



II. INTERNATIONAL EURASIAN AGRICULTURE AND NATURAL SCIENCES CONGRESS

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**BOOK OF
FULL-TEXT**





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CLIMATE CHANGE AND LEGUME NITROGEN FIXATION

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Abstract

Increase in the world population is directly related with requirement of fossil energy and production of fertilizer as well. The truth in this condition is economic difficulty and environmental damage. Intensive agriculture systems cause to huge amount of nitrogen fertilizer usage which led to concern on N cycle over the soil-water nitrate accumulation and nitrogen oxide in atmosphere.

Change in climate over the world is an essential issue for humankind. Scientific researches on plant response to environmental factors is a topic which increasingly takes attention due to concern on resources of plants, biodiversity and global food security. Legume family known as eco-friend and health-care plants which are fundamental crops for sustainability besides presenting second major crop of agricultural importance over the world. Depending on environmental changes, response of legume nitrogen fixation varies by view of drought, salinity, heat stress, carbon dioxide concentration and soil acidity.

Present paper describes the main environmental factors which are directly connected with climatic changes and their major effects on N₂ fixation and legume production worldwide. Additionally, suggestions for adaptation of symbiotic legumes to climatic variability on production quantity are given depending on recent studies by view of molecular and biotechnological efforts over the world. Therefore, aim of the paper is improvement of healthy food supply consider to sustainable agricultural system.

Key Words: Eco friendly, global warming, grain legumes, *Rhizobium*, sustainable agriculture.

1. Introduction

Impacts of climate change will be a matter of life and death in the world due to a lot of synergistic concepts in environment and human systems. These concepts may be affected by changes on; biodiversity, climate, ecosystem, natural resources etc. natural structures of world.

Using of chemical fertilizers in agricultural production is almost indispensable. As it reported in many reports, yield related characteristics of the plants are directly related with fertilizers in addition to other factors such as chemical composition, cultural practices, environment and genetic structure (Bozoglu et al. 2007; Jankowski et al., 2015; Erdinç et al., 2018; Ozkose, 2018).

One of the most important factor in researches focused on plants is improvement of genetic structure to provide sustainability of supplying and security of food. From this perspective, agriculture is under the remarkable effects of climate change and especially water besides equable fertilizing.

Production of fertilizers is expensive and has side effects such as footprint on environment. It is fair that nitrogen is one of the most used fertilizers over the world. Primarily storing of nitrogen is realized in seeds as storage protein which contains amino acids that are essential for both human and animal.

Legumes are essential crops for rotation systems due to the main features as; fixation mechanism, root systems, organic matters etc. soil improving characteristics. Although climatic changes have many effects on growing plants, legumes are able to be cultivated on a large scale of the world. Present paper summarized the main effects of climatic changes and legumes by view of sustainable agricultural systems.

2. Climate Change and Effects on Plants

Global warming and climate change is related with emission of greenhouse gases which cause to changes on biotic and abiotic factors and their relationships. Main features of changes in climate and effects on both human and earth systems are modified from IPCC synthesis report (2007) and presented on Figure 1 (Amedie, 2013).

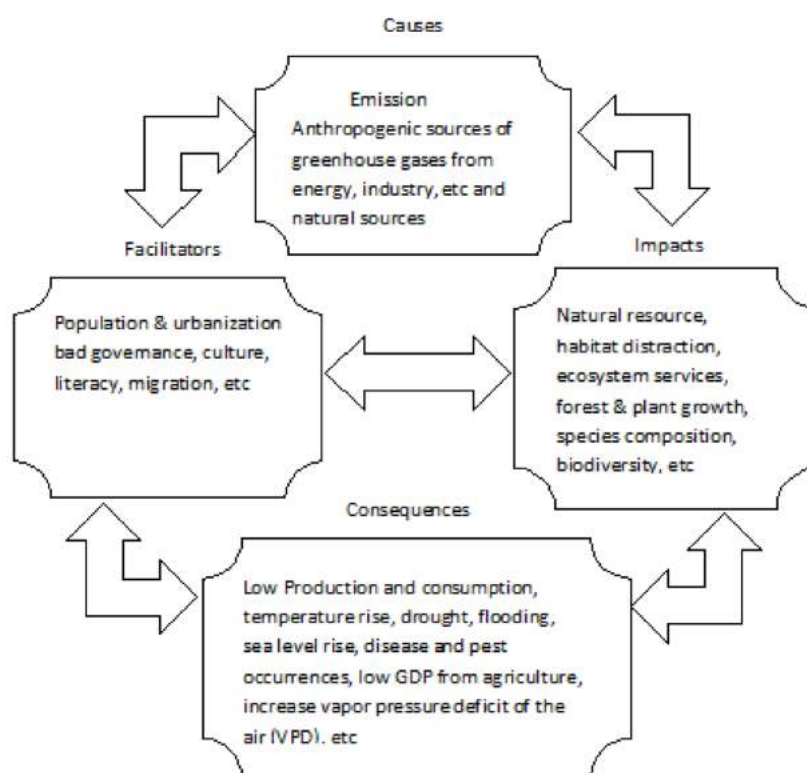


Figure 1. General features of climate change and its impacts on human and earth systems

(Source: IPCC, 2007; modified by: Amedie, 2013)

Climate change is a political and socioeconomic issues of 21st century although it was a part of science in 1970s while an important concept during 1990s over the world. It is consisted from science, economy, society and political issues (Dawson and Spannagle, 2009). Change in climate is a serious danger for sustainability of agriculture over the world. Its effects are very fast and there is no chance for prediction. Therefore, it is hard to making coordination for agronomists, breeders, farmers and other stakeholders. Additionally, there are other direct or side effects on diseases, insects, pesticides and weeds as well (Halford et al., 2008).

Increase in global warming has direct effects on respiration of plants and photosynthesis. Rise in CO₂ concentration can cause to increase in photosynthesis of plants which are located on dry and warm statues like C₃ plants which are 95 % of world plants are in that group (wheat, rice, fruits and vegetables). In normal conditions, there are own tolerance mechanisms of plants for temperature. When an increase of temperature is realized in soil, rate of decomposition in organic matter increases, and therefore availability and mineralization of nutrients increases under sufficient water conditions and the rest of the statues are stable. For this reason, there is need for two main precautions for uptake of water, minerals and nutrients form soil to plants under climatic changes; 1) relief – decreasing of effects by decrease in greenhouse gases, 2) better adaptation mechanism; a) decreasing of exposure, b) conservation of biodiversity, c) increasing of productivity in both quantity and quality, d) minimization of effects, e) developing of forest ecosystems (Amedie, 2013).

3. Climate Change and Symbiotic Nitrogen Fixation in Legumes

World is facing with a lot of serious problems today; population is rapidly growing while most of the people are living in poverty. Using of chemical fertilizers is very much and give rise to very dangerous environmental problems. Therefore, there is an increased attention to sustainable agricultural systems which is including legumes due to their symbiotic nitrogen fixation mechanism that is an eco-friend way.

It was reported (Rustad, 2006) that, human cause to significant increase in atmospheric CO₂ which welded by unprecedented changes in climate system on the global scale. Many studies (Hebeisen et al., 1997; Tissue et al., 1997; Lüscher et al., 1998; Grünzweig and Körner, 2001) revealed that legumes are an essential group which are strongly respond for elevated CO₂ due to their symbiotic nitrogen fixation mechanism.

A well planned question summarize about biological nitrogen fixation, sustainable agriculture and the environment (Werner et al., 2005) is given in the below.

- Are signaling compounds in the rhizosphere area can limit nodulation and fixation of nitrogen?
- For the best integration of breeding of legumes, how can improved the symbiotic characters?
- How to gain advantage from “new” nitrogen fixing plants (for example *Sesbania*)?
- What is the relations among quality of ground water quality and nitrogen fixation?
- What are the better issues for best to use agroforestry, e.g. legume trees and actinorhiza trees?
- How may be better; conservation of soil and nitrogen-fixing trees and deep rooting annual legumes?
- What about the advantages of transgenic plants?
- How is the relations with other symbioses (e.g. *Frankia*, arbuscular mycorrhiza)?
- What are the possible issues for maximizing of competitiveness and inoculum efficiency?

It is highlighted that C cost of symbiotic N fixation is quite high, furthermore fixation is restricted at high N in soil (Marschner, 1995) besides affected by high CO₂ (Hungate et al., 2004). Fixation of N and nodulation are sensitive to increase in mean growth temperature (e.g., decreasing at

35 versus 25°C) as well (Montaneza et al., 1995). Therefore, nodulation of legumes may quite sensitive to higher CO₂ rates. A concept model is presented on Figure 2 (Heckathorn et al., 2014).

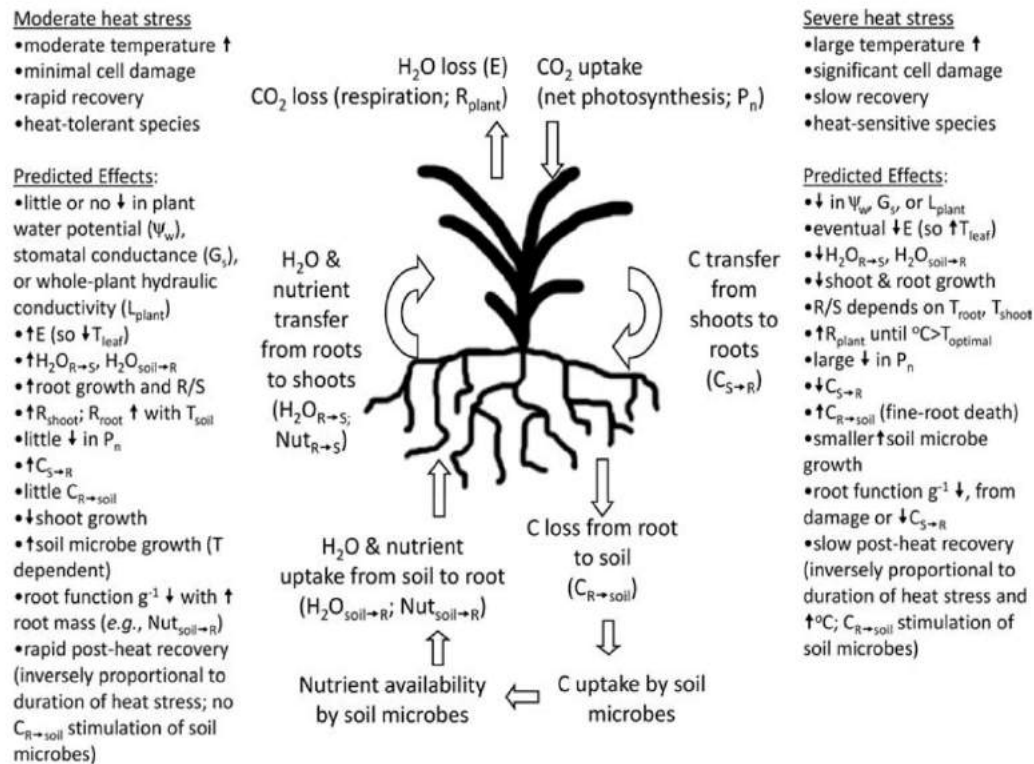


Figure 2. A tentative model of how acute heating affects roots, plant–soil links, and shoot–root interactions (Source: Heckathorn et al., 2014)

Although legume crops are less productive than perennials or grasses in addition to may not be used as bioenergy crops, it is fair that using of legumes as rotation crop with bioenergy crops, they minimize losing of nutrients and increase in their cycling (Eisenbies et al., 2009; Searchinger et al., 2008; Rosgaard et al., 2012], most of the legumes biologically fixates the nitrogen about 200–300 kg N ha⁻¹ year⁻¹; while it is the most quantity as 450 kg N ha⁻¹ year⁻¹ for *Lupinus albus* – that is a promising bioenergy legume crop. It is reported that N uptake for inoculated *L. albus* is around 2.9–6.1 g C g⁻¹ N and when supplied by N fertilizer the quantity would be 25–40% less (Tuteja and Sarvajeet, 2013).

According to the prediction of climate models for the next decades, there would be a significant loss of ozone by a rate of 50 % of the layer in Arctic while an increase in radiation of ultraviolet-B (UV-B) (280–315 nm) achieving the Earth surface. Therefore, there is risk for decrease in nitrogen fixation (Solheim et al., 2006).

4. Conclusion

In relation with the subject, the map is very well defined by Rustad (2006). Planning for the future researches, it is essential to focus on: linear vs. non-linear responses, direct vs. indirect effects, lags in response, acclimation, resource limitation, homeostasis, buffers, thresholds, ecosystem stoichiometry, turnover rates and times, and alterations in species composition. These are need to study in multidisciplinary and for long terms. Additionally, Wang et al. (2005) highlighted that, for respect to the environment and sustainability, there is need to work on molecular and physiological mechanisms for better adapted crops on salinity, higher nodulation capacity, bioremediation of dangerous chemicals and inoculants. On the other hand, there is need to pay attention on molecular ecology to discover the agricultural components.

For sustainable agricultural systems, further long-term researches should focus on effects of climatic changes on plants in every single zone, well adapted and high productive crops besides nitrogen balance of the ecosystem to achieve sustainable environment and health systems.

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COMPARISON OF FATTENING PERFORMANCE AND BODY MEASUREMENTS OF AKKARAMAN AND AWASSI MALE LAMBS

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Abstract

This research was carried out to compare fattening performance Akkaraman and Awassi sheep breeds. In this research, a total of 16 lambs were used and each genotype group consisted of 8 male lambs about 3 months of age of which beginning live weight averaged 20 kg. They were fed up with ad libitum concentrated feed and given 150 g alfalfa to each animal for a fattening period of 70 days. Feed conversion ratios were found as follows; 4.93, 4.61 and total feed intakes (FI) were 106.8 and 89.9 kg for Akkaraman and Awassi respectively. Daily live weight gains were 314 g and 284 g respectively. There were significant differences between groups in respect of total live weight gains (LWG), daily live weight gains (DLWG) ($p<0.05$) and feed consumption rates ($p<0.01$). Whereas there is no significant difference in feed conversion ratios.

Keywords: Lamb, Akkaraman, Awassi, fattening performance, body measurements

1. Introduction

Lamb production has an important position in Turkey because of the sheep population, which is approximately 33 million, and traditional consumption behaviors of the people (TÜİK 2017). Nearly 87% of the sheep population in Turkey consists of fat-tailed sheep breeds (Anonymous, 2000). About 10-15% of the carcass in domestic breeds consists of tail fat. The aim of this research is to compare some fat tailed domestic sheep breeds of fattening performance and body measurement. Red meat production in Turkey is approximately 1,130 thousand tons. About 100 thousand tons of this amount is produced from sheep. Mutton production constitutes 8.9% of total red meat production (TÜİK 2017). In terms of number and breeding, Akkaraman is the most important breeds in Turkey. They are bred both pure and also crossbreed with different breeds. The tail of this breed is fat and fattening performance is better than other native breeds. The Awassi is an indigenous breed, which usually takes attention with milk yield, produced in the southern provinces. Although it is known with milk yield the fattening performance of male lambs is noteworthy in the literature. The purpose of this study was to compare the fattening performances and body measurement of Akkaraman and Awassi male lambs.

2. Materials and Methods

This study was carried out on the reared in the Research and Application Farm of Department of Animal Science, Agricultural Faculty, Selcuk University. Akkaraman (AK) and Awassi (AW) sheep breeds were used as the research material. In the research, about 3 month-old 8 male lambs from each breed, which had approximately 20 kg live weight, were employed. During the research, about 150 g dehydrated alfalfa was given to each animal per day. Concentrate feed and water were provided as ad-libitum. Feeding diet used throughout the study contains 2750 kcal/kg metabolic energy, 17% crude protein. During the research, the lambs were kept in individual divisions in open shelter conditions. After 10 days of adaptation period, lambs fattening were started. Fattening lasted at the end of 10 weeks. Live weight every week, feed consumption and body measurements of lambs at twice week were measured, early in the morning after a night of hunger as reported by Ertuğrul (1996).

3. Results

The averages of fattening performance of Akkaraman and Awassi lambs were given in Table 1. Average fattening start weights were determined of Akkaraman lambs was 37.94 kg and Awassi lambs were as 20.6 kg. There was no statistically significant difference between the mean initial live weights of the groups. The average weight of Akkaramans was 43.28 kg and Awassi was 39.66 kg. at the end of the fattening. The difference between the groups was statistically significant ($P<0.05$). Total weight gain was found to be 21.70 kg and 19.60 kg, respectively. Total live weight gain was significantly differenced between of the groups ($P<0.05$). During the fattening period, daily live weight gain was determined of Akkaraman was 314 g and Awassi was 284 g ($P<0.05$). The means of feed intake of Akkaraman and Awassi were determined 106.8 kg and 89.9 kg respectively ($P<0.01$). The feed conversion ratio was calculated as 4.94 for Akkaraman lamb and 4.61 for Awassi lamb.

Table 1. Means of Fattening Performance

	Breed	Beginning	1	2	3	4	5	6	7	8	9	10	Total
LW	AK	21.58	24.04	25.98	28.15	30.55	32.66	34.62	36.91	39.48*	41.64*	43.28*	21.70*
	AW	20.06	22.30	23.98	25.79	27.74	29.73	31.69	33.66	35.93*	38.02*	39.66*	19.60*
LW	AK		2.64	1.94	2.17	2.40	2.11	1.96	2.29	2.57	2.16	1.64	21.70*
	AW		2.24	1.68	1.81	1.95	1.99	1.96	1.97	2.28	2.09	1.64	19.60*
DLWG	AK		352	277	310	343	301	280	328	367	308	274	314*
	AW		320	240	259	278	285	280	281	325	298	274	284*
FI	AK		9.82**	9.14**	9.47**	11.14*	10.57*	11.02*	10.73	11.91**	12.28*	10.54**	106.8**
	AW		7.78**	7.30**	7.81**	9.14*	8.92*	9.23*	9.61	10.01**	10.47*	9.37**	89.9**
FCR	AK		4.48	4.92	4.53	4.94	5.38	6.02	7.63	5.00	6.20	7.13	4.93
	AW		3.95	4.91	4.39	5.00	4.58	4.94	5.17	4.64	5.24	6.86	4.61

* $P<0.05$, ** $P<0.01$

In this study, withers height, rump height, leg girth, body length, chest girth, chest depth, chest width, and shin girth were measured and body development was followed. Determining of the

body measurements are important in defining breed characteristics and it is also important of the course of fattening activity and in determining some carcass characteristics. The body measurements of lambs during the fattening period are given in Table 2. According to these results, the total body length gains were significantly affected by the groups ($P<0.05$).

At the beginning of fattening, the averages of the lambs' withers height were measured as 58.38 cm and 57.13 cm. The total increase and percentage increase in the withers height were found to be 10.13 cm and 17.4% in Akkaramans. Withers height of Awassi lambs was calculated as 9.75 cm and 17.1% in the respectively. At the beginning of fattening the average of the lambs, rump heights were measured in Akkaraman and Awassi sheep breeds 59.38 and 58.13 cm, respectively. Total and percentage increases in rump heights for Akkaraman and Awassi were 9.75 cm, 16.4%, 9.38 cm, 16.2%, respectively. The total increase and percentage increases of the leg girth in the Akkaraman were 58.63 cm, 8.50 cm, and 14.5%, respectively. But in the Awassi were be found 57.88 cm, 7.75 cm, and 13.3%, respectively. Body length measurements were 52.06 cm in the Akkaraman and 50.38 cm in the Awassi ($P < 0.05$). The total and percentage increases in Akkaraman were 6.06 cm and 11.7%, whereas the values for Awassi were 7.75 cm and 15.4%, respectively. The difference between the increases at body length was statistically significant ($P<0.05$).

Table 2. Means of Body Measurements

		1	2	3	4	5	6	Total	%
Withers height	AK	58.38	61.25	63.88	65.75*	66.88*	68.50	10.13	17.4
	AW	57.13	60.00	62.13	63.88*	65.25*	66.88	9.75	17.1
Rump height	AK	59.38	61.75	64.00	66.13	67.00	69.13	9.75	16.4
	AW	58.13	61.25	63.50	65.00	66.13	67.50	9.38	16.2
Leg girth	AK	58.63	60.13	62.38	64.38	65.75	67.13	8.50	14.5
	AW	57.88	60.00	61.63	63.00	64.38	65.63	7.75	13.3
Body length	AK	52.06*	52.50	54.25	55.56	57.13	58.13	6.06*	11.7*
	AW	50.38*	51.88	53.75	55.50	56.63	58.13	7.75*	15.4*
Chest girth	AK	66.50	71.50	73.75*	75.25	76.63	79.00*	12.50	18.8
	AW	64.88	69.13	70.75*	73.00	74.63	76.13*	11.25	17.4
Chest depth	AK	21.88	22.5	23.63	24.75	26.00	26.75*	4.88	22.5
	AW	21.13	22.25	23.25	24.31	25.25	25.63*	4.50	21.4
Chest width	AK	13.75	15.25	16.25	17.25	18.44*	19.00*	5.25	38.6
	AW	13.13	14.50	15.38	16.38	17.50*	17.88*	4.75	36.4
Shin girth	AK	7.31	7.25	7.38	7.56	7.69	7.81	0.50	7.1
	AW	7.44	7.50	7.50	7.69	7.88	8.00	0.56	7.8

* $P<0.05$

For Akkaraman, the beginning measurement, total increase, and percentage increase in the chest girth were 66.50 cm, 12.50 cm, and 18.8% respectively. For Awassi, they were 64.88 cm, 11.25 cm, and 17.4% respectively. The beginning measurement, total increase, and percentage increase in the chest depth of Akkaraman were 21.88 cm, 4.88 cm, and %22.5 respectively. In the Awassi, they were 21.13 cm, 4.50 cm, and %21.4 respectively. The beginning measurement, total increase, and percentage increase of the chest width in the Akkaraman were 13.75 cm, 5.25 cm, and %38.6 respectively. For the Awassi, they were 13.13 cm, 4.75 cm, and %36.4 respectively. The beginning

measurement, total increase, and percentage increase of the shin girth at the initial fattening of Akkaraman were 7.31 cm, 0.50 cm, and 7.1%. However, for Awassi, they were 7.44 cm, 0.56 cm, and 7.8%, respectively.

4. Conclusions

When the Akkaraman and Awassi lambs are subjected to the same feeding regime under the same environmental conditions, it is seen that the Akkaraman breed has gained more live weight. Feed intake was lower in Awassi. The amount of feed consumed for per kg live weight gain is low in the Awassi breeds. Live weight gain was found to be significant in Akkaraman breeds ($P<0.05$). Feed intake in Awassi breeds was found to be statistically significant ($P<0.01$). The difference between feed conversion ratios was found to be insignificant ($P> 0.05$).

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DEPONİ GAZI POTANSİYELİ HESAPLAMADA METOT SEÇİMİ VE YAKLAŞIK TAHMİNLER

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Özet

Teorik olarak, tam kapasite çalışan katı atık depolarındaki metan gazı potansiyeli 50-400 L/kg (m^3/ton) arasındadır. Verilen aralığın bu kadar geniş olması (minimum ve maksimum değerler arası 8 kat fark bulunmaktadır) yukarıda belirtildiği gibi çöp karakteristiği, iklim ve depolama sahasına özgü diğer özelliklerin çıkacak gaz miktarını etkilediğinin bir başka göstergesidir.

Anahtar Sözcükler: Düzenli Depolama Alanı, Deponi Gazı, Potansiyel Hesaplama Metotları.

1. Giriş

BM'nin hesaplamalarında dünya nüfusunun 2017 tahminlerinde 7,5 milyar olduğu, bu sayının 2020 yılına kadar 7,7 milyara, 2040'ta 9,1 milyara ulaşacağı tahmin edilmektedir. (Anonim, 2018). Şehir merkezlerindeki nüfusun ve sanayi tesislerinin bu ölçüde artması, şehirlerimiz etrafında süratle büyüyen kontrolsüz çöp dağlarının oluşmasına neden olmaktadır. Bu nedenle bu tür atıkların sağlıklı ve ekonomik ve ekonomik bir şekilde depolanması ve geri kazanılması konusu önemle gündeme gelmiştir (İrıcın, 2011).

2. ÖNCEKİ ÇALIŞMALAR

Gazın toplanması ile ilgili mevcut koşulların fizibilite edilmesi, oluşan metan gazı potansiyelinin belirlenmesi ve bertaraf edilmesi ile ilgili seçeneklerin araştırılması hakkında yapılmış olan çalışmalar aşağıda iki alt bölümde özetlenmiştir.

2.1. Deponi Gazının Kullanımına İlişkin Çalışmalar

Deponi alanına katı atığın depolanması ile birlikte deponi içerisinde ayrışma başlamakta olup, anaerobik ortamda organik maddelerin bozunması sonucunda bozunma gazları meydana gelmekte ve oluşan bu gazlar “Deponi Gazı” olarak adlandırılmaktadır (Sezgin vd., 2003).

Aslında deponi gazı azot oksitlerinin, deponi gazının yakılması sonucunda düşük alev sıcaklığı sağlandığından, doğal gazlı yanmalarına göre %70 daha düşük salım oluşturduğu iddia edilmektedir (Cakir vd., 2016).

2.2. Deponi Gazının Tahminlenmesine Yönelik Çalışmalar

Bir deponideki atığın bozunma süresince oluşan karmaşık değişiklikleri basit terimlerle tanımlayabilmektir (Lamborn, 2010).

3. Deponi Gazı Modelleme Çalışmaları

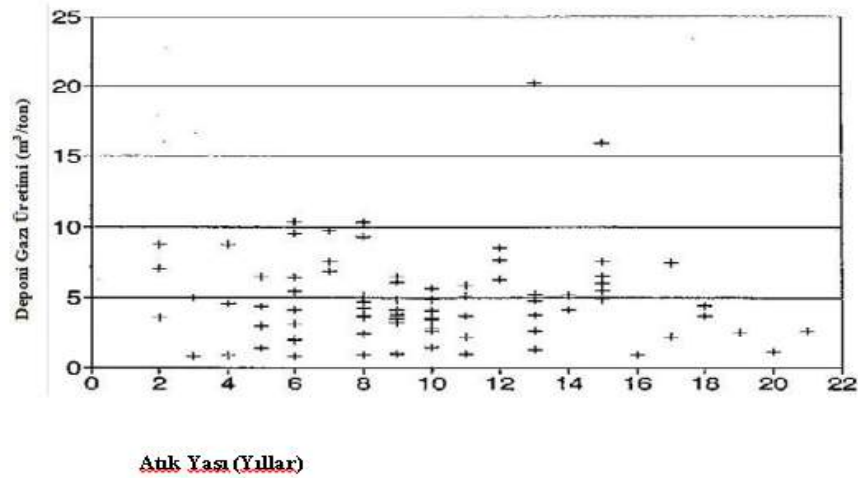
Depolanan çöpün yıllara göre miktarı, atık karakteristiği, sahanın işletilme süresi vd.'dir. Model hesaplamalarında kullanılan L_0 , DOC, DOCf vb. değerleri için, evsel katı atığın spesifik özellikleri dikkate alınmalıdır.

3.1. Literatür Esaslı Yaklaşık Tahmin

Gendebien vd. (1991) yaptıkları bir çalışmada, bir deponi alanında 1975- 1990 yılları arasında üretilen deponi gazı miktarının $60-400 \text{ m}^3/\text{ton}$ arasında değiştiği ve sürecin 50-100 yıl devam edeceği vurgulanmıştır.

Uzun yıllar yapılan araştırma ve tahkikatlar sonucu, gerçek bir gaz toplama periyodu 40-80 yıl sürmekte ve ton başına üretilen deponi gazı miktarı $50-100 \text{ m}^3$ olmaktadır (Terraza and Willumsen, 2009). Willumsen, et al.'nın (1991) yaptıkları bir çalışmada, 1990 yılında, yaklaşık 250 deponi tesisi hakkında bilgi toplandı. Şekil 1'de, 86 deponi tesisinden ilk 5 yıllık süreç boyunca, ton başına atık miktarından ortalama 5 m^3 deponi gazının çıktığı görülmektedir.

Şekil 1. Dünya genelinde 86 deponi tesisinin atık yaşı ve deponi gazı üretim oranları (Terraza and Willumsen, 2009).



Bu veriler ışığında, yıllık atık ton başına üretilen deponi gazı miktarını 5 m^3 alınabilir. Buna göre depolama sahasının işletim ömrü boyunca üretilen gaz miktarının $35-140 \text{ m}^3/\text{ton}$ atık arasında olabileceği söylenebilir.

Tam ölçekli katı atık sahaları için çıkabilecek teorik deponi gazı (LFG) miktarıyla ilgili olarak $50-400 \text{ L/kg}$ (m^3/ton) aralığı verilmiştir (Ham and Barlaz, 1987). Verilen aralığın bu kadar geniş olması (minimum ve maksimum değerler arası 8 kat fark bulunmaktadır) yukarıda belirtildiği gibi çöp karakteristiği, iklim ve depolama sahasına özgü diğer özelliklerin çıkacak gaz miktarını etkilediğinin bir başka göstergesidir.

3.2. Tabasaran/Rettenberger Modeli ile Tahmin

Gaz üretiminin hesabı için Tabasaran ve Rettenberger (1987) tarafından geliştirilen matematik model ile belli bir zaman süresince üretilen gaz miktarı kümülatif olarak belirlenmektedir. Model bağıntısı Denklem (7.1)'de verildiği gibidir.

$$G_t = 1,868 \times C_{org} \times (0,014T + 0,28) \times (1 - 10^{-k}) \times M_t \quad (7.1)$$

Bağıntıda; Gt: t. yıla kadar

üretilen gaz miktarı (Nm³) Corg: Organik karbon içeriği (kg/ton atık) T: Sıcaklık (°C) t: İlk atık depolama yılından başlayarak geçen süre (yıl) k: Deponi gazı oluşum hızı sabiti (yıl⁻¹)

Mt: t. yılda depolanan atık miktarı (ton) olarak tanımlanmaktadır.

Çalışma kapsamında, yukarıda belirtilen sakıncalar göz önünde bulundurularak, Tabasaran/Rettenberger modeline ait parametre ve değişkenler kullanılarak, Düzenli Depolama Alanı özelinde uygulanmalıdır. Modelin çalıştırılması için depolanan çöpün organik karbon içeriği (Corg) kg/ton atık, sıcaklık değeri ve deponi gazı oluşum hızı sabiti (k) bilgileri formülasyona girilmelidir.

3.3. Multi-Phase (Çoklu Faz) Modeli ile Tahmin

Deponi gazı oluşumunun tahmin edilmesi için kullanılan modellerden biri de multi-phase (çoklu-faz) modelidir. Model, atık içindeki biyolojik ayrışabilen organik karbon oranı ve kümülatif atık miktarını esas alarak hesaplama yapmaktadır. Modelin matematiksel ifadesi, Denklem (7.2) ile verildiği gibidir. Denklem (7.2)'yi oluşturan parametrelerin açıklamaları aşağıda verildiği gibi tanımlanabilir.

$$\alpha_t = \zeta \sum_{i=1}^3 1,87 A C_{0,i} k_{1,i} e^{-k_{1,i} t} \quad (7.2)$$

α_t : Deponi gazı oluşum miktarı (Nm³/yıl),

ζ : Üretim faktörü,

A: Atık miktarı (ton),

C_{0,i}: Organik karbon miktarı (kg C/ ton atık),

k_{1,i}: Model değişkenleri (yavaş, orta ve hızlı parçalanma için ayrı ayrı verilir),

t: Atığın depolanmaya başladığı ilk yıldan başlayarak geçen süre (yıl).

Modelde sadece hızlı, orta ve yavaş parçalanabilir organik atıklar hesaba katılmıştır. Modelde atık içindeki parçalanabilir atık türleri, parçalanma hızlarına göre üç grupta ele alınmaktadır. Literatürde hızlı parçalanabilen atıklar için k_{t,i}: 0,076-0,694 yıl⁻¹, orta hızla parçalananan atıklar için k_{t,i}: 0,046- 0,116 yıl⁻¹, yavaş parçalananan atıklar için k_{t,i}: 0,013-0,076 yıl⁻¹ arasında kabul edilebileceği ifade edilmektedir (Jacobs J., and Scharff H. 2006; Kalaman, et al., 2011). Multi-phase modelinde tahmini oluşacak deponi gazı miktarı, farklı parçalanma hızlarındaki atık miktarlarının kümülatif toplamı ile elde edilir.

Kentsel katı atıklar, %40-50 selüloz, %10-15 lignin, %12 hemiselüloz ve %4 protein içermektedir (Booker and Ham, 1982). Selüloz ve hemiselüloz hızlı parçalanabilirken lignin, anaerobik koşullarda parçalanmaya engeldir (Young and Frazer, 1987). Selüloz ve hemiselüloz

mutfak atıkları ve bahçe atıklarında bulunurlar ve anaerobik koşullar altında kolayca biyolojik olarak parçalanabilirler. Lignin ise, odun, kâğıt ve kâğıt türevi ürünlerde (Gazete, dergi vb.) bulunur ve anaerobik koşullar altında biyolojik parçalanmayı zorlaştırır (Thompson et al. 2009).

3.4. Scholl Canyon Modeli ile Tahmin

1.derece kinetik denklem içeren modeller, deponilerden deponi gazı hesaplamada sıkça kullanılan yaklaşımlardır. Bu modeller, deponi alanlarındaki koşullar hakkında bir dizi varsayıma dayanarak tasarlanmıştır (Esmap, 2004). Scholl Canyon'da, tek kademeli 1.derece kinetik bir modeldir. Bu model, anaerobik koşulların ve mikrobiyal popülasyonun oluşması için gerekli olan bir gecikme zamanından sonra biyogaz oluşumunun maksimum hızla başladığını kabul etmektedir (Özaktaç, Ş., 2004). Bu modele ait matematiksel eşitlik Denklem (7.3) ile verilmiştir.

