence of the weight coefficients ci, (i = 1.4) on the forecasting accuracy lij under the conditions of automatic correction of equation (2) of the mathematical model according to the described algorithm, it has been established that there is an optimal ratio of the coefficients ci at which only one from the weighting factors. For example, with successive correction of equation (2) by coefficients a2 and a4, the correction algorithm has the following form:

$$a_2' = a_2 - (l_{\phi i1} - l_{pi1}) \frac{n_{i1}^2}{P_{i1}}$$
$$a_4' = a_4 - (l_{\phi i2} - l_{pi2}) n_{i2} \tag{8}$$

In the described correction method, the identification of the control object, that is, the finishing grinding technological process, is carried out in a minimum time equal to the duration of one or two technological transitions. After determining and indicating Lpij, during the entire time of the technological transition, it is in 60 state of waiting for a signal, the appearance of which means the end of the technological transition. The signal is used to enter the actual deformation value Lpij into the computer. As a result, the values of Lphij (obtained at the beginning of the transition) and (obtained at the end of the transition) are found simultaneously. Moreover, the value Lfij is a preliminary (predicted) estimate of Lfij. With ideal forecasting, these values should be the same, that is, Lpij = Lϕij. However, predicting the Lpij value based on equation (2) gives an error Δy = (l_phi1-l_pi1). To reduce this error, the equation (2) of the mathematical model is corrected. In this case, at the beginning of each technological transition, the calculated value Lpij is displayed on the external indicator, and at the end (when the KV = 1 signal appears), the content of the transition counter increases by 1. The described cycle of operation is carried out until the next signal appears, which means the end of processing of this part. The estimation of the forecasting accuracy Lij during the system operation was carried out experimentally on the "Matrix 5708" grinding machine. The processing was carried out with a single-thread grinding wheel with the characteristic 92A16SM17K5. During the processing, I-20A oil was used. Each method for correcting equation (2), implemented by the corresponding control programs, was investigated when processing a batch of blanks of at least 10 pieces, and the logging of experimental data Loij, Pif, nij, Lpij, Lϕij was performed automatically in the data accumulation and forecasting mode.

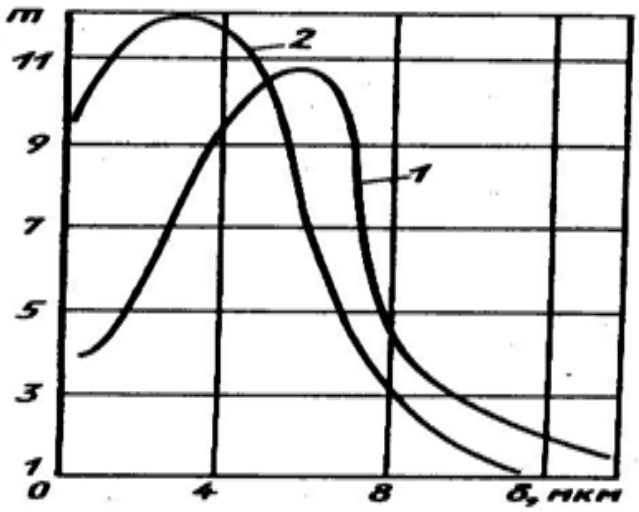

Fig. 1. Distribution of the forecast error with one (curve 1) and two-time (curve 2) correction of the mathematical model; m- frequency.

In fig. 1 shows the distribution curves of the prediction error for the cases of one- and two-time model correction. In the first case (curve 1), the correction of the mathematical model is carried out after the first technological transition once during the processing cycle of the part. In the second case (curve 2), the correction is carried out sequentially after the first and second technological transitions. Analysis of curves 1 and 2 shows that the probability of forecasting Lij with an error of up to 6 μm for one- and two-time correction is 60 and 72%, respectively.

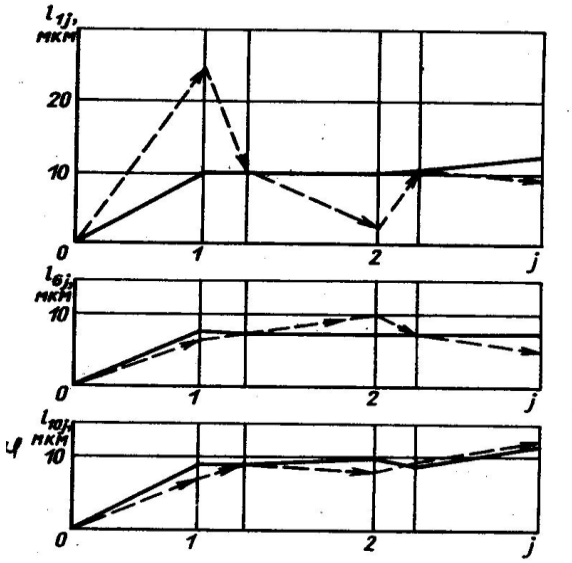

Fig. 2. Timing diagrams of the calculated (dashed line) and actual (solid line) axial deformations of the machined screws 63x10x630 mm (j is the number of the technological transition).

In fig. 2 shows the experimentally obtained time diagrams of axial deformations of the first (L1j), sixth (L6j) and tenth (L10j) machined screws, selectively taken from sequentially machined parts. Left-hand threads are ground in the feed direction from the front center of the machine to the rear,

and right-hand threads are vice versa. To compensate for the displacement, it is necessary, continuously, during the transition of thread grinding, to control according to the criterion:

$$\frac{\Delta\varphi}{\Delta l} = const \tag{9}$$

where Δφ is the increment in the angle of rotation of the screw to be ground;

Δl - increment of axial thermal deformation of the ground screw, measured by the axial deformation sensor.

The stability of the Δφ to Δl ratio can be achieved by turning the machine spindle, or by additional movement of the grinding wheel relative to the profile of the thread to be ground. The signal was blocked if the condition of formula (7) was not met, while, as the screw cooled, the axial temperature deformation was monitored. The value of the reverse stroke speed was set in such a way as to ensure the removal of the required amount of heat from the workpiece during the return stroke, by the method of local irrigation over the entire surface of the part, in order to fulfill the condition of formula (8).

$$\Delta L_{ofij} = K_{xb} \tag{10}$$

where L_{ofij} is the actual axial temperature deformation of the i-th screw being ground before the beginning of the last j-th transition,

K_{xb} is the correction made to the machine lead screw.

This method of stabilizing axial temperature deformations during multi-pass grinding was proposed in work / 9 /. If, upon completion of the penultimate transition of grinding, the value of the axial temperature deformation of the screw to be ground is *-Δl (j-1),* and *Δl (j-1)> Kхв,* then to compensate for the excess heat content of the workpiece, on the return travel of the machine table, it is necessary to set the speed determined from the following equations:

$$\Delta l = \frac{2\alpha l_0 \left\{ L_p \gamma \Delta T_M + \frac{U_{oj}\Delta l_{j-1} \exp\left(-\frac{K}{V_{j-1}}\right)}{V_{j-1}(1-\exp(-\frac{K}{V_{j-1}}} (1-\exp(-\frac{K}{U_{oj}} \right\}}{c\gamma_c R V_{j-1} - \alpha_1 (L_p - l_o)} + \frac{2\alpha_1 K_{хв}(L_p - l_0)}{c\gamma_c R V_{j-1} - \alpha_1 (L_p - l_0)}$$

Where $\Delta l = \Delta l_{j-1} - K_{хв}$

$$K = \frac{2\alpha_1 L_p}{c\gamma_c R}$$

$$\Delta T_M = T_B - T_M \tag{11}$$

In the formulas (8) - (11)

U_{oj} is the required reverse speed before the beginning of the last J -th transition, which allows compensating the value of Δl, m / s;

Vj-1 - speed of the part at the penultimate transition, m / s; 176

TV, TM, - air and lubricant temperatures, respectively.

So when processing right-hand threads, control is carried out in two stages, at the penultimate transition and on the reverse, before the start of the last transition:

1. At the penultimate transition, control is carried out in accordance with the criterion *Δl(j-1) ≥Kхв,* while the control parameter is the speed of the part nj-1.

2. On the return stroke, the cooling compensates for the excessive elongation of the screw to be ground, i.e. control is carried out in accordance with the criterion $\Delta l_{0j} = K_{хв}$ and, the control parameter is the cooling time of the part, or the return speed of the machine table - Uoj, calculated by the formula (8) (in this case, the return speed also determines the cooling time of the part).

When grinding left-handed threads, an additional third stage of control appears to compensate for the value of $\Delta l\ (lz)$. For this, at each transition, including the last one - j, it is necessary to carry out control in accordance with the criterion $\Delta\varphi / \Delta l = const$.

Conclusions.

1. Axial thermal deformation of the machined lead screws can be used as a parameter characterizing the state of the technological system of final thread grinding, since this parameter predetermines the accumulated error of the thread pitch and characterizes the processing performance.
2. Proactive active control of temperature deformation of precision screws, carried out using an automatic system, allows you to stabilize the temperature deformation at the level of adjustment of the correction ruler, and thereby eliminate the random component of the accumulated error of the thread pitch
3. The accumulation of technological data on a computer and their subsequent processing allow an objective assessment of the quality of the technological operation of the final grinding of threads.

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MARKETING DEVELOPMENT OF INNOVATIVE PRODUCTS

M. Sakhatskiy, H. Zapsha, P. Sakhatskiy

Odessa State Agrarian University 65012 Odessa Ukraine

ABSTRACT

The study of the marketing development of innovative products is crucial due to the active implementation of scientific and technical achievements, the rapid spread of digital technologies, globalization of the economy, the division of labor and involving different participants in production and economic activity, increasing competition between producers of various forms of management and countries of origin, the transformation of innovative products into a commodity for which demand is constantly growing. It is determined that the development of the marketing of innovative products is based on the ambiguity of a new socio-economic phenomenon, the system of properties of which characterizes innovation. It is proved that the properties of the product are inherent in both the innovative product - the result of research and development, and innovative production - new competitive products. The object of research is the processes of economic, institutional, and environmental nature, the integral unity of which reflects the development of marketing of innovative products. The subject of the study is a set of theoretical and methodological and practical aspects of the development of the marketing of innovative products. The purpose of scientific work is to substantiate the theoretical and methodological provisions and develop scientific and practical recommendations for the development of the marketing of innovative products. As a result of research, the urgency of development of marketing of innovative products is proven; the functional content of innovation marketing is determined; the characteristic features and properties of innovations as a market commodity are established; the importance of the strategy for constant updating of products is substantiated for market participants; the socio-economic expediency of marketing innovations for business entities is substantiated; the main sources of generating innovative goods are identified; the affiliation of human needs to the factors that combine innovation and marketing activities is proved; the institutional components of innovation marketing development are singled out.

Keywords: innovative goods, intellectual property, marketing, market demand, commodity offers, differentiation of production and economic activity, diversification, management, consumer, market activity.

INTRODUCTION

The relevance of scientific research of the problem of marketing of innovative products is due to a number of objective and subjective factors, the main of which should include:

- acceleration of scientific and technological progress and the spread of digital technologies, the achievements of which are actively implemented in business practice. The technologies also reduce the life cycle of goods and require their constant updating;
- orientation of production and economic complexes to meet market demand, which is growing due to the steady growth of human needs;
- deepening the division of labor in the field of innovation, the results of which require transfer to product offers on the market;
- globalization of the economy, the marketing principles that serve as a common denominator for producers of goods of different organizational and legal forms of management and countries of origin;
- intensification of competition in the domestic and world markets, the advantage of which economic entities provide innovations in product, production, administrative, organizational and marketing format;
- features of innovative products, tangible and intangible nature of which are largely determined by the scope of applied use in society;
- transformation of innovations into commodity offers, the demand for which is constantly growing.

The object of research is the processes of economic, institutional, and environmental nature, the integral unity of which reflects the development of marketing of innovative products. The subject of the study is a set of theoretical and methodological and practical aspects of the development of the marketing of innovative products. The purpose of scientific work is to substantiate the theoretical and methodological

provisions and develop scientific and practical recommendations for the development of the marketing of innovative products.

The logic of the study of the problem of marketing the development of innovative products involves the consistent solution of such tasks as: clarifying the essence of innovative products; establishing the functional content of innovation marketing; identification of characteristics and properties of innovations as a market commodity; substantiation of the importance for market participants of the strategy for constant renewal of products; argumentation of socio-economic expediency of innovation marketing for business entities; identification of the main sources of generating innovative products; bringing human needs to the factors that combine innovation and marketing activities; identification of institutional components of innovation marketing development; identification of promising areas for further research into the development of innovation marketing.

RESULTS AND DISCUSSION

Studies show that current legislation of Ukraine interprets innovations as newly created (applied) and (or) improved competitive technologies, products or services, as well as organizational and technical solutions of production, administrative, commercial or other nature that significantly improve the structure and quality of production and (or) social sphere. The Law of Ukraine "On Innovation" states that innovation is an activity aimed at using and commercializing the results of research and development and determines the release of new competitive products on the market [1]. Such institutional support corresponds to the origin of the term from the English language "innovation" - an innovation, or a new one that has recently or just been introduced.

The concept of "new" explanatory dictionary of the modern Ukrainian language is interpreted in the meanings:

1. Which recently arose, appeared, did not exist before; recently made, created, etc.
2. Concerning the near future; modern. Which replaced the old one.
3. Recently discovered, invented, bred, created, etc. Manifested recently; unknown. Still unknown, unknown. What has recently appeared was not previously known.
4. Quite different, not the one that was before. Which comes directly after something.
5. Whom they have not seen before, with whom they were not acquainted; unknown, unfamiliar. The first to arrive appeared somewhere. A newcomer to a job does not have enough experience, inexperienced in anything.
6. Who replaces the previous one, replaces it (about people). Introduced to replace the old one.
7. Next, next. Grown this year or made from the last harvest [2].

The given list of interpretations testifies to the existence of a number of approaches to the new as a certain socio-economic phenomenon, the system of properties of which characterizes innovations. The qualitative side of innovations reflects their usefulness (consumer value) and is the ability to meet certain human needs. The quantitative side of innovations is based on the costs incurred in their creation, forms the exchange value and is used in exchange for other goods. The ability to meet a certain human need and suitability for exchange for other goods are properties of the product that are inherent in innovative products - the result of research and development, as well as new competitive products.

The modern market of innovations reflects economic relations, the level of development of which involves meeting the identified and formed demand for newly created (improved) goods on the basis of their purchase and sale to achieve predetermined by the market entity socio-economic goals. Functionally, this process includes marketing activities to identify needs and demand, production (services) for identified demand, pricing, distribution, communication to promote newly created goods. The integral unity of these processes reflects the phenomenon of a real market economy, which is defined as the marketing of innovative products. The core of innovation marketing is market demand, the satisfaction of which requires manufacturers to find tools that, unlike existing ones, allows you to do it better, more efficiently, faster.