Denklem (7.3)'de belirtilen parametrelere ait bilgiler aşağıda verildiği gibidir. Q_{lfg}: Yıllık deponi gazı

$$Q_{lfg,i} = 2 \times k \times L_0 \times M_i \times e^{-kt} \quad (7.3) \quad \text{miktarı (Nm}^3\text{/yıl)}$$

L₀: Metan üretim potansiyeli (Nm³ CH₄/ ton atık)

M_i: i. yıldaki depolanan atık miktarı (ton) k: Metan üretim hızı sabiti (yıl⁻¹)

i: 1-yıllık zaman artışı

t: Atığın ilk depolanmaya başladığı yıldan itibaren geçen süre (yıl).

Model, CO₂ ve CH₄ salımlarının aynı oranda olduğunu kabul etmektedir. Bir başka ifade ile deponi gazı miktarının metan salımının iki katı olduğu varsayılmaktadır.

Düzenleme Depolama Alanındaki atık kompozisyonu incelendiğinde, atık içeriğinin büyük bir çoğunluğunu yiyecek atıklarından oluştuğu anlaşıldığında, bu durum sizin daha hızlı atıklarınızın bozunacağını ifade etmektedir.

Atık kompozisyon verileri alınarak alana özgü parçalanabilir organik karbon miktarını (DOC)

Denklem (7.4)'e göre hesaplanır.

$$DOC = 0,4A + 0,16(B + C) + 0,3D \quad (7.4)$$

A: Kâğıt, karton, hacimli karton, tekstil vb. oranı (%)

B: Mutfak atıkları oranı (%)

C: Park-bahçe atıkları oranı (%)

D: Odun oranı (%)

Parçalanabilir organik karbon fraksiyonu (DOC_f) ise, Denklem (7.5)'e göre bulunur. Burada, deponi alanının ortalama sıcaklığı için 35°C değeri kullanılmıştır.

$$DOC_f = 0,014 \times T + 0,28 \quad (7.5)$$

Hacimce metan fraksiyonunun (F) değeri ise, ortalama metan değeri esas alınarak hesaplanmalıdır.

$$L_0 = MFC \times DOC \times DOC_f \times F \times 16/12 \quad (7.6)$$

MFC: Düzeltme faktörü

DOC: Parçalanabilir organik karbon miktarı DOCf: Parçalanabilir organik karbon fraksiyonu

F: Hacimce metan fraksiyonu (%)

16/12: Moleküler ağırlık oranı, CH₄/C ile açıklanmıştır.

Denklem (7.4) ve Denklem (7.5)'den elde edilen değerlerin Denklem (7.6)'da yerine konulması ve diğer belirtilen parametre değerlerinin de yazılması ile Düzenli Depolama Alanınıza özgü metan üretim potansiyeli m³ /ton olarak elde edebilirsiniz.

4. SONUÇ ve ÖNERİLER

Matematiksel modellere ait en yüksek deponi gazı tahmini sonucu, Tabasaran/Rettenberger metodunun kullanılmasıyla elde edilen sonuçlardır. Bunun nedeni, Tabasaran/Rettenberger metodunun atıkları fraksiyonlarına göre ayırmamasıdır.

Scholl Canyon modeli, deponi gazının mikrobiyal büyümesini kıstas almaktadır. Hesaplamalarda elde edilen sonuçlar atıkların yüksek, orta ve düşük hızda parçalanmalarına göre elde edilmiştir. Bu iki modelde atıklar bileşenlerine ayrılmamış olup, hesaplamalarda kentsel katı atıkların tamamı hesaplamalara dahil edilmiştir.

Multi-Phase modeli ise, deponi gazı hesaplamalarında organik bazlı atıkların parçalanma oranlarını kıstas almaktadır. Bu, üç ayrı fraksiyon halinde (Yüksek, orta ve yavaş hızlı) hesaplanmaktadır. Daha sonra bu fraksiyonlara göre elde edilen değerler toplanarak o yıl için üretilen deponi gazı miktarı çıkartılmaktadır.

Deponi gazı enerji değerinin hesaplanmasında organik bazlı atıklar önemli yer tutmaktadır (hidrokarbon kaynağı içerdiğinden). Bu nedenle Multi-Phase modeline ait hesaplama sonuçları, ileride kurulabilecek güç tesisi için referans gaz değerleri olarak alınabilir.

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EFFECTS OF RHIZOBACTERIA INOCULATION ON GROWTH AND YIELD COMPONENTS OF PEPPER

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Abstract

PGPRs have great potential for plant growth promotion have been considered important in sustainable agriculture. PGPRs induce and/or synthesize various growth-promoting and biocontrolling chemicals such as phytohormones, antibiotics, enzymes, etc. This study was under taken to determine the influence of three different formulation of preparing with bacteria strains of *Paenibacillus polymyxa* (TV-12E), *Bacillus megaterium* (TV-91C), *Pantoea agglomerans* (RK-92), *Bacillus megaterium* (TV-87A), *Bacillus subtilis* (TV-17C), *Bacillus megaterium* (M3), *Bacillus pumilus* (TV-73A) and Mega Flu (microbial fertilizer) on yield and some quality parameters of pepper (*Capsicum annuum* L.) grown under greenhouse conditions. In this study, the cultivar of üçburun pepper was used, and the seedlings were planted in the second week of May in 2016. The experiment was conducted according to randomized plot design with three replications and 12 plants in each replicate. According to the statistical analysis, fruit number per plant, average fruit weight (g), fruit weight per plant (g), yield (kg da⁻¹), fruit width (mm), Plant length (cm), L (fruit brightness), b (yellowness), water soluble dry matter (°Brix) and dry matter ratio (%) were found statistically important.

Keywords: PGPR, *Capsicum annuum* L, Greenhouse, Growth-promoting, Sustainable agriculture.

INTRODUCTION

Pepper is a species of vegetable that can be grown in almost all parts of the world, and is widely consumed in our country and around the world. Pepper, as well as eggplant and tomato, is found in *Solanaceae* family and is located within the genus *Capsicum* (Özalp, 2010; Eşiyok, 2012). Turkey ranks third among the countries producing peppers in the world. In 2016, about 35 million tons of pepper production was realized in the world, and China ranked first with 17 million tons and Mexico ranked second with 2.7 million tons and Turkey ranked third with 2.5 million tons (FAO, 2018).

In modern cultivation process indiscriminate use of fertilizers, particularly the nitrogenous and phosphorus, has led to substantial pollution of soil, air and water. Excessive use of these chemicals exerts deleterious effects on soil microorganism, effects on the fertility status of soil and also pollutes environment (Youssef et al., 2014). The application of these fertilizers on a long term basis often leads to reduction in pH and exchangeable bases thus making them unavailable to crops and the productivity of crop declines. To obviate this problem and obtain higher plant yields, farmers have become increasingly in dependent on chemical sources of nitrogen and phosphorus. Besides being costly, the production of chemical fertilizers depletes nonrenewable resources, the oil and natural gas used to produce these fertilizers, and poses human and environmental hazards (Joshi et al., 2006). In recent years, biological applications have come to the forefront in ensuring continuity in agriculture instead of chemicals. Useful microorganisms have been introduced in order to increase in the

resistance of plants to biotic (pathogens, harmful insects, weeds) and abiotic (adverse environmental conditions, soil conditions) factors and to improve the yield and quality of plants (Bäckman et al., 1997; Debez et al., 2001; Egamberdieva et al., 2017). Rhizobacteria, which promote plant development, have been found to be able to make a positive impact on plant growth and yield by increasing in nitrogen fixation, phosphorus solubility, water use efficiency and production of phytohormones (such as auxins, cytokinins, gibberellins), by activating the uptake of nutrients, by or by enzymatically reducing the level of ethylene in the plant (Glick, 1995; Lucy vd., 2004; Çakmakçı ve Erdoğan, 2008).

Aim of the study was to determine the effects of three different formulation of preparing with bacteria strains on yield and some quality parameters of pepper (*Capsicum annuum* L.) grown under greenhouse conditions.

MATERIAL AND METHOD

The study was carried out in the research greenhouses of the Department of Horticulture, Faculty of Agriculture at Atatürk University, in 2016. In the study, üçburun pepper variety was used as vegetable material.

Bacteria used in the study were obtained from Department of Plant Protection, Faculty of Agriculture at Atatürk University. In this study, formulations prepared from *Paenibacillus polymyxa* (TV-12E), *Bacillus megaterium* (TV-91C), *Pantoea agglomerans* (RK-92), *Bacillus megaterium* (TV-87A), *Bacillus subtilis* (TV-17C), *Bacillus megaterium* (M-3) ve *Bacillus pumilus* (TV-73A) bacteria and Mega flu (microbial fertilizer) were used (Table 1).

Bacteria taken from fresh cultures, by taking from the surface of the agar medium was inoculated into liquid nutrient medium which had been previously prepared in the fermentor and autoclaved at 121 °C for 20 min and Nutrient Broth (NB) containing. These cultures after than incubated in flasks on a rotating shaker for 24 hours at 26 °C, inoculation was carried out by mixing 1:10 of the carrier liquid, which is completely organic and steam sterilized. inoculated organic liquid carrier was left to incubate in flasks on a rotating shaker for 24 hours at 26 °C. Prepared microbial fertilizer formulation, was prepared by diluting 100 times with chlorine-free water and thoroughly was mixed. Sugar was added at a ratio of 1/40 (kg / L) to the prepared solution and was waited for 1 night.

Pepper seedlings were dipped into these liquid microbial formulations and were waited for absorb completely into to the liquid of seedling medium during 15 min. In the control application has been used seedlings kept in liquid carrier not inoculated with bacteria.

Table 1. Formulations used in the study

Application	Used bacterial isolations			
B1	TV-12E	TV-91C	RK-92	-
B2	TV-87A	TV-17C	RK-92	M3
B3	TV-12E	TV-73A	RK-92	M3
B4	Mega Flu	-	-	-

RESULTS AND DISCUSSION

Many researchers have conducted studies on different bacterial strains (Adesemoye et al., 2008; Dursun et al., 2010; Yildirim et al., 2011; Turan et al., 2014; Ekinici et al., 2014; Ahmed et al., 2017). Datta et al. (2015) have investigated on effects to plant growth and capsaicin production in local pepper varieties of *Streptomyces sp.* and *Bacillus sp.* bacteria. Researchers have stated that microbial fertilizers are an eco-friendly application that increases in the yield and content of the capsaicin.

The results of our study showed that treatment of different formulations of bacteria and Mega flu (microbial fertilizer) significantly affected especially on yield parameters tested in study. The results showed that the average fruit weight ($p<0.001$), fruit number per plant ($p<0.05$), the fruit weight per plant ($p<0.05$) and yield ($p<0.05$) significantly increased in by bacteria treatments compared with control. Yield value of all bacteria was in the same column but the highest yield value was obtained from the B1 formulation (6486.80 g/m²) and the other applications were listed in B3 (6274.00 g/m²), B2 (6109.60 g/m²) and B4 (5960.93 g/m²), respectively (Table 2).

Table 2. The effects of treatments on some yield and fruit properties

Application	Fruit number per plant	Fruit weight per plant (g)	Average fruit weight (g)	Yield (g/m ²)
Control	79.90 b*	1127.90 b*	14.88 c***	4511.60 b*
B1	98.10 ab	1621.70 a	17.31 a	6486.80 a
B2	97.47 ab	1527.40 a	16.65 a	6109.60 a
B3	102.30 a	1568.50 a	15.73 b	6274.00 a
B4	95.50 ab	1490.23 a	16.56 a	5960.93 a
Mean	94.65	1467.15	16.23	5868.59
Application	Fruit width (mm)	Fruit length (cm)	Plant length (cm)	
Control	34.63 a***	15.31 ^{ns}	123.83 ab*	
B1	31.33 c	14.22	124.17 ab	
B2	32.65 bc	14.62	122.50 b	
B3	28.91 d	14.52	137.67 a	
B4	33.08 b	14.86	120.67 b	
Mean	32.12	14.70	125.77	

*: $p<0.05$, **: $p<0.01$, ***: $p<0.001$, ns: $p>0.05$. The numbers in one column having the same letter are not significantly different.

Mirik et al. (2008), in field studies having been done in bitter pepper, determined that application of *Bacillus* race bacteria the plant's stem diameter, root length, root and stem dry weight and yield increases in at rates 5%, 20.5%, 7%, 17%, 4.5% and 23.5%, respectively. In this study, while the bacterial applications did not effect on the fruit length statistically ($p>0.05$), the highest value of the fruit width was determined in the control group (34.63 mm). When examined the effect of applications on plant length, the highest value was obtained from the B3 formulation (137.67 cm), while the lowest value was obtained from the B2 and B4 applications (122.50 and 120.67 cm, respectively).

The results of our study showed that applications of different bacterial solutions did not affect ($p>0.05$) on pH, ascorbic acid and a value. B4 (7.91%) and B3 (7.60%) applications gave the highest % dry matter of pepper representing increases in over control. B3 formulation has significantly ($p<0.001$) increased in the total soluble solid matter content of the pepper, but that it was determined to be in the same column of all other applications. Fruit color is one of the most important and complicated fruit quality criteria. Color formation in the fruit varies depends on both genetic and environmental factors (Lopez Camelo and Gomez, 2004). As the color becomes darker, the L value decreases. The most light color fruit crust formation was obtained by B1 and control application (51.92 and 50.92, respectively). The a (redness) and b (yellowness) values were shown in Table 3. Parallel to the L value, the most yellow color was also observed in the B1 application (26.97).

Table 3. The effects of treatments on some fruit properties

Application	L	a	b	Ascorbic acid (mg/l)
Control	50.92 a*	16.93 ^{ns}	26.16 ab*	149.50 ^{ns}
B1	51.92 a	17.13	26.97 a	149.50
B2	47.86 b	16.50	24.38 c	153.50
B3	47.66 b	16.40	24.60 bc	108.00
B4	50.13 ab	16.91	26.05 ab	163.50
Mean	49.70	16.77	25.63	144.80
Application	pH	Total soluble solid(°Brix)	% Dry matter	
Control	5.75 ^{ns}	3.90 b***	7.14 bc**	
B1	5.63	3.95 b	6.95 c	
B2	5.72	4.05 b	7.55 ab	
B3	5.66	4.90 a	7.60 a	
B4	5.63	3.90 b	7.91 a	
Mean	5.68	4.14	7.43	

*: $p<0.05$, **: $p<0.01$, ***: $p<0.001$, ns: $p>0.05$. The numbers in one column having the same letter are not significantly different.

CONCLUSION

In conclusion, this study has determined that different bacterial solutions have positive effects on plant growth, fruit quality and yield characteristics in pepper cultivation. According to the results of the research, given the environmental pollution and high cost brought about by the use of excessive chemical fertilizers, it has been found that the bacterial formulations used are quite promising for environmentally friendly agriculture. Further, in line of the results obtained in our study, we believe that the bacterial formulations used here can be used as microbial fertilizer in vegetable cultivation.

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PLEUROTUS OSTREATUS'UN MİSEL GELİŞMESİNE HUMİK MADDELERİN ETKİSİNİN ARAŞTIRILMASI

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Özet

Bu çalışmada *Pleurotus ostreatus*'un misel gelişimi üzerine humik maddelerin etkisi araştırılmıştır. Malt ekstrakt agar (MEA) ve patates dekstroza agar (PDA) besi yeri olarak kullanılmıştır. Malt ekstrakt agar ve patates dekstroza agarlara humik maddenin belirli dozları ilave edilerek otoklavda 121°C'de 15 dk steril edilmiştir. Pastör fırınında steril edilmiş petrilere steril güvenlik kabini içerisinde besi yerleri dökülmüştür. Besi yerleri katılaştıktan sonra aynı kabin içerisinde misel iltiva eden besi yeri aktarımı yapılmıştır. Bu işlemde sonra petrilere etüve alınmıştır. Belli aralıklarla miselyum gelişmeleri alansal olarak çizilmiştir. Ön çalışma olarak besi yerlerine %0, %1, %3, %5, %7, %9 oranlarında humik madde ilavesi yapılmıştır; bu oranlarda yapılan uygulama sonuçlarına göre, çalışma denemelerinin %0, %0.5, %1, %1.5 oranlarında yapılmasına karar verilmiştir. Bu çalışmada malt ekstrakt agar ve patates dekstroza agarlara %0, %0.5, %1 ve %1.5 oranında humik madde eklenerek petrilere aktarılmıştır. *Pleurotus ostreatus*'un misel gelişim hızları ve yoğunlukları incelenmiştir. Denemeler 3 tekrarlı olarak yapılmıştır. Deneme sonuçlarına göre humik madde oranı %1.5 olan besi yerlerindeki kültürlerin daha yavaş gelişirken %1.5'in altındaki oranlarda gelişim hızı ve humik madde miktarı arasında bir korelasyon tespit edilememiştir. Humik madde eklenen tüm kültürlerde misel yoğunluğunun, eklenmeyenlere göre daha fazla olduğu gözlenmiştir.

Anahtar kelimeler: *Pleurotus ostreatus*, Humik Madde, Misel Gelişmesi, MEA, PDA

INVESTIGATION OF THE EFFECT OF HUMIC SUBSTANCES ON MYCELIUM GROWTH OF *PLEUROTUS OSTREATUS*

Abstract

In this study, the effect of humic substances on mycelial development of *Pleurotus ostreatus* was investigated. Malt extract agar (MEA) and potato dextrose agar (PDA) were used as feedstock in the study. Malt extract agar and potato dextrose agar were sterilized by autoclaving at 121°C for 15 min with the addition of specific doses of agaric material. In the Pasteur oven, nutrients were poured into sterile petri dishes in the sterile safety cabinet. After the feedstock sites solidified, the transfer of the media containing the mycelium was carried out in the same cabin. After this process, the petri dishes were removed from the sterile safety cabinet to the incubation oven. At certain intervals mycelial developments are plotted spatially. As preliminary study, humic substances were added at 0%, 1%, 3%, 5%, 7%, 9% However, according to the results of the applications made at these rates, it has been decided to make the working trials at 0%, 0.5%, 1%, 1.5%. In this study, malt extract agar and potato dextrose agar supplemented with 0%, 0.5%, 1% and 1.5% of humic substance were applied to petri dishes, *Pleurotus ostreatus* tissue culture was done and the growth rates and densities of misplants were examined. The experiments were done in 3 replicates. According to the results of the experiment, it was found that the cultures of the feeder with 1.5% humic substances were slower, while the rate of growth and the amount of humic substances were not correlated at rate below 1.5%. It was observed that the micelle density was higher in all the cultures added with humic substance than those not added.

Key words: *Pleurotus ostreatus*, Humic Substance, Mycelium Development, MEA, PDA

GİRİŞ

Agaricus bisporus (JE Lange) Imbach'tan sonra en çok üretilen kültür mantarı *Pleurotus ostreatus* (Jacq.) P. Kumm. 1871 (Eren ve Pekşen 2016) Dünya'da ve Türkiye'de insanlar tarafından kullanılan önemli mantar türlerinden biridir. *Pleurotus ostreatus* ticari olarak "İstiridye Mantarı, Kavak Mantarı, Yelpaze Mantarı ve Yaprak Mantarı" gibi isimlerle pazarlarda ve marketlerde satılmaktadır. *Pleurotus ostreatus* türü yapraklı ağaçların odunları ve diğer bitkisel artıklar üzerinde gelişerek bolca ürün verebilen bir mantardır. İstiridye mantarı gibi diğer pek çok kültür mantarlarının da çeşitli kompostlarda yetiştirilebilmesi için öncelikle mantarların tohumluk misellerinin elde

edilmesi gerekmektedir. Tohumluk misellerin elde edilmesi için farklı besi yerlerinde steril ortamlarda doku kültürü yapılmalıdır.

Bu çalışmada *Pleurotus ostreatus*'un Malt Ekstrakt Agar (MEA) ve Patates Dekstroz Agar (PDA) besi yerlerinde misel gelişmesine hümkik maddelerin etkisi araştırılmıştır. Bu çalışmada amaç, dünyada önemli bir kültür mantarı olarak bilinen *Pleurotus ostreatus* türünün tohumluk misel üretiminde kullanılacak saf kültürlerin geliştirilmesinde hümkik maddelerin misel gelişmesine gerek süre gerekse yoğunluk açısından etkisini tespit etmektir.

MATERYAL VE METOT

Bu çalışmada materyal olarak *Pleurotus ostreatus*'un saf kültürleri ile MEA ve PDA besi yerleri kullanılmıştır. Hümkik madde olarak piyasada satılan hümkik asit, fulvik asit ve organik madde içerikli çözeltiler denemelerde kullanılmıştır.

Bu çalışma Selçuk Üniversitesi Mantarcılık Uygulama ve Araştırma Merkezi Müdürlüğü'nün Misel Üretim Laboratuvarı'nda gerçekleştirilmiş ve *Pleurotus ostreatus*'a ait doku kültürleri önceden steril olarak çoğaltılmış saf kültürlerin bulunduğu besi yerlerinden aktarım yapılarak kullanılmıştır. Yaptığımız çalışmada %15'lik hümkik asit ve fulvik asit karışımının %0, 0.5, 1 ve 1.5 lik oranlarının (MEA) ve (PDA) ile ayrı ayrı karıştırılarak oluşturulan besi yerleri kullanılmıştır. Hümkik madde ilave edilmiş besi yerleri hazırlanırken pH değerleri not edilmiştir. Hazırlanan her bir besi yeri manyetik karıştırıcıda 500ml lik erlenlerde distile suyla 600 rpm'de 10 dk karıştırılmıştır(Şekil 1a). Hazırlanan besi yerlerinin oranları ve pH değerleri Tablo 1 ve 2'de sırasıyla verilmiştir. Otoklavda 1 atm basınçta 121 °C' de 15 dk steril edilmiş besi yerleri ve pastör fırınında steril edilmiş petrilere steril ekim kabinine koyularak 15dk UV ışığına maruz bırakılmıştır(Şekil 1b). Tamamen steril olan besi yerleri bunzen beki alevi yanında petrilere eşit olarak dökülmüştür(Şekil 1c). Güvenlik kabininde doku kültürü ile hazırlanan saf kültürler denemeler için hazırlanan petrilere 6-7 mm kenar uzunluğunda kare şeklinde yerleştirilmiştir(Şekil 1d).

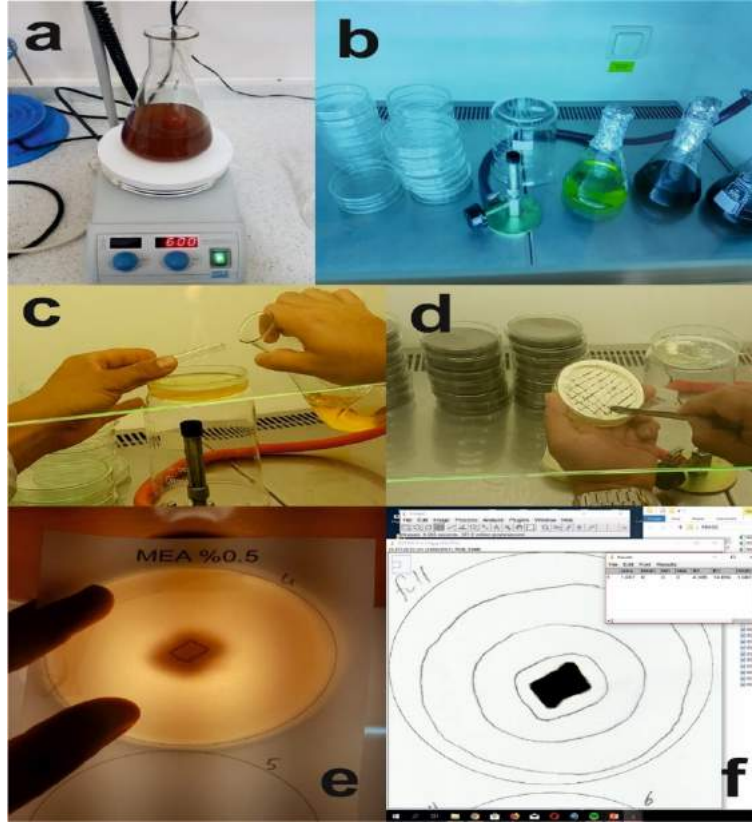
Tablo 1. Malt Ekstrakt Agar ile hazırlanmış besi yerleri

	Malt Ekstrakt Agar	% hümkik madde	pH	Karıştırma hızı
1	9.6gr/200ml	% 0	5	600 rpm-10dk
2	9.6gr/200ml	% 0.5	5.5	600 rpm-10dk
3	9.6gr/200ml	% 1	6	600 rpm-10dk
4	9.6gr/200ml	% 1.5	6	600 rpm-10dk

Tablo 2. Patates Dekstroz Agar ile hazırlanmış besi yerleri

	Patates Dekstroz Agar	% hümkik madde	pH	Karıştırma hızı
1	7.8gr/200ml	%0	5	600 rpm-10dk
2	7.8gr/200ml	%0.5	5.5	600 rpm-10dk
3	7.8gr/200ml	%1	6	600 rpm-10dk
4	7.8gr/200ml	%1.5	6.5	600 rpm-10dk

Otoklavda 1 atm basınçta 121 °C' de 15 dk steril edilmiş besi yerleri ve pastör fırınında steril edilmiş petrilere steril ekim kabinine koyularak 15dk UV ışığına maruz bırakılmıştır(Şekil 1b). Tamamen steril olan besi yerleri bunzen beki alevi yanında petrilere eşit olarak dökülmüştür(Şekil 1c). Güvenlik kabininde doku kültürü ile hazırlanan saf kültürler denemeler için hazırlanan petrilere 6-7 mm kenar uzunluğunda kare şeklinde yerleştirilmiştir(Şekil 1d). Ölçümler yapılırken kontaminasyonu engellemek için petrilere kenarları parafilmle kaplanmıştır. Daha sonra petrilere 24 °C etüvde inkubasyona bırakılmıştır. Besi yerindeki misel gelişimleri 2 günde bir olmak üzere petrilere alt yüzeyinden misel gelişim çizgileri çizim dolabı kullanılarak asetat kağıtlara çizilmiştir(Şekil 1e). Gelişen misel petri kabını tamamen sarıncaya kadar çizimlere devam edilmiştir. Miselin petri kabını tamamen sarma süresi her denemede tespit edilmiş ve kaydedilmiştir. Daha sonra imagej programı kullanılarak her bir büyüme halkasının cm² cinsinden ölçümleri yapılmıştır(Şekil 1f).



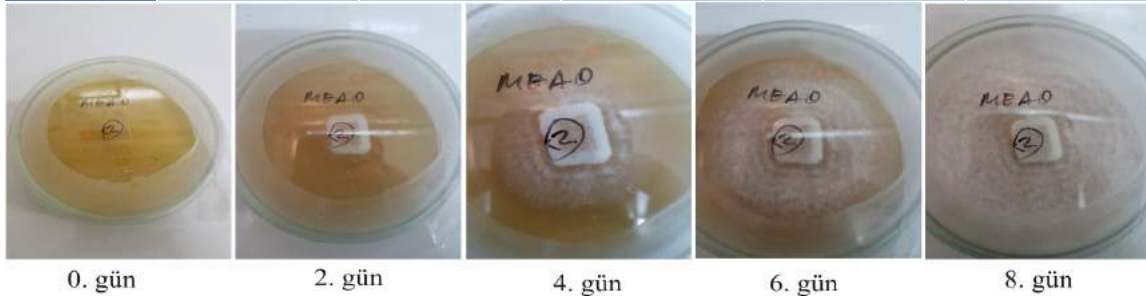
Şekil 1. **a:**Saf su ile hazırlanan besi yeri, **b:**Steril besi yeri, **c:** Sıvı besi yerinin petrilere aktarımı, **d:** Saf *Pleurotus ostreatus* miselli doku aktarımı, **e:** Gelişen mantar misellerinin asetata aktarımı, **f:** Gelişen halkaların imagej programında ölçümü (cm²)

BULGULAR

Yapılan çalışmadaki tekrarlı denemelerde elde edilen sonuçlar sırasıyla verilmiştir. %0'lık MEA örnekleri ve gün aşırı kapladığı alan (cm² cinsinden) (Tablo 3, Şekil 2).

Tablo 3. % 0'lık MEA örneği gün aşırı ölçüm sonuçları

	0.gün	2.gün	4.gün	6.gün	8.gün
2(2)	0.705 cm ²	2.783 cm ²	17.609 cm ²	31.436 cm ²	63.617 cm ²



Şekil 2. % 0'lık MEA petri gelişim görüntüleri

%0.5'lik MEA örnekleri ve gün aşırı kapladığı alan (cm² cinsinden) (Tablo 4, Şekil 3).

Tablo 4. % 0.5'lik MEA örneği gün aşırı ölçüm sonuçları

	0.gün	2.gün	4.gün	6.gün	8.gün
2(2)	0.802 cm ²	3.755 cm ²	18.445 cm ²	39.765 cm ²	63.617 cm ²

0. gün 2. gün 4. gün 6. gün 8. gün

Şekil 3. % 0.5'lik MEA petri gelişim görüntüleri

%1'lik MEA örnekleri ve gün aşırı kapladığı alan (cm² cinsinden) (Tablo 5, Şekil 4).

Tablo 5. % 1'lik MEA örneği gün aşırı ölçüm sonuçları

	0.gün	2.gün	4.gün	6.gün	8.gün	10.gün
8(11)	0.558 cm ²	3.376 cm ²	14.788 cm ²	36.908 cm ²	61.851 cm ²	63.617 cm ²

0. gün 2. gün 4. gün 6. gün 8. gün 10. gün

Şekil 4. % 1'lik MEA petri gelişim görüntüleri

%1.5'lik MEA örnekleri ve gün aşırı kapladığı alan (cm² cinsinden) (Tablo 6, Şekil 5).

Tablo 6. % 1.5'lik MEA örneği gün aşırı ölçüm sonuçları

	0.gün	2.gün	4.gün	6.gün	8.gün	10.gün	12.gün
5(5)	0.712 cm ²	2.390 cm ²	14.157 cm ²	29.855 cm ²	43.832 cm ²	43.832 cm ²	63.617 cm ²

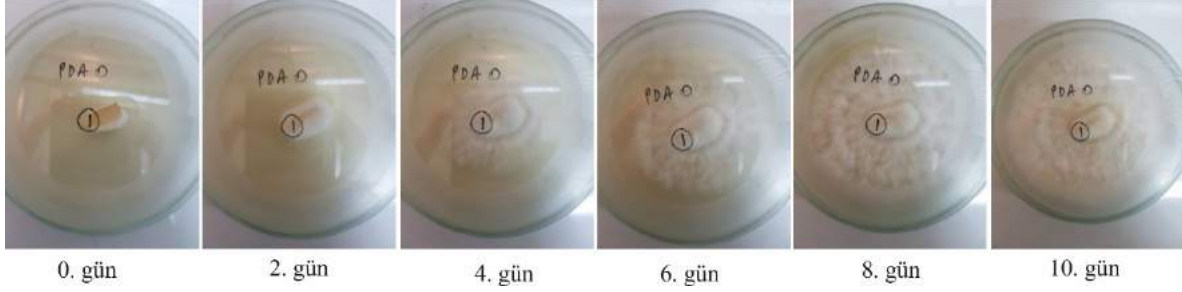
0. gün 2. gün 4. gün 6. gün 8. gün 10. gün 12. gün

Şekil 5. % 1.5'lik MEA petri gelişim görüntüleri

%0'lık PDA örnekleri ve gün aşırı kapladığı alan (cm² cinsinden) (Tablo 7, Şekil 6).

Tablo 7. % 0'lık PDA örneği gün aşırı ölçüm sonuçları

	0.gün	2.gün	4.gün	6.gün	8.gün	10.gün
1(1)	1.215 cm ²	3.393 cm ²	9.571 cm ²	30.144 cm ²	49.007 cm ²	63.617 cm ²

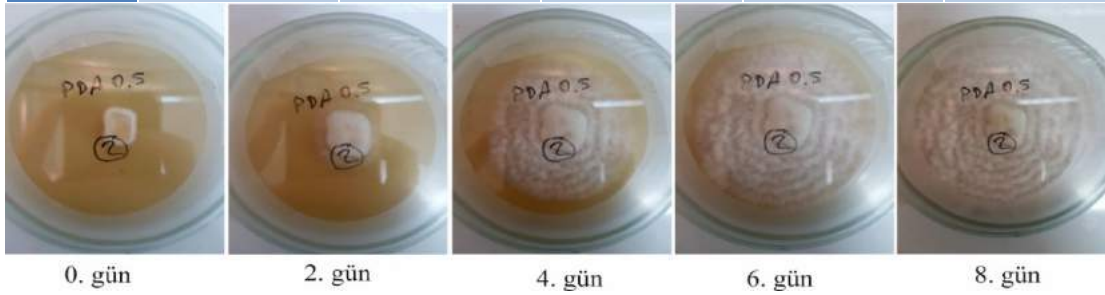


Şekil 6. % 0'lık PDA petri gelişim görüntüleri

%0.5'lik PDA örnekleri ve gün aşırı kapladığı alan (cm² cinsinden) (Tablo 8, Şekil 7).