As a sphere of direct exchange, the market of innovative goods functions effectively only in conjunction with other markets - investment, labor, services, capital, technology, technology, etc. They are united by: independence of buyers and sellers; independence and equality of all market participants; the ability to choose market partners at their own discretion and respond to market demands; the importance of the impact on the pricing of supply and demand; the presence of competition. It was found that the market of innovative products has a number of characteristics, the main of which should include:

- belonging of the product of the innovation market to the result-intellectual and (or) creative activity;
- protection of most innovative products by intellectual property rights as objects of copyright, related rights, industrial property rights, brand and commercial names, plant varieties and animal breeds, etc .;

- a variety of innovative goods that have an intangible (ideas, inventions, discoveries, projects, innovation proposals) and material (trial product, models, industrial designs, batch of innovative products) nature, and which are offered as ready for sale on the market;

- the need to coordinate the possibility of using innovative products with the owner of intellectual property, which retains the right to it for possession, use, disposal;

- the global market for innovative products, covering all national economic complexes;

- lack of balance of supply and demand in the innovation market.

Innovations as a market product are offered in the form of objects, which include:

- innovative programs and projects;

- new knowledge and intellectual products;

- production equipment and processes;

- production and business infrastructure;

- organizational and technical solutions of production, administrative, commercial or other nature, which significantly improve the structure and quality of production and (or) social sphere;

- raw materials, means of their extraction and processing;

- marketable products;

- mechanisms for the formation of the consumer market and sales of marketable products.

From a marketing standpoint, the product is recognized as new on the market under the following conditions:

- satisfies needs that were not previously met;

- is fundamentally new in relation to existing analogue products;

- has improved operational and (or) design characteristics;

- offered for the first time in a specific market;

- used in a new field of life.

The strategy of market participants for constant product renewal is based on objective laws of development of the modern economy and takes into account such its characteristic features as:

- accelerating economic globalization and involving the vast majority of countries in world economic relations;

- reduction of product life cycle;

- increasing demand for goods from consumers;

- strengthening state regulatory policy on consumerism and environmental protection;

- intensification of competition between producers of various forms of ownership, management, production and economic parameters and countries of origin of goods.

Under such conditions, only the accelerated introduction of new products into business practices allows businesses to be competitive in domestic and global markets. After all, traditional products, as a rule, are in conditions of significant competition. While the introduction of products with new characteristics (quality, technical, design, etc.) gives the market entity an advantage and allows some time to be out of competition.

Arguments in favor of the socio-economic feasibility of marketing innovations for businesses is the opportunity to:

- to meet ever-increasing human needs;

- increase the number of supporters of their own products;

- expand the range of consumers in different market segments;

- work in a market that has a constantly growing demand;

- to support active business activity;

- to avoid direct competition with other manufacturers, including with recognized world brands;

- to diversify business and focus it on the most attractive and promising sectors of the economy and national economic complexes;

- increase the share of intangible assets;

- to start production and economic activity and to steadily strengthen resource potential without significant previously accumulated material and financial resources;

- to dictate its own pricing policy by being on the market for a certain period of time as a monopolist;

- to receive income from an inexhaustible source, which is intellectual work;

- to position own goods as modern and high-tech;

- to conduct in the market of economic entities effective branding;

- use state support in terms of its legal framework and economic mechanisms that stimulate innovation;

- to stand out with their products and have an advantage over competitors in terms of quality, technical, design and other product characteristics;

- belong to the cohort of world market leaders, which are characterized by constant updating of their products and the practical implementation of the principle: "Make your own products obsolete before anyone else does";

- to supplement new existing sources of cash income;

- to show new knowledge in a certain sphere of society, which is positively assessed by the community in relation to the business entity and increases the social status of its management and professionals;

- to maintain in market subjects the most rational ratio of goods with different stages of the life cycle, thus obtaining the highest in absolute and relative terms of income and profits.

The institutional basis for the development of innovation marketing in the country is the Constitution of Ukraine, Laws of Ukraine "On Innovation", "On Scientific and Scientific-Technical Activity", "On Scientific and Scientific-Technical Expertise", "On Priority Areas of Innovation in Ukraine", " On the special regime of innovative activity of technology parks", "On the special economic zone "Yavoriv" and other normative legal acts of state authorities and local self-government. They regulate public relations in this area and create legal, organizational, managerial and socio-economic conditions for the effective reproduction, development and use of scientific and technological potential of the country. The empirical basis of innovation marketing is formed by business entities and individuals

Innovations are generated by the needs of specific consumers, various spheres of life, market competition, research and development, and other product innovations. At the same time, human needs act as a common link and combine innovation and marketing activities. The systemic integrity of marketing and innovation creates a new quality, the synergy of which is manifested in economic, social, institutional and environmental results.

In strategic terms, the development of innovation marketing meets the main goal of the state innovation policy, which means the introduction of modern environmentally friendly, safe, energy and resource-saving technologies, production and sale of new types of competitive products in domestic and global markets. This should be facilitated by:

- focus on the innovative way of development of the national economic complex, its sectors and business entities;

- ensuring the interaction of science, education, production, financial and credit sphere in the development of innovation;

- creating conditions for the preservation, development and use of domestic scientific, technical and innovative potential;

- implementation of measures to support international scientific and technological cooperation, technology transfer, protection of domestic products in the domestic market and its promotion on the foreign market;

- financial support, implementation of favorable credit, tax and customs policies in the field of innovation;

- maintaining the functioning and development of modern market and innovation infrastructure;

- information support of subjects of marketing and innovation activity;

- formation and implementation of state, sectoral, regional and local innovation programs;

- protection of the rights and interests of the subjects of innovation activity;

- stimulation of commercial banks and other financial institutions that lend to the implementation of innovative projects;

- establishment of preferential taxation of subjects of innovative activity;

- training of specialists in the field of marketing, management and innovation;

- marketing approach to the management of production and economic activities of economic entities to balance the interests of producers, consumers, society and the natural environment.

The main source of initiating the creation of new products and marketing innovations is market demand. To satisfy it, business entities are pursuing a strategy of constant updating of product offers. The practice of implementing such a strategy is based on the differentiation and diversification of production and economic activities of market entities.

Problems of further development of marketing of innovative products are related to the need to meet the growing needs of man. Today, for this purpose, the use of natural resources is increasing in production and economic activities, the volume of which is limited by the scale of the planet, and some of them are non-renewable. There is an intensification of production, which increases the anthropogenic pressure on the environment, which is losing biodiversity. For the economic interests of market participants there is

interference in natural processes, which creates conditions for mutations of biological organisms with not always predictable behavior. Introduction of scientific and technical achievements into the practice of management, such as robotization and computerization of production and economic activities, frees up labor resources and increases unemployment. As a result, the climate is changing in a negative direction,

Prospects for solving current and future problems are based on the socio-ethical principles of marketing. At the same time, highly effective innovative activity of business entities is real provided that a combination of marketing tools and a balanced state regulatory policy. An obligatory condition is to bring both goods and their production in accordance with technical and social safety standards, provisions for the protection of the natural environment, moral and ethical principles of specific regional markets both in the country and abroad. It is important to align the level of consumer properties of the product with modern requirements.

Therefore, the further development of marketing of innovative products should include:

-satisfaction of market demand on the basis of harmonization of interests of commodity producers, consumers, community and natural environment;

-encouragement in production and economic activities of technologies that minimize the cost of material resources and use renewable energy sources;

- preservation of the natural environment and increase of productivity of use of flora and fauna;

- formation of human-centered behavior of market participants;

-involvement in new types of economic activity of persons who are released as a result of the introduction of innovative achievements in the practice of management;

-stimulation of the growth of the educational level of the population and their development of the results of the latest scientific thought.

CONCLUSION

1. Marketing of innovative products involves the implementation of a set of measures carried out in the field of design, production and marketing of newly created products, quantitative, qualitative, range and price characteristics which are consistent with the needs of specific market segments and meet both strategic and current socio-economic goals business entities.
2. The legislation of the country determines the legal, economic and organizational provisions of state regulation of innovation processes, establishes forms of their stimulation in order to guide the development of the economic complex on an innovative basis.
3. Innovations in Ukraine have legal support, scientific and technical support and significant opportunities as a market product.
4. Further research on the development of marketing of innovative products should harmonize the interests of producers, consumers, society and the environment.

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FACTORS OF UKRAINIAN SOUTHERN REGIONAL GRAIN MARKET DEVELOPMENT

Nataliia SMYRNOVA[1], Hanna DIDUR[2], Iryna NAIDA[3]

Odesa State Agrarian University 65012 Odesa Ukraine

ABSTRACT

The composition of Ukrainian grain market subjects has determined. The potential of Odessa region grain market development has considered. The tendencies of growth of grain and leguminous crops sown areas, gross production and productivity of Southern regional grain market of Ukraine on the example of Odessa region have investigated. The dynamics of average prices on Odessa region cereals and legumes market have studied. Problems of Ukrainian Southern regional grain market development have revealed. The key strategic guidelines for Southern Regional Grain Market development have proposed. The components of digital logistics system in the regional grain market development have determined.

Keywords*: regional grain market, development, tendencies, grain areas, grain gross production, grain productivity, digital logistics.*

INTRODUCTION

Ukraine's grain economy is a strategic and most efficient branch of the national economy. Grain and products made from it are always liquid, as they form the basis of food security of the state.

Natural and climatic conditions and fertile lands of Ukraine promote the cultivation of all grain crops and allow obtaining high quality food grain in sufficient quantities to meet domestic needs and the formation of export potential.

The southern region of Ukraine has significant potential for the grain market development. A special advantage of the region in resolving this issue is still a large area of arable land, which is one tenth of arable land worldwide, which produces various types of cereals, legumes and other crops.

Further development of the grain market requires a thorough economic assessment, revision of a number of positions on technical-technological, organizational-economic conditions of its operation.

In the research process the following *methods* have used: concretization; structural, trend, regression analysis.

RESULTS AND DISCUSSION

The grain market is a system of commodity-money relations arising between its subjects in the

process of production, storage, trade and use of grain on the basis of free competition, free choice of grain sales and pricing, as well as state control over its quality and storage. [1]. The subjects of the grain market are grain producers, grain storage enterprises, subjects of mortgage purchases of grain and intervention operations, accredited exchanges and others (Fig. 1).

In general, the grain complex is the basis for the development of the grain domestic market, bakery, flour and cereals, alcohol, confectionery, feed, bioethanol production and other industries. In some cases, from the economic current to the final sale, the process of grain movement accumulates in itself from 3 to 22 related or by-products, which affect the cost of the final product [1].

By adopting the Law of Ukraine "On Grain and the Grain Market in Ukraine" in 2002 [2], the state determined the priority of grain production and undertook to promote the development and stable functioning of its market. The principles of the state policy on Ukrainian grain market regulation have determined. These are, first of all, the provision of priority budget, credit and investment support to the subjects of collateral procurement of grain and intervention operations, meeting the domestic needs of the state in food, seeds, fodder, technical grain and measures to increase its exports; establishment of a minimum guaranteed price for mortgaged grain; prevention of restrictions on the movement of grain and products of its processing; control over grain quality and storage.

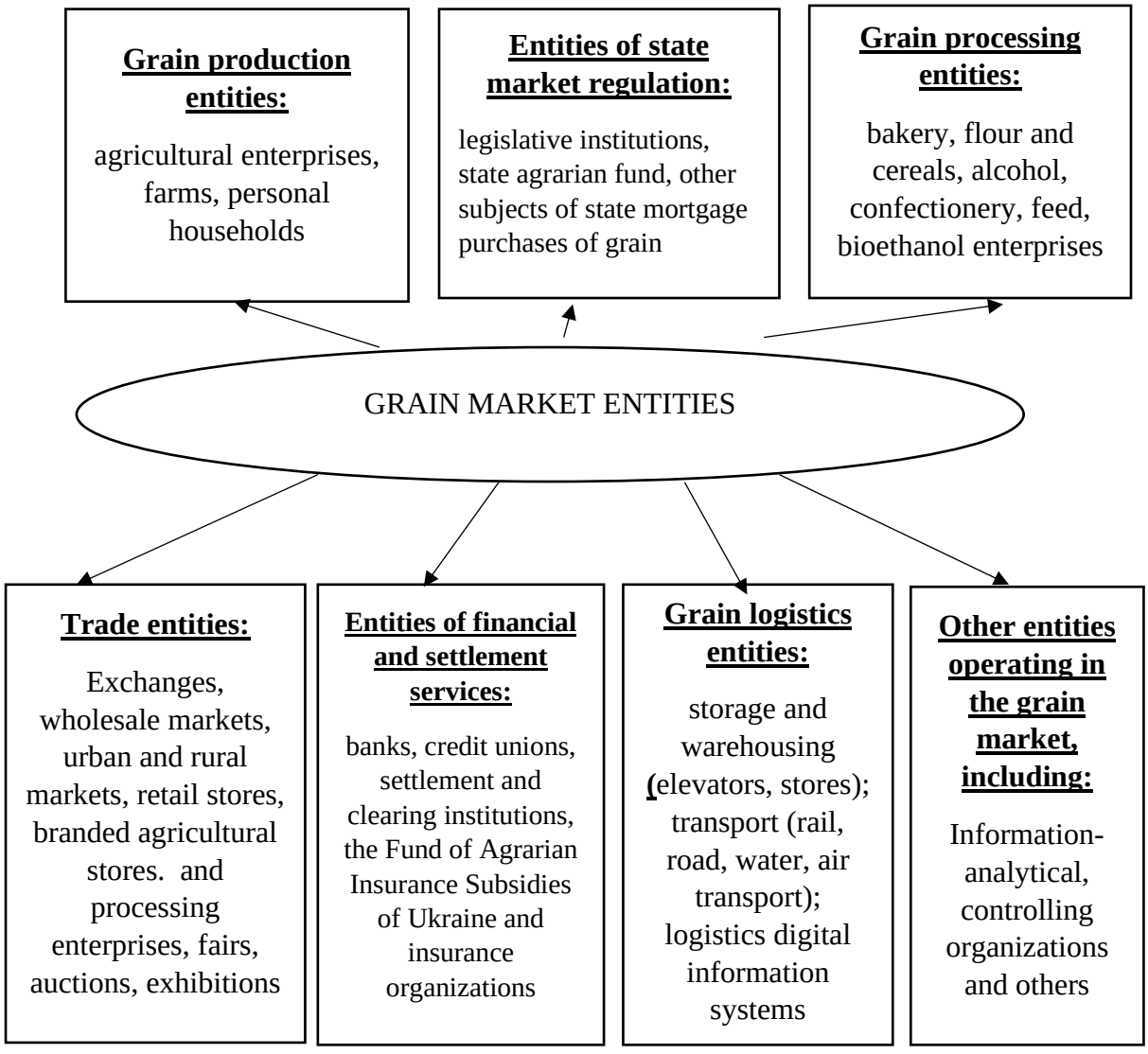

Figure 1. Subjects of the grain market of Ukraine
Source: built by the author[1] and author[3]

First of all, agriculture in Odessa region is based on the cultivation of cereals, the area of which is shown in Fig. 2.