Tablo 8. % 0.5'lik PDA örneği gün aşırı ölçüm sonuçları

	0.gün	2.gün	4.gün	6.gün	8.gün
2(2)	0.911 cm ²	2.969 cm ²	13.141 cm ²	40.705 cm ²	63.617 cm ²

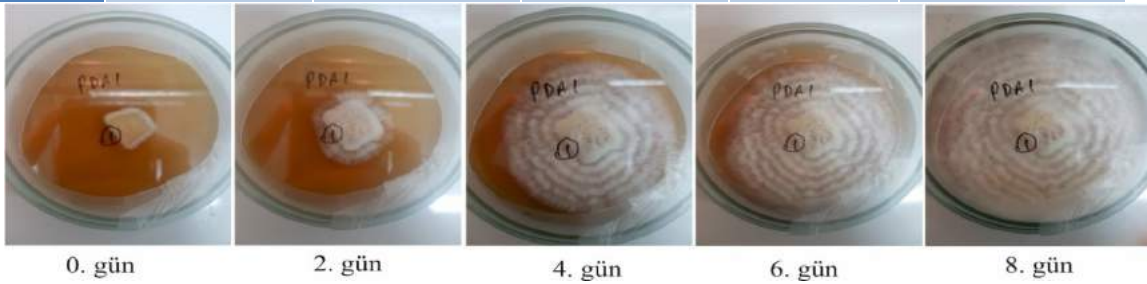


Şekil 7. % 0.5'lik PDA petri gelişim görüntüleri

%1'lik PDA örnekleri ve gün aşırı kapladığı alan (cm² cinsinden) (Tablo 9, Şekil 8).

Tablo 9. % 1'lik PDA örneği gün aşırı ölçüm sonuçları

	0.gün	2.gün	4.gün	6.gün	8.gün
1(1)	1.701 cm ²	5.774 cm ²	19.499 cm ²	43.493 cm ²	63.617 cm ²

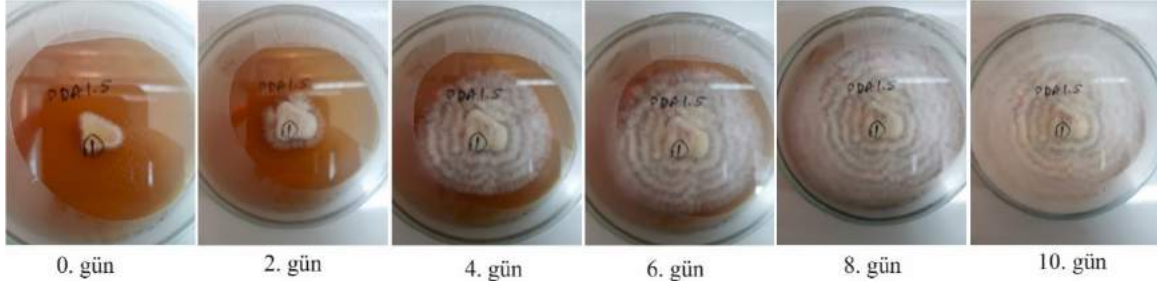


Şekil 8. % 1'lik PDA petri gelişim görüntüleri

%1.5'lik PDA örnekleri ve gün aşırı kapladığı alan (cm² cinsinden) (Tablo 10, Şekil 9).

Tablo 10. % 1.5'lik PDA örneği gün aşırı ölçüm sonuçları

	0.gün	2.gün	4.gün	6.gün	8.gün	10.gün
1(1)	0.842 cm ²	2.637 cm ²	13.697 cm ²	38.952 cm ²	57.676 cm ²	63.617 cm ²



Şekil 9. % 1.5'lik PDA petri gelişim görüntüleri

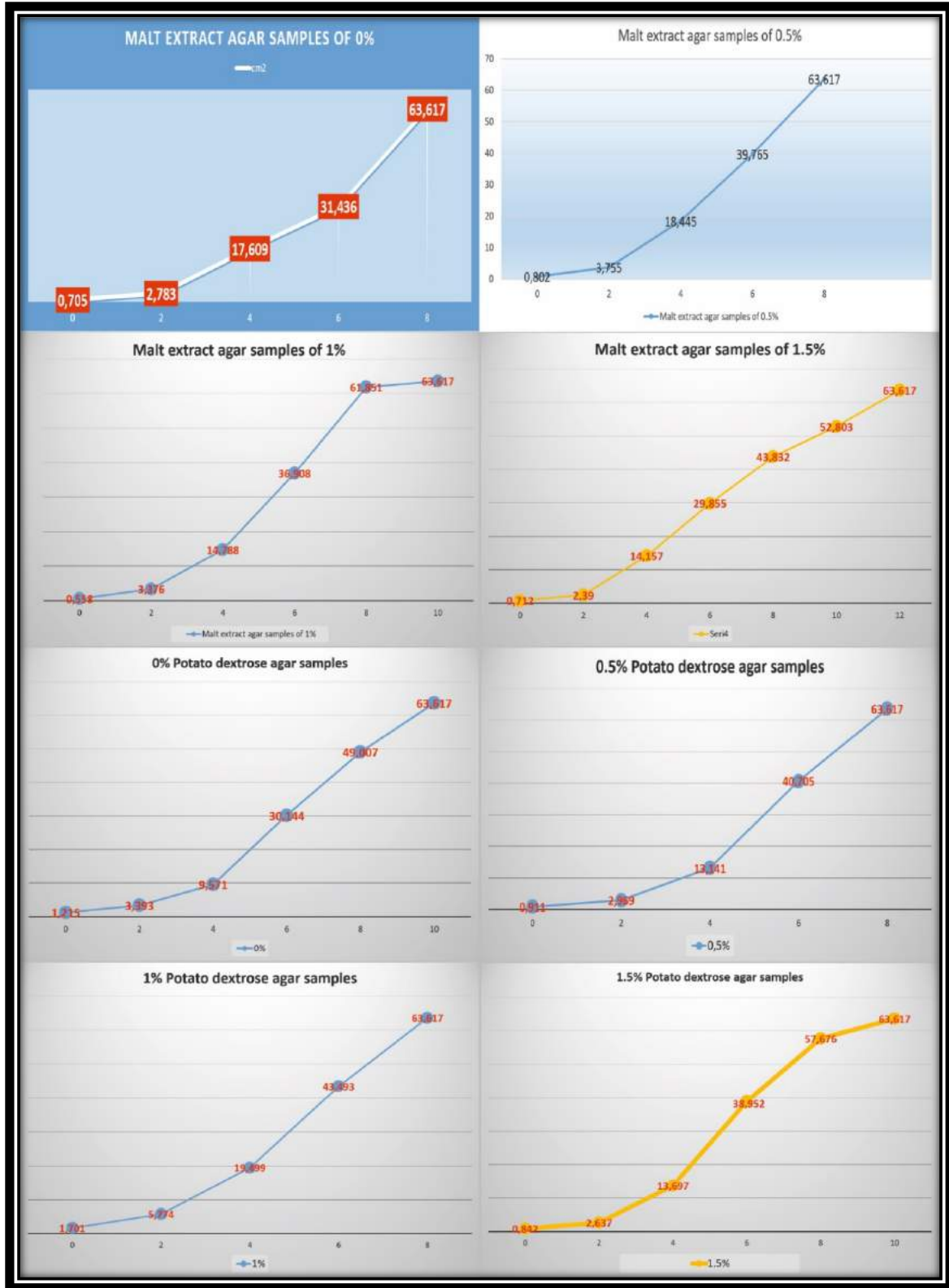
TARTIŞMA VE SONUÇ

Ülkemizde Kültür mantarcılığı son yıllarda kayda değer bir şekilde gelişme göstermiştir. Kültür mantarcılığı ilk önce beyaz kültür mantarı yetiştiriciliği açısından gelişme gösterirken, bunu takiben son yıllarda da *Pleurotus* yetiştiriciliği yaygınlaşmaya başlamıştır. *Pleurotus* cinsi, özellikle *P. ostreatus* türü ile yapılan çalışmalar misel gelişmesi, tohumluk misel elde edilmesi ve kültürde verimlilik ve gelişmeler hakkında yapılmıştır. Gerçekleştirdiğimiz çalışmadaki verilerin ortalamalarına göre MEA besi yerlerinde uygulanan hümit madde yüzdesi % 0.5 oranında besi yeri ile hiç ilave edilmeyen besi yeri karşılaştırıldığında büyüme sürelerinde anlamlı bir fark görülmemiştir; ancak %1 ve %1.5 oranlarına çıkıldığı zaman büyüme süresinin anlamlı bir şekilde 2'şer gün arttığı görülmüştür. PDA besi yerlerinde uygulanan hümit madde yüzdesi % 0.5 ve %1 oranlarındaki besi yeri ile hiç ilave edilmeyen besi yeri karşılaştırıldığında büyüme sürelerinde 2 gün kısalma gözlemlenmiştir (Şekil 10); ancak %1.5 oranlarına çıkıldığı zaman büyüme süresinin hiç ilave edilmeyen besi yeri ile karşılaştırıldığında aynı kaldığı görülmüştür.

Sonuç olarak MEA ve PDA'ya değişik oranlarda ilave edilen hümit madde gelişim süresi açısından yalnızca PDA'daki %0.5 ve % 1'lik oranlardaki karışımlarda 2 gün azalmıştır. MEA besi yeri ile hazırlanan denemelerde ise gelişim süresinde azalma olmadığı gibi %1 ve %1.5 oranlarında süre 2'şer gün artarak daha da uzamıştır. Misel yoğunluğu açısından ise hiç hümit madde ilave etmediğimiz kontrol gruplarında misel yoğunluğunun normal olduğu gözlemlenmiştir. Hümit madde ilave edilen tüm besi yerlerinde de miselin yoğun olduğu gözlemlenmiştir. Gün aşırı yapılan ölçümlerle asetata aktarılan gelişim alanlarının cm² cinsinden hesaplanması sonucunda her bir besi yerinde doğrusal bir çizgi grafiği ortaya çıkmıştır (Şekil 10). Bu da mantarın gelişiminin düzenli bir şekilde ilerlediğini göstermektedir.

Pleurotus cinsine ait türlerle yapılan çalışmalara bakıldığında; Yıldız (1998) yapmış olduğu çalışmada, misellerin vejetatif çoğaltımı için hazırlanan ve 1 lt saf suda, 10 g malt-ekstrakt, 0.2 g K₂HPO₄, 0.1 g CaCl₂.2H₂O, 0.05 g MgSO₄.7H₂O, 0.5 g NH₄SO₄ ve 15 g agar içeren besin ortamına, arpa kırması ve buğday unundan 10, 15 ve 20 gr'lık dozlar katkı maddesi olarak ilave ederek hazırladığı besi yerlerine *Pleurotus florida* aşılamış ve gelişimlerini gözlemlemiştir.

Yıldız (2000) yapmış olduğu çalışmada *Pleurotus florida*'nın mısır nişastası ve malt ekstrakt besi yerlerinde gelişim hızlarını karşılaştırmış ve anlamlı bir farklılık bulamamıştır.



Şekil 10. MEA ve PDA besi yerlerindeki misel gelişim grafikleri

Kalmış ve Kalyoncu (2007) *Pleurotus ostreatus*'un misel gelişim hızına meşe odunu parça büyüklüğünün etkisi üzerinde bir çalışma yapmışlardır. Çalışma sonucunda % 50 oranında meşe odunu talaşı kullanılan ortam içerisinde diğer denenen ortamlara kıyasla en iyi misel gelişimi olduğunu saptamışlardır. Bu ortam içerisinde miseller 45 günde 15 cm ilerleme kaydederken % 50

oranında meşe odunu parçası kullanılan ortamda bu ilerleme sadece 11 cm olduğunu, tüm ölçüm değerleri incelendiğinde meşe talaşı kullanımının farklı boyutlardaki meşe odunu parçası kullanımına göre yaklaşık olarak % 50 oranında daha hızlı misel ilerlemesine yol açtığını tespit etmişlerdir. Kalyoncu ve arkadaşları (2008) yapmış oldukları çalışmada 8 farklı makrofungus türüne ait misellerin farklı içerikteki besi yerlerinde sergiledikleri büyüme değerlerini araştırmışlardır. Besi yeri olarak; Patates Dekstroz Agar (PDA), Hagem ortamı (HO), Minimal ortam (MO) ve Malt Ekstrakt Agar (MEA) kullanılmıştır. Petri kabı içinde bulunan besi yerlerine stok kültürlerden misel aşılması yapılmış ve belli aralıklar ile koloni çapları ölçülmüştür. Çalışma sonucunda her bir makromantar türü için gelişme değerleri tespit edilmiştir.

Sonuç olarak, yaptığımız ve diğer çalışmalarda elde edilen olumlu ya da olumsuz sonuçlar kültür mantarcılığının doku kültürü ve tohumluk misel üretimi aşamalarında misel kalitesinin artırılmasında ve raf ömrünün uzatılmasında yapılacak yeni çalışmalara temel oluşturacaktır.

TEŞEKKÜR

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THE IMPACT OF VIBRATIONS OF TRANSPORTATION VEHICLES ON ANGELINO PLUM (*Prunus salicina* L.) FRUIT

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Abstract

In the world market, demand and sales of plums are increasing day by day. Angelino plum (*Prunus salicina* L.) is consumed fresh and dry. In the fresh product market, the freshness and continuousness of products affect the continuity of the market, because of products must be put on market at high quality consistently. Because of product quality must be conserved, and in order to deliver the products to the market at high quality, due to for should be avoided vibrations of generated by transport vehicles. During transport of products by transport vehicles, vibrations generated by the road cause deformations on fruits and vegetables. Deformation on the product under the influence of vibration lowers the market value of the products.

Fresh plums are exposed to certain vibrations in transportation and transmission of market and lokal market, by being placed in the wood transport boxes from the production gardens. One of the vibrations that products are exposed to is the transport vibrations created by the road while transporting the Products by means of transport vehicles. These vibrations cause damage to the fresh product. In this study, an attempt was made to reduce for the effects of vibration on fresh plums fruits, transporting with transport boxes coated with different paper, sponge and plastic. In this study, wood transport boxes of dimensions of 40x55x20 cm was coated with paper, sponge and plastic material and then Angelino varieties plum fruits placed thees transporting boxes.

Then, three floors of the transport boxes were exposed to transport vibrations by connecting them on the road simulation vibration platform. The experiments were carried out three times. As a result of the study, it was determined that the fruit damage rates of the products coaded with sponge (%9) are lower than those coaded with paper (15%) and plastic(11%).

Keywords : Plum, vibration, road,damage, fruit, trasport vehicles.

Angelino Erik (*Prunus Salicina* L.) Meyvesine Taşıma Araçlarının Titreşimlerinin Etkisi

Özet

Dünya pazarında, erik talep ve satışları her geçen gün artmaktadır. Angelino erik (*Prunus Salicina* L.) taze ve kuru olarak tüketilir. Taze ürün pazarında, ürünlerin tazeliği ve devamlılığı pazarın sürekliliğini etkiler, çünkü ürünlerin sürekli olarak yüksek kalitede pazarlanması gerekir. Ürün kalitesinden dolayı muhafaza edilmeli ve aynı zamanda yüksek kalitede ürünlerin piyasaya sunulması için, nakliye araçlarından kaynaklanan titreşimlerden kaçınılmalıdır. Ürünlerin nakliye araçları ile

taşınması sırasında, yoldan kaynaklanan titreşimler, meyve ve sebzelerde deformasyona neden olur. Titreşimin etkisi altındaki ürün üzerindeki deformasyon, ürünlerin piyasa değerini düşürmektedir.

Bu çalışmada, taze erik meyvelerinde titreşimin etkilerinin azaltılması için , kağıt, sünger ve plastik ile kaplanmış taşıma kutuları ile taşınma işlemi yapılmıştır. Bu çalışmada, 40x55x20 cm boyutlarında ahşap taşıma kutuları kağıt, sünger ve plastik malzeme ile kaplanmış ve daha sonra Angelino çeşitleri erik meyveleri taşıma kutularına yerleştirilmiştir. Daha sonra, taşıma kutuları üç katlı olarak, yol simülasyonu titreşim platformuna bağlanarak taşıma titreşimlerine maruz bırakıldı. Deneyler üç kez gerçekleştirilmiştir. Çalışma sonucunda meyve hasar oranını en düşük süngerle kaplanmış ürünlerde (% 9) olduğu , bu değer kâğıtta (% 15) ve plastikte (% 11) olduğu tespit edilmiştir.

Anahtar Kelimeler: Erik, titreşim, yol, hasar, meyve, taşıma araçları.

Introduction

Agricultural products are loaded on trucks from the point of production to the point of consumption. Those trucks' suspension systems influence the damage to sensitive agricultural products in transit. The damage takes place when the road conditions are bad and the suspension systems fort he trucks are either sof tor too hard. The damaged to the fruits are brusing and tearing of the skin and internal damage.(Kaynap et al., 1989; Mohsenin,1970)

Prunus, "Prunus Domestica" is a kind of fruit belonging to the family of roses known under the Latin name. It is known that Prunus Domestica foliage spread more and more around the Caucasus and the Caspian Sea. A large number of hybrids have been made between Prunus Domestica's cultivars and the native plums in these countries, and the number of plum varieties has increased.Plums can be grown in different climatic conditions in general according to their species. It is also possible to grow in moderate-warm, temperate-cold climatic regions, and even winter recreation in subtropical regions, (Anonymous,a,b,2018).

Plum in Turkey is an important fruit among the first-season fruits. Plum tree garden in Turkey usually found mixed among other fruit trees. However, in recent years, the green gardens of turquoise in the coastal areas of the Aegean and the Mediterranean have gained importance, and gardens have also started to be established. In the production of hard-stone fruit, plum is in third place after olives and peaches in the world. In Turkey, the production of plums, olive, apricots, peaches, cherries and sour cherries comes after production. Plum is a kind of hard stone fruit used as dried or fresh. Plum, Turkey's being grown in almost every region and more is consumed as fresh fruit. In addition, compost, coffe, syrup, molasses, jam, marmalade and pestle are also kept hidden. (Anonymous, a,b,2018). Turkey's plum production was 297 589 tons according to 2016 data. With an average production of 300 thousand tons, it is among the world's major plum producer countries,(FAOSTAT, 2018).

Angelino plums (*Prunus salicina L.*) are an excellent source of both soluble and insoluble fiber. The soluble fiber content helps regulate blood sugar by slowing the breakdown of carbohydrates and reducing the absorption of sugar into the bloodstream. It is also known to lower LDL “bad” cholesterol levels by limiting the uptake of cholesterol. The other kind of fiber, insoluble fiber, is

important for digestive health. It adds bulk to the diet and keeps the digestive tract running smoothly. A plentiful source of antioxidants, Angelino plums are a great defense against damaging free radicals. These free radicals build up in the body from exposure to toxins. The antioxidants present in Angelino plums neutralize free radicals and reduce the risk for the age-related disease and degeneration they are linked to. Angelino plums are rich in other vitamins which have antioxidant-like properties. They're also a good source of potassium, boron, and magnesium, but nutritional values lose their properties when Angelino fruits are damaged. (Anonymous a,b, 2018, Aydin, 1993).

In this study, an attempt was made to reduce for the effects of vibration on fresh plums fruits, transporting with transport boxes coated with different paper, sponge and plastic. In this study, wood transport boxes of dimensions of 30x40x20 cm was coated with paper, sponge and plastic material and then Angelino varieties plum fruits placed thes transporting boxes.

Materials and Methods

In this study, the plums of Angelino varieties were used (Figure 1). Some physical properties of the plum fruit are given in Table 1, below. The plum fruits are placed in a wooden transport boxes covered with paper, plastic and sponge and connected to on the vibrating platform in three layers. This work has been carried out with a vibration platform, (Figure 3).

Sphericity is calculated from equation: $Sphericity = D_i / D_d$; where D_i is the diameter of the greatest inscribed circle; and D_d , smallest circumscribed., (Sitkei,1986).

Table 1. Some Pysical properties of Plum Fruit of Angelino

Grain density, (kg/m ³) :	1113
Bulk density, (kg/m ³) :	557
Sphericity, (%) :	89
Mean diameter, (mm) :	52
Mean height, (mm). :	49
Moisture content (%) :	86.9



Figure 1. Angelino variety Fruits

In order to determine the damage during the transport, the modulus of elasticity was measuring for fruit, before the fruits was placed on the transport box, and then fitted vibration platform for the modulus of elasticity was determined.(Figure, 2)

The order to determine elasticity of the plums, a plate test was used (Zohadie, 1982). The modulus of elasticity was calculated with the following equations.

$E = F / \Delta R^2$ where,

E = Modulus of elasticity (N/m²)

F = Compression force (N)

R = Deformation of one side of fruit (m).

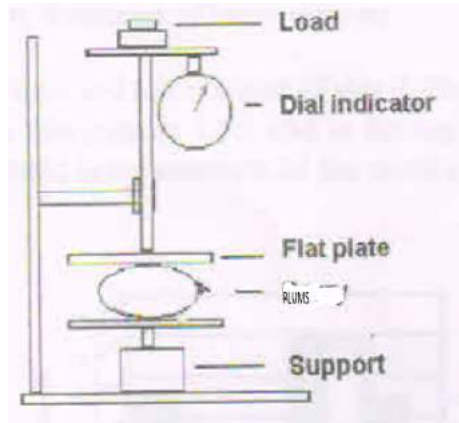


Figure 2. Measurement of Elasticity

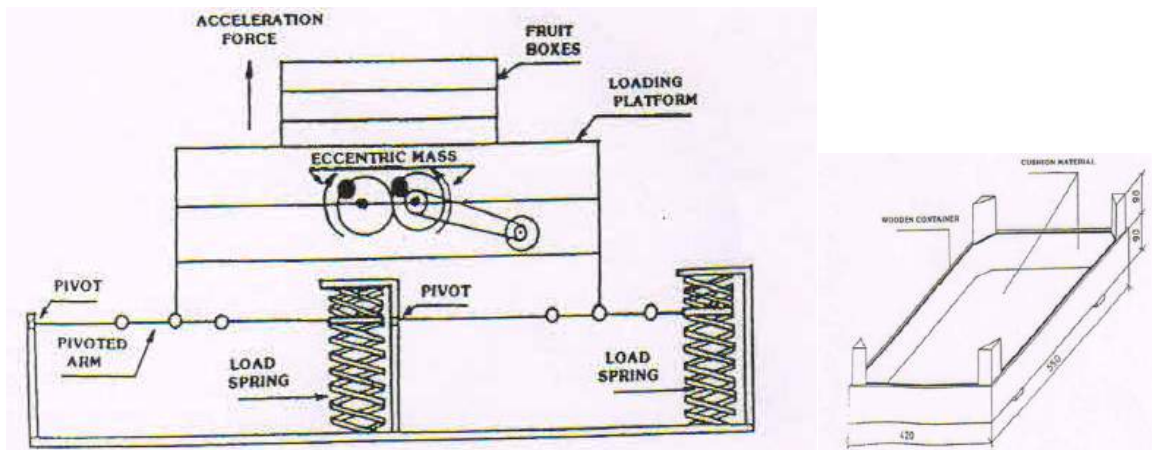


Figure 3. Vibrations platform and transport box

In this study, the frequency of vibration on mass transport vehicles was simulated by using vibration platform in laboratory conditions. The frequency and amplitude of vibration platform can be adjusted by means of eccentric weights rotating in opposite direction. The vibration platform was driven at any speed up to 2800 rpm by belt from a 0.37 kW electric motor. The speed of the motor was adjusted by means of Electronic variator.

In this study, used to vibration simulation platform. The vibration simulation projected by Aydın. (Aydın,1993) The vibration platform had worked 15 min which is equal to transportation of truck with 270 km in Turkish highways conditions. (Figure 3.)

Results and discussions

One of the vibrations that products are exposed to is the transport vibrations created by the road while transporting the Products by means of transport vehicles. These vibrations cause damage to the fresh product. In this study, an attempt was made to reduce for the effects of vibration on fresh

plums fruits, transporting with transport boxes coated with different paper, sponge and plastic. In this study, wood transport boxes of dimensions of 30x40x20 cm was coated with paper, sponge and plastic material and then Angelino varieties plum (*Prunus Salicina L.*) fruits placed thes transporting boxes. Then, three floors of the transport boxes were exposed to transport vibrations by connecting them on the road simulation vibrating frames. The experiments were carried out three times.

As a result of the study, sponge-covered boxes damages were found to be 4 % in the lower boxes, 6 % in the middle boxes and 9% in the upper boxes; paper-covered boxes damages were found to be 8% in the lower boxes, 10% in the middle boxes and 15% in the upper boxes; plastic-covered boxes damages were found to be 6% in the lower boxes, 8% in the middle boxes and 11% in the upper boxes (Figure 4).

Damage ratios (%)		
Paper coted	Plastic coated	Sponge coated
Top box %15	Top box %11	Top box %9
Middle box %10	Middle box %8	Middle box %6
Lower box %8	Lower box %6	Lower box %4
Vibration Platform		

Figure 4. Damages ratios for plum fruit in transport boxes.

As a result of the study, this type of transport box was recommended because the lowest damage (4,6,9,%) occurs in the sponge-covered fruit carriers.

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VANDALISM IN KASTAMONU

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ABSTRACT

Maslow's hierarchy of needs is a motivational theory in psychology comprising a five-tier model of human needs, often depicted as hierarchical levels within a pyramid. Human needs are grouped under main three headings (basic needs, psychological needs and self-fulfillment needs) in Maslow's Hierarchy of Needs. A person who can not fulfill these five needs can not be a normal healthy individual and one side is missing. Vandalism can be described as exploitation. Today, vandalism can be defined as aggression towards public goods or a tendency to exist in aggressive behavior against the properties of other people. In this context, these people make vandalism at high level. In this study, it is revealed that what kind of vandalism is widespread in Kastamonu and why people need vandalism. What will be done as a landscape architect to reduce the rate of vandalism and the tendency of the people of Kastamonu to vandalism will be revealed through this study. For this, a questionnaire study was conducted with the users of Kastamonu open green area (100 person). In the questionnaire, it was questioned demographic characteristics of users, whether the users had any tendency of Vandalism in the past and the reason for the tendency to vandalism. As a result, people's tendency to vandalism has arisen since the needs of people have not been met.

Key Words: social dimension of vandalism, hierarchy model of human needs, varieties of vandalism, vandalism in Kastamonu

INTRODUCTION

It possible to make cities livable and ensure their permanence only by forging and governing the relationship between the city and city-dwellers correctly. Ensuring the permanence of livable urban spaces requires first to protect the current urban spaces. We need to look into the causes of the problems experienced in the urban spaces we live in and accordingly, we come up with possible solutions. One of the current major problems, which is an urban problem causing financial losses, lowering the quality of the environment and damaging urban aesthetics, the effects of which are becoming more apparent in time (Yavuz and Kuloğlu, 2011). Vandalism is more than an environmental problem and it is a significant issue the social dimension of which needs to be taken into consideration (Ward, 1975). Vandalism is the act of damaging or destroying both public and private goods (Phillips, 1996). The act of vandalism is problematic because it causes damaging of public goods, visual pollution, a threat to well-being and comfort and accidents and it also encourages other crimes and has a high cost (Yavuz and Kuloğlu 2010). There are various factors contributing to vandalism such as psychological factors, social and physical environment, education, possessiveness,

repair, intense use, population density and the number of children, visual control, color, surface texture and durability (Yıldırım, 2000).

Vandalism generally more common in areas which are not developed socio-economically, where there is an unemployment problem and the level of income is low (Phillips, 1996). Vandals sometimes believe that they prove themselves and enhance their prestige by participating in acts which are not tolerated by the society. Some also perform acts of vandalism to prove themselves as a precondition to becoming a member of a group. It is known that there are teenagers who commit acts of vandalism for revenge or to possess an object, and there are also some who participate in the acts of vandalism to show off (URL 1). An individual's life, family, friends, school, environment and free time affect his acts of vandalism (Phillips, 1996). Some of the causes of the behavior disorder that leads to vandalism are anger towards to the society, boredom, loneliness, disciplinary problems, personal problems, alcohol-drug addiction and peer pressure (Phillips, 1996, URL 1). Sometimes individuals also participate in the acts of vandalism solely for the joy of it (Ferrell and Sanders, 1995). It is observed that most actions, which are defined as acts of vandalism, are not preplanned and mostly occur as a result of momentary reactions (Stollard, 1991).

The problems people face with in their daily lives are always increasing and thus, individuals' resistance against the problems decreases. This accumulation of the stress of life in the individual leads to the expression of it as hate, anger, jealousy, hatred, longing, love and yearning (Goldstein, 1996). It is easy to observe the traces of these emotions in the environment. This study will help demonstrate the acts of vandalism performed in Kastamonu and determine the reasons causing the urban-dwellers to perform these acts.

MATERIALS AND METHOD

This study covers the province of Kastamonu in the Western Black Sea region. The research area borders Sinop and Çorum in the East, Bartın and Karabük in the West, Çankırı in the South and the Black Sea in the north. The city has a coast of 140 km (Figure 1). The total area is 13.108 km² and it consists of 74.6% mountains, 21.6% plateaus and only 3.8% plains (İbret, 2001). The province of Kastamonu has rich vegetation. The total population of the city center of Kastamonu, which has 20 counties and 1072 villages, is 145.754 (URL 2). The city center is on a plateau, shaped like a boat, at an altitude of 790 meters, along the valley of the Karaçomak stream.

This study determined the spatial elements and components subjected to vandalism as a result of the observations carried out in the central county of Kastamonu and looked at the reasons behind these acts of vandalism urging the acting urban-dwellers to resort to vandalism. Therefore, we conducted a survey with a randomly-selected sample of 100 users in the area. The survey questioned the demographic characteristics of the participants such as their age and level of education as well as whether they ever participated in an act of vandalism, what kind of acts of vandalism they tend to perform, the reasons for their committing these acts of vandalism and the emotions that led to their committing these acts, whether they want locations that they can freely vandalize and lastly, which acts of vandalism are the most common in Kastamonu.

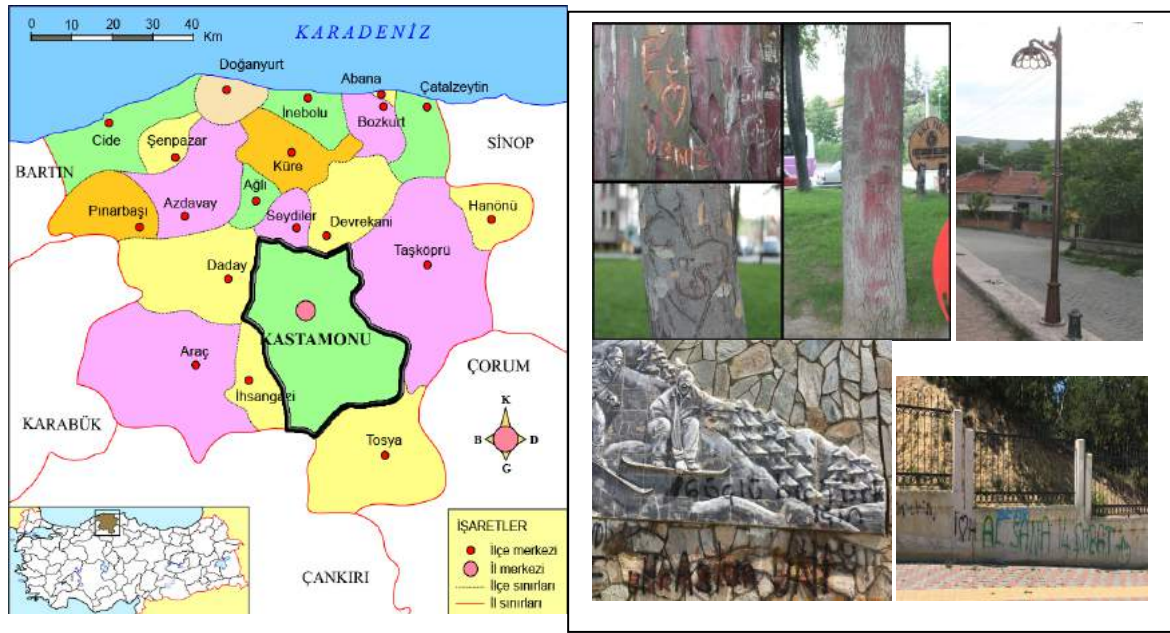


Figure 1. Study Area and examples of vandalism in Kastamonu

FINDINGS

As a result of the observations we carried out in Kastamonu, we determined that the locational elements and components that are being vandalized are, respectively: walls, benches are public goods, trash cans, floor materials, picnic tables, bus stops, boards, lighting fixtures, way-marks, plants and border elements. The most commonly observed act of vandalism was writing on various surfaces.

Because of the fact that most of the individuals resorting to the acts of vandalism are young people (Underwood, 1980), we made the survey with a sample group mostly made up of young adults in the 15-20 age group and high school students. Table 1 shows the demographical characteristics of the participants.

Table 1. Demographic characteristics of the participants

Age distribution	%	Level of education	%
15-20	46	Elementary School	4
21-25	21	Middle School	6
26-30	13	High School	54
31-35	11	License	30
36-40	9	Master's Degree	6

About 68% of the participants accepted that they previously had vandalism tendencies and reported that they committed such acts mostly for personal reasons (34%), boredom or stress (26%), being unable to prove themselves (14%) and feeling useless (10%). When we examined the acts of vandalism, we found that they included writing respectively on the walls (33%), on benches (19%), bus stops (13%), tables (10%), trash cans (8%), lighting fixtures (6%), plants (6%) and traffic signs (5%).

A majority of the participants (61%) argued that individuals lacking social communication skills tend to commit acts of vandalism and they perform such acts mostly in parks (67%) and the least in public spaces (3%). The participants explained their reasons for committing acts of vandalism with the

need to, respectively, prove themselves (24%), leave a mark (17), make others talk about them (16%), show their interest in breaking the rules (16%), express themselves in a way since they cannot do so in their personal relationships (14%) and feel that they are considered important (13%). When asked whether they would like to have special places where they can perform acts of vandalism, 67% of the participants said yes.

CONCLUSION AND DISCUSSION

Vandalism is not only an environmental problem or an issue with a product design. It is also a phenomenon that tends to increase or decrease according to social, psychological, economic, infrastructural, educational, cultural and administrative conditions, which requires to be examined from a much larger perspective. We concluded that individuals, who do not have a place in the society, who are not talked about by the people around them, tend to commit this kind of acts mostly to prove themselves. As Maslow explained, individuals have five main needs, which are physiological, safety, social, esteem and self-actualization, and these needs have to be somehow fulfilled. Otherwise, they tend to display negative behavior towards their environment.