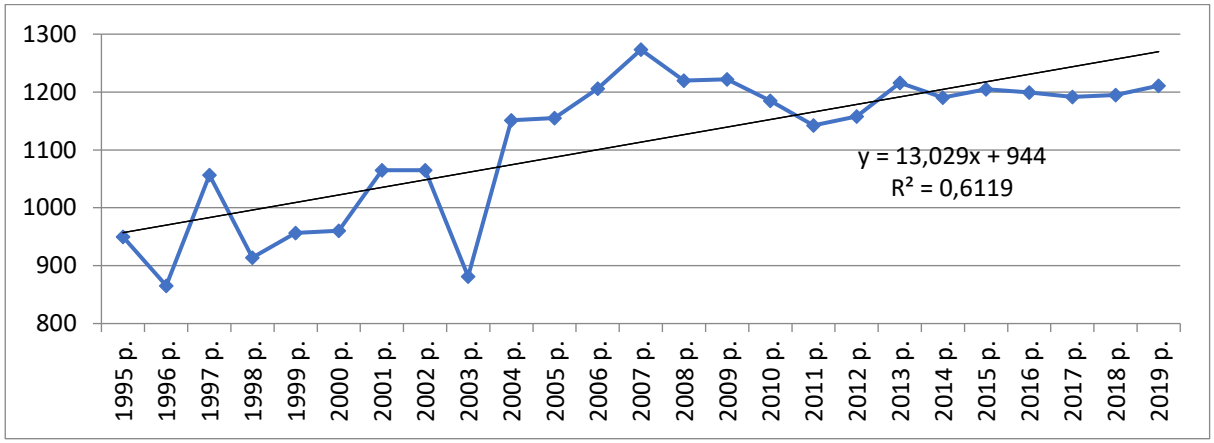

Figure 2.Sowing area of grain and legumes (specified) of enterprises of Odessa region, thousand hectares

Source: built by the author[1] according to the data [3]

The data of fig. 2 show a tendency to increase the sown area of cereals on average per year by 13 thousand hectares. This increase is due to the refusal to grow other crops and to maintain pastures for animals.

Grain production occupies a special place among other branches of crop production. Odessa region occupies a leading position among other regions of Ukraine in grain production, so the level of economic efficiency of growing cereals and legumes significantly depends on the economic level of the region. The dynamics of the indicators (Fig. 3) shows the annual average growth of grain production by 90 thousand tons in the last 24 years.

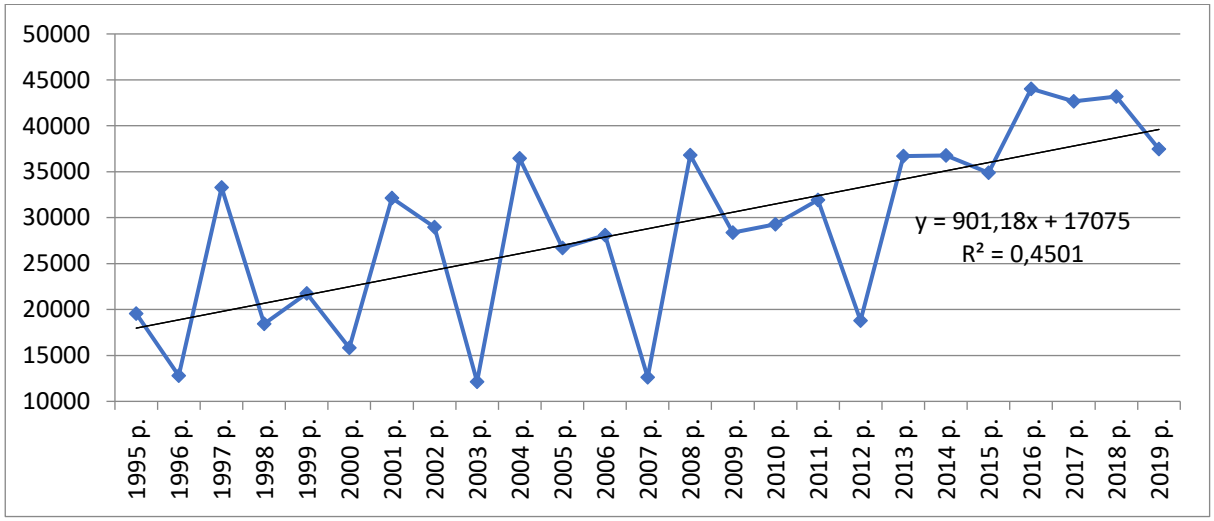

Figure 3. Production of grain by the enterprises of Odessa region in weight after finishing, thousand quintals

Source: built by the author[1] according to the data [3]

Winter wheat and barley were the predominant cereals in 2019. According to the results of 2019, the yield of cereals and legumes in the Odessa region amounted to 31 quintals per hectare (Fig. 4), which is less than in 2018, but shows a tendency to increase by 0.5 quintals/ hectare annually.

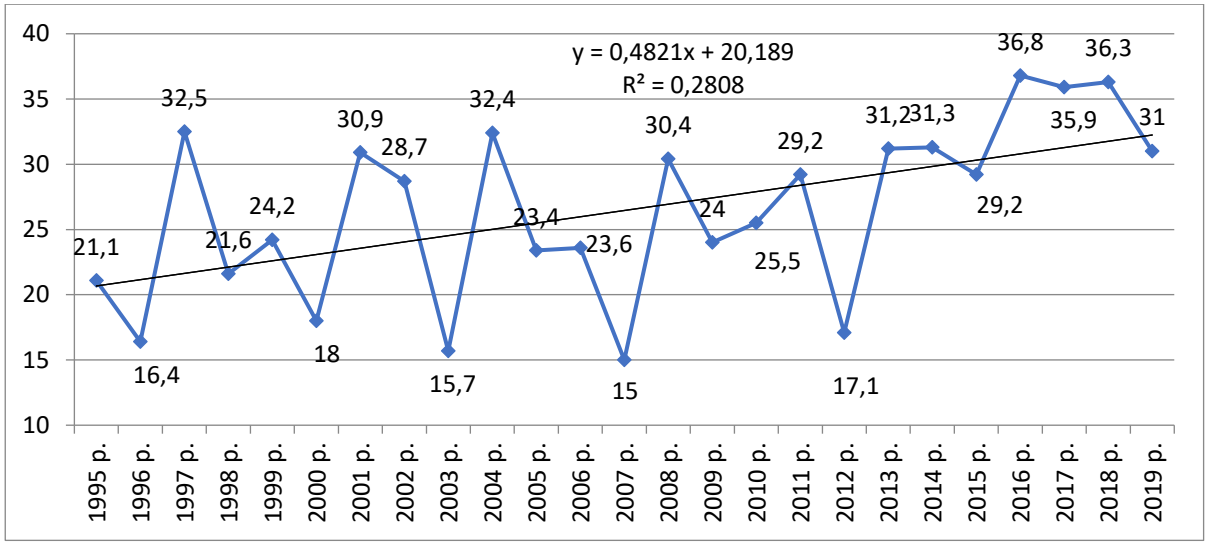

Figure 4. Yield of grain and legumes in the enterprises of Odessa region, quintals per hectare

Source: built by the author[1] according to the data [3]

However, according to grain yield indicators, Ukraine has only 25 results in the world. Most European countries, China, Mexico, Egypt, have the best indicators, and New Zealand showed the highest wheat yield: 9.1 t / ha. At the same time, the share of wheat in the production of agricultural products of our country is 13% [4].

The volumes of gross grain production largely depend on natural and climatic conditions. In 2019 the lowest level of yield among the districts of Odessa region was obtained in the city of Izmail, Reni and Bolgrad districts - that are the driest. The highest yields in 2019 were obtained in Kodyma and Savran districts - the most humid.

In 2020, the situation in the Odessa region was extremely serious with the harvest of winter grain crops due to drought, which could lead to losses of UAH 15 billion. The meteorological center recorded the lowest rainfall in the last 20 years in the region. Low rainfall, dust storms, dry winds, as well as frosts to −9… −11 degrees during the growing season led to the death of winter crops.

Among the most affected farms are Bolgrad, Izmail, Tatarbunary, Kiliya and Reni districts, where 70% of crops died. Crops in Bilgorod-Dniester, Bilyaiivka, Artsyz, Sarata, and Tarutyno districts died on 50% of the area.

In general, the situation on the regional market of grain products is ambiguous. Most farmers deliberately grow agricultural products for further export. They are stimulated to do so by world prices and constant demand for products. Ukraine is the sixth largest exporter of wheat in the world and ranks 9th in terms of production [4].

At the same time, grain prices were constantly growing during the study period (Fig. 5).

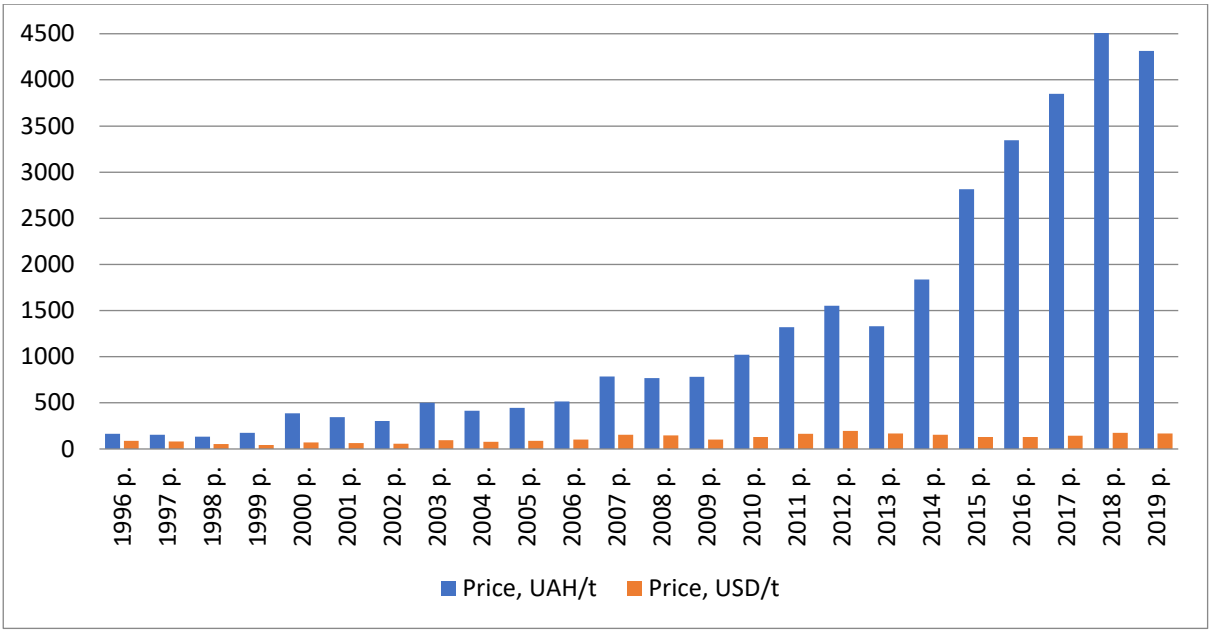

Figure 5. Average prices on the market of cereals and legumes in Odessa region

Source: built by the author[1]and author[2] according to the data [3]

In the Odessa region, the average price of grain increased in 26,3 times: from 163.9 UAH / t in 1996 to 1313.4 UAH / t in 2019. At the same time, the price in dollars increased only 1.9 times. This is due to the inflationary processes that took place in the country during the study period. The hryvnia became cheaper much faster than the dollar.

One of the important areas of export support is the development of river and sea port elevator systems. With the production of 71 million tons of grain in Ukraine in 2015, there is enough available capacity for its storage, as 9.0 million tons will be produced and used in households, and corn will enter the warehouses no earlier than September, 4.5 million tons of grain will be used for livestock feed and 2.1 million tons - for processing for food and non-food purposes.

However, when grain exports increase to 35-36 million tons, it is necessary to increase its monthly shipment to 3.0-3.5 million tons, which requires the organization of a clear operation of port elevators, or the construction of new capacity by 8.5-9.0 million t [1].

Therefore, an important condition for ensuring the stability of the grain market should be the use of effective mechanisms of state regulation, the essence of which is to ensure a balance of quantitative and qualitative parameters of supply and demand for grain products.

The current practice of regulating the regional grain market of Ukraine does not meet the current needs of increasing the competitiveness of the national grain sector, does not take into account changes in the global environment associated with financial and economic and food crises, and as a result does not offer adequate tools for state regulation of the grain sector.

The relative passivity of the state in ensuring the national economic interests of Ukraine in the world grain market narrows the advantages of national grain producers in competition. Strengthening the role of the state in regulating the economy, which corresponds to the current trend of all leading countries, highlights for Ukraine the need to form and ensure a national export grain strategy focused on critical tasks of foreign economic component of the grain sector and the national economy as a whole [1].

According to the relevant action program, the role of the state in pursuing a balanced foreign economic policy can be significantly strengthened by intensifying public and private initiatives in ensuring Ukraine's foreign economic priorities in the world grain market. The National Grain Export Strategy should be considered as a comprehensive, purposeful, long-term program of state action in domestic and foreign grain markets, focused on implementing and ensuring sustainable and comprehensive development of the national export potential of the grain sector to effectively use it to address strategic issues. Based on the appropriate logic, the following target is needed: increase the profitability of national grain producers based on the use of the effective potential of the European market.

Relevant goals include, firstly, enshrining in the legal field of the relevant document (national grain export strategy), and secondly, the state operator as a significant agent in determining its legal status, called by market methods to influence the price dynamics of grain purchases from national grain producers and to sell the purchased volumes of grain on the foreign market, which will shift the balance of interests in the national grain market towards production and ensure further expansion of trade with EU countries.

Ukraine's main competitors in world grain markets are the United States, Canada, Australia, France, Russia, and Kazakhstan. Increase competition between countries and other grain exporters: Hungary, Poland, Turkey, and Hungary. Therefore, in the domestic grain market it is necessary to develop logistics infrastructure, which is an important prerequisite for strengthening Ukraine's competitive position in foreign markets.

The prospect of developing the infrastructure of the regional grain market in the context of globalization is the creation of digital logistics (DL), which is adapted to the needs of market participants system of data collection and processing in order to rationally use resources and effectively plan them. It consists of three key components - wireless network, service and consulting services, geographic information system and provides market participants with quality information through the use of the latest technologies, as well as the integration of science in DL (Fig. 6).

The digital system must manipulate information in the form of a visual image of the necessary objects, text and digital data, audio messages. Therefore, programmers must choose the appropriate range of digital technologies and software, which are integral elements of the digital system.

Specialists must establish communication and information links between the port, railways, vehicles, manufacturer and trader. The introduction of digital logistics in the grain market of Ukraine has a specific goal - to reduce losses of financial and grain resources in the country. The system must be adapted to the modern needs of market participants and take into account the degree of technological and software changes over a period of time. Digital logistics should be available to every grain market participant. At the initial stage, scientific support of the system operation will be required.