According to the survey results, acts of vandalism in Kastamonu are mostly committed in public parks where there are not sufficient security measures and such acts are the least observed in the yards of institutions with the highest level of security. It is an accepted fact that security measures are deterrents for acts of vandalism (Ward, 1973). However, it does not diminish the individuals' desire to commit these acts. The main reason the people in Kastamonu commit these acts is that these individuals have issues resulting from their being unable to prove themselves due to lack of communication and self-expression and their desire to be talked about. However, if areas, where acts of vandalism can be freely committed, are arranged, public goods would suffer less damage.

The results of our survey showed that individuals in the age group of 15-20 perform the highest number of acts of vandalism and there is an inverse relationship between the occurrence of the acts of vandalism and the level of education and age. Individuals who are younger and with lower levels of education tend to perform more acts of vandalism. Thus, both their parents and teachers should help children from a young age develop an awareness of the environment and teach them about their responsibilities towards nature so that they can embrace their environment.

No matter what the reason is, acts of vandalism cause significant damage socially, psychologically and economically. To prevent such damages, every individual should embrace their environment and feel responsible for it. Because the environment belongs to everyone.

Acts of vandalism resulting from psychological disorders, personal problems or social problems may not be completely prevented by design decisions. However, designers can adopt new measures to minimize the occurrence of the acts of vandalism by having a positive influence on people's behaviors. At this point, it is clear that there needs to be made some changes in and some additions to the education system. Education makes it possible to inform the students about laws and obeying them and converting this information into behavior would be one of the social measures for preventing vandalism.

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EVALUATION OF PRIMARY SCHOOL YARD DESIGNS IN KASTAMONU

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ABSTRACT

Break time has an important function in order to relief children from the effects of the past lecture and to enable them to participate more actively in the next lesson. Active break time is the complement of the school experience and learning process. In break time, school yards are extremely important to relieve mental tiredness during classes. School yards should be organized as areas that allow pupils to feel comfortable, have experience and adventure, increase communication power, and experience different kinds of physical mobility. Within the scope of this study, the current situation of primary school yards in Kastamonu and the opportunities that they provide to students were examined. For this purpose, 8 primary school yards located in Kastamonu city center were identified as study material. These schools are Abdülhamit Primary School, Ali Fuat Darende Primary School, Candaroğulları Primary School, Cumhuriyet Primary School, Gazi Primary School, Isfendiyar Primary School, Mehmet Akif Ersoy Primary School, Toki Primary School. These school yards have been examined in line with the criteria of access-connection, safety, material reinforcement, plant arrangement and efficiency of space. As a result, it has been determined that school yards do not have sufficient regulation to allow extracurricular activities during breaks, the lack of greenery, and the concrete or asphalt flooring cannot respond to the needs of the students such as social learning, physical movement and rest. Another situation was observed that the landscape design in the school yards are very similar.

Key words: school yard, children's perception, school yard activity, school yard design criterias

INTRODUCTION

Due to intense urbanization, the areas where children can play are disappearing day by day. Moreover, since the playgrounds are equipped with modular play systems, they do not consist of creative activities and materials and they are all identical to each other, which are not attractive enough to children. Accordingly, there are not any playgrounds that meet the children's physical, cognitive, psychological and social needs.

Children spend most of their time at the school. The school environment, where children can rest, move, learn and have various experiences, is crucial for the children (Hauser, 2002). The school environment is important to raise individuals who are sensitive to the environment, healthy and active (Melzer, 2001; Zask et al., 2001, Lorenz, 2005). Nowadays schoolyards are used by children to rest

physically and cognitively during the class transition times in addition to being used for special celebrations and ceremonies. The right design of schoolyards would help children feel comfortable during the class transition times, get actively involved in activities and thus, behave less aggressively towards others and objects, gain awareness of their abilities and improve their self-confidence and develop healthily (being aware of their own abilities, self-confidence, being responsible, having the ability to express oneself, etc.) (Melzer, 2001; Hauser, 2002; Breul, 2005; Tai et al., 2006, Hoff et al., 2007, Scharf et al.2008). Furthermore, it would also be possible to raise the children's awareness of nature through the mini gardens which would be created on the schoolyards in accordance with the children's imagination and wishes. Therefore, school is seen as an important supporting institution for the children's quality of life (Hauser, 2002).

Physical development is generally related to activities such as running, jumping and climbing. Children learn about their bodies and their limits thanks to these activities in addition to becoming aware of their abilities and improving their learning process by playing games that engage their imagination (Marcus and Francis, 1998). Areas arranged naturally on the schoolyards would enable children to improve their creativity in designing and implementing while also supporting their physical development (Marcus and Francis, 1998). Schoolyards prepared to include natural components (trees and bushes, grasses, walkable ground-covers, colourful flowers, dirt surface, tree trunks, rock pieces, sand, water, mud, etc.) would support the children's comprehension, imagination and creativity.

It is an important issue how much schools meet the above-mentioned spatial criteria. Several studies (Melzer, 2001; Hauser, 2002; Hoff et al., 2007) argued that schoolyards, which are a crucial part of the school, had a cold and monotonous look, made up of concrete or asphalt surfaces, consisting of a few trees or herbaceous plants and a few sitting areas, and many are used as parking lots. Schweizer (1999) demonstrated in his study that schoolyards did not have the characteristics that would urge children to act, help them rest and make it possible for them to experience the nature (Özdemir, 2011). As Breul (2005) underlined, it is a fact which has been known by everyone for a while that sitting for a long time and insufficient amounts of physical movement leads to coordination problems and other health issues. The absence of active and creative playgrounds causes children to not improve their imagination, suffer from neurological tension, not being able to spend their free time and become violent (Scharf et al., 2008). This is also valid for the schools in Turkey. We observed that schoolyards are designed without paying any attention to the children's needs and wishes (Özdemir and Yılmaz, 2008; Özdemir, 2011). The importance of the present study is clear when we look at the sheer number of scientific studies analysing the effects of the schoolyards, where children spend their breaks, on child development.

This study will examine 8 schoolyards in the province of Kastamonu and find out how much these schoolyards meet the children's needs and wishes.

MATERIALS AND METHOD

This study has been conducted at the schoolyards of 8 public schools, located in the city centre of Kastamonu, as shown in Table 1 and Figure 1.

Table 1. The schools in Kastamonu and their neighbourhoods

The Primary School's Name	Its Neighbourhood
1.Abdülhakhamit Primary School	Akmescit Neighbourhood
2.Ali Fuat Darende Primary School	İnönü Neighbourhood
3.Candaroğulları Primary School	Candaroğulları Neighbourhood
4.Cumhuriyet Primary School	İnönü Neighbourhood
5.Gazi Primary School	Hepkebirler Neighbourhood
6.İsfendiyar Primary School	Topçuoğlu Neighbourhood
7.Mehmet Akif Ersoy Primary School	7.Mehmet Akif Ersoy Neighbourhood
8.Toki Primary School	Kuzeykent Neighbourhood

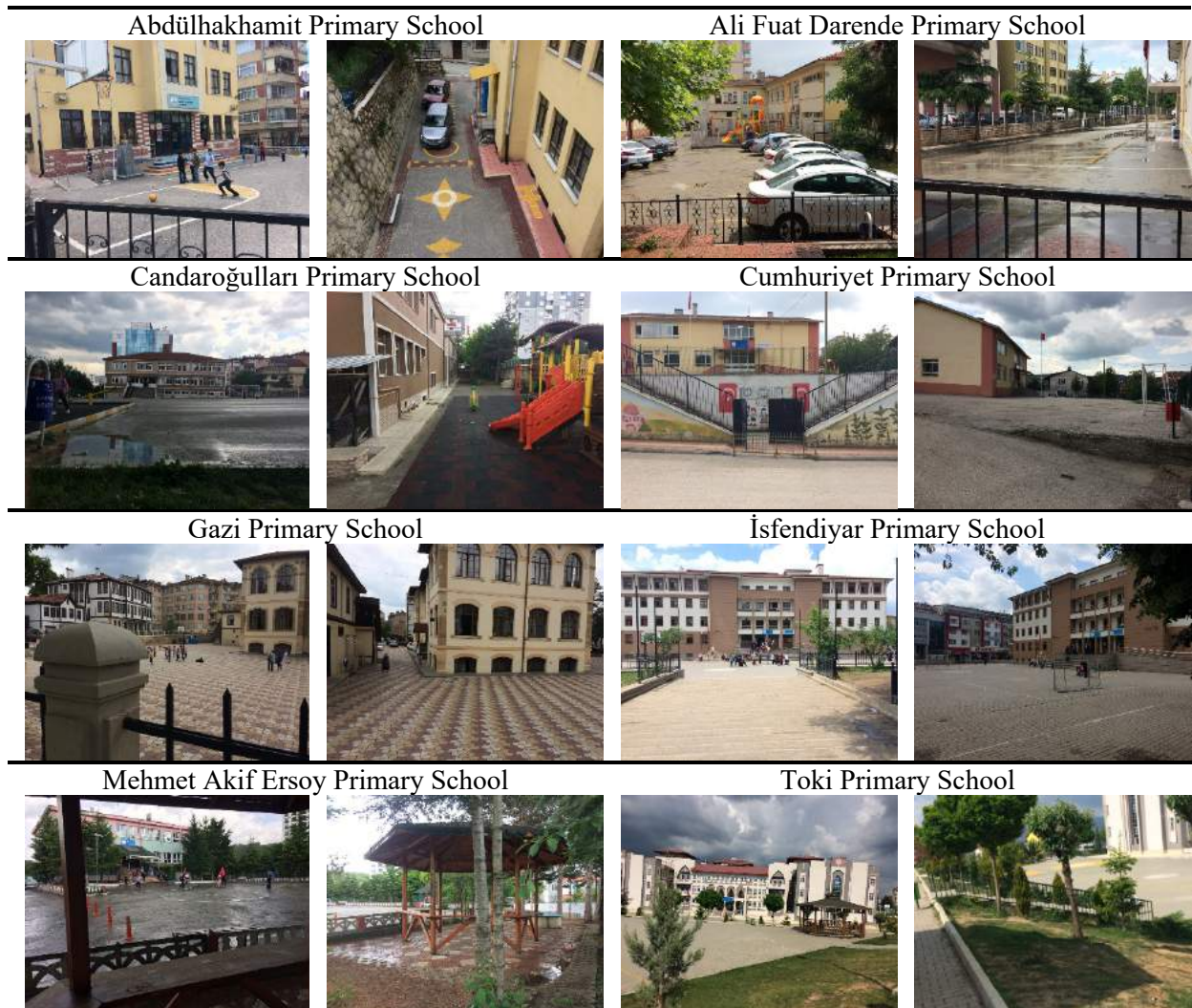


Figure 1. The primary schools in Kastamonu

The researcher visited the above-mentioned school's yards and examined their activity areas and landscaping characteristics structurally and vegetation-wise. Afterwards, an expert group composed of 6 landscape architects looked into how much the schoolyards met the users' wishes and needs using a survey. The purpose of the survey was to collect data according to five main criteria which are access-

connection, safety-security, material-furniture, planting design and activity-space. The survey consisted of a total of 34 questions and the results were analysed using the three-level Likert scale. The responses were scored as 1: A Little, 2: Average, 3: A lot.

Five questions helped examine the parking lot, roadway and circulation for access-connection, three questions helped examine roadway-pedestrian way separation, limits and security for safety-security, five questions helped examine three furniture and materials used in the area from a health and ergonomics perspective for material- furniture, five questions helped examine the suitability, efficiency, variety and colours of the plants used for vegetation design, and 17 questions helped examine the suitability of the space for activities, diversity of activities and their naturalness for activity-space.

Table 2. The criteria used to examine schoolyards and the questions asked to determine these criteria

Questions	Crit.	Questions	Crit.
Does the roadway reach the entrance of the area? Is the parking lot sufficient? Is it appropriate for circulatory use? Did solved with ramps the elevation problem? Is it possible to reach every part of the garden?	Access Connection	Does the area provide a diversity of location? Is it various activities in the yard? Are there discovery and research areas? Are there open, semi-open and closed areas? Are there training grounds?	Activity
Are there any security? Are there areas for pedestrians and vehicles? Is the yard enclosed?	Safety Security	Are there natural areas? Is it possible to learn by experience in yard? Is there a waiting area for the parents?	
Is the equipment in the yard appropriate? Is the equipment in the yard healthy?	Materials- Furniture	Is there a special area for teachers or staff? Does the area contribute to social communication, experience and learning processes? Is it possible to have group activities? Are there resting grounds in the yard?	
Are there natural elements? Is the ratio of hard to soft surfaces appropriate?	Planting Design	Are there playgrounds and sports grounds? Is the ceremonial area suitable single activity? Is there a mini garden/hobby garden?	
Is the used plant appropriate for the area? Are the plants being used functionally? Is the landscaping sufficient? Is there plant diversity?		Are there different activity areas (such as an amphitheatre, chess area and traffic park)? Are there special grounds?	
Are there colourful plants?			

RESULT

When we examined the schools in Kastamonu according to the criteria we determined, we concluded that the best school for Access-Connection is Candaroğulları Primary School with a rate of 67.3% (2.02 points), the best schools for Safety-Security are Candaroğulları Primary School and Gazi Primary School with a rate of 51% (1.53 points), the best school for Materials- Furniture is Gazi Primary School with a rate of 52.7% (1.58 points), the best school for Planting Design and Activity-Space is Toki Primary School with rates of 44% (1.32 points) and 48% (1.44 points) respectively. When we have a look at the overall averages of all the schools according to these criteria, we see that the schools meet the Access-Connection criterion with a rate of 48.7%, the Safety-Security criterion with a rate of 40.3%, the Materials- Furniture criterion with a rate of 28.7%, the Planting design and Activity-Space criteria with a rate of 21.7%. If we examine the schools individually and look at the overall average of all the criteria, we see that Toki Primary School is the best school among the schools included in this study with a rate of 46%. Toki Primary School was followed by Gazi Primary School with a rate of 45.7%, Candaroğulları Primary School with a rate of 39.7%, Ali Fuat Darend

Primary School with a rate of 24.7%, Mehmet Akif Ersoy Primary School with a rate of 20.3%, Abdülhakhamit Primary School with a rate of 19% and Cumhuriyet Primary School with a rate of 17.7%. When we have a look at the analysis results of the schools we examined in Kastamonu, we see that they meet the said criteria only with a rate of 32%. The success ratios and overall averages of these schools are given in Table 3.

Table 3. Success ratios of the schools according to the determined main criteria

MAIN CRITERIA	THE PRIMARY SCHOOLS IN KASTAMONU								Overall Average	Success Ratio
	No1*	No2*	No3*	No4*	No5*	No6*	No7*	No8*		
Access-Connection	1	1.16	2.02	1.12	1.82	1.82	1.1	1.62	1.46	48.7%
Safety-Security	1.33	0.93	1.53	0.93	1.53	1.6	0.83	1	1.21	40.3%
Materials- Furniture	0.2	0.63	1.03	0.15	1.58	1.4	0.38	1.53	0.86	28.7%
Planting Design	-	0.62	0.56	0.12	1.16	1.06	0.32	1.32	0.65	21.7%
Activity-Space	0.32	0.38	0.82	0.34	0.74	0.71	0.44	1.44	0.65	21.7%
Overall Average	0.57	0.74	1.192	0.53	1.37	1.32	0.61	1.38	0.96	32%
SUCCESS RATIO	19%	24.7%	39.7%	17.7%	45.7%	44%	20.3%	46%	32%	

* **No1.** Abdülhakhamit Primary School, **No2.** Ali Fuat Darende Primary School, **No3.** Candaroğulları Primary School, **No4.** Cumhuriyet Primary School, **No5.** Gazi Primary School, **No6.** İsfendiyar Primary School, **No7.** Mehmet Akif Ersoy Primary School, **No8.** Toki Primary School

CONCLUSION AND DISCUSSION

When we examined the analysis results of the schools in the city centre of Kastamonu according to the access-connection, safety-security, materials- furniture, planting design and activity-space criteria, we found that the schoolyards did not meet more than 50% of any of the main criteria and all the schools included in this study had an average success ratio of 32%. When we examined the main criteria individually, we concluded that although some schools scored higher than 50%, none of them managed to score above the overall average regarding the planting design and activity-space criteria. Even if the schools are ranked according to their success ratios, the yards of the schools in Kastamonu need to be revised according to the wishes and needs of children. The results indicated that the schoolyards do not sufficiently meet the students' needs such as providing opportunities for non-course related activities, urging the students for social learning, moving and resting during the class transition times, and the schoolyards are landscaped in similar ways. A well-designed schoolyard which helps the students improve their concrete thinking abilities and consists of natural playgrounds would urge students to rest and motivate them to pay more attention to their classes while also contributing to teaching and learning (Schemm and Streicher, 2006).

We observed that the green areas in schoolyards are not sufficient, plants are used only along the limits, the ground is made of concrete or asphalt, the most frequently used areas by the children are the ceremonial grounds which are referred to as ceremonial grounds and these areas consist of a goalpost or a basketball hoop and their use is mostly restricted. Toki Primary School among the

schools examined for the purposes of this study had various areas arranged for various sports activities; yet, students still mostly spent their times during the breaks at the ceremonial grounds.

The schoolyards of Abdülhakhamit Primary School, Cumhuriyet Primary School and Mehmet Akif Ersoy Primary School are smaller than the yards of the other schools and they do not include enough vegetation. None of the yards is sufficient other than that of Toki Primary School. The main problem of all these schoolyards is that they do not provide a variety of activity grounds and spaces.

In this regard, the yards of the primary schools in the city centre of Kastamonu need revisions to make sure that they provide comfort, experience and adventure, improve the communication skills, urge various movement experiences, as expressed by Melzer (2001) in his evaluations of schoolyard designs. It is crucial that these revisions are made to the schoolyards as promptly as possible to make sure that the teaching and learning activities are conducted more healthily. This is a process that needs to be conducted jointly by students, teachers, school boards, parents and landscape architects.

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THE IMPACT OF EMBRYO RESCUE TECHNIQUE ON INCOMPATIBLE CROSSING OF WINTER SQUASH (*Cucurbita maxima* Duch.) AND PUMPKIN (*Cucurbita moschata* Duch.) FOR ROOTSTOCK BREEDING.

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Abstract

The hybrids of *C. maxima* x *C. moschata* are widely used as rootstock in watermelon, melon and cucumber cultivation all over the world. Unfortunately, many potential parent lines with desirable agronomic and economic traits are lack of fruit and full seed set in interspecific hybridization due to complete or partial incompatibility generated by postzygotic or prezygotic barriers. Therefore, embryo rescue technique was investigated to overcome these incongruities and produce a wide range promising hybrids rootstock candidates. Six winter squash (female) and two pumpkin (male) dihaploid lines produced by irradiated pollen technique were hybridized and embryos at different stages were cultured on E20A medium combined with 0.1 mg/l IAA and 0.1 mg/l GA₃. A total of 461 flowers were pollinated and 117 hybrid fruits, 864 embryos and 137 hybrid lines were developed. These promising hybrids candidates will be tested for rootstock potential, subsequently, highly compatible hybrids will be evaluated for resistance to biotic (*Fusarium* spp. and *Meloidogyne* spp.) and abiotic (salinity, drought and low soil temperature) stress conditions in our future breeding efforts.

Keywords: Interspecific hybridization, embryo rescue, rootstock, winter squash, pumpkin

1. Introduction

C. moschata and *C. maxima* are economically important species in *Cucurbita* genus and they are used for food, medicinal plant and also their rootstock potential. In current, resistance to abiotic and biotic stress conditions are preliminary breeding efforts for generating new lines with desirable agronomic traits. In view of resistance to soil-borne diseases and tolerance to low soil temperatures, salinity and drought, rootstocks have been offered a wide range of alternative in vegetable growing. But, grafting compatibility between scion and rootstock are the main problem of rootstock breeding technology. Thus, the breeders concentrated on production compatible rootstock lines and combined the different *Cucurbita* species via interspecific hybridization to overcome this bottleneck. Interspecific hybridization is a way of transferring and combining desirable traits in compatible species and releases the new germplasms. Nevertheless, crossing barriers (partial or complete

incompatibility) among the Cucurbita species is the most important problem to develop new interspecific hybrid lines. Crossing barriers may be related to the genetic differences (Sharma, 1995) and biological defence mechanism to maintain species originality.

Nowadays, interspecific hybrids of *C. maxima* x *C. moschata* are commonly used as a rootstock for watermelon, melon and cucumber cultivation while some crossing of *C. maxima* x *C. moschata* has shown incompatible (or incongruity) reaction due to prezygotic and postzygotic barriers (Korakot et al., 2010; Karaagac and Balkaya, 2013). In this way, seeds and fully seeds (including embryo end endosperm) are rarely seen in a fruit, and fruits have some seeds with only embryos (without endosperm) at a wide range of developmental stage, thus next generation were not maintained in some crossing. In the circumstances, in vitro embryo culture technique has been released valuable solution to overcome the incompatibility, and allows regeneration of the hybrid embryos and production of superior hybrid lines. On the other hand, the success of embryo rescue technique is mainly depending on male and female genotypes in crossing (especially female), media composition (PGR's combination), embryo development stage (heterotrophic or autotrophic) and culture conditions (light intensity, photoperiod and temperature) (Pierik 1999). Moreover, embryo rescue is a way of obtaining haploid plants in some interspecific crosses (Sharma et al., 1996).

The objective of this study is to develop interspecific inbred lines in some incompatible crossing of *C. maxima* x *C. moschata* via embryo rescue technique. Thus, the embryos at different stages were cultured on E20A medium combined with 0.1 mg/l IAA and 0.1 mg/l GA₃.

2. Material and Methods

According to the our previously works, some *C. maxima* x *C. moschata* hybrid combinations produced fruit and seed set smoothly, but, some of the superior lines combinations produced a few fruit with immature seeds (empty or having only embryos at different stage) due to incompatibility.

Dihaploid but incompatible six winter squash (WDH1, WDH2, WDH3, WDH4, WDH5, WDH6) and two pumpkins (PDH1, PDH2) lines produced via irradiated pollen technique in our previous studies were used for hybridization program (Figure 1).

Winter squashes were used as female (♀) parents, and pumpkins were used as male (♂) parents. At full-flowering period, female flowers were isolated with white cloth bags and male flowers were collected a day before anthesis, separately.

The following day, the pollinations were made in the morning at 7.00–9.00 a.m. and the female flowers were then isolated with cloth bags again to avoid undesired pollen contamination. Cloth bags were removed at 2nd days of pollination.

Fruits were harvested at 4-5 weeks after pollination to reduce embryo loss and increase regeneration rate of plant, and surface disinfected with 96% ethanol (combustion method). Seeds were opened individually in a laminar air flow cabinet and embryos were initially cultured on modified E20A medium (Table 1).

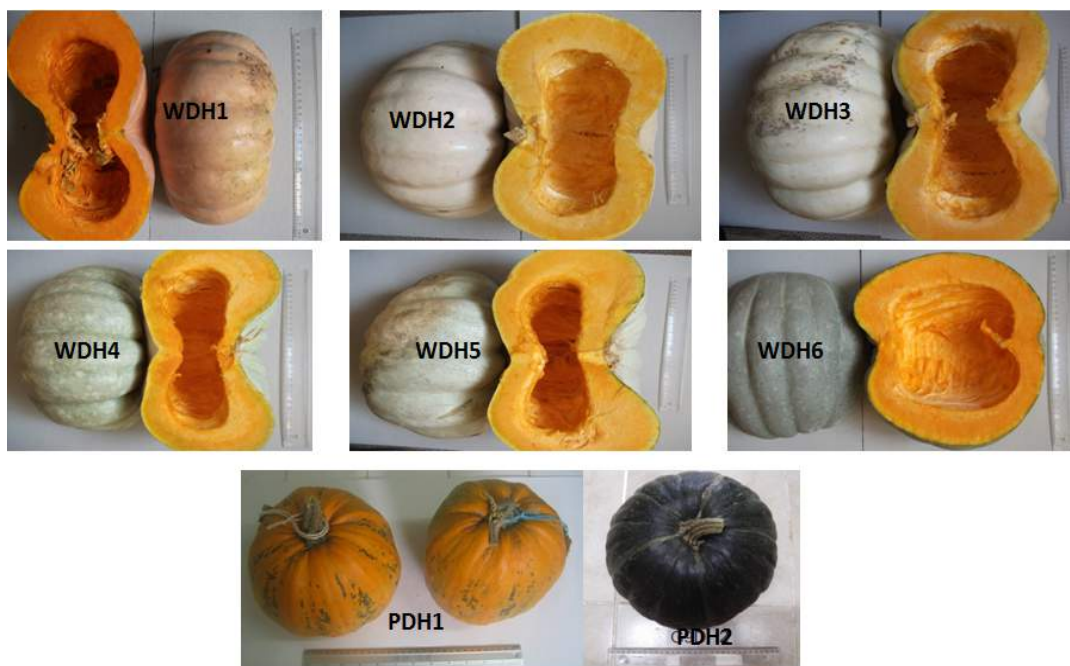


Figure 1. Winter squash and pumpkin lines used in the experiment

Table 1. The composition of modified “E20A” medium

KNO ₃	1075.0	MnSO ₄ .7H ₂ O	11.065
NH ₄ NO ₃	619.0	ZnSO ₄ .7H ₂ O	1.812
MgSO ₄ .7H ₂ O	206.0	H ₃ BO ₃	1.575
CaCl ₂ .2H ₂ O	156.5	KI	0.345
KH ₂ PO ₄	71.0	Na ₂ MgO ₄ .2H ₂ O	0.094
Ca(NO ₃) ₂ .4H ₂ O	25.0	CuSO ₄ .5H ₂ O	0.008
NaH ₂ PO ₄ .4H ₂ O	19.0	CoCl ₂ .6H ₂ O	0.008
(NH ₄) ₂ SO ₄	17.0	FeSO ₄ .7H ₂ O	27.8
KCl	3.5	Na ₂ EDTA	37.3
Myo-Inositol	50.30	Sucrose	20.00 g/l
Pyridoxine-HCl	5.500	Agar	7.00 g/l
Nicotinik asit	0.700	IAA	0.1 mg/l
Thiamine-HCl	0.600	GA ₃	0.1 mg/l
C. Pantothenate	0.500	pH	5.90
Glycine	0.100		
Biotine	0.005		

The processes of embryo rescue technique is given in Figure 2. The fruits obtained from incompatible hybridization had few seeds, and the seeds containing embryos in different developmental stages (Figure 3).

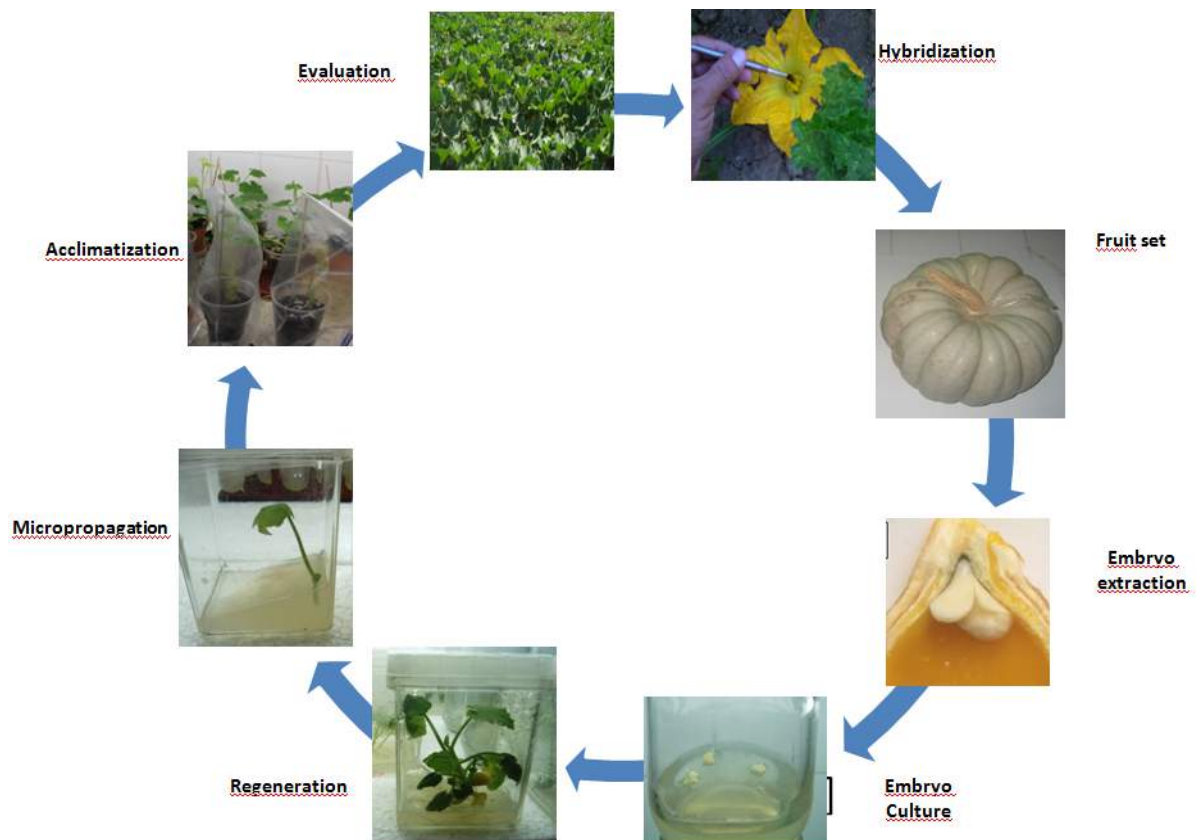


Figure 2. The processes of embryo rescue technique

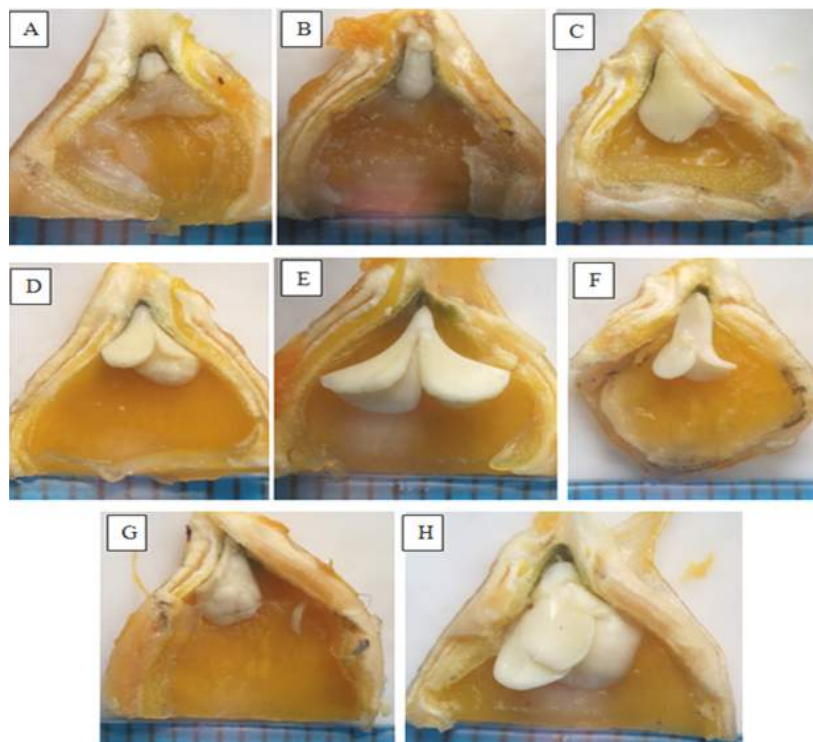


Figure 3. Embryos in different developmental stages. A) Globular B) Torpedo C) Cotyledon D and E) Heart F) Arrow Tip G and H) Amorphous

The embryos were cultured at 16/8 photoperiod, 4000 lux illumination and $27 \pm 1^\circ\text{C}$ in a growth cabinet (Figure 4 and 5).

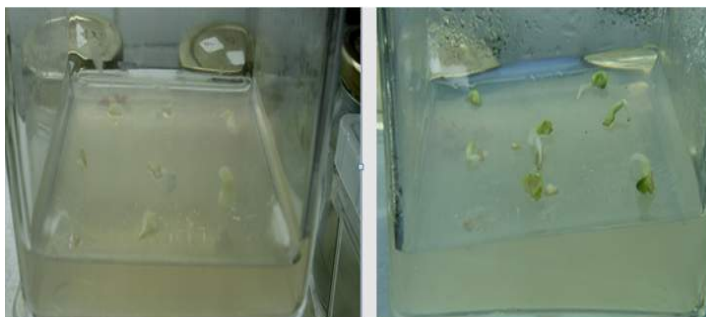


Figure 4. Embryos placed in E20A medium (left) and rooted embryos (right).



Figure 5. Developing plantlets.

After 15 -25 days of culture, mini-plantlets transferred on to fresh medium individually, and well developing plants (having good root and shoot system) were propagated via 2-3- micro-cuttings (Figure 6).



Figure 6. Propagation in *in vitro* condition

Plants (30–50 days-old) were transplanted to plastic bags containing sterilised mixture of 2 peat-moss: 1 perlite (v/v) under high moisture and were acclimatised for 10 days according to Kurtar and Balkaya (2010) (Figure 7).



Figure 7. Acclimatized plantlets

3. Results and Discussion

A total of 461 flowers were pollinated and 117 fruits were obtained (Table 2).

Table 2. The results of hybridization processes

♀	♂	PDH1					PDH2				
		PF	FR	FSR	FW	SN	PF	FR	FSR	FW	SN
		41	17	41,5	7,62	181	46	19	41,3	7,81	159
		31	5	16,1	6,64	117	39	9	23,1	6,58	102
		36	7	19,4	6,91	98	47	11	23,4	7,09	106
		44	15	34,1	7,97	131	37	12	32,4	8,08	121
		30	3	10,0	8,04	64	41	5	12,2	7,91	78
		37	7	18,9	7,63	102	32	7	21,9	7,74	113
		Σ / AVR.	219	54	24,7	7,49	242	63	26,0	7,54	124,4

PF: Number of Pollinated Flower; **FR:** Number of Fruit; **FSR (%):** Fruit-Set Rate

FW: Average Fruit Weight (kg); **SN:** Average Seed Number

While only a few full-seeds were obtained, empty seed and embryonal seeds were encountered at high rate (Table 3). 117 hybrid fruits were extracted and 864 embryos were cultured in E20A medium, and 137 plants were acclimatized and transplanted to the open field conditions (Table 4).

Table 3. Number of Full-Seed (FSN), Number of Empty-Seed (ESN) and Seed Number with Embryos (SNE)

♀	♂	PDH1			PDH2			Overall		
		FSN	ESN	SNE	FSN	ESN	SNE	FSN	ESN	SNE
WDH1		5	54	122	9	71	89	14	125	211
WDH2		3	42	80	6	38	68	9	80	148
WDH3		6	28	64	8	47	51	14	75	111
WDH4		11	39	101	11	35	85	22	74	186
WDH5		-	7	29	-	16	22	-	23	51
WDH6		4	29	69	8	31	84	12	60	153
Σ		29	199	465	42	238	399	71	437	864

Table 4. Number of Embryo (EN), Number of Viable Plant (VP), Rate of Viable Plant (CR%)

	EN							VP							
	WDH1	WDH2	WDH3	WDH4	WDH5	WDH6	Σ	WDH1	WDH2	WDH3	WDH4	WDH5	WDH6	Σ	CR
<u>Globular</u>	31	11	13	19	-	15	89	1	-	1	-	-	1	3	3,4
<u>Torpedo</u>	9	4	-	6	1	2	22	1	1	-	-	-	-	2	9,1
<u>Cotyledon</u>	117	92	64	93	31	79	476	31	16	14	24	6	22	113	23,7
<u>Heart</u>	42	31	29	49	17	44	212	4	3	-	2	2	1	12	5,7
<u>Arrow Tip</u>	3	-	7	5	-	2	17	-	-	1	-	-	-	1	5,9
<u>Amorphous</u>	9	10	2	14	2	11	48	3	1	-	1	1	-	6	13,0
Σ	211	148	115	186	51	153	864	40	21	16	27	9	24	137	15,9

The results indicated that the compatibility of genotypes is important in interspecific hybridization and it is needed to identify the superior compatible parents in hybrid combinations. The similar results were found in findings of Yongan et al. (2002), King et al. (2010), Lee et al. (2010) and Karağaç and Balkaya (2013).

4. Conclusion

- The embryo rescue technique has been successfully performed in incompatible *C. maxima* and *C. moschata* hybrids.
- Incompatibility of *C. maxima* x *C. moschata* hybrids was found to be highly genotypically originated.
- Conversion rates of embryos to plant are not at the desirable rate. Therefore it will be useful to study on different media and combinations.

- These promising hybrids candidates will be tested for rootstock potential.
- Superior rootstock candidates will be evaluated for resistance to biotic (*Fusarium* spp. and *Meloidogyne* spp.) and abiotic (salinity, drought and low soil temperature) stress conditions in our future breeding efforts.

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BAZI CUCURBİTA TÜRLERİNDE (*C. pepo*, *C. maxima* ve *C. moschata*) GÜNCEL ISLAH HEDEFLERİ VE ISLAH AMAÇLI ÖZELLİKLERİN KULLANIMI

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ÖZET

Bu derleme ile, yazlık kabak (*C. pepo*), kışlık kestane kabağı (*C. maxima*) ve kışlık balkabağı (*C. moschata*) türlerinde ıslah çalışmaları yürüten araştırmacılara rehber olunması amaçlanmıştır. Bitki ıslahında temel amaç bir genotipte güncel ihtiyaçlarla ortaya çıkan herhangi bir eksikliğin giderilmesi veya agronomik ve ekonomik açıdan istenilen özellikleri içeren yeni bir genotipin ortaya çıkarılmasıdır. Ancak hedeflenen sonuca başarıyla ulaşmak için aktarılması arzulanan karakterin/karakterlerin özellikleri, kalıtsallık durumları, bulunduğu kaynaklar, aktarılabilme durumu ve hangi ıslah metoduyla aktarılacağı gibi konuların bilinmesi gerekmektedir. Sunulan bu çalışmada, adı geçen türlerin ıslah hedefleri açısından önemli özellikleri ele alınarak incelenmiş, bu özelliklerin kalıtım durumu, kalıtım kaynakları, aktarılabilme durumu ve ıslah metodları ayrıntılı olarak verilmiştir.

Anahtar Kelimeler: Cucurbita spp., ıslah, kalıtsal özellikler

The Current Breeding Perspectives and Utilization of Desirable Breeding Characteristics of Some Cucurbita Species (*C. pepo*, *C. maxima* and *C. moschata*)

ABSTRACT

The present study was conducted to guidance for breeders which concentrated on summer squash (*C. pepo*), winter squash (*C. maxima*) and pumpkin (*C. moschata*). The main objective of plant breeding is eliminated any deficiency of a genotype via current requirement or generated a new genotype with respect to desirable agronomic and economic traits. Hence, a series of important issues must be organized such as character traits, inheritance, donors (or source), transmissibility and suitable breeding methods. In this study, desirable traits of aforementioned species were evaluated in view of breeding goals, and inheritance, source, transmissibility, and breeding methods of these desirable traits were given in particular.

Keywords: Cucurbita spp., breeding, inheritance traits

1. Giriş

Cucurbitaceae familyasında yer alan ve yetiştiriciliği yapılan türlerin gerek üretim (hastalık ve zararlılara, stres koşullarına tolerant, yüksek verimli ve kaliteli, erkenci vb.) ve gerekse tüketim (kuru maddesi, vitamin, mineral ve besleyici değeri yüksek, meyve eti koyu, sofralık ve sanayilik özellikleri yüksek vb.) yönünden güncel ihtiyaçları karşılayabilecek hale getirilmesi bir dizi ıslah çalışmasını gerektirmektedir. Ancak, çalışılan karakterin/karakterlerin özellikleri (kalitatif, kantitatif), kalıtsallık durumu (dominant, resesif, epistatik, monogenik, poligenik v.b.), bulunduğu kaynaklar ve faydalanılabilirlik durumu (hangi cins, tür, genotip ve/veya melezlerde) ve kalıtımın nasıl aktarılacağı (melezleme, kısırılık, uyumsuzluk, biyoteknolojik yöntemler) gibi faktörlerin bilinmesi ıslah çalışmalarında başarıyı ve sürdürülebilirliği önemli derecede etkilemektedir.

Yukarıda adı geçen türler üzerinde yapılan çalışmalarda meyve ağırlığı, bitkideki meyve sayısı, meyve çapı, perikarp kalınlığı, dişi çiçek oluşturmaya eğilim, meyve olgunlaşma süresi gibi faktörlerin verim üzerinde önemli etkilere sahip olduğu ve yüksek verimli genotiplerin seçiminde anahtar rol üstlendiği ortaya koyulmuştur. Toplam şeker, beta-karoten ve askorbik asit miktarı ise meyve kalitesine yönelik çalışmalarda dikkate alınmaktadır (Mandal, 2006). Beta-karoten ile meyve çapı ve vitamin C ile kuru madde arasında pozitif ilişki bulunmuş (Danilcenko ve Genyte, 1999), *C. moschata* türünde duyuşal tat ile toplam eriyebilir şeker ve duyuşal tekstür ile meyve eti pulpunun katılığı arasında yüksek oranda ilişki tespit edilmiştir (Daniel ve ark., 1996).

Doijode ve Sulladmath (1988) kol uzunluğu ve yan kol sayısında, Doijode ve ark. (1987) meyvedeki tohum sayısı, 100 tohum ağırlığı ve tohum boyut indexi özelliklerinde eklemesiz gen etkisinin olduğunu bildirmiştir. Meyve ağırlığında (Galka, 1987), kol uzunluğunda, bitkideki meyve sayısında, meyve eti kalınlığında, meyve şekil indeksi ve bitki başına verimde (Sirohi ve ark., 1986), toplam çözünabilir kuru madde, karotenoid, askorbik asit, kalsiyum ve demir içeriği gibi besleyici özelliklerde (Sirohi and Yayasani, 2001) yüksek oranda dominansi bulunmuştur. Sirohi ve Behera (2000) kol uzunluğu, meyve olgunlaşma süresi, bitkideki meyve sayısı, meyve ağırlığı ve bitki başına verim özelliklerinde dominant gen etkisi olduğunu bildirmiştir. Sultana ve ark. (2015) *C. moschata* türünde bitki başına dişi ve erkek çiçek sayısı, meyve ağırlığı ve bitki başına verim gibi özelliklerin yüksek kalıtmı özellikler olduğunu belirlemişlerdir.

Ayrıca, herbisitlere (trifluralin) toleransı kontrol eden “T” geninin dominant (Adeoye ve Coyne, 1981), meyvede açık ve koyu yeşil benekliliğin koyu yeşil meyve rengine monogenik dominant (Cardoso ve ark. 1995) olduğu, tohumda kabuksuzluğun bir çift resesif gen ile idare edildiği (Zhou, 1987), yaprakta gümüşü beneklenme üzerine kısmi dominant “M” geninin sorumlu olduğu (Wessel-Beaver ve Katzir, 2000), gynogenik özelliğin *C. foetidissima* türünde tek bir gen ile kontrol edildiği ve bu özelliğin *C. moschata*’ya aktarılabilceği ifade edilmiştir (Robinson, 2000).

Sunulan bu mini derleme ile cucurbita cinsi içerisinde yer alan türlerde (*C. pepo*, *C. maxima* ve *C. moschata*) yapılacak olan ıslah çalışmalarında ıslahçılara rehber olunması amaçlanmıştır.

2. Cucurbita Türlerinde Güncel Islah Hedefleri

2.1. Hastalık ve zararlılar ile abiyotik stres faktörlerine dayanım

Cucurbita türleri genelde ZYMV (Kabak Sarı Mozaik Virüsü), WMV-2 (Karpuz Mozaik Virüsü-Irk 2), PRSV (Papaya Halkalı Lekelilik Virüsü), CMV (Hıyar Mozaik Virüsü) gibi virüslere, külleme (*Podosphaera* spp), mildiyo (*Pseudoperonospora cubensis*) ve kök çürüklüğü (*Phytophthora capsici*) gibi fungal etmenlere karşı hassasiyet gösterir ve dayanıklı çeşitlerin geliştirilmesi mecburidir. Cucurbita içerisinde birçok yabancı türde hastalıklara dayanıklılık belirlenmiş olup türlerarası melezleme ve geriye melezleme teknikleri hastalıklara ve zararlılara dayanıklılığın aktarılmasında tercih edilmektedir.

ZYMV'nin farklı ırklarına karşı direnç *C. ecuadorensis*, *C. maxima* ve *C. moschata* (Soler, Menina, Nigerian Local) türlerinde rapor edilmiştir (Paris ve Brown, 2005). Nigerian Local aynı zamanda *C. moschata* and *C. pepo* türlerinde WMV'ye dayanımın aktarılması amacıyla da kullanılmaktadır (Brown ve ark., 2003). WMY'ye dayanım için *C. ecuadorensis* türü de tercih edilmektedir ve bu tür kullanılarak *C. maxima*'ya hem WMV hem de düşük düzeyde de olsa kabak mozaik virüsüne (SqMV) dayanım aktarılmıştır (Provvidenti, 1997). Yukarıda adı geçen virüslere karşı dayanım bazı *C. maxima* tiplerinde de bulunmaktadır (Kristkova ve Lebeda, 2000).

Fungal hastalıklardan ise külleme en önemlisidir. Ayrıca mildiyo özellikle nemli bölgelerde zarar yapmaktadır. Küllemeye karşı *C. maxima*'ya ait yerli tiplerde arazi dayanımı bildirilmiştir (Wessel-Beaver, 1993). Ayrıca *G. cichoracearum*'a karşı *C. lundelliana* ve *C. moschata* (La Primera, Seminole) türlerinde dayanım bulunmuştur (Paris ve Brown, 2005). *P. xanthii*'ye karşı dayanım ise *C. okeechobensis* subsp. *martinezzi* türünden elde edilmiş, bu dayanım *C. moschata* türü köprü olarak kullanılarak *C. pepo* türüne aktarılmıştır (Cohen ve ark., 2003). Günümüzde küllemeye dayanıklı bir çok kışlık ve yazlık kabak çeşidi bulunmaktadır. Mildiyo'ya dayanım ise *C. ecuadorensis* ve *C. okeechobensis* türleri kullanılarak *C. pepo*, *C. maxima* ve *C. moschata* türlerine aktarılmıştır. Cocozelle, Marrow ve Zucchini tipi kabakların mildiyoya karşı daha az hassas oldukları belirtilmiştir (Kristkova ve Lebeda, 2000).

Cucurbita türlerinin en önemli zararlısı, yapraklarda gümüşlenme şeklinde kendini gösteren ve meyve şeklini bozarak büyük ekonomik kayıplara neden olan gümüşlenme (Silvering) hastalığının vektörü beyaz sinektir. Bunun yanında meyve sineği, iç kurdu ve gövde kurdu da zararlanmalara sebep olmaktadır. *C. moschata* (PI-162889 ve Butternut tipleri) içerisinde gümüşlenmeye dayanıklı genotiplerin olduğu bildirilmiştir (González ve Wessel-Beaver, 2002). Ayrıca meyve sineğine karşı *C. maxima*'da, iç kurduna karşı *C. pepo*, *C. moschata* ve *C. maxima*'da dayanım, gövde kurduna karşı ise *C. moschata*'da tolerans olduğu bildirilmiştir (Paris ve Brown, 2005).

Genellikle Cucurbita cinsine giren türler kabul edilebilir derecede kuraklığa ve tuzluluğa toleranslıdır. Nitekim günümüzde karpuz anaç olarak kullanılan birçok çeşit büyük oranda *C. maxima* x *C. moschata* melezlemesi ile üretilmiştir.

2.2. Kompakt yapılı, dallanması az, erkenci ve verimli tiplerin geliştirilmesi

Günümüzde üreticiler kompakt yapılı, daha az dallanan (nispeten küçük dallı), bol yapraklı ve bitki başına verimi yüksek çeşitleri tercih etmektedir. Kompakt yapı kısa ve kalın boğum araları, erken çiçeklenme, yüksek dişi/erkek çiçek oranı, erkencilik, yüksek oranda biomas ve hızlı bitki gelişimi ile kendisine göstermektedir. Böylece birim alanda daha fazla bitki yetiştirilmesine olanak vermekte, hasat, hastalık, zararlı ve yabancı otlarla mücadele işlemlerini kolaylaştırmakta, sonuç olarak verim ve kaliteyi artırmaktadır. Yarı kompakt yapılı bitkiler yüksek fotosentetik aktiviteye sahip olduklarından meyvelerindeki kuru madde oranı yükselmekte ve bu sebeple kestane ve balkabağı yetiştiriciliğinde tercih edilmektedir.

Kompakt yapı *C. pepo* türünde yaygın olarak bulunmaktadır. *C. pepo*'dan aktarılan bu özellik sayesinde günümüzde yarı kompakt yapılı *C. moschata* (Table Ace) ve *C. maxima* türlerine ait küçük meyveli ancak yüksek verimli hibrit çeşitler geliştirilmiştir. Kompakt yapı çerçevesinde yüksek oranda ve erken dişi çiçek açan tiplerin geliştirilmesi de güncel ıslah hedefleri arasındadır. *C. pepo* çeşitlerinin seleksiyonu ile yüksek oranda dişi çiçek açan *C. moschata* ve *C. maxima* tipleri elde edilmiştir.

2.3. Meyve özelliklerinin geliştirilmesi

Günümüzde tüketiciler, beslenme düşüncesinin ve tüketim alışkanlıklarının da değişmesiyle birlikte, gerek dış (bir örnek, hasar görmemiş, kabuk ve meyvede çeşide has rengi taşıyan, nispeten daha ince kabuklu ve küçük meyveli), gerekse iç (lifsiz, acılık içermeyen, tad ve lezzeti uygun, besleyici değeri yüksek) kalite özellikleri yüksek kabak çeşitlerini tercih etmektedirler. Dahası, karotenoid, tokoferol ve askorbik asit içeriği yüksek, A, E ve C vitaminlerince zengin çeşitler ön plana çıkmaktadır (Murkovic ve ark., 2002). Zira bu ürünler taze marketlere sunulduğu gibi, son ürün olarak konserveye işlenmekte, çocuk mamalarına katılmakta ve çerez olarak da tüketilmektedir. Özellikle konserve sanayinde kullanılan *C. maxima* ve *C. moschata* çeşitlerinde daha tatlı ve çok koyu meyve etine sahip çeşitler tercih edilmektedir.

Meyve büyüklüğü ve şekli, ince kabukluluk, lifsizlik ve cucurbitacine içeriği poligenik karakterdir. *C. pepo* (*Di*, *Disc*) ve *C. moschata* (*Bn*, *Butternut*) türlerinde bazı major genler bildirilmiştir. *C. pepo*'nun yazlık tiplerinde, *C. maxima* ve *C. moschata* türlerinde kabuk rengini kontrol eden ve meyve rengine de etkisi olan birçok gen belirlenmiştir.

2.4. Tohum özelliklerinin geliştirilmesi

Kabak tohumları çerezlik olarak yaygın olarak tüketilmekte olup % 35-50 yağ içermektedir (Seymen ve ark., 2016). Yağda bulunan linoleik asit vitamin E'nin en önemli kaynağıdır. Kabak çekirdeği tohumu Ca, K, P, Mg, Mn, Fe ve Zn mineralleri bakımından zengin olup, B grubu vitaminlerinin de iyi bir kaynağıdır.

Kabak çekirdeği yağı gerek beslenmede gerekse farmasotik etkilerinden dolayı tıpta yaygın olarak kullanılmaktadır. Genellikle *C. pepo* türüne giren yağlık kabaklar (var. *styriaca*) yağ çıkarma amaçlı olarak yetiştirilirken, *C. maxima*, *C. moschata* ve *C. ficifolia* türleri de farklı bölgelerde yağlık olarak kullanılmaktadır. Yağlık kabak tohumlarında kabuk engelini ortadan kaldırmak amacıyla, bir

mutasyon sonucu oluşmuş ve resesif tek bir major gen (n) ile idare edilen kabuksuzluk özelliği kullanarak, kabuksuz tohumlara sahip yağlık çeşitler geliştirilmiştir.

Diğer taraftan kaliteli meyve eti için *C. maxima* x *C. moschata*; kompakt bitki gelişimi için *C. pepo* x *C. moschata*; hastalıklara dayanım için *C. lundelliana* veya *C. martinezii* x *C. moschata* melezleri kullanılabilmektedir.

2.5. “Anaç ıslahı” amaçlı çalışmalar

Çeşidin erkencilik, verim, meyve kalitesi (iç ve dış kalite), biyotik (toprak kökenli hastalık ve zararlılar) ve abiyotik (kuraklık ve tuzluluk) stres koşullarına dayanımları üzerinde etkili olan anaçlar günümüz sebze yetiştiriciliğinde önemli bir yere sahiptir.

Kabakgiller familyasına giren karpuz, kavun ve hıyar türlerinde günümüzde olumlu birçok özelliği nedeniyle yaygın olarak kullanılan ticari anaçlar *Cucurbita maxima* x *Cucurbita moschata* türler arası melez anaçlardır. Bu türler azda olsa tek başlarına veya *Cucurbita moschata* x *Cucurbita maxima* melezleri şeklinde de kullanılabilmektedir. Ayrıca erkek kısırılığı açısından *C. pepo*, *C. maxima* ve *C. moschata* türlerinde mutasyon sonucu oluşan ms-1, ms-2 ve ms-3 genleri tespit edilmiştir.

3. Gelecekteki ıslah hedefleri

Gerek global iklim değişikliği, gerekse üretim, tüketim ve beslenme tarzının farklılaşması bir çok özelliği birden barındıran çok özellikli çeşitlerin talebini de beraberinde getirecektir. Artık sadece belli bir hastalığa, hastalığın belli bir ırkına dayanıklı çeşit talebi, yerini birçok virütik (özellikle ZYMV, WMV, CMV) ve fungal (özellikle külleme) hastalığa ve zararlıya (özellikle nematod, beyazsinek ve afidler) dayanıklı (multi-resistant), farklı ekolojilerde ve farklı abiyotik stres (özelikle kuraklık, tuzluluk, aşırı yüksek ve düşük sıcaklıklar) koşullarında yetiştirilmeye uygun (multi-tolerant), besleyici değeri yüksek (özellikle karotenoid ve vitaminler) ve aynı zamanda raf ömrü uzun kabak tip ve çeşitlerine bırakacaktır. Bu özelliklerin bir çeşitte toplanması klasik ıslah yöntemleriyle imkânsızdır. Kaldı ki, özellikle virüs hastalıkları ve zararlı tipleri gerek değişen iklimin tetiklemesi gerekse yanlış zirai mücadele uygulamalarıyla direnç kazanmakta, farklılaşmakta ve her geçen gün mücadeleleri zorlaşmaktadır.

Cucurbita türlerinin ıslahındaki amaç ve hedefler ne olursa olsun, bunlara ulaşmada gidilecek yolun klasik ıslah yöntemleri ile biyoteknolojik yöntemlerin birlikteliğinden geçeceği aşîkârdır. Genetiği değiştirilmiş organizmalara (GDO) karşı hala bir tüketici karşıtlığı olmasına rağmen biyoteknolojik yöntemler, özellikle genetik mühendisliği ve moleküler ıslah teknikleri aşılması zor ve hatta imkansız görülen bir çok engelin aşılmasında yardımcı olacaktır. Özellikle MAS, genetik mühendisliğine alternatif olması, çok kısa sürede ve daha az maliyetle sonuca ulaşılması sebebiyle önemli avantajlara sahip olarak görülmektedir, ancak *Cucurbita* türleri için tekniğin geliştirilmesine ihtiyaç vardır. Zira günümüzde *Cucurbita* cinsine giren türlerin ticari yetiştiriciliği halen birçok türe göre çok gerilerdedir ve biyoteknolojik çalışmaların çoğunluğu daha ekonomik türler üzerine yoğunlaşmıştır. Ayrıca in vitro rejenerasyon teknikleri, türlerarası melezlemelerden sonra farklı özelliklere sahip genotiplerin eldesine olanak sağlayan embriyo kültürü çalışmaları, dihaploidizasyona

olanak sağlayan androgenesis ve gynogenesis teknikleri, diğer türlerde olduğu gibi, Cucurbita türlerinin gelecekteki ıslah çalışmalarında belirleyici olacaktır.

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ARŞİV BELGELERİ IŞIĞINDA TÜRKİYE’DE TARIM SEKTÖRÜNÜN GELİŞTİRİLMESİNDE ZİRAAT BANKASININ ROLÜ (1923-1950)

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Özet

Cumhuriyetin ilk yıllarından 1950 yılına kadar tarım sektörünün geliştirilmesine yönelik Ziraat Bankasının, yaptığı faaliyetler ve bu faaliyetlerin ekonomiye olan yansımaları çalışmasının konusunu teşkil etmektedir. Çalışma, 1923-1950 döneminde Türkiye’de Ziraat Bankasının faaliyetleri ile sınırlandırılarak tek dönem halinde ele alınmıştır. Bankanın yaptığı çalışmalar ele alınırken sayısal veriler üzerinde değerlendirilmelerde bulunulmuştur. Ziraat Bankasının tarımsal faaliyetleri ve bu faaliyetlerin ekonomiye olan katkıları sayısal veriler ışığında değerlendirilmiştir. Çalışmanın başlıca kaynak materyalini, Cumhuriyet arşivi belgeleri oluşturmakla birlikte, resmi yayınlardan; zabıt ceridesi, kanunlar ve tutanak dergileri, resmi gazete ile istatistik yıllıklarından da yararlanılmıştır. Konu incelenirken, Ziraat Bankasının tarım sektörünün kredi, alet ve makine sorunlarını çözmeye yönelik attığı adımlar göz önüne alınarak gerekli değerlendirilmeler yapılmıştır. Çalışmada elde edilen sonuç şudur: 1924 yılından itibaren bir anonim şirket halinde çalışmalarını sürdüren Ziraat Bankası, 12 Haziran 1937 tarihinde kabul edilen 3202 sayılı Kanun ile müstakil bir devlet müessesesi haline gelerek Türkiye Cumhuriyeti Ziraat Bankası adını almıştır. Kuruluşunun hemen ardından sadece zirai kredi veren teşekkül olmaktan çıkarak birinci derecede ülke tarımıyla ilgilenen bir kurum haline gelen banka, don, sel, dolu, kuraklık gibi doğal afetler ve haşereler yüzünden ürünleri zarar görmüş çiftçilere yardım edip dış ülkelerden tarım alet ve makineleri satın almasıyla ülkenin milli ekonomisine katkılar sağlamıştır.

Anahtar Kelimeler: Ziraat Bankası, Zirai Kredi, Ziraat Aletleri, Doğal Afetler, Tarımsal Kalkınma

THE ROLE OF ZİRAAT BANK IN THE DEVELOPMENT OF AGRICULTURAL SECTOR IN TURKEY IN LIGHT OF ARCHIVE DOCUMENTS (1923-1950)

Abstract

This study deals with Ziraat Bank’s activities for the development of agricultural sector in Turkey from the first years of the Republic to 1950 and the reflections of these activities on economy. The study is limited to Ziraat Bank’s activities in Turkey in the period from 1923 to 1950. That is, it focuses on a single period. Evaluations on the bank’s agricultural activities and the contributions of these activities to economy have been made based on numeric data. Though the main source material of the study consists of Republic archive document, the study has also benefited from official publications such as proceedings of memorandum, laws, journals of official reports, official gazettes, and statistical annuals. The relevant evaluations have been made considering the steps taken by Ziraat Bank to solve the credit, tool, and machinery problems of agricultural sector. The study has found out that Ziraat Bank, which maintained its operations as a joint-stock company as of 1924, turned into an independent state enterprise under the name of Türkiye Cumhuriyeti Ziraat Bankası [The Republic of Turkey Ziraat Bank] with the Law no. 3202 accepted on 12 June 1937. Right after its foundation, the bank stopped being only an enterprise providing agricultural credit and started to be an enterprise engaged in the agriculture of the country in the first degree. The bank contributed to the national economy by helping farmers whose products were damaged due to insect pests and natural disasters such as frost, flood, hail, and drought and purchasing agricultural tools and machines from foreign countries.

Key Words: Ziraat Bank, Agricultural Credit, Agricultural Tools, Natural Disasters, Agricultural Development

Giriş

Osmanlı Devleti'nde, köylünün tarım kredi ihtiyacını gidermek için ayrı bir teşkilat teşkil edilmesi gerektiğinde bunu ilk uygulayan şahıs Niş ve Tuna Valisi Mithat Paşa olmuştur (TCZB, 1957; Yurtoğlu, 2017).

1863 yılında Sırbistan-Bulgaristan sınırında yer alan Pirot Kasabasında yapılan deneme mahiyetindeki çalışmaların ardından bu uygulama 1867 yılında çıkarılan özel bir mevzuatla *Memleket Sandıkları* adı altında ülkenin her tarafına yayılmıştır. Zamanla sandıkların verimli çalışmaması üzerine, bunları merkezi yönetime bağlayarak, daimi bir sermaye kaynağı oluşturmak amacıyla, 1883 yılında aşar vergisini onda bir oranında artırılarak, *Memleket Sandıkları*, *Mena'fi Sandıkları*na dönüştürülmüştür. Akabinde 15 Ağustos 1888 tarihinde çıkarılan Ziraat Bankası Nizamnamesi ile *Mena'fi Sandıkları* lağvedilerek yerine, merkezi bir kredi müessesesi olan Ziraat Bankası kurulmuştur (Ataşağın, 1939; Yurtoğlu, 2017).

Ziraat Bankası teşkil edildiği 1888 yılından itibaren yoğun bir teşkilatlanmaya gidilerek hızla büyümeğe başlamış, kuruluşunun birinci yılında 97'si şube 244'ü sandık olmak üzere toplam 331 yerde hizmet görevini yerine getirmiştir. 1889 yılından Cumhuriyetin 15. yılına kadar olan dönemde toplam 124 şube ve 455 sandık faaliyete geçmiştir (Ataşağın, 1939; Yurtoğlu, 2017).

Ziraat Bankasının Tarım Sektörü Alanında Faaliyetleri (1923-1950)

Ülkenin içinde bulunduğu zor şartlara rağmen, Milli Mücadele'nin sürdürüldüğü yıllarda Ziraat Bankasına önem verilerek Genel Müdürlüğüne 8 Kasım 1920 tarihi itibarıyla Hüseyin Avni Bey tayin edilmiştir (BCA, 1920). Hüseyin Avni Beyin Genel Müdür olarak atanmasından kısa bir süre sonra 17 Ocak 1921 tarihinde dış ülkelerden tarım aleti getirilmesi için çalışmalar yürütülmüştür (BCA, 1921).

1924 yılı sonuna gelindiğinde ulusal bankalar içinde Nominal sermayenin %8'ine ödenmemiş sermayenin %82'sine, yedek akçelerin %63'üne, mevduatın %31'ine, açılan kredilerin %73'üne ve şubelerin %96'sına Ziraat Bankası sahip olmuştur (Çelebican, 1982).

Banka bir anonim şirket olarak zamanın şartlarına göre yapılandırmasını sürdürmüş, esas sözleşmesinin bazı maddelerini 27 Şubat 1929 tarihinde 1/7722 sayılı Bakanlar Kurulu Kararnamesi ile değiştirmiştir (BCA, 1929).

1929 Dünya Ekonomik Buhranının yol açtığı ekonomik tahribatın tarım sektörünü sekteye uğratması, hububat üretiminin artırılarak depo edilmesini zorunlu kıldığından Ziraat Bankasınca silo ve ambar yapımı için kanun tasarıları hazırlanmıştır¹ (BCA, 1933).

Ziraat Bankası ayrıca, kuraklık veya başka sebeplerle 1931 yılı sonrasındaki hasat dönemlerinde ürünlerin ihtiyacını karşılayamayacak düzeyde olması ve çiftçilerin borcunu ödemede güçlük çekmesi üzerine yeni uygulamalarla köylünün yardımına koşmuştur. 14 Haziran 1935 tarihinde yürürlüğe giren 2814 sayılı Yasayla Ziraat Bankası 1931 yılı sonu çizelgesinde kayıtlı tarımsal alacaklarının yıllık %3 faizle on beş yıl gibi uzun dönemlerle taksitlendirilmesi suretiyle borçluların ödeme zorluklarına uygun bir plan hazırlandığı gibi alacakların da kolaylıkla tahsili yoluna gidilmiştir (TBMMKD, 1935; RG, 1935; Karınca, 1936; Yurtoğlu, 2017).

Bunun yanı sıra 1933 yılı içerisinde Isparta'nın Ali köyünde yangından zarar görenlere Ziraat Bankasınca yardım edilmesi konusunda çalışmalar yürütülmüştür (BCA, 1933).

Bankanın bünyesinde yabancı uzmanlar da görev almıştır. İnşaat tesisleri işlerinde çalışan Avusturya uyruklu Karl Maixner'in 2007 sayılı Kanunun ikinci maddesi uyarınca Ziraat Bankanın faaliyetlerinde çalışmasına izin verilmesi, 25 Nisan 1937 tarihinde Bakanlar Kurulu tarafından kararlaştırılmıştır (BCA, 1937).

Bu arada 12 Haziran 1937 tarih ve 3202 sayılı Yasayla Ziraat Bankası devlet kuruluşuna dönüştürülmüştür. Türk çiftçilerinin tarım üretimiyle, bu üretimden elde edilen satışı gerçekleştirme, tarım sanayinin ve bunlarla ilgili her türlü teşebbüslerin millî ekonomi prensiplerine göre yürütmesi ve ilerlemesi için gerekli ve elverişli kredileri düzenleme, yönetme ve dağıtma işlevini yerine getirme, Bankanın başlıca görevleri arasında yer almıştır. 76 madde ve 9 geçici maddeden oluşan 3202 sayılı

¹ 11 Eylül 1936 tarih ve 2/5503 sayılı Ziraat Bankası Kanun Tasarısı için Bk. (BCA, 1936)

Ziraat Bankası Kanunuyla bankanın hukukî esaslarında, idare mekanizmasında ve genel faaliyet prensiplerinde köklü değişikliklere gidilmiştir. 1924'ten sonra anonim şirket şeklinde idare edilen Bankanın adı Türkiye Cumhuriyeti Ziraat Bankası olarak değiştirilerek, bir devlet müessesesi haline getirilmiştir (TBMMKD, 1937; RG, 1937; Atasagun, 1939; Yurtoğlu, 2017).

3203 sayılı Kanunun 58. maddesi uyarınca Ziraat Bankası memurları tekaüt sandığı Nizamname Projesi, 23 Aralık 1938 tarihi itibarıyla uygulamaya konulmuştur (BCA, 1938).

Bu Kanunun yayınlanmasından sonra Ziraat Bankası basit bir zirai kredi verme kurumu olmaktan çıkarılarak birinci derecede ülkenin genel tarımına, ikinci derecede ülkenin genel ekonomisine hizmet verecek modern bir kurum haline getirilerek gerekli imkânlarla donatılmıştır (Türk Ekonomisi, 1947).

3202 sayılı Kanundan sonra çıkarılan 17 Haziran 1938 tarih ve 3460 sayılı İktisadi Devlet Teşekkülleri Kanununun 50. maddesi Ziraat Bankasını da kapsadığından, bu kuruluş muhtar iktisadî bir devlet teşekkülü halini almıştır (TBMMKD, 1938; RG, 1938).

Cumhuriyet Hükümetleri Bankanın yönetim kadrolarına da önem vererek zaman içerisinde bunları yenilemiştir. Türkiye Cumhuriyeti Ziraat Bankası Genel Müdürlüğüne Nusret Meray'ın tayini üzerine açılan Genel Müdür Yardımcılığından birine 700 lira ücretle Cezmi Erçin, diğerine 650 lira ücretle Mithat Dülge'nin tayinleri 2 Nisan 1938 tarihinde Bakanlar Kurulu kararı ile gerçekleştirilmiştir (BCA, 1938).

Bu arada Türkiye'de biralık arpa ve kalitesi yüksek buğday üretimini artırmak amacıyla hububat yetiştiren mahallerden Ziraat Bankasına tohumluk satın alınarak köylülere intikal ettirilmesi çalışmaları da Ankara, Eskişehir, Kütahya ve Afyon vilayetlerinde başlatılmıştır. Çalışmalarda çiftçilere satılacak 4.000 ton biralık arpa ile 5.000 ton iyi vasıflı buğday tohumluğunun maliyet ve satış fiyatları arasında oluşan farktan zararın bir sonraki yıl Ziraat bütçesinden karşılanması ve tohumlukların satışı için Tarım Bakanlığına yetki verilmesi, 26 Temmuz 1938 tarihinde Bakanlar Kurulunca kararlaştırılmıştır (BCA, 1938).

Bankaya, ayrıca Toprak Mahsulleri Ofisi kuruluncaya kadar Buğday Komisyonu adına Bakanlar Kurulu kararı ile buğday satın alımı yetkisi tanınmıştır. Fiyatları belirlemede bir önceki yılın fiyatları temel alınarak nakil masrafları, kalite farkları, diğer amiller göz önünde tutulmuştur. %3'ten fazla çavdarlı ve içerisinde yabancı madde bulunmayan buğdayların kilogramı için beş kuruşa kadar; %2'den fazla çavdarlı ve yabancı madde olmayan hektolitresi 76'dan yukarı bulunan sert buğdayın kilogramı için beş buçuk kuruşa kadar olmak üzere fiyatların tespiti 25 Temmuz 1938 tarihi itibarıyla Bakanlar Kurulunca onanmıştır (BCA, 1938).

Cumhuriyet Hükümetleri doğal afetler yüzünden zarar gören çiftçilere her konuda yardımcı ihmal etmemiştir. 1940 yılında meydana gelen sel yüzünden tarım alanları zarara uğrayan Ürgüp köylerine Kızılay tarafından yardım edilerek borçlarının bir yıl süreyle ertelenmesi talebi, 29 Ağustos 1940 tarihi itibarıyla gerçekleştirilmiştir (BCA, 1940).

1942 yılına gelindiğinde Ziraat Bankası bünyesinde atamaların devam ettiği görülmektedir. Hulki Alisbah'ın Sümerbank Genel Müdürlüğüne tayini dolayısıyla açılan Ziraat Bankası Genel Müdür Yardımcılığına 500 lira ücretle, 23 Mart 1942 tarihinde Ticari Krediler Müdürü Hamit Pekcan atanmıştır (BCA, 1942).

Yine Malatya'nın merkez kazası ile köylerinde 13-14 Nisan 1942 tarihinde esen rüzgârlar nedeniyle oluşan don olayı yüzünden, %95 oranında meyveler hasara uğramış, sürme hastalığı ve yağmursuzluk sebebiyle ziraat ürünleri normal halde gelişmemiştir. Bu bakımdan 445 Numaralı Merkez Kooperatifi ortaklarının Bankaya olan 58.634 liralık borçlarının bir sonraki yıla ertelenmesi, 31 Ocak 1942 tarihinde Bakanlar Kurulu tarafından tespit edilmiştir (BCA, 1942).

1943 yılı içerisinde Türkiye'de Ziraat Bankası uhdesinde atamaların sürdürüldüğü bilinmektedir. Münhal bulunan Ziraat Bankası Genel Müdür Yardımcılığına aylık 500 lira ücretle

Banka Teftiş Heyeti Başkanı Suheyip Nizami Derdel 13 Eylül 1946 tarihi itibarıyla tayin edilmiştir² (BCA, 1943).

1944 yılında Bolu’da depremde zarar gören çiftçilerin zararını karşılamak amacıyla Başbakanlığın ayrıca seferber olduğu bilinmektedir (BCA, 1944).

1945 yılının ilk yarısı içerisinde ise Ziraat Bankası Tüzük tasarısının yürürlüğe girdiği göze çarpmaktadır. 3202 sayılı Yasanın 73 maddesi uyarınca hazırlanan ve Danıştay tarafından incelenerek gönderilen Türkiye Cumhuriyeti Ziraat Bankası Tüzük Tasarısının, 6 Nisan 1945 tarihinde Bakanlar Kurulu tarafından yürürlüğe konulması kararlaştırılmıştır (BCA, 1945).

1947 yılına gelindiğinde ülkenin çeşitli yörelerinde hastalık, don, kuraklık, olaylarının baş göstermesi ve tarım ürünlerinin zarar görmesi üzerine 1948’de Ziraat Bankası tarafından borçlarının ertelendiği dikkat çekmektedir.³

Sürme hastalığı ve kuraklık nedeniyle mahsulleri hasara uğrayan ve ortaklarına dağıttığı paraları geri alamayan 534 sayılı Kulu Köy Tarım Kooperatifine, Ziraat Bankasınca verilen 242.643 liralık borcun 18 Ocak 1948 tarihinde bir yıl süreyle ertelendiği göze çarpmaktadır (BCA, 1948).

Aynı yıl içerisinde Manisa’nın Kula bölgesinde ortaya çıkan don ve kuraklık nedeniyle mahsulün yetersiz bulunması yüzünden 824 sayılı Menye Tarım Kredi Kooperatifince ortaklarına dağıtılan paralar tahsil edilememiştir. Bu nedenle Türkiye Cumhuriyeti Ziraat Bankası tarafından Kooperatife borç olarak verilen 28.863 liranın vade bitiminden sonra bir yıl süreyle ertelenmesine 30 Ocak 1948 tarihinde Bakanlar Kurulunca kabul edilmiştir (BCA 1948).

Türkiye’de çeşitli doğal afetler yüzünden ürünleri zarar görmüş çiftçilerin zararlarını karşılamak her yıl bütçeden tahsis edilen ödenek miktarının artırılmasına bağlı olmuştur. Tarım kredi ihtiyacı hakkında Ziraat Bankası tarafından hazırlanan tafsilatlı rapor 18 Mart 1948 tarihinde Başbakanlığa sunulmuştur. Rapora göre; tarıma ayrılan kredi miktarı 408 milyon lira olarak tahmin edilmiştir. Bu kredi miktarının 300 milyonu çevirme, 25 milyonu donatım, 3 milyonu topraklandırma, 20 milyonu hayvancılık, 3 milyonu verimlendirme, 4 milyonu meyve bahçelerini kurma, 3 milyonu zirai sanat çalışmalarına ve 50 milyonu sürüm ve satış işlemlerine tahsis edilmiştir (BCA, 1948) .

Benzer şekilde 1947 yılında Kırkağaç ilçesinde ortaya çıkan don ve kuraklık yüzünden Gelenbe Tarım Kredi Kooperatifi ortaklarından bazılarının ürünlerinin hasara uğraması ve Kooperatifçe dağıtılan paraları ödeyemeyecek duruma düşmesi üzerine, Bankanın verdiği 14.190 liralık borcun bir yıl süre ile ertelenmesi, 10 Temmuz 1948 tarihinde Bakanlar Kurulu tarafından kararlaştırılmıştır (BCA, 1948).

Yine 1947 yılı içerisinde Hayrabolu’da meydana gelen don ve kuraklık yüzünden çiftçilerin ürünlerinin hasara uğraması ve Hayrabolu, Ç. Müsellim, Alacaoğlu, Emiryakup ve S. Müsellim Tarım Kredi Kooperatifleri ortaklarından bir kısmının borcunu ödeyememesi üzerine Ziraat Bankası tarafından adı geçen kooperatiflere verilen 232.165 liranın bir yıl süreyle ertelenmesine 5 Haziran 1948 tarihinde Bakanlar Kurulunca kabul edilmiştir (BCA, 1948).

Aynı yıl içerisinde Ziraat Bankasının yönetim kadrosunda değişikliğe gidilerek Banka Genel Müdürlüğüne 5 Haziran 1948 tarihi itibarıyla Genel Müdür Yardımcısı Hamit Tahsin Pekcan’ın getirildiği görülmektedir (BCA, 1948).

Banka bünyesinde yerli uzmanların yanı sıra yabancı uzmanlar da görev almıştır. Alman uyruklu Dr. Günter Noell’in 800 dolar aylık ücret ve üç ay süre ile Ziraat Bankasında çalıştırılması, 8 Nisan 1949 tarihinde Bakanlar Kurulunca kararlaştırılmıştır (BCA, 1949).

² Ziraat Bankası’nın diğer kadrolarına 15 Temmuz 1943 tarihli Bakanlar Kurulu Kararı ile ilgili yapılan atamalar için Bk. (BCA, 1943).

³ 1947 yılında bağlarda görülen don olayı nedeniyle İzmir ve çevresi bağcılarının zarar görmesi, bu zararın tarım kredi kooperatifleri ve Ziraat Bankası tarafından karşılanmasını zorunlu hale getirmiştir (BCA, 1947); Deprem, dolu, kuraklık ve sel nedeniyle Ziraat Bankasına olan borçlarının ödeyemeyen çiftçilerin 1936-1946 yılları arasındaki taksit borçlarının vade bitiminden sonra bir yıl süreyle ertelenmesi 30 Haziran 1947 tarihinde gerçekleştirilmiştir (BCA, 1947).

Bu arada Türkiye’de 1949 yılı içerisinde Ziraat Bankası tarafından verilen kredileri ödeyemeyen çiftçilerin Bakanlar Kurulu Kararı ile borç erteleme işlemlerinin sürdürüldüğü görülmektedir. Bayındır ilçesindeki 936 sayılı Ereğli Tarım Kredi Kooperatifi ortaklarının aşırı soğuklar yüzünden mahsullerinin %75-92 oranında hasara uğraması, Ziraat Bankası tarafından bu Kooperatife verilen 30.820 liranın 11 Ağustos 1949 tarihinde bir yıl süre ile ertelenmesine yol açmıştır (BCA, 1949). Aynı yıl içerisinde Banka Genel Müdür Yardımcılığına 875 lira aylık ücretle 22 Eylül 1949 tarihinde Merkez Bankası Mali Müşavir Yardımcısı Berin Beydağ atanmıştır (BCA, 1949).

Yine 1949 yılında Adana Merkez ilçesinde sel afeti ve Yeşilkurt haşeratı yüzünden ürünleri zarar görmüş, 404 Nolu Gerdam ile 456 Nolu Misis Tarım Kredi Kooperatifleri üyelerinin Ziraat Bankasından alınan 82.800 liralık borçları bir yıl süre ile 8 Eylül 1949 tarihli Bakanlar Kurulu Kararı ile ertelenmiştir⁴ (BCA, 1949).

Antalya’nın Elmalı ilçesinde 1949 yılında meydana gelen don ve kuraklık olayları nedeniyle mahsulleri hasara uğrayan 274 sayılı Elmalı, 972 sayılı Akçay, 973 sayılı Eskihisar ve 974 sayılı Gilevge Tarım Kredi Kooperatifleri üyelerinin Ziraat Bankasına olan 250.903 liralık borçları 19 Aralık 1949 tarihinde bir süre ile ertelenmiştir (BCA, 1949).

Ziraat Bankasının Yönetim Kurulu Başkanlığına Bakanlar Kurulu tarafından 875 lira ücretle 27 Ekim 1949 tarihinde Emekli Sandığı Yönetim Kurulu Başkanı Yusuf Ziya Ersin, Maliye Üyeliğine 21 Şubat 1950 tarihinde eski Milletvekillerinden Haydar Çerçel atanmıştır (BCA, 1949; BCA, 1950).

1949 yılının kurak geçmesi ülkenin birçok yöresinde çiftçilerin mahsul bakımından zarara uğramasına neden olmuştur. Kayserinin Pınarbaşı ve Sarız ilçelerinde yaşanan kuraklık nedeniyle çiftçilerin ürün verimlerin düşmesi ve 996 Nolu Pınarbaşı Tarım Kooperatifi ortaklarının 127.440 liralık Ziraat Bankasına olan borçlarını ödeyememesi 3 Mart 1950’de bu borçların bir yıl süreyle ertelenmesine yol açmıştır (BCA, 1950).

Tablo: 1’de 1940 ile 1950 yılları arasında Ziraat Bankası tarafından çiftçilere verilen tarım kredilerinin toplu hacmi gösterilmiştir.

Tablo 1: TC Ziraat Bankası Tarafından Çiftçilere Verilen Tarımsal Kredi Miktarları (1940-1950)

Yıllar	Verilen Kredi Miktarı (Bin TL)
1940	50.165
1945	112.704
1946	176.924
1947	243.931
1948	241.952
1949	336.900
1950	412.197

Kaynak: (İGM, 1951; İGM, 1952; İGM, 1953; İGM, 1959).

Tablo 1’e göre, 1940 yılından itibaren Ziraat Bankasının çiftçilere verdiği kredi miktarında 1948 yılı dışında istikrarlı bir artış kaydedildiği göze çarpmaktadır. Buna göre, 1940 yılında, çiftçilere açılan kredi miktarı 50.165 bin lira iken 1950 yılında bu rakam 362.032 bin lira artışla 412.197 bin liraya çıkarılmıştır. Böylece 1940 yılından 1950 yılına kadar olan dönemde bankanın verdiği kredi miktarında %721,68 oranında bir artış sağlanmıştır.

Sonuç

Milli Mücadele yıllarından itibaren ülkede yaşanan zorluklarına rağmen, Ziraat Bankasının faaliyetini sürdürdüğünü, yönetim kademesine yapılan atamalar ve dış ülkelere tarım aleti getirilmesi çabalarından anlıyoruz. Banka, Cumhuriyetin ilk yıllarından itibaren ürünlerin depo

⁴ Yeşil Kurt haşeratı yüzünden ülkenin bazı yörelerinde ürünlerinden randıman alamayan çiftçilerin Ziraat Bankası borçları 27 Temmuz 1949 tarihi itibarıyla Bakanlar Kurulu tarafından ertelenmiştir (BCA, 1949); Yine 1949 yılında kuraklık yüzünden zarar gören köylülerin Ziraat Bankası borçlarının bir yıl süreyle 8 Mart 1950 ve 4 Nisan 1950 tarihli Bakanlar Kurulu Kararı ile ertelendiği bilinmektedir (BCA, 1950).

edilmesi için silo ve ambar yapımı inşa etmesinin yanı sıra mahsulleri kuraklık, yangın, don, sel ve doğal afetlerden zarar gören çiftçilere yardım elini uzatmıştır.

12 Haziran 1937 tarih ve 3203 sayılı Kanunun çıkarılması Ziraat Bankası tarihinde yaşanan en önemli gelişme olmuştur. Bu Kanunla birlikte 1924'ten sonra anonim şirket şeklinde idare edilen Bankanın hukukî esaslarında, idarî mekanizmasında ve genel faaliyet prensiplerinde köklü değişikliklere gidilerek bir devlet müessesesi haline getirildiği görülmektedir. Banka ayrıca tohum ıslahı konusunda çalışmalar yapmış, Toprak Mahsulleri Ofisi kuruluncaya dek Buğday Komisyonu adına buğday satın alımında bulunmuştur.

Ziraat Bankasının verimli şekilde işletilmesini sağlamak amacıyla yerli personelin yanı sıra yabancı uzmanların da ilgili banka birimlerinde çalıştırıldığı gözlenmektedir. Yurdun çeşitli yörelerinde meydana gelen doğal afetler yüzünden ürünleri zarar görmüş çiftçilerin üye bulunduğu kooperatiflere olan borçlarını vade bitiminden itibaren bir yıl süreyle ertelemesi yine Bankanın uygulamaları arasında yer almıştır. 1945 ile 1950 yılları arasındaki dönemde Bankanın sadece çiftçilere verdiği tarımsal kredi miktarı yaklaşık 1,5 milyar lirayı bulmuştur.

Çiftçilere verilen bu yardım türlerinden en önemlileri çevirme, donatma verimlendirme, çay bahçeleri kurma kredilerinin yanı sıra, sürüm ve satış kredileri, tarım makineleri kredileri, hayvancılık kredileri, tohumluk yardım kredisi ve vadesi geçen tarımsal krediler olmuştur. Bu kredileri çiftçilerin kullanılması sayesinde her yıl ekilen arazi ile hububat ürünleri miktarında artışlar kaydedilerek tarım sektörü geliştirilmeye çalışılmıştır.

Netice itibarıyla 1923 ile 1950 döneminde Ziraat Bankasının tarım sektörü alanına yaptığı kredi desteği sayesinde tarım üretimi ve ihracatı artmış, ülkede istihdam imkânları genişletilerek milli ekonomiye katkılar sağlanmıştır.

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INSULIN-LIKE GROWTH FACTORS (IGFS) IN FARM ANIMALS

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ABSTRACT

Insulin-like growth factors (IGFs) are known as peptides that have important metabolic effects that are necessary for cellular growth and its metabolism. In the process of growth hormone (GH) to accelerate growth, IGF-1 occupies a large place. IGF-1 has important role after birth and has a glucose-regulative feature at insulin-like doses. IGF-1 is synthesized in liver tissue under control of GH and released to blood. IGF-1 clearly showed its important effects on the growth with animal studies. Especially on farm animals, the relationship of IGF-1 with many yield features was introduced. Therefore, in animal husbandry, since IGF-1 genes are directly related to, it can be used as an important selection parameters.

Key words: Insulin-like growth factor, Farm animals, Growth hormone

INTRODUCTION

Since recent 50 years, highly intensive studies have been carried out on growth physiology, as a result of these studies, many hormones were introduced to be effective on growth physiology (Kopchick, 2006). Toward the mid -century we passed, it was discovered that growth hormone provided growth. It was initially considered that growth hormone provided growth alone. But in the studies carried out, it was demonstrated that peptide, termed as IGFs, has functions as stimulating cellular division, providing growth (Daughaday, 1992).

Growth factor, dependent on isolated growth hormone, was firstly defined by Salmon and Daughaday in 1957 as sulfation factor due to increase sulfate composition in cartilage (Whitler et al., 1996). In further studies carried out, it was seen that an insulin-like biological activity was present, independently from serum- immunoreactive insulin and this was called Nonsuppressible Insulin-Like Activity (NSIL). In 1978, due to its insulin-like structural characteristics, these peptides were called Insulin-Like Growth Factors (IGFs) (Whitler et al.1996; Glucknam et al., 1987; Harbili, 2008). IGFs, due to the fact that they structurally have proinsulin form and that they metabolically lead to hypoglycemia, resemble to insulin (Wang et al., 1999).

IGFs has two main basic forms. These are IGF-I and IGF-II forms which are single -chain polypeptide in structure and consist of insulin ligands (Le Roith ve ark 2001). Molecular weights of IGF-I and IGF-II are 7649 -7471 kilodalton (kDa), respectively (Clemmons, 1994). IGF-I, dependent on growth hormone, is also called somatomedin C and is an alkali peptide containing 70 amino acids (pH=8.1-8.5). IGF-II is a neutral peptide containing 67 amino acids. IGF-1 and IGF-II are single chain molecules. While there is a similarity between IGF-I and IGF-II in the rate of 43% in terms of amino acid sequence, it is seen that there is a similarity between IGF -II and proinsulin in the rate of 41% (Clemmons, 1994).

In this review, information is given about insulin-like growth factors and genes, which have significant effect on growth, and on farm animals, the studies carried out related to IGFs genes are summarized.

STRUCTURE AND FUNCTIONS OF IGFs

Due to the fact that insulin –like growth factors structurally have insulin form and metabolically lead to hypoglycemia which are similar to insulin. IGFs are generally small peptides which locally show effect; stimulate growth in special cells, and whose primer amino acids strings are similar to each other and proinsulin. They are classified as family of growth factors due to their structures and the works they do. IGFs in blood circulation show a direct effect which is valid either *in vivo* or *in vitro* environments for proliferation of tissue and cellular group through somatic growth in bone, brain, prostate, muscle, breast and some other tissues. It was seen that there were locally synthesized IGFs and it is considered that there are responsible for the growth and differentiation of tissues (Kulkarni, 2002).

In the process of growth hormone to accelerate growth, IGF-1 has largely functions to accelerate. Throughout life after birth, it has significant level in blood circulation and shows a glucose-regulative feature in insulin-like doses. IGF-1 is synthesized in liver tissue under control of GH and released to blood and it has important role in liver concentration (Yakar et al., 1999). IGF-1 is a single chain polypeptide which can also be synthesized in peripheral tissues such as bone, lung, kidney, skeletal muscle, heart, spleen, gastrointestinal region, ovary, and testis and which has 70 amino acids and strong mitogenic effects. This synthesis of IGF-1 is controlled by the factors locally synthesized by GH and types of cell around these tissues (Lowe ve ark, 1989).

The important effects of IGF-1 on the growth were clearly shown by animal studies (Styne, 2007; Orgensen et al., 2007). IGF gene-dispelled rats, in such a way that IGF-1 has critical importance are small in birth and after birth, show a heavy growth interruption. The rats whose growth hormone is missing, grows in utero normal and show postnatal growth retardation. In intrauterine period, it is understood that IGF-1 is not regulated by GH and prenatal control is related to genetic factors, not endocrine. Otherwise, IGF-1 or GH gene-transplanted rats observed bigger than normal ones (Styne, 2007; Roith, 2003).

Diet directly or indirectly affects IGFs system (Cianfarani et al., 2005). Therefore, physical growth is related to diet. In order to maintain serum IGF-1, it should be taken at least 1500 calories per day (Beaune et al., 1997). The intaking of nutrient less than 800 calories per day, GH is not responded. In case that young rats are hungered, a decrease of 50% was identified in the number of liver GH receptor (Nazari et al., 2016). The yield, in IGFs ruminants, plays an important role in lactation, growth, and fetal development (Nazari et al., 2016).

Despite pulsatile oscillation of growth hormone, serum-IGF-1 levels are more stable. GH is only weakly binded to plasma proteins in blood. In view of this, it quickly passes from blood to tissue and half-life in blood is shorter than 20 minutes (Beaune et al., 1997). Otherwise, IGF-1 is more tightly binded to carry proteins and its half –life is about 20 hours. IGF-1 can reduce the effects of growth hormones in the significant rate (Beaune et al., 1997).

In the various growth factors, IGFs contains muscle –specific proteins. Cellular effect of IGF-1 is arranged by IGF-1 receptor (IGF-1R). IRS-1 signal is important to myogenic activation of IGFs. After extraction of IRS-1 and IGF-1 genes, it was demonstrated that while normal organ development in rats is dampened (heart and kidney), normal development of gastrocnemius muscle was insufficient (Pete et al., 1999). There are two different mechanisms of effects on IGF-1R muscle. The first of these is nitrogen –activated protein kinase (NAPK) while the second is phosphatidylinositol 3-kinase activation. NAPK is very important to especially mitogenesis. In the studies, where NAPK activation

is blocked, it was seen that myoblast proliferation, which has IGF-1 and IGF-II response was prevented (Coolican et al., 1997).

One of the most determinants of bone arrangement is bone mineral density (BMD). BMD increase very rapidly during puberty (Stabnov et al., 2002). The reason for this is gender hormones increasing in this period. In rats, where the function of IGF-1 gene is reduced, it was identified that puberty-originated BMD increase was insufficient. In phase of pubertal growth, in the rats showing decrease of 60% in IGF-1 serum level, with support of IGF-1, some increases in BMD were recorded (Stabnov et al., 2002). While it is shown that there is a positive correlation between peak BMD and IGF-1 serum level, it is considered that low IGF-1 level may be a good determinant of the decrease in BMD (Libanat et al., 1999; Kurland et al., 1997).

IGF-1 is also synthesized in the tissues such as liver in its environment and environmental tissue synthesis contributes to plasma concentrations (Han et al., 1987).

Bone and cartilage are two important skeletal resources of IGF-1 mRNA. Parathyroid hormone (PTH) arranges IGF-1 transcription in bone. GH also increases IGF-1 synthesis by osteoblasts and chondrocytes (Govoni et al., 2005). It contributes to growth regulation. IGF-1 is also regulated in overs and administration of follicle - stimulant hormone increases IGF-1 concentrations in follicular liquid (Thomas et al., 2007). IGF-1 passes through blood –brain barrier in a limited way. Local tissue synthesis like central neural system contributes to IGF-1 levels (Anderson et al., 2002).

METABOLIC EFFECTS OF IGF-1

In animal models, it was identified that IGF-1 had many metabolic effects and it could be reflected to the physiology in people. At molecular level, in GH-receptor –knock out rats, the number of insulin –receptor in liver increased. In these knock out rats, although there is an increase in insulin sensitivity, glucose inequality is out of order. The possible reason for this disorder, as a result of decrease in GH stimulation to islets, is reduction in pancreatic islets and that pancreas beta cells, dependent on decrease at insulin secretion, cannot produce insulin at the level to meet increased beta load (Lin and ark, 2004). In GH receptor-knock out rats, provided that IGF-1 was expressed under control of insulin parameters, IGF-1 improves islet cell and thus amount of insulin in Beta cell increase and improve insulin secretion and glucose inequality. This study makes think that GH increases IGF-1 expression through its own receptor and this also provides the most effective GH cell (Guo ve ark, 2005).

IGF stimulates mitogenesis, participates in activation of cellular cycle genes, stimulates progesterone production, and participates in DNA, RNA, and protein synthesis (Chelongar et al., 2014; Ge et al., 2001). Also, in continuation of pregnancy (Sirotkin et al., 2003), formation of twinning and embryo development (Velanquez et al., 2005).

The Effects of IGF-1 on Carbohydrates Metabolism

GH deficit in humans leads glucose level in blood to be very low in infancy period. GH in adult leads insulin resistance and glucose level in blood to be very low, depending on the anti-insulin effects of GH (Mauras et al., 2000). From the other aspect, IGF-1 has very diverse effects on carbohydrate metabolism (Rose et al., 2002). Recombinant IGF-1 (rhIGF-1) infusion suppresses the glucose production in liver and stimulates glucose intake in blood tissue (Di Cola et al., 1997). While GH generally increases glucose levels and insulin resistance, IGF-1 reduces glucose level and increases insulin resistance. But GH is administered in low amounts to young adults, forming a temporary increase in IGF-1 levels, provides improvements in insulin sensitivity of all body (Yuen et al., 2002).

The Effects of IGF-1 on Fat Metabolism

In contrast to GH, both insulin and IGF-1 show anti lipolytic effect on the mature fat cells through insulin receptor (IR). There is no he important effect of administration of rhIGF to body adiposity (Taaffe ve ark, 2002). The reason for this ineffectiveness may be that IGF-1 receptor (IGF-1R) is present in less number and GH receptor in more number. In preadipositis, IGF-1 receptor expression is at very high level and IGF-1 stimulates cellular proliferation in preadipositis cells (Scavo et al., 2004). In differentiation process, the number of IGF-1 R decreases and it replaces with IR. In differential adipositises, IGF-1 expression is quite high (Zizola et al., 2002). These studies showed that IGF-1 R does not have any role on the effects of GH on lipid metabolism.

The Effects of IGF-1 on Protein Metabolism

The effects of GH on protein metabolism are generally through IGF-1. In blood tissue, IGF-I stimulates protein synthesis through IGF-1 receptor and suppresses proteolysis for suppressing proteolysis, that there is a need for high dose makes think that this effect of IGF-1 is through IR. Both GH and IGF-1 were used in the treatment of carbolic diseases and, in most of these, they provided metabolism and patients to be recovered (Horber et al., 1990, Wilmore, 1994).

IGF-1 GENE POLYMORPHISM

Since IGF-1 plays important role in the development of many tissues and lactation features, IGF-1 gene has become a candidate gene for growth features in farm animals (Nazari, 2016). Polymorphism of IGF-1 gene plays important role in regulation of IGF-1 concentration, growth features (Ge et al., 2001; Yilmaz et al., 2005) and many hormones (He et al., 2012). IGF-1 takes place in chromosomes 3 in sheeps; and 5 in cattles and goats; and it contains 5 regions of exon (Alakilli, 2012). IGF-1 takes place in chromosome 1 in chickens and more dense compared to IGF gene regions of mammals (McMurty et al., 1997).

THE STUDIES CARRIED OUT TOWARD IGF-1 GENE ON FARM ANIMALS

In the recent years, the relationship of IGF-1 with many features of economic yield has been begun to be introduced. Therefore, many researchers carried out studies on the subject. In this section, some part of these studies is summarized.

Many investigators have investigated polymorphisms IGF gene and the correlation of yield in livestock. For example, Lan et al. (2007) performed PCR-SSCP studies in the IGFBP-3 locus in goats and investigated it's relationship with milk yield characteristics. But they did not find any significant relationship ($P>0.05$) (Alakilli et al. 2012). In another study of the same locus, sheep were compared with cattle and buffalo and found to have approximately 93% amino acid sequence identity (Kumar et al. 2006).

It was observed that IGF-1 polymorphism may be related to IGF-1 expression and IGF-1 differentiation (Rosen ve ark 1998). In addition to its relationship to IGF-1 levels, bone mineral density was also associated with body fat distribution and birth weight (Kim, 2002; Sun 1999). IGF-1 polymorphism was found to be associated with reproduction features in sheep (He et al., 2012; Nazari et al., 2016).

This gene was found to be associated with the early and late growth, and it was identified that it coded hormone –like polypeptide (Grossi Ddo et al., 2015). Salvetti et al. (2007) identified that it played role in ordering of formation of follicle in cattle and pathogen formation of cattle cystic ovarium. Again, in cattle, it was identified that there was a relationship between IGF-1 alleles and yield, fat, protein content of milk (Siadkowska et al., 2006; Zhang et al., 2014).

Nazari et al. (2016), as a result of the study of PCR-RELP they carried out on IGF-1 gene on sheep, found two alleles and predicted that these alleles had the relationship with growth features of

early period. Among these alleles, they demonstrated that allele A could have a relationship between high birth weights. In another study on goats, carried out with the same method, it was concluded that kashmir thickness is considerably lower in AA genotype than AB genotype (Qiong et al., 2011). In another study, carried out on four different races of sheep, it was revealed that there was a relationship between IGF-1 and the number of litter (He et al., 2012). Proskura and Szewczuk (2014) found that polymorphism in IGF-1 gene was significantly association with body weight and average daily weight gain in sheep's.

As a result of PCR-RELP study Ali et al. (2016) carried out on chickens, they identified a significant relationship between live weight and IGF-1. In another study, carried out on chickens, it was identified that there was a correlation between polymorphism and egg yield, laying time, live weight, and increase of live weight (Li et al., 2008). Attarchi et al. (2017) showed significant association between genotypes of IGF-1 gene and abdominal fat and intramuscular fat.

CONCLUSION

As a conclusion, according to many studies carried out, since IGF-1 genes are directly related to the growth and development, they can be used as an important correlation parameter for a yield feature having much economic importance in farm animals.

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***PLEUROTUS OSTREATUS* KÜLTÜRÜNDE *POPULUS* TÜRLERİNİN KABUKLARININ KOMPOST ANA HAM MADDESİ OLARAK KULLANMA İMKANLARININ ARAŞTIRILMASI**

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Özet

Bu çalışmada *Populus* L. türlerinin kabuklarının *Pleurotus ostreatus* (Jacq.) P. Kumm. 1871 üretiminde kullanılma imkanları araştırılmıştır. Çalışmada keresteciler sanayinden temin edilen kavak kabukları ham ve patozdan geçirilmiş olarak kullanılmıştır. Ham şekliyle üretim denemeleri yanında ilave besin maddeleri de katkı olarak kullanılarak elde edilen karışımlar üretim denemelerinde kullanılmıştır. İlave katkı maddesi olarak buğday sapı, ince kavak talaşı, buğday kepeği ve pamuk küspesi kullanılmıştır. Çalışmada kullanılan ham kavak kabuklarından ve patozdan geçirilerek öğütülmüş kabuklardan ve ilave besin maddesi karışımlarıyla elde edilmiş tüm ortamlardan mantar elde edilmiştir. Ham kavak kabuklarının sıkıştırılarak blok haline getirilmesi durumunda verimin artacağı görülmüştür. Kavak kabuklarının patozdan geçirilerek elde edilen öğütülmüş kavak kabuklarından da mantar elde edilmiş, ancak kompostta havalanma konusunda problem yaşanmasına sebep olmuştur.

En çok verim öğütülmüş kavak kabuğu+buğday sapı+buğday kepeği+ince kavak talaşı karışımlarından elde edilmiştir. Netice olarak keresteciler sanayinde genellikle çöp olarak atılan kavak kabuklarının *Pleurotus ostreatus* kültüründe kullanılabilecek bir substrat olduğu görülmüş ve değerlendirilemeyen bir maddenin ekonomiye katkı sağlayabileceği bir alan tespit edilmiştir.

Anahtar kelimeler: *Pleurotus ostreatus*, Kavak kabuğu, Kültür, Konya, Türkiye

THE INVESTIGATION OF USING BARKS OF THE *POPULUS* SPECIES, AS A MAIN RAW MATERIAL FOR COMPOSTS, IN THE *PLEUROTUS OSTREATUS* CULTURE

Abstract

In this study, the possibilities of using the barks of *Populus* L. species in the production of *Pleurotus ostreatus*(Jacq.) P. Kumm. 1871 were investigated. In the study, the poplar barks obtained from the lumber industry were used as raw and small pieces separated. Mixtures obtained by using additional nutrients as additives as well as production experiments in raw form have been used in production experiments. Wheat stalk, poplar sawdust (fine), wheat bran and cotton pulp were used as additional additives. In the study, the fungus has been grown from the raw poplar barks, from the crushed barks and in all media obtained by mixing the additional nutrient. If the raw poplar barks are

compressed into blocks, the yield will increase. Mushrooms were also obtained in the milled barks obtained from the poplar barks but caused problems with aeration in compost.

The most yields were obtained from the milled poplar barks + wheat stalks + wheat bran + poplar sawdust (fine). As a result, it has been found that poplar barks, generally garbage, are a substrate that can be used in *Pleurotus ostreatus* culture, and an area where an unevaluated material can contribute to the economy has been identified.

Key words: *Pleurotus ostreatus*, Poplar barks, Culture, Konya, Turkey

GİRİŞ

Bu çalışma dünyada *Agaricus bisporus* (JE Lange) Imbach'tan sonra en çok üretilen kültür mantarı olan *Pleurotus ostreatus* (Jacq.) P. Kumm. 1871 ile ilgili olarak yapılmıştır (Eren ve Pekşen 2016). *Pleurotus ostreatus* ticari olarak istiridye mantarı, kavak mantarı, yelpaze mantarı, yaprak mantarı gibi isimlerle bilinen bir mantardır. Ticari ismi istiridye olan bu mantar türü yapraklı ağaçların odunlarında ve diğer bitkisel artıklar üzerinde gelişebilen bir mantardır. Kültür mantarları içerisinde en yaygın yetiştirme substratına sahip türdür. Birçok substrat üzerinde gelişme gösterebilen *Pleurotus ostreatus* için kompost ana maddesi olarak kavak kabuklarının kullanma imkânları araştırılmıştır.

MATERYAL VE METOT

Kavak kabukları kereste sanayinde atık madde olarak ortaya çıkan ve çoğu zaman değerlendirilemeyen bir substrattır. Denemelerde kullanılan kavak kabukları Konya kereste sanayinden temin edilmiştir. Çalışmada kullanılan *Pleurotus ostreatus*'a ait tohumluk miseller Selçuk Üniversitesi Mantarcılık Uygulama ve Araştırma Merkezi Araştırma Laboratuvarında çoğaltılmıştır. Denemelerde buğday sapı, ince kavak talaşı, buğday kepeği, pamuk küspesi ilave besin maddesi olarak, alçı pH düzenleyici olarak kullanılmış ve reçeteler oluşturulmuştur (Tablo 1). Kavak kabukları kereste sanayinde atık madde olarak ortaya çıkan ve çoğu zaman çöp olarak atılan bir substrattır. Denemelerde kullanılan kavak kabukları Konya kereste sanayinden temin edilmiştir. Denemeler Selçuk Üniversitesi Mantarcılık Uygulama ve Araştırma Merkezi üretim odalarında gerçekleştirilmiştir. Kavak kabukları alındığı şekliyle ve öğütülerek kullanılmıştır (Şekil 1, 2). Öğütme işlemi patoz yardımıyla gerçekleştirilmiştir.

Karışımlarda kullanılacak ham maddelerde yeterli nem sağlamak amacıyla belli sürelerde ıslatılmıştır. Karışımları oluşturan substratlar yeterli ölçüde nemlendirildikten sonra karıştırılarak homojenize olması sağlanmıştır. Karışımlar 6-7 gün arasında naylon örtü altında tutularak, karışımın az miktarda fermente olması sağlanmıştır. Daha sonra karışımlara %4-5 oranında kireç veya alçı ilavesi yapılmıştır. CuSO_4 ile kimyasal yolla dezenfekte edilen karışımlara misel ekimi (60-80 gr) yapılarak, torbalara doldurulmuştur.

Ekimi yapılan kompost ağırlığı yaklaşık 4 kg olacak şekilde torbalanarak; sıcaklığı 22-24°C nemi %80-90 arasında olan kuluçka odasına alınmıştır. Misel gelişmesi takip edilerek, gerekli bilgiler kaydedilmiştir. Misellerin yoğun şekilde torba içerisini sardığında üretim odasına alma işlemi

yapılmıştır. Üretim odalarının nemi %75-85 arasında, sıcaklığı ise 17-19°C arasında tutulmuştur. Ayrıca günün yarısında aydınlatma yapılmıştır.

Hasat dönemi içerisinde torbalardan elde edilen mantar miktarları tespit edilmiş ve ortalamaları alınmıştır.

Tablo 1. Deneme yapılan kompost reçeteleri

Ham Kavak Kabukları (1)	Öğütülmüş Kavak Kabuğu (2)
Öğütülmüş Kavak Kabuğu Buğday Sapı (3)	Öğütülmüş Kavak kabuğu Buğday Sapı Buğday Kepeği (4)
Öğütülmüş Kavak Kabuğu Buğday Sapı Buğday Kepeği İnce Kavak Talaşı (5)	Öğütülmüş Kavak Kabuğu Buğday Sapı Buğday Kepeği İnce Kavak Talaşı Pamuk Küspesi (6)



Şekil 1. Ham kavak kabukları



Şekil 2. Öğütülmüş kavak kabukları

BULGULAR

Denemelerden elde edilen ortalama torba başına hasat miktarları Tablo 2’de verilmiştir.

Tablo 2. Karışımlardan elde edilen hasat miktarları

Karışım	1	2	3	4	5	6
Hasat Miktarı	384.3a* %9.60	415.3a %10.38	782.5b %19.56	591.7c %14.79	840.5b %21.01	860.5b %21.51

*Aynı harfle gösterilen veriler 0.5-0≥P önem derecesine göre birbirinden farklı değildir. Farklı harfle gösterilenler diğerlerinden istatistiki olarak farklı bulunmuştur.

TARTIŞMA VE SONUÇ

Çalışma sonunda sıkıştırılmış ham kabuklarda ve öğütülmüş kabuklar ile yapılmış karışımların tümünden mantar elde edilmiştir. Ham kabuklarda istenilen düzeyde yapılamaması ve misel bütünlüğünün sağlanamaması sebebiyle mantarlar küçük kaldığı görülmüştür(Şekil 3).

Ayrıca verim miktarı kütle/ürün açısından diğer karışımlara göre daha düşük gerçekleşmiştir. Öğütülmüş kabuklarda da verim miktarı ham kabuklara yakın olarak gerçekleşmiştir. Ancak kütle bütünlüğü sağlanması sebebiyle verim ham kabuklardan biraz iyi olduğu görülmüştür. Yine ÖKK+BS+BK karışımından da ham kabuk ve öğütülmüş kabuğa göre iyi verim elde edilmiştir. Çalışmaya göre en iyi verim genel olarak ÖKK+BS karışımı, ÖKK+BS+BK+KT karışımı ile ÖKK+BS+BK+KT+PK karışımından elde edilmiştir. ÖKK+BS+KT+BK+PK karışımında ise elde edilen ürün miktarı rakamsal olarak en iyi ürün miktarı olarak görülmüştür.



Şekil 3. Ham kabuklarda görülen mantar örnekleri

Yapılan çalışmalara bakıldığında; Eren ve Işık (1992) yaptıkları çalışmada *Pleurotus ostreatus* üretiminde buğday samanında 114.88 gr/kg, çeltik sapında ise 168.50gr/kg kompostta verim aldıklarını bildirmiştir.

Karakoç (1995), *Pleurotus ostreatus* ile ilgili olarak bitkisel artıkların ve atıkların hammadde olarak kullanılıp, kullanılamayacağı konusunda yaptıkları çalışmada bitkisel artıklardan fındık yaprağı, buğday sapı, odun talaşı ve mısır sapının ham madde olarak kullanılabileceğini belirtmişlerdir.

Yıldız ve Demir(1998), yaptıkları çalışmada *Pleurotus ostreatus* var. *salignius*'un yetiştirilmesinde bitkisel materyallerden yer fıstığı sapından yapılan komposttan 8.6gr/100gr olarak elde ettiğini bildirmiştir.

Baysal(2000) yaptığı çalışmada Fındık yaprağı, odun talaşı ve buğday sapı ham maddeleri ile katkı maddesi olarak atık kağıt, ot, mısır sapı, alçı karışımı denemelerinde en yüksek verim değerini fındık yaprağı+atık kağıt karışımından %54.4 olarak elde ettiklerini belirtmişlerdir.

Kurt ve Büyükalaca 2010'da tarımsal artıkların *Pleurotus ostreatus* yetiştiriciliğinde kullanılması ile ilgili yaptıkları çalışmada en yüksek mantar verimini buğday sapı+kepek karışımından(2+1) karışımından elde ettiklerini bildirmişlerdir.

Kırbağ ve Korkmaz 2013'de selülozik artıkların *Pleurotus ostreatus* yetiştirilmesinde kullanılabilmesine ilişkin yaptıkları çalışmada *Pleurotus ostreatus* 'un primordium oluşturma süresini 22-71.3 gün, hasat süresini 27.7-80.0 gün, toplam verim miktarını ise 27.3-42.7 gr/100gr olarak elde etmişlerdir.

Kurtcephe (2013) hazırladığı yüksek lisans tezinde en yüksek verimi 154.24 gr/kg olarak buğday sapı:kepek (2+1) karışımından elde etmişlerdir.

Avcı (2015) hazırladığı tezinde farklı odun talaşları ile yaptığı çalışmasında meşe talaşı + buğday kepeği karışımından 202.82 gr/kg olarak tespit etmiştir.

Çalışma sonunda genel olarak kavak kabuklarının kompost yapımında kullanılabileceği, kompost ana maddesi olarak ve de yardımcı katkı materyali olarak kullanılmasının uygun olacağı, kompost ana maddesi olarak kullanılırken ilave substratlarla zenginleştirilmesi gerektiği, sonuçlarına ulaşılmıştır.

Böylelikle çöp olarak atılan kavak kabukları ekonomik olarak değerlendirilmiş olacaktır.

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FISH SPECIES DISTRIBUTION IN DADAY (KASTAMONU, TURKEY) STREAM

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Abstract

Aim of this study is to determine the fish biodiversity of Daday Stream placed in Kastamonu province. Daday Stream confluent with Gökırmak river, which is one of the main branch of Kızılırmak. Also, Gökırmak confluent with Kızılırmak, after passing through the Sinop province. Daday Stream, branch of the Kızılırmak basin, is used for agricultural irrigation and recreational fishing nowadays. Samples collected in various dates were fixed in 4% formaldehyde solution. After that, samples were dehydrated through an alcohol series and were kept in 70% ethanol for long-term preservation. Fixed samples were measured, counted and various indexes were calculated. After measuring, counting and calculating processes, distribution of *Capoeta baliki*, *Squalius* cf. *pursakensis*, *Alburnus chalcoides*, *Alburnoides tzenevi*, *Oxyneomachilus banerescui*, *Oxyneomachilus kosswigi* and *Oxyneomachilus angarae* species was determined.

Keywords: Kastamonu Water Resources, Fish Taxonomy, Fish Systematic, Biodiversity, Stream.

INTRODUCTION

In the world, approximately 58000 vertebrate species have been reported so far. Some of them are synonyms and some are just misidentified species. It is estimated that valid species number is around 50000. More than 34300 of that valid species are belong to fishes (Institute of Biodiversity Science and Sustainability, 2018).

Distribution of fish species can be seen in different habitats from deep ocean holes to high mountain lakes, marine waters to freshwaters, highly acidic lakes to alkaline lakes, caves to intensively irradiated photic zones (Demir, 2009). This diversity is relatively clear in inland waters which constitutes only 1% of total waters of the world.

Anatolia is one of the richest region in species diversity of Turkey. Anatolia is an important transition zone, zoogeographically. Persian Gulf and Red Sea which are connected Indian ocean in the east and south east side, Mediterranean basin in the south side, Black Sea and Caucasia in the north side, Balkans and Europe in the west side contribute rich gene pool on diversity of species. Unique geographical characteristics and climate of Anatolia increase the diversity of species along with the effect of neighboring regions. Thus, inland waters of our country has more than 370 species and more than 115 species are endemic (Çiçek et al., 2015). This endemism might be restricted in very limited

areas, even in a couple of km². Variability of Anatolian geography and climate is the reason of these situation.

Kastamonu province is placed in the west part of the Black Sea region and the area of the province is 13108.1 km². Big part of the province has the fracture land structure and is covered with forests. İsfendiyar (Küre) mountain which is parallel with Black Sea is in the north and Ilgaz mountain is placed in the south of the province. Major streams are Gökırmak, Devrez, Filyos, İnebolu, Aydos and Devrekani.

Daday Stream gets its name and its initial resources from the Daday district. It flows in west-east direction. This flow conflues with other streams including Şadibey Stream where the Germeçtepe Dam is placed and flows into Gökırmak which is one of the main branch of Kızılırmak (İbret, 1998; Anonim, 2012).

There is no study on biodiversity of Daday Stream which is used for agricultural activities. With this work, distribution of fish species was determined and is aimed to create a perspective for the future.

MATERIALS AND METHODS

This work was done to identify fish species distribution in Daday Stream. Hand net and electroshock device were used to collecting the samples for identification. Samples were fixed in 4% formaldehyde, were brought to the laboratory and recorded as labelled with catalogue numbers. After a week in formaldehyde, were dehydrated through an alcohol series and were kept in 70% ethanol. Samples which the fixation period was completed were taken under examination, were photographed, metric and meristic measurements were completed (Geldiay and Balık, 2002). Measurements were done from point to point with digital caliper. Obtained data were used to identify species in family level according to data given by Geldiay and Balık (2002). Varied sources were utilized to identify of genus and species.

RESULTS

Examination of the samples of Daday Stream was showed that teeth on lower jaw were absent but pharyngeal teeth were present. Homocercal caudal fin was observed. Adipose fin was absent in front or behind of the dorsal fin and no ray was found in dorsal fin. Pelvic fins were located behind of the pectoral fins. Species belong to families *Cyprinidae* and *Nemacheilidae* were identified.

Alburnoides, *Alburnus*, *Capoeta* and *Squalius* members which are belong to the *Cyprinidae* family were identified. *Nemacheilidae* was represented by 3 species (*Oxynoemachailus angorea*, *Oxynoemachailus banarescui* ve *Oxynoemachailus kosswigi*) belonging to 1 genus. Morphological structures of species are shown in figures 1-7.

REGNUM : *Animalia*

PHYLUM : *Chordata*

CLASSIS : *Actinopterygii*

ORDER : *Cypriniformes*

FAMILY : *Cyprinidae*

Alburnoides tzanevi

Alburnus goekhani

Capoeta baliki

Squalius cf. *pursakensis*

ORDER : *Cypriniformes*

FAMILY: *Nemacheilidae*

Oxynoemacheilus angorae (Steindachner, 1897)

Oxynoemacheilus banarescui (Delmastro, 1982)

Oxynoemacheilus kosswigi (Erk'akan & Kuru, 1986)

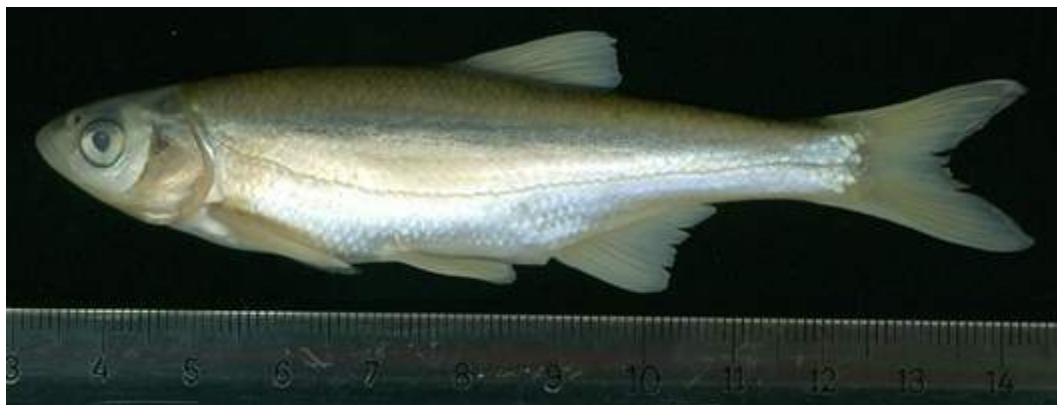


Figure 1. *Alburnus goekhani*, Turkey: Daday Stream



Figure 2. *Alburnoides tzanevi*, Turkey: Daday Stream



Figure 3. *Squalius cf. pursakensis*, Turkey: Daday Stream

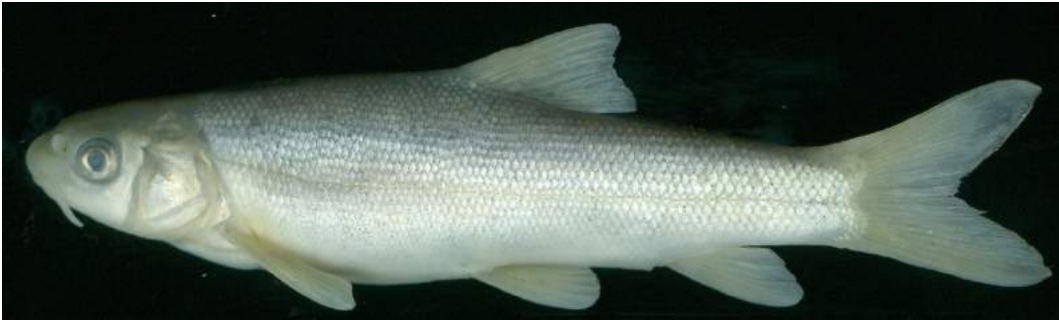


Figure 4. *Capoeta baliki*, Turkey: Daday Stream



Figure 5. *Oxynoemachailus banarescui*, Turkey: Daday Stream



Figure 6. *Oxynoemachailus angorea*, Turkey: Daday Stream



Figure 7. *Oxynoemachailus kosswigi*, Turkey: Daday Stream

DISCUSSION

Turkey has 7 drainage basins including 26 stream and lake basins. Annual average precipitation is around 640 mm and one third of that amount reaches to water reservoirs and provides the sustainability of wetlands (Anonim, 2008). When we take a look on inland waters potential of Turkey; 33 stream (177 714 km), 200 natural lakes (906 118 hectare), 159 dam lakes (342 377 hectare) and 750 ponds (15 500 hectare) appear. Turkey have 8 streams longer than 500 km: Aras, Kızılırmak, Yeşilirmak, Sakarya, Seyhan, Ceyhan, Fırat and Dicle (Anonim, 2008). Daday Stream is located in Kızılırmak basin (İbret, 1998). Daday Stream gets its initial source from near Çamlıbel village and passes through Akılçalman village and Daday center. Then, it confluent with Şadibey stream, where the Germeçtepe dam lake is placed. Daday Stream, which continues its flow through west-east direction, then confluent with Karaçomak stream (Kastamonu city centre) and Karasu stream (İlgaz mountain) and finally takes the name Gökırmak (İbret, 1998). Gökırmak is one of the main branch of Kızılırmak. Daday Stream is used intensively in agriculture production. Yet, there is no study on its biodiversity or how the species are affected from agricultural activity.

Turkey with its streams and lakes has an important internal ecosystem in terms of biodiversity (Anonim, 2008). *Cyprinidae* is represented by 4 species in Daday Stream. *Alburnoides tzenevi*, *Alburnus goekhani*, *Capoeta baliki*, *Squalius* cf. *pursakensis* species are spread in the stream. *Nemacheilidae* the second fish family of Daday Stream is represented by *Oxynoemachailus angorae*, *O. banarescui* and *O. Kosswigi* species.

Species fed on planktonic herbivore, herbivore and benthic invertebrate. Any carnivorous species was not observed. Interestingly, carnivorous species *Perca fluviatilis* which was distributed in Germeçtepe Dam Lake was not seen in the stream. It is thought that the reason might be barrier and regulators between the stream and the dam lake. Study on the population of that carnivorous species is needed. Also, new preventions are needed to prevent the introduction of invasive *Perca fluviatilis* into Daday Stream. It is seen that great risk of spreading of that invasive species into the stream under current conditions.

There is no record about *Alburnoides tzenevi* which was determined in Daday Stream. However, İlhan and Balık (2008) was reported *A. bipunctatus* species in their study conducted also in inland waters of Kastamonu province. Studies on *Alburnoides* shows that high species diversity in this

genus and it is revealed that different species were accepted as *A. bipunctatus*, previously. When related studies are analyzed it is reached that *Alburnoides tzanevi* is the species which distributed in Daday Stream.

Existence of the member of *Alburnus* genus *A. goekhani* was found in Daday Stream. This species was identified in Yeşilırmak and Kızılırmak newly (Özuluğ et al., 2018). Distinguishing characteristics given by the authors of that study have shown similarities with the characteristics of samples were obtained in this study. At this point, distribution area of the species should be expanded with Kızılırmak basin and a new study is needed to define its actual boundaries.

C. baliki species determined in Daday Stream. It was recorded as endemic species for around Kastamonu province (Turan et al., 2006). Doubts on systematic position of *C. baliki* (Özdemir, 2015), was eliminated with new molecular study (Bektaş et al., 2017).

S. cf. pursakensis species distributed in the environment was found and identified as *Leuciscus cephalus* in Germeçtepe dam lake, previously (Saylar, 2001). However, there is no direct connection with Daday Stream. When metric and meristic specifications of collected samples were examined, it was seen that it is closely similar with *S. Pursakensis* species. However, several non-matching distinguishing characteristics were also detected. Therefore, the final decision could not be made. If it is identified according to available data, it will be needed that re-arrangement of lower and upper limits of previously reported characteristics. Therefore, a new study with more samples are required.

O. angorae was identified from the environment, previously was reported in Filyos Stream which starts from Kastamonu and drains to Black Sea from Bartın province (İlhan and Balık, 2008). It is also indicated that the species was distributed in Kirazbaşı Stream and Bayat Stream. Additionally, identification of that species in Daday Stream has revived the subject of its actual distribution area. New studies are needed also in this subject.

O. banarescui species found in the environment was reported from Filyos Stream (Mengen) and Kocaçay Stream previously (Delmastro, 1982). Identification of this species is the first time in Daday Stream.

Kızılırmak is one of the locality of *O. kosswigi* species which was also identified in Daday Stream (Erk'akan and Kuru, 1986). In this study it is shown that *O. kosswigi* species is distributed in Daday Stream which is one of the upper branch of the Kızılırmak.

It is thought that all the existed species mentioned above are naturally distributed species. However, all the species except *Alburnoides tzanevi* were reported in other zones of Kızılırmak even not in Daday Stream previously. It was reported that *Alburnoides tzanevi* was found in Thrace region and in streams drain to the Black Sea from Bulgaria, previously. Systematic confusion of *Alburnoides* genus is not solved yet and when this subject is ended, gathering under one species of the remaining species between the regions is possible.

Fish biodiversity of Daday Stream is discovered with this paper. Thus, information of population status will help to sustainability with next studies. Inland water resources are exposed to

anthropogenic interventions, frequently. Factors of the anthropogenic interventions are; entrance of alien species, excessive or illegal hunting, pollution, habitat damage, ripping of the aquatic plants, burning and uncontrolled cut of the reeds, sedimentation, pressure of tourism and interventions on water regime (Anonim, 2008). Opinion that domestic wastes, agricultural irrigation, agrochemicals and dairy products are polluted the environment and are threatening the populations was evolved in this study. Also, existence of *Perca fluviatilis* in Germeçtepe dam lake is considered as great threat. If *Perca fluviatilis* reaches to the stream possibly it will create a big pressure on all the species are already distributed in the environment. Consciously or unconsciously, it is known that species released into the environment with economic purposes might cause unrecoverable changes of biodiversity of the inland waters (Anonim, 2008). Necessary precautions should be taken to avoid of such situations.

Consequently, 7 species belong to 2 families are distributed in Daday Stream. It is determined that 6 of them are endemic species. There is no sufficient information on the population structures of the species. Also, species mentioned before are threatened by domestic wastes and alien species. Particularly, existence of *Perca fluviatilis* confronts us as a big problem.

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***Nannochloropsis* sp: HISTORY OF CULTURE, ANALYSES AND LAST SITUATION OF THE LIMITS**

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Abstract

Microalgae are a fertile source of valuable biomolecules such as poly unsaturated fatty acids (PUFA), vitamins and pigments. These biomolecules are used in different fields; aquaculture, human nutrition, fertilization, feed, pharmaceutical and bioenergy. *Nannochloropsis* sp. belongs to the class of Eustigmatophyceae and is a green microalgae species commonly used in marine fish hatcheries. Its small size (2-4 μ), sufficient protein and lipid concentrations, high amount of polyunsaturated fatty acids (PUFAs), especially eicosapentaenoic acid (EPA), arachidonic acid (ARA) and docosahexaenoic acid (DHA) increase the importance of *Nannochloropsis* sp. in aquaculture industry. Also, as a result of its high lipid ratio, it has become a subject of biodiesel research. Therefore, researchers have focused on increase its production efficiency and alter the biochemical composition to get higher amounts of desired metabolites. In this purpose, varied production methods, culture systems, environmental conditions and nutrient media have been tested. The information achieved to date will help to show us the point where we stand today. In the light of information from previous studies, this article gives an overview on the past and now of *Nannochloropsis* sp., then evaluates the future projection of this algae. Thus, it is believed that will provide useful information to the next studies.

Keywords: Microalgae, Fatty Acid, Aquaculture, Eustigmatophyceae, Biodiesel.

INTRODUCTION

Microalgae are a fertile source of valuable biomolecules such as poly unsaturated fatty acids (PUFA), vitamins and pigments (Brown et al., 1999; Durmaz, 2007; Del Campo et al., 2007; Maadane et al., 2015) In order to benefit from these biomolecules, different processes are used depending on the application. Various species of microalgae are used in aquaculture as live feed of zooplankton and larvae while astaxanthin pigment of *Haematococcus pluvialis* is extracted to use in human nutrition as dietary supplement (Guerin et al., 2003; Zou et al., 2013).

It is known that the addition of phytoplankton into larval fish rearing tanks bring some advantages; supply for the growth of rotifers, stabilization of water qualities, enhancing visual contrast and light dispersion (Krienitz and Wirth, 2006; Rocha et al., 2008; Nakagawa et al., 2009). Importance of the EPA (eicosapentaenoic acid) and (DHA docosahexaenoic acid) fatty acids has been demonstrated in oyster larvae growth (Enright et al., 1986; Ronquillo et al., 2012). Beneficial effects

of *Nannochloropsis sp.* on Artemia and Rotifer enrichment is also indicated (Zhukova et al., 1998; Ferreira et al., 2009).

Nannochloropsis sp. belongs to the class of Eustigmatophyceae and is a green microalgae species commonly used in marine fish hatcheries. Its small size (2-10 μ) (Lubian, 1982; Fietz et al., 2005; Cao et al., 2013), sufficient protein and lipid concentrations, high amount of polyunsaturated fatty acids (PUFAs), especially eicosapentaenoic acid (EPA), arachidonic acid (ARA) and docosahexaenoic acid (DHA) increase the importance of *Nannochloropsis sp.* in aquaculture industry. Also, advantage of alterable lipid concentration and new techniques in biodiesel production make this algae a good candidate as raw material (Converti et al., 2009; Koberg et al., 2011).

PRODUCTION

A lot of improvements were recorded in *Nannochloropsis sp.* cultivation. Enhancements on culture density, biochemical composition (fatty acids, proteins, pigments, etc.) and continuous, reliable production of these algae can be given as examples.

Cell counts could be useful parameter to indicate the quality and density of production if all cells were the same weight and composition (Table 1). But, it is already known that, single cell weights and biochemical composition of cells may vary depending on culture conditions. Therefore, only looking at the cell counts may result in misdirection.

Studies have already shown that *Nannochloropsis sp.* are producible in different systems at high cell densities. But also as it is mentioned above, cell counts are not enough to evaluate the state of cultures without other parameters. It is indicated that *Nannochloropsis sp.* cell weight might be altered by light path length and also by environmental conditions. Effect of the cell density on cell weight was also demonstrated in the same study (Zou and Richmond, 1999). Besides, inverse ratio between cell weight and light intensity was appeared in another paper (Fabregas et al., 2004).

Table 1. Cell numbers given by different studies.

Species	Maximum Cell Counts (cells.mL ⁻¹)	Year	Reference
<i>Nannochloropsis sp.</i>	6.3 x 10 ⁷	1990	James and Al-Khars
<i>Nannochloropsis oculata</i>	3.0-3.5 x 10 ⁷	1993	Brown et al.
<i>Nannochloropsis sp.</i>	66 x 10 ⁷	1999	Zou and Richmond
<i>Nannochloropsis sp.</i>	>100 x 10 ⁷	2000	Lubian et al.
<i>Nannochloropsis sp.</i>	105 x 10 ⁷	2001	Cheng-Wu et al.
<i>Nannochloropsis sp.</i>	90.7 x 10 ⁷	2001	Richmond and Cheng-Wu
<i>Nannochloropsis sp.</i>	1400 x 10 ⁷	2003	Richmond et al.
<i>Nannochloropsis sp.</i>	40 x 10 ⁷	2004	Fabregas et al.
<i>Nannochloropsis sp.</i>	60 x 10 ⁷	2010	Briassoulis et al.
<i>Nannochloropsis oceanica</i>	55 x 10 ⁷	2013	Wan et al.
<i>Nannochloropsis oculata</i>	59 x 10 ⁷	2017	Durmaz and Erbil

Many studies have been done to investigate these changes and their causes. Production methods and conditions (light, temperature, salinity, etc.) are constituted the center of studies. At first, effects of illumination, light-dark cycles and temperature were investigated. Searching a path of increasing the ratio of valuable metabolites (fatty acids, pigments, etc.) was followed the initial investigations. Then,

researchers were sought a way to produce *Nannochloropsis sp.* heterotrophically. At the same time, different types and shapes of photobioreactors and their use in *Nannochloropsis sp.* production was become an important research topic.

Medium

Quite a lot medium recipes can be found for marine and freshwater microalgae cultivation. Also, various modified versions of these nutrient media are accessible, which are depended on species based requirements. These requirements are not determined only by species, aimed cellular biochemical composition plays an important role as well. In general, microalgae species are forced to produce target metabolites by different stress conditions.

F/2 (Guillard, 1975) is one of the most preferred medium in marine microalgae culture. It is the modified version of F medium (Guillard and Ryther, 1962) and is the basal medium of most of optimization studies. For instance, it is found that NO_3^- -N deprivation increases the α -tocopherol amount in *Nannochloropsis oculata* (Durmaz, 2007). In another study, reduction in chlorophyll content of *Nannochloropsis oceanica* under intensive illumination was revealed (Simionato et al., 2011). Also, combined effects of different stress conditions were described such as in *Nannochloropsis oculata* (Su et al., 2011). That work demonstrated combined effect of N-deficiency and irradiance on lipid accumulation. Several studies on medium and their effects are shown in the table below (Table 2).

Table 2. Several studies on culture medium

Species	Variable	Effect	Year	Reference
<i>Nannochloropsis sp.</i>	CO ₂	EPA concentration and productivity	2005	Hoshida et al.
<i>Nannochloropsis oculata</i>	NaNO ₃	FAME composition	2009	Converti et al.
<i>Nannochloropsis oceanica</i>	Fertilizer as a medium	Specific growth rate	2011	Bae and Hur
<i>Nannochloropsis oceanica</i>	KNO ₃	Biochemical composition and yield	2013	Xiao et al.
<i>Nannochloropsis oculata</i>	Iron concentration	Cell density and lipid composition	2014	Huang et al.
<i>Nannochloropsis salina</i>	Cobalt concentration	Growth rate and chlorophyll a	2018	Hala et al.

As shown in the table, studies on major and minor ingredients of medium have been investigated. Also, plant growth regulators are used in *Nannochloropsis sp.* experiments, along with other microalgae species. Search of new medium ingredients still continues. This search aims to promote the growth and inducing the bioaccumulation of valuable biomolecules. Also, modification of common medium recipes is widespread application to create the stress condition.

Photobioreactors

Photobioreactors are bioreactors those utilize light sources to produce phototrophic organism such as microalgae. Microalgae production systems can be separated as open and closed systems, mainly. Open systems provide advantages of low investment and operational costs while closed systems provide the controllable cultivation environment which minimizes the contamination. Indoor and outdoor systems differ by controlled parameters (illumination, temperature) and by operational costs. Therefore, selection of the production system is dependent on the properties of target product and environmental conditions.

Environmental conditions

Light is the source of energy for photoautotrophic organisms. Entire production is dependent on this energy source. However, its properties are important as well. In microalgae cultivation, sunlight or artificial illumination are used to provide energy when phototrophic production is chosen. Even though sunlight is the most suitable and cheapest way of collecting energy, artificial illumination gives the chance of total control, and independence from the environment. Unfortunately, total costs (investment, electricity) of artificial illumination is around 25-27 \$ per kg DW (dry weight). Expectations shows that, new advances in LED (light emitting diode) lightning may decrease that cost to 16 \$ per kg DW (Blanken et al., 2013). After that work, one may easily assume that use of artificial illumination is only worth to produce highly valuable biomolecules.

Biochemical composition of microalgae is even more important than total mass of the culture. Using alteration factors provide the accumulation of desired metabolites in higher ratios. In this manner, it is intended to achieve more efficient cultures. For instance, if the main objective is to get higher ratios of unsaturated fatty acids, *Nannochloropsis sp.* culture under lower irradiances (40-80 $\mu\text{mol quanta m}^{-2}\text{s}^{-1}$) could be more suitable (Fabregas et al., 2004). *N. gaditana* under white, blue and red light was showed that white light yields higher amounts of pigments and higher ratio of PUFA/FAME while red light yields higher amounts of carbohydrates and protein contents (Kim et al., 2014).

Zittelli et al., (2000) indicated that *Nannochloropsis sp.* production in MFPP (modular flat plate panel photobioreactor) with one side illumination provides higher amounts of chlorophyll a and carotenoids than two side illumination. However, two side illumination of MFPP was yielded higher TFA (total fatty acid) content. It is found that, volumetric productivity ($\text{gL}^{-1}\text{24h}^{-1}$) of two side illumination was higher than one side and volumetric productivity ($\text{gL}^{-1}\text{24h}^{-1}$) was also enhanced by increased illumination from 115 $\mu\text{mol photon m}^{-2}\text{s}^{-1}$ to 230 $\mu\text{mol photon m}^{-2}\text{s}^{-1}$ (Zittelli et al., 2000). Various illumination sources are tested to obtain higher yields and specific biomolecules of microalgae. In *Nannochloropsis sp.*, researches are mainly focused on lipid production and intensive cultivation (Table 4).

Table 4. *Nannochloropsis* sp. culture under different intensity of artificial illumination

Species	Light intensity	Result	Year	Reference
<i>Nannochloropsis</i> sp.	0, 2, 4, 10, 18, 20, 40, 60, 80, 220, 480 $\mu\text{mol quanta m}^{-2}\text{s}^{-1}$	Higher cell density, higher protein, lower lipid and carbohydrate content under higher light intensity	2004	Fabregas et al.
<i>Nannochloropsis</i> sp.	170-700 $\mu\text{mol photon m}^{-2}\text{s}^{-1}$	Higher DW and TFA under higher light intensity	2011	Pal et al.
<i>Nannochloropsis salina</i>	5, 50, 120, 150, 250, 350, 1000 $\mu\text{E m}^{-2}\text{s}^{-1}$	Highest cell density under 150 $\mu\text{E m}^{-2}\text{s}^{-1}$	2012	Sforza et al.
<i>Nannochloropsis</i> sp.	50, 100, 200 $\mu\text{mol photon m}^{-2}\text{s}^{-1}$ with 12:12, 18:6 and 24:0 L:D cycles	Highest cell density and lipid content under 100 $\mu\text{mol photon m}^{-2}\text{s}^{-1}$ with 18:6 L:D cycle	2013	Wahidin et al.
<i>Nannochloropsis gaditana</i>	White, blue and red LED's with 50 $\mu\text{mol photon m}^{-2}\text{s}^{-1}$	Highest cell density under red LEDs, highest pigment content and PUFA ratio under white LEDs	2014	Kim et al.
<i>Nannochloropsis oceanica</i>	71.5, 157.7, 331.2 $\mu\text{mol photon m}^{-2}\text{s}^{-1}$	Higher DW, lipid and fatty acid content under higher light intensity	2015	Xiao et al.
<i>Nannochloropsis salina</i>	Various colored LED's with 40, 70, 100, 130 $\mu\text{mol photon m}^{-2}\text{s}^{-1}$	Highest DW with blue LED, highest lipid ratio with green LED; both under 100 $\mu\text{mol photon m}^{-2}\text{s}^{-1}$	2016	Ra et al.

Most of commercial microalgae species demand warm waters. Besides, temperature might be decisive on growth rate and biochemical composition of culture. According to Converti et al. (2009), *N. oculata* was reached higher growth rate at 20 °C than 15 °C and 25 °C. But, lipid yield was decreased at 20 °C. Authors indicated that lipid productivity of *N. oculata* is not dependent on temperature because of inverse ratio between growth rate and lipid accumulation. Also, Wei et al., (2015) was found similar result of temperature effect on growth rate of *N. oculata*. However, unlike Converti et al. (2009), lipid content at 25 °C significantly higher than 15 °C. This difference might be occurred because of different strains.

Most of commonly produced microalgae species are grown suitable at pH 6.5-8.5 except *Spirulina* sp. which prefer higher pH between 8.5-11 (Sarada et al., 2002; Ogbonda et al., 2007; Moheimani, 2013). *Nannochloropsis* sp. is also producible at pH between 7-9. A study shows that optimum pH value estimation was 7.8 for growth of *N. salina* and there was no significant difference on FAME (fatty acid methyl esters) composition at varied pH values (Bartley et al., 2014). It was shown that *Nannochloropsis* sp. was grown at pH 8.5, optimally. In the same work, carbohydrate content was increased after raised the pH from 7.5 to 8.5 while lipid content was decreased. No significant difference was found in protein content between pH 7.5-8.5 (Khatoon et al., 2014).

CONCLUSIONS

Nannochloropsis sp. is an important species used in aquaculture hatcheries. Physical and biochemical properties make this species a suitable organism to exploitation as live feed source. The studies done so far, highlight that *Nannochloropsis* sp. is producible intensely and sufficient composition of valuable fatty acids could be obtained. Affecting factors such as pH, medium, temperature and light have been examined by researchers. Although different values are obtained from these studies, it is found that biochemical composition is alterable by environmental conditions, production methods and even by strain of the species. In general, results have shown that high amounts of lipids are obtainable and therefore its possible use in bioenergy is also been investigated.

Low cost production of microalgae is a common problem for broad use of these organisms in aquaculture and other commercial fields. For this reason, researches have been focused on reducing the production cost since the last decade. Different types of photobioreactors are designed to increase the efficiency of cultivation. Besides, nutrient recovering from wastewaters gets more attention day by day along with addition of new substances and optimizations of culture media.

Consequently, the progress in microalgal cultivation has come a long way since the beginning. Cultivation of *Nannochloropsis* sp. and other commercial microalgae species are already widely understood. Nowadays, optimization of production systems, culture media and reducing the costs of cultivation are appeared as new goals. All developments in this regard, will provide a chance to use of that sustainable resource more common as a raw material in various fields.

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INFILTRATION RATE UNDER DIFFERENT SOIL WATER CONTENT CONDITIONS

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Abstract

Infiltration rate is fundamental and one of the most important hydrological factors used in the design of irrigation systems and modeling practices in agriculture. It is known as the rate of penetration of water through the soil surface into the soil. It is usually measured by the depth (in mm) of the water layer that can enter the soil in time (hour). For this reason, it is necessary to determine infiltration rates of soil types before designing irrigation systems of agricultural lands. In order for infiltration to determine, different methods have been put into use. For this purpose, infiltrometers with double-cylinder are generally preferred to find out the infiltration rates of the soils. Infiltration readings are continued until soil water content in the infiltration zone reaches, to some extent, at a constant value over time. Then, the relationship between time and the decreasing water levels in infiltrometer determines the rate of infiltration. In this hydrological event, the initial water content of the soil during the infiltration test is thought to be influential on the infiltration and the duration of the infiltration. In this study, it was aimed at finding out the values regarding the infiltration rate in the soil with different soil water contents. Research findings are promising in practice.

Keywords: Soil water content, infiltration test, infiltration rate.

INTRODUCTION

Different definitions have been given for drought. However, drought has different meanings for hydrology, meteorology, agriculture, economy and public. In general, there may be a description regarding the lack of plant development or the pause of plant development due to the decrease in the water content of the soil during period. In other words, drought can be defined as that enough water cannot be found in the root zone due to lack of rainfall during the growing seasons of plants. Türkiye (2001) defined drought as a natural occurrence that happens when the rainfall is below the normal level and leads to serious hydrological imbalances that adversely affect land resources and production systems.

In recent years, droughts have been experienced frequently due to the global warming and climate change phenomena over the globe. Additionally, sudden and heavy rainfall events has also started to occur for a brief period. During the sudden and heavy rainfall events, the amount of water penetrating into the soil is very important issue in order to refrain from flooding. Furthermore, it is also important to conserve the penetrated water in the soil. Soil water loss soil can be reduced by using different mulches. The use of mulch has many benefits as well as conserving the water in the soil for a long time. On the other hand, there are many benefits of mulching such as increasing plant growth and yield, positively contributing to the soil structure, increasing microorganism activity in the soil and preventing erosion (Küçükyumuk et al., 2013) etc. Mulch application can particularly prevent soil moisture by evaporation. Mulch materials of sufficient thickness that do not contain weed seeds and microorganisms reduce the growth of weeds (Kuşlu and Memiş, 2010).

Infiltration is the vertical penetration speed of the water into the soil from the surface (Kanber, 2010). In other words, the rate of water ingestion or infiltration is the speed rate of water penetrating into the soil under certain conditions and within certain time periods. Infiltration rates are very important hydrological characteristic of soil medium commonly used in the design of irrigation systems (Yilmaz and Önder, 2010). Soil chemical contents, structure, surface conditions, and initial soil water content, soil and water temperature, salt contents of soil and water, time, plant type, surface mulch, slope, cultivation condition etc. all affect the infiltration rate. In particular, soil surface conditions of test site govern the ability or rate at which water passes into the soil, whereas the internal soil structure of the site governs the rate at which water passes through the soil.

It is important to characterize infiltration rates of soils. To this aim, further studies regarding infiltration are needed in the field. Estimation of infiltration rates is done under nearly saturated conditions through using infiltrometers, i.e. double-ring ones. It needs measuring a number of water level decreases in infiltrometers by time. Then, the relationship between time and the decreasing water level determines the rate of infiltration. However, initial water content of the soil during the infiltration test affects the magnitude of infiltration. Therefore, it is necessary to measure soil water content duration the infiltration study. In this study, it was aimed to figure out infiltration rates of soil under variable soil water conditions.

MATERIALS AND METHODS

The research was carried out in the experimental field of Agricultural Structures and Irrigation Department of Faculty of Agriculture, Çukurova University. The experimental field is located in the southern part of Turkey, in Adana province, at 36° 59' N latitude and 35° 18' E longitude. It's altitude is about 20 m above mean sea level. In the experimental site, the Mediterranean is dominant; summers are warm and dry, winters are warm and rainy. The long-term average temperature in the region is about 18.8 °C. The hottest month is August by 28.1 °C, the coldest month is January by 9.9 °C. Nearly all of the precipitation falls in the winter months. The long-term average precipitation is approximately 647 mm per annum.

In the study, square-shaped soil impoundment terraces/borders were formed for each treatment. The infiltration test was conducted at the specified time in each border. Firstly, the borders were saturated with irrigation water. After saturation of borders, one of them (Treatment 1) was mulched with straw; other border (Treatment 2) was left without mulching. Approximately two and a half months later, soil infiltration test was conducted at the two borders having different water contents through using double-ring infiltrometers. Thus, it was tried to find out the effect of soil initial water content on infiltration rate.

RESULTS AND DISCUSSION

In this study, the infiltration rate, which is defined as the rate of water penetration into the soil, was tested under two different conditions (Treatment 1 and Treatment 2). In the first treatment (Treatment 1), the soil was saturated with water and then covered with straw. In the second (Treatment 2), no mulching was applied after saturating the soil. Approximately two and a half months later, under two different conditions (Treatment 1 and Treatment 2), soil infiltration test with two different soil water contents was performed. Thus, it was tried to figure out the effect of initial soil water content on infiltration rate.

The final infiltration (water intake) rate of any soil is generally expressed in terms of " f_c ". This infiltration rate (f_c) is also a constant value, indicating steady-state infiltration rate of the site, depending on the saturation status of the soil profile. At the very beginning of the infiltration process, due to the unsteady-state conditions, it is at the maximum rate. Therefore, the maximum infiltration rate (f_0) of the soil is achieved under dry conditions regarding the soil water in the profile, i.e. at the wilting point.

In Treatment 1, the infiltration study lasted approximately 229 minutes. For Treatment 1, there was a strong correlation between the infiltration event and time ($R^2 = 0.90$).

In Treatment 2, the infiltration readings lasted approximately 221 minutes. For Treatment 2, there was a strong correlation between the infiltration rate and time ($R^2 = 0.97$).

The process of water infiltrating through a surface soil is a complex interaction between rainfall intensity, soil type, and surface cover and condition. Infiltration has been expressed by Hillel (1998) as rainfall, snow melting or irrigation application process. Many situations may arise in the pool or precipitation conditions where the evaluation of infiltration is desired (e.g., Skaggs et al., 1969). In hydrological studies, infiltration plays an important role in determining the excessive precipitation or flow to predict surface run-off. Hickok and Osborn (1969) summarize countless initiatives to derive spatial infiltration data by analyzing stream flow and cumulative precipitation hydrographs from homogeneously grounded small drainage basins. In this study, we tried to determine the infiltration of the soil under two different conditions. Thus, we attempted to find out the effect of the initial water content of the soil on the infiltration event, which is a very important hydrological event on the infiltration issue.

CONCLUSION

It is very important to determine the water intake rate of the soil, especially during dry periods. As it is known, global warming and climate change have had many negative effects on the use of water resources in recent years. For this reason, in drought periods, the water available with precipitation must penetrate into the soil in abundant quantities. Thus, it is possible to make more use of the water resources which are scarce and limited. For this reason, infiltration capacities of the soils must be determined in arid conditions.

This study can be considered as a preliminary study. As a result, it is recommended that similar studies is needed to get reliable results. However, the results obtained in this study is promising and corresponds with the documented ones.

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SOIL SALINITY PROBLEM AND ITS REMOVAL

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Abstract

Water is one of the scarcest natural resources in today's world. As the pressure on these scarce resources keeps increasing due to the global climate change, the quality of water resources is gradually deteriorating. Beside this, soil salinity has been one of the most important problems in sustainable irrigated agriculture. On the other hand, no matter how good the quality of the soil and irrigation water is, salt accumulation occurs in the plant root zone at the end of the agricultural production season if the salinity is not removed from the soil. The salt can rise above the tolerance threshold of the plants as years pass. Under these conditions, salt accumulation in the soil can cause a significant decrease in the yield in agricultural production. In addition, the increasing salt accumulation leads the cultivated lands with good quality to becoming non-agricultural lands by time. In this article, the possibilities of salt accumulation and desalination methods are discussed in detail. As a result of this study, it is suggested that an effective soil washing should be applied in the soil salinity removal.

Keywords: Soil fertility, salinity estimation, excess irrigation, drainage, leaching.

INTRODUCTION

The increasing degradation of the quality of water resources necessitates the evaluation of wastewater and marginal water resources in the agricultural sector. In these conditions, salt accumulation, which may occur in the soil, may affect the yield in vegetable production considerably. Salinity continues to be a problem increasingly important in our country and in the world. Water is at the forefront of today's scarce natural resources. In this context, irrigation water saving is an important issue in the production made in the greenhouse, but the salt accumulation that occurs over the years can bring about more serious problems. As it is known, irrigation water contains slightly soluble materials. On the other hand, the fertilisers used as plant nutrients also accumulate in the plant root zone. With the increasing temperatures in general, there is also an increase in the number of irrigation applications and the amount of water applied. As a result, no matter how good the soil and irrigation water quality is, there is a salt accumulation in the plant root zone at the end of the production season, which is a well-known fact. This situation has become one of the most important problems for producers. The producers are trying to solve this problem in two ways. The first one is to change the

greenhouse soil. However, this is not sustainable. The second is to carry out the leaching process for breeding purposes. There is also an unconscious and excessive use of water in the leaching process.

LITERATURE REVIEW

Hamdy (1990) reported that the most efficient method of reducing salt accumulation in the soil and plant yield is periodic leaching. The new soil has been formed, which is affected by the salinity and secondary salinity, which is a result of irrigation practice. The secondary salt mentioned above is suggested to be because of water shortages in irrigation applications, the use of high-grade salt water, inadequate drainage, inadequate irrigation systems, excessive irrigation without adequate drainage and groundwater rise, fertiliser applications (Ghassemi et al., 1995).

The leaching requirement is the ratio of the volume of water to the volume of irrigation water to be infiltrated under the root zone by applying to the soil in order to obtain the minimum salinity conditions required for plant development in the soil root zone. Because this value is directly related to the plant species, the values regarding the leaching needs will differ according to the plant species susceptible to or not susceptible to salt (Yurtseven, 2000).

Kaman et al. (2006) found that soil salinity increased in time in irrigation in an open field cotton plant. Especially in arid and semi-arid regions, natural leaching methods in the soil will be an effective method since annual rainfall is inadequate. In such cases, the salinity value in the soil will increase, so leaching becomes important in terms of efficiency.

Kaman et al. (2006) also examined salinity changes in greenhouse conditions. Here, the factors affecting salinity change are irrigation water and fertilisers applied during the production. Despite the electrical conductivity of the lower irrigation water, the salt concentration in the soil has increased visibly. Depending on the beginning and end of the production, the greenhouse showed salt accumulation in the greenhouse soil and in the open area. Despite the fact that winter rains provide a certain natural wash in the open area, no leaching factor appears in the greenhouse area. They found that leaching in such greenhouse areas became important in terms of efficiency and production sustainability.

Ünlükara et al. (2008) investigated changes in soil mineralisation and soil mineral content when they were washed at different ratios with each irrigation application. It was observed that soil salinity decreased with the increasing leaching rate while yield increased with leaching.

In the remediation of existing troubled soils, leaching operations vary according to the condition of the water source and soil characteristics. According to the features available, soil salinity is improved by continuous shading, intermittent gliding and sprinkling applications. Drip irrigation method was not widely used. It was found that the periodical pooling resulted in a 1/3 increase in leaching water compared to continuous pooling. In another study on soil leaching, sprinkler irrigation was found to have more effective leaching values than the values obtained by continuous irrigation (Kanber and Ünlü, 2010).

Two-dimensional flow occurs in the cablegation and drops irrigation (line source), and salt accumulates in the upper parts of the root zone between the neighbouring lines. The semi-spherical

water flow in the dripping water allows salt accumulation as it moves away from the dripper. Sprinkling and intermittent gliding lead to a one-dimensional vertical flow in the water, and the salt accumulates in the lower parts of the root zone (Anonymous, 2011).

Kaman and Özbek (2016) suggested some values regarding the amount of change in salinity depending on the depth at the beginning and the end of the season. They found that greenhouse soil areas, which were not effectively washed, would increase over the years and cause salinity accumulation.

CONCLUSION

It can be concluded that the effective application of leaching and drainage systems to arable land due to loss of yield due to salinity can contribute significantly to the production without a decrease in productivity. As a result of effective leaching, a land of good quality will always be available for sustainable agricultural production. If leaching is not provided, the salt will accumulate deep in the plant root zone in time. Especially in the countries such as our country where a large part of arid and semi-arid climatic regions do not wash the soil with low rainfall and soil with irrigation water, the soil becomes salty and sodic in time and turns into an inefficient form that crop production cannot be done.

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BAZI BİTKİ EKSTRAKTLARININ *Callosobruchus maculatus* (Coleoptera: Chrysomelidae)'UN ERGİNİNE, YUMURTASINA VE ERGİN YUMURTA BIRAKMA TERCİHİNE ETKİLERİ

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Özet

Börülce tohum böceği (*Callosobruchus maculatus* (Fab.)) birçok ülkede nohut, börülce, mercimek, soya fasulyesi ve fasulye gibi depolanan baklagillerin önemli bir zararlısıdır. Bu zararlının larvası dane içerisine girmekte ve beslenmektedir. Depolanmış ürün zararlılarıyla kimyasal mücadelede insektisitler yaygın olarak kullanılmakta, fakat bu kimyasallar çevre ve insan sağlığını olumsuz etkilemekte, zararlı böceklerde direnç gelişimine neden olmaktadır. Bu nedenle, insan ve çevre dostu biyopestisitlerin önemi artmaktadır. Bu çalışma, ısırgan (*Urtica dioica* (L.)), fesleğen (*Ocimum basilicum* (L.)), şerbetçi otu (*Humulus lupulus* (L.)) ve sütlegan (*Euphorbia cyparissias* (L.)) bitkilerinin metanol ekstraktlarının *Callosobruchus maculatus* erginlerine rezidüel, yumurtalarına ovisidal etkilerinin belirlenmesi için yapılmıştır. Buna ilaveten ekstraktların dişi yumurta bırakma tercihine etkileri de belirlenmiştir. Denemeler 28±0.5°C sıcaklık, %55±5 orantılı nem ve karanlık ortamda yürütülmüştür. Erginlere rezidüel ve yumurtalara ovisidal etki testlerinde bitki ekstraktlarının % 2,5, 5 ve 10 (w/w)'luk konsantrasyonları kullanılmıştır. Dişi yumurta bırakma tercihine etki testinde % 5 (w/w)'lık ekstrakt konsantrasyonu kullanılmıştır. Erginlere rezidüel etki testlerinde 24 ve 48 saat sonunda *Urtica dioica* ekstraktının diğer bitkilerin ekstraktından daha toksik olduğu tespit edilmiştir. *Urtica dioica* ve *Ocimum basilicum* ekstraktlarının yumurtaya ovisit etkileri yüksek bulunmuştur. Yumurta bırakma tercihine etki denemelerinde dişinin bıraktığı toplam yumurta sayısı bakımından bitki ekstraktları arasında fark bulunmamıştır. *Urtica dioica* ekstraktı *Callosobruchus maculatus*'un kontrolünde biyoinsektisit olarak kullanılma potansiyeline sahiptir.

Anahtar Kelimeler: *Callosobruchus maculatus*, bitki ekstraktı, etki, ergin, yumurta, yumurta bırakma tercihi

Effects of Some Plant Extracts on Adult, Egg And Egg-Laying Preference of *Callosobruchus maculatus* (Coleoptera: Chrysomelidae)

Abstract

Cowpea weevil (*Callosobruchus maculatus* (Fab.)) is a major pest of stored legumes seeds like chickpea, cowpea, lentil, soybean, bean in many countries. Larvae of this insect pest enter and feed within one seed. Insecticides for chemical control of stored product pests are commonly used but there are negative impact of these chemicals on the environment and human health and insect pests have developed resistance to insecticide. Therefore, importance of human and environmental friendly bio-pesticides has increased. This study was conducted to determine the residual and ovicidal effects of nettle (*Urtica dioica* (L.)), basil (*Ocimum basilicum* (L.)), hops (*Humulus lupulus* (L.)), spurge (*Euphorbia cyparissias* (L.)) methanol extracts against *Callosobruchus maculatus* adults and eggs. In addition, effect of extracts on female egg-laying preference was determined. The experiments were conducted at 28±0.5°C, 55±5% RH and dark conditions. In the tests of residual effect to adults and ovicidal effect, the concentrations of 2.5, 5 and 10% (w/w) of the plant extracts were used. In the test of effect on female egg-laying preference the extract concentration was 5 % (w/w). In the test of residual toxicity, at the end of 24 and 48 hours *Urtica dioica* extract was found to be more toxic than other plants extract. *Urtica dioica* and *Ocimum basilicum* extracts were the highest and equal toxic effect on eggs of *Callosobruchus maculatus*. In free-choice tests it was not difference in the total

number of laid egg among plant extracts. *Urtica dioica* extract have potential as used bio-insecticide in control of *Callosobruchus maculatus*.

Key words: *Callosobruchus maculatus*, plant extract, effect, adult, egg, egg-laying preference

1. GİRİŞ

Mercimek, nohut, fasulye ve börülceninde içinde bulunduğu baklagiller, dünya genelinde insanlar için protein ve karbonhidrat gereksinimlerinin karşılandığı besinler olarak kullanılmaktadır. Bu bitkiler hayvan yemlerinde de kullanıldığı gibi, tohumluk olarakta değerlendirilmektedir. Baklagiller dökme, çuvallanarak ve paketlenmiş olarak uzun süre depolanabilmektedir. Baklagillerin tarlada ve depolanması aşamalarında büyük kayıplara sebep olan zararlıları bulunmaktadır. Baklagil tohum böceklerine ait türler, meydana getirdikleri kayıplar nedeniyle büyük önem taşımaktadır (Yıldırım ve ark., 2001). Bu türler içerisinde *Callosobruchus maculatus* (F.)’un oluşturduğu zararlar; ağırlık kaybı, pazar değeri kaybı (Elhag 2000), tohum çimlenme gücünün kaybı ve protein içeriğinde azalma (Baier ve Webster 1992) şeklinde gerçekleşmektedir. Zararlı, vücut kalıntıları, pislikleri ve benzeri maddeler nedeniyle de ürünün kalite özelliklerinde önemli ölçüde düşüslere neden olmaktadır (Anonim, 2008). Zararlı ergininin tarlada ve depoda faaliyetlerini sürdürmesi ve yüksek üreme gücü bu zararlıya karşı mücadelenin önemini artırmaktadır. Günümüzde depolarda, seralarda ve tarımsal faaliyetlerin yürütüldüğü alanlarda zararlılarla mücadelede sentetik organik insektisitler yoğun olarak kullanılmaktadır. Kullanılan bu insektisitler insan, hayvan ve çevre sağlığı açısından tehlike oluşturması yanında zararlıda meydana gelen direnç nedeniyle ilerleyen zaman içinde mücadele giderek zorlaşmaktadır. Sentetik insektisitlerin olumsuzlukları dikkate alındığında, zararlılarla mücadelede doğal kaynaklardan yararlanma ve farklı savaş yöntemleri arayışı giderek artan bir önem kanmıştır. İnsanların, günümüze kadar böceklerle mücadelede en çok kullandıkları ve olumsuzlukları düşük düzeyde olan bitkisel kaynaklar üzerindeki çalışmalar artmaya başlamıştır. Bitkiler zararlılardan korumak için çeşitli savunma mekanizmaları geliştirmişlerdir. Bunlar bitkideki morfolojik engeller olabildiği gibi bitkilerin sentezlemiş olduğu bazı kimyasallar da olabilmektedir. Biyokimyasal olaylar sonucu sentezlenen sekonder metabolitler, bitkinin zararlılara karşı göstermiş olduğu dirençte rol almaktadır. Zararlılar üzerinde davranışsal ve fizyolojik etkilere sahip olan bu metabolitler çok değişik kategorilerde sınıflandırılmaktadırlar (Güncan ve Durmusoglu, 2004; Zoubiri ve Baaliouamer, 2011). Bunların en önemlilerinin alkaloidler, glikozitler, fenoller, terpenoidler, taninler ve saponinler olduğu bildirilmiştir (Shanker ve Solanki, 2000). Bitkilerin insektisit eldesinde potansiyel bir kaynak olabileceği birçok araştırmacı tarafından belirtilmiştir (Şener ve ark., 1998; Erler, 2004; Ertürk ve ark., 2006; Gökçe ve ark., 2007). Bitkilerden elde edilen maddelerin kullanılması ile bir çok zararlının ekonomik zarar eşiğinin altında tutulması mümkündür (Onouğur ve Çetinkaya, 1999). Bu çalışmada dört farklı bitkiden elde edilen bitki ekstraktlarının baklagillerde yaygın olarak bulunan *C. maculatus*’un erginlerine rezidüel etkisi, yumurtalarına ovisit etkisi ve dişinin yumurta koyma tercihine etkileri araştırılmıştır.

MATERYAL VE METOT

2.1. Materyal: Çalışmada, börülce tohum böceği [*Callosobruchus maculatus* (F.) (Coleoptera: Chrysomelidae)] ergin ve yumurtaları, ‘Azkan’ çeşidi nohut, ve dört bitkiden [*Humulus lupulus* (L.) (şerbetçi otu), *Ocimum basilicum* (L.) (fesleğen), *Urtica dioica* (L.) (ısırgan) ve *Euphorbia cyparissias* (L.) (sütlegan)] elde edilen ekstraktlar çalışmanın materyalini oluşturmuştur. Bitkiler Konya ili, Selçuklu ilçesi, Başarakavak beldesinden toplanmıştır. Toplanan bitkilerin teşhisler, Selçuk Üniversitesi, Fen Fakültesi, Biyoloji Bölümü, Botanik Anabilim Dalın Öğretim Üyesi Prof. Dr. Yavuz Bağcı tarafından yapılmıştır.

Tablo 1. Ekstrakt elde edilen bitkiler ve kısımları

Familiya	Latince Adı	Türkçe adı	Bitki kısmı
Cannabaceae	<i>Humulus lupulus</i> (L.)	Serbetçi otu	Yaprak, sap, gövde
Labiatae	<i>Ocimum basilicum</i> (L.)	Fesleğen(Reyhan)	Yaprak, sap, gövde, tohum
Urticaceae	<i>Urtica dioica</i> (L.)	Isırgan	Yaprak, sap, gövde, tohum
Euphorbiaceae	<i>Euphorbia cyparissias</i> (L.)	Sütlegan	Yaprak, sap, gövde, tohum

2.2. Bitki ekstraktlarının elde edilmesi: Ekstrakt elde edilen bitkiler gölgede beş gün kurutulduktan sonra değirmen yardımıyla küçük parçalara ayrılmış, 50 g tartılıp 1000 ml’lik kavanozlara alınmıştır. Daha sonra üzerlerine 500 ml Metanol (Merck %99.5) eklenmiş, kavanoz kapakları sıkıca kapatılmıştır. Yedi gün oda sıcaklığında bekletilen ve günlük çalkalanan örnekler filtre kağıdı

(Whatman Filter Paper No:1) kullanılarak süzildükten sonra Vakumlu Rotary Evaporatör (Heidolph-Vap Precision) yardımıyla 42°C'de Metanolü uçurulmuş, aynı sıcaklıktaki su banyosunda bir gün bekletilerek saf ekstrakt elde edilmiştir (Gökçe ve ark. 2007 ve Tavares ve ark. 2009). Saf ekstraktlar renkli flakonlarda buzdolabında muhafaza edilmiştir. Ekstraktların üç farklı konsantrasyonu (%2.5, 5, 10 w/w) metanol ile hazırlanmıştır.

2.3. Erginlere rezidüel etki denemeleri: Rezidüel etki testi Mollah ve Islam (2007)' in metodunda bazı değişiklikler yapılarak uygulanmıştır. Çalışmamızda her bir ekstrakt için 3 farklı konsantrasyon (%2.5, 5 ve 10w/w) kullanılmıştır. Uygulama dozları püskürtme kulesi kullanılarak (Manual Potter Spray Tower-Burkard Scientific Limited, Uxbridge, UK) her bir konsantrasyon için 1 ml ekstrakt çözeltisi 0.8 bar basınçla boş petrilere (kapakları dahil) uygulanmıştır. Kontroller ise sadece metanol ile muamele edilmiştir. Püskürtme işleminden sonra petri kabı ve kapağı 15 dakika beklenmiştir. Her bir petri kabına 20 adet 1 günlük ergin birey bırakılmış ve petri kaplarının kapakları kapatılarak iklim kabinine yerleştirilmiştir. 24, 48 ve 72 saat sonunda ölü ve canlı birey sayımları yapılmıştır. Sayımlarda, petri kaplarındaki böcekler tek tek ince uçlu fırça ile dokunularak canlı olup olmadıkları gözlenmiş, herhangi bir hareket göstermeyenler ölü, az da olsa hareket görülenler canlı olarak kabul edilmiştir.

2.4. Ovisit etki denemeleri: Ekstraktların ovisit etkisinin tespitinde, bir günlük erginlerden 2 erkek ve 2 dişi böcek, içinde nohut bulunan petrilere yerleştirilmiştir. Erginler çiftleşmeleri ve yumurta bırakmaları için 24 saat petri kaplarında bekletilmişlerdir. Daha sonra her nohut tanesinde üzerinde 5 yumurta bırakılarak diğer yumurtalar iğne ile tahrip edilmiştir. Her bir petriye 4' er nohut aktarılmıştır. Böylece her bir petriye 20 yumurta bırakılmıştır. Her bir konsantrasyon için 1 ml ekstrakt püskürtme kulesi yardımıyla üzerinde yumurta bulunan nohut danelerine uygulanmıştır. Muamele edilen yumurtalı tanelerden ergin çıkışı sona erinceye kadar beklenmiştir. Bitki ekstraktı ile muamele görmüş her petri kabındaki ergin çıkış sayısı ve kontrol petrililerindeki ergin çıkış sayıları belirlenip, yumurta açılımını engelleme oranı hesaplanmıştır (Rice ve Coats 1994). Denemelerde 3 farklı konsantrasyon (%2.5, 5 ve 10w/w) kullanılmıştır. Denemeler tesadüf parselleri deneme deseninde 3 tekerrürlü olarak yürütülmüştür.

$Y.A.E.O(\%) = [(Kontroldeki\ ergin\ sayısı - Muameledeki\ ergin\ sayısı) / Kontroldeki\ ergin\ sayısı] \times 100$

2.4. Yumurta bırakma tercihinin etki denemeleri: Yumurta koyma tercihinin etki (free-choice) denemesinde dairesel bir kap, karton mukavvalar yardımıyla beş eşit parçaya bölünmüştür. Her bir ekstrakt uygulaması için 10 adet nohut tanesi petri kaplarına konmuş, bu şekilde 5 petri kabı hazırlanmıştır. Hazırlanan 5 petri kabından 4 'üne % 5' lik dört bitki ekstrakt 1 ml olacak şekilde püskürtülmüştür. Beşinci petri kabına sadece metanol püskürtülmüştür. İşlem püskürtme kulesi yardımıyla yapılmıştır. Taneler 15 dakika bekletilerek kurutulmuştur. Daha önce hazırlanmış olan beş bölmeli düzenegin dördüne, dört farklı ekstrakt uygulaması yapılan 10'ar adet nohut, beşinci bölmeye metanol uygulanan 10 adet nohut yerleştirilmiştir. Daha sonra düzenegin merkezine (düzenegin merkezinde bütün bölmelere böcekler geçiş yapabilmektedir) bir gün yaşındaki 10 erkek ve 10 dişi birey konulmuştur. Düzenegin üzeri tamamen tül ile kapatılarak böceğin bütün daneleri dolaşması sağlanmıştır. Düzenek üzerindeki tülentler böceklerin tamamı ölünceye kadar açılmamıştır. Daha sonra beş bölmedeki 10 daneye bırakılan yumurtalar her bölme için ayrı ayrı sayılarak kaydedilmiştir. Beş bölmeli düzenekten üç adet hazırlanmıştır. Denemeler tesadüf blokları deneme tertibinde 3 tekerrürlü olarak yürütülmüştür.

2.5. İstatistiksel analizler