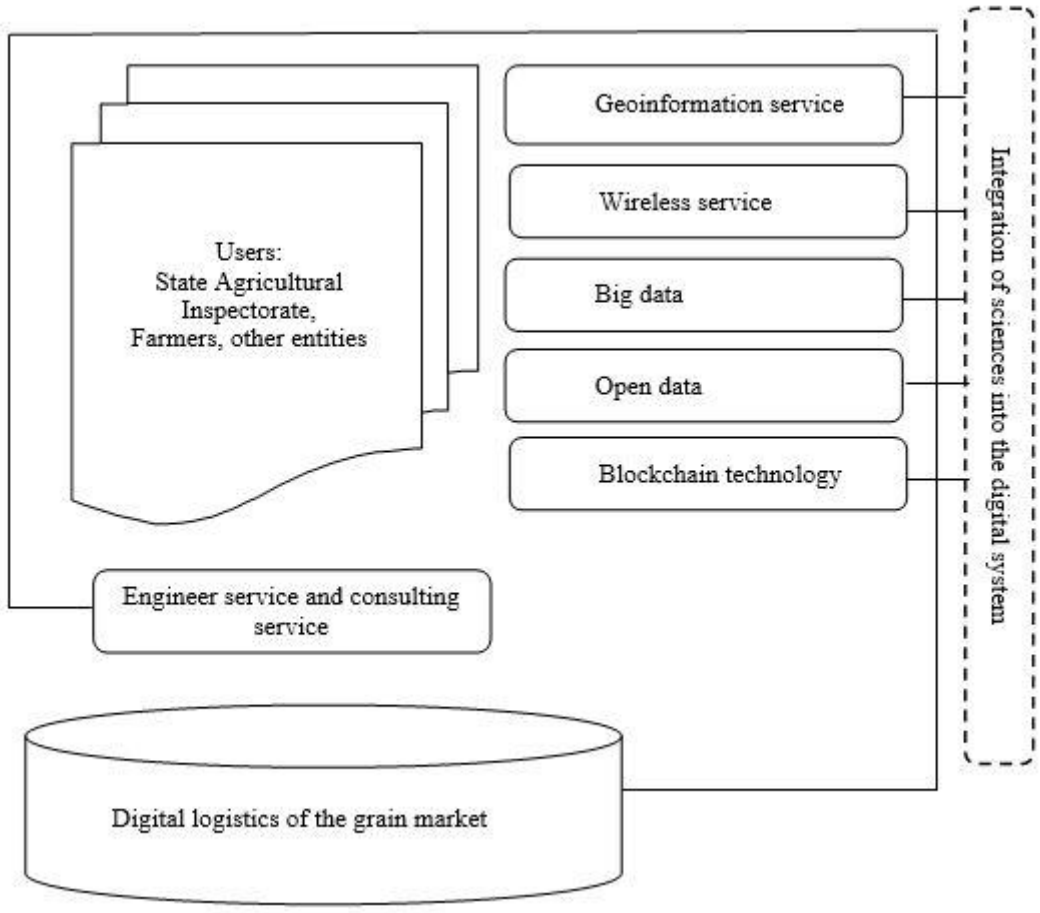

Figure 6. Components of digital logistics of Ukrainian grain market

Source: built by the author[1]and author[3]jn the base

There will be a powerful information system that will reduce grain losses in Ukraine to 0.99% of total grain production in the country [5]. The state will be able to make the right decisions to regulate the grain market in Ukraine, using operational information, to effectively regulate not only stocks but also grain flows in the country. DL users will be able to maximize profits, which is important primarily for grain producers. Eventually, the culture of grain production and agribusiness in Ukraine will rise to a better level.

The geography of domestic grain exports in the Odessa region is constantly expanding. However, there is global competition in world markets for grain markets among major exporting countries. It should be emphasized that one of the important conditions for the effective functioning of the market is the availability of developed infrastructure. Equally important for the effective functioning of the domestic grain market is also the provision of its participants with quality operational information.

CONCLUSION

Based on the above material, the key strategic guidelines in the regional grain market are the following:

−ensuring the balance of interests of the Ukrainian grain market by regulatory harmonization of the distribution of profits in the chain from grain producer to grain trader, as well as taking into account the interests of the national consumer;

−management of volumes, quality and price of grain products in the European and Asian

markets in order to increase foreign exchange earnings in the region's economy;

–increasing of added value in grain trade due to expansion of national participation in strategic links of logistics and transport networks;

–wide introduction of modern advanced post-harvest technologies in order to optimize commercial and logistical losses in the grain sector of the region;

–introduction of joint consortium international projects in logistics and transport chains and participation in joint ownership of terminals outside the region, organization of direct outlets in promising grain markets of individual countries, expansion of trade with other countries;

–state support for new concepts of entering promising local European markets;

–strategic diversification of national grain markets;

–management of protection of the value of national grain in conditions of unfair competition in the world market (including through the management of national stocks of grain to optimize its value in case of market fluctuations);

–ensuring the quality of grain production by complying with European standards;

–ensuring the systematic and consistent actions of national grain market entities and public authorities in the formation and implementation of annual priorities for grain export trade;

–developing of the of Ukrainian grain market logistics infrastructure.

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ASSESSMENT OF THE MAIN SELECTION-GENETIC SIGNS OF THE PRODUCTIVITY OF THE SHEEP OF THE ODESA TYPE OF THE ASCANIAN MEAT AND WOOL BREED OF DIFFERENT ETHOLOGICAL TYPES

Valeriy Chigiryov, Mykola Bohdan, Kristina Mazhilovskay, Ievgenia Gurko

ODESSA STATE AGRARIAN UNIVERSITY

Keywords: sheep, behavior, meat productivity, wool productivity, dairy productivity.

INTRODUCTION

The diversity of breeds and areas of sheep breeding in Ukraine is due to natural and economic conditions and zonal traditions of the industry. In the Odesa region, sheep breeding has always been a traditional livestock industry, especially in the southern regions.

Odessa type of Askanian meat-wool breed of sheep with crossbred wool. It was bred in 1982-2000 by crossing ewes of the Tsigai breed of Odessa selection with Askanian crossbred rams. In the formation of this gene pool, both breeding rams of intra-breed types of the Tsigai breed of the Azov, Crimean and Volga types, as well as rams of the Ostfriesian dairy breed, which were brought from Germany at one time, were used.

Odessa-type sheep have a strong constitution, a proportionate physique, a rounded body, wide limbs, thighs, back and waist are full, meat forms are well defined. Live weight of breeding rams 93-110 kg, ewes 58-62 kg, shearing of pure wool, respectively, 5.0-6.5 and 2.5-2.8 kg, fertility of ewes 101-123%.

MATERIAL AND METHODS OF RESEARCH

To objectively determine the types of behavior in sheep under natural conditions, the method of motor-food reactions of sheep was used [2] in improvement [1]. Thus, three behavioral types of animals were identified, which differed in a set of behavioral traits:

-sheep type I, having the opportunity to enter the detachment quickly ran to the feeder and without fear of human presence began to greedily eat food. During the whole time in the pen, the sheep did not move away from the feeder;

- type II sheep were included in the detachment together with type I sheep or they were sent forcibly. Some of them ran up to the feeder but after receiving the mark ran away and did not approach the feeder anymore, other animals approached the feed after a while;

- Type III was more cautious and timid animals. They had difficulty entering the detachment and stood in the far corner, not approaching the feeder. Sometimes they approached the feeder carefully, grabbed the food and immediately ran away.

Meat productivity of purebred and local lambs was studied by carrying out control fattening of walnuts for 60 days (from 6 to 8 months of age) and their slaughter at 8 months of age (according to the method of BIT, 1978). For slaughter, 5 cornflowers were selected, typical for their groups in terms of live weight and body structure.

Wool productivity was studied by weighing the runes of unwashed wool during the shearing of bright with an accuracy of 0.1 kg, in sheep 14-15 months.

The physical properties of wool were studied during individual grading of sheep, in accordance with the "Instructions for grading sheep" (2003), the classification of runes [4].

The shearing of unwashed wool was determined by weighing each fleece when shearing sheep in the spring, length, tonnage, evenness, elasticity, fatness and shine of the wool during grading in accordance with the sheep grading instructions developed in 2003.

Shearing of washed wool was determined by the calculation method in relation to unwashed.

The elasticity of wool and its luster were determined visually [3].

General assessment of the class of animals, determined by a set of constitutionally productive features and the degree of compliance with the standard.

Dairy productivity of ewes was determined by the first lactation by the method of control milkings, every 15 days for 153 days of lactation. The digital material was processed by the method of variation statistics.

In our researches the slaughter qualities of cornflowers of different ethological types were evaluated. For slaughter from each group were selected 5 heads of cornflowers at the age of 8 months. In accordance with GOST 1935-55, all carcasses after slaughter were classified in the first category.

The results of control slaughter showed that the best slaughter qualities were characterized by mixtures of experimental groups

The most active animals predominated timid and cautious cornflowers in terms of pre-slaughter weight, carcass weight and slaughter yield. Thus, in terms of pre-slaughter weight, the difference in favor of active sheep was: in group II - 7.5% (P> 0.95), in group I - 15.4% (P> 0.99); by carcass weight in group II - 9.0% (P> 0.95), in group I - 22.2% (P> 0.99).

A similar trend is observed for carcass weight. Carcasses of crossbreds of group II were heavier by 8.9% (P> 0.95), and group I by 22.1% (P> 0.99) than carcasses of young animals of group III. Carcasses of lambs of the I and II groups were characterized by a high slaughter yield.

The difference between the groups equalized in slaughter yield is: between III and II - 0.62 absolute percent in favor of group II; between I and III - 2.7 absolute percent in favor of group I.

By the mass of internal fat of the crossbreed of the I group, the peers of the III group prevailed by 23.9%, and the local young of the II group by 11.2%.

In our studies to study the morphological composition of the carcasses of cornflowers of different types of behavior.

That in the carcasses of the most active and moderate animals there was more flesh and less bones. Thus, the flesh in the carcasses of local cornflowers of group II was 76.7%, I - 77.6%, while in group III only 75.2%. Young animals of the II and I experimental groups in terms of meat content in the carcass outperformed the control group I by 11.4% (P> 0.95) and by 26.0% (P> 0.99), respectively.

When assessing meat productivity, it is necessary to take into account such an indicator as the meat ratio. According to the results of our research, the coefficient of meat content was higher in the cornflowers of both experimental groups: II -3,28; And - 3.47, while in the carcasses of lambs of the control group - 3.03.

One of the indicators of the meat quality of sheep is the area of the "muscle eye".

In our experiments, the offspring, with different most active behavioral responses, had a larger area of "muscle muscle".

Group II animals were 14.9% (P> 0.95) and 24.9% (P> 0.99) more timid and cautious animals.

In turn, the area of the "muscle eye" in the carcasses of Group I cornflowers is 8.7% (P> 0.95), more than this indicator of group II peers.

Cornflowers of groups II and I were characterized by better development of the longest muscle tissue of the back. Thus, in terms of the mass of the longest muscle tissue, group II sheep

outperformed group III peers by 20.1% (P> 0.95) and group I by 29.3% (P> 0.999). The table shows that the difference in carcass length in favor of animals of group II is 3.3%, and animals of group I - 6.3%. Thus, the best meat qualities were characterized by carcasses of the most active and moderate behavior, including carcasses of group I.

From the given data it is visible that shearing of wool changes depending on behavior. The average haircut of both washed and unwashed is the highest in the bright most active and moderate behavior. The difference between groups III and II on these indicators, respectively 17.9% and 26.4%, is statistically significant (td = 13.1; P> 0.999).

In terms of wool shearing (both unwashed and washed), the brightness of the first group exceeds the brightness of the third group by 7.8% and 13.4%, the difference between the groups is quite significant (td = 3.7; P> 0.99).

When comparing these indicators of bright II and I groups, the predominance of bright II groups by 9.4% and 11.5%, respectively (td = 4.5; P> 0.99).

The yield of washed fiber in groups II and I was 62.1% and 60.9%, respectively, which is 4.0 and 3.0 absolute percent higher than in bright group III.

All groups of ewes are characterized by a fairly high milk yield, which we associate with the hereditary high level of milk productivity of Odessa-type sheep of the Askanian meat-wool breed with crossbred wool.

The advantage of ewes of the II experimental group over ewes of the I control is 10.86 kg, or 8% (P> 0.95), and over ewes of the III experimental group - 25.04 kg, or 21.6% (P> 0.95).

During lactation there is a decrease in milk yield in all groups of ewes. The maximum milk yield is observed in the first month of lactation, and the minimum - in the last.

Characterizing the variability of the level of milk productivity, we can conclude that it is quite high and is 21.0 -25%. This indicates that the herd has animals with a wide variety of milk production (min - 78.94 kg, max - 186.91 kg), and this allows the selection of high-milk queens for further use in breeding and breeding work.

CONCLUSIONS

1. The young of the most active and moderate behavior were characterized by the best fattening, slaughter and meat qualities. Cornflowers in these groups had higher growth energy during the fattening period. At slaughter, these cornflowers significantly outweighed timid and cautious animals in terms of slaughter weight, carcass weight, and meat ratio.
2. At cultivation of bright I and II groups their big wool productivity, both shearing of wool in the original and the washed fiber, respectively on 7,8 - 17,9% and 13,4 - 26,4% in comparison with peers of III group is established. .
3. In terms of milk productivity, the advantage of ewes of the II experimental group over ewes of the I control is 10.86 kg, or 8% (P> 0.95), and over ewes of the III experimental group - 25.04 kg, or 21.6 % (P> 0.95).

They studied the slaughtering qualities of cornflowers, their morphological composition of carcasses, meat qualities of sheep, bright wool productivity, dairy productivity of ewes. Sheep, wool and dairy productivity were found to be the most active and moderate behavior of the sheep outweighed the more cautious and timid animals.

The objective of determining the types of behavior in sheep in natural conditions was the technique of moving and eating reactions of sheep in perfection.

In our studies, the slaughtering qualities of cornflowers of different ethological types were evaluated. The results of the control slaughter showed that the best slaughter qualities were characterized by mixtures of experimental groups.

The most active animals were dominated by cowardly and cautious cornflowers by pre-slaughter weight, carcass weight and slaughter output.

A similar trend is observed in the mass of the carcass. The carcasses of lambs I and II groups were characterized by high slaughter output.

By weight of the internal fat of group I, the peers of group III prevailed. In our study, to study the morphological composition, the carcasses of carcasses of different types of behavior were collapsed.

The carcasses of the most active and moderate animals had more flesh and fewer bones. When evaluating meat performance, you should consider an indicator such as the coefficient of meatiness.

One of the indicators of the meat quality of the sheep is the area of the muscle.

In our experiments, the offspring, with different most active behavioral responses, had a larger area of muscle. The II and I group shafts were characterized by the best development of the longest muscular tissue of the back. Thus, the best meat qualities were characterized by carcasses of the most active and moderate behavior, among them carcasses I groups.

One of the main evaluations of wool performance is the mass of runes. The data above shows that the wool trimming varies with behavior. The average purge of both washed and non-washed highest in brightest most active and moderate behavior.

All groups of ewes are characterized by a high milk yield, which we associate with the inherited, high level of milk productivity of sheep of the Ascanian meat-wool breed with cross-wool.

During lactation, there is a decrease in milk yield in all groups of ewes. The maximum yield is observed in the first lactation month and the minimum in the last month.

Characterizing the variability of the level of milk productivity, we can conclude that it is quite high. This indicates that the herd contains animals with a sufficiently diverse dairy productivity and this enables the selection of high-milked uterus for further use in breeding and breeding work.

The best fattening, slaughter and meat qualities were characterized by young animals of the most active and moderate behavior. The rollers of these groups had higher growth energy during the fattening period. At slaughter, these carcasses, by slaughter weight, carcass weight, meatiness ratio, were significantly outweighed by cowardly and cautious animals.

When breeding bright I and II groups, their wool productivity is greater, both in the original wool and in the washed fiber, compared to the peers in the III group.

In milk productivity, the superiority of ewes of the second experimental group over the ewes and control.

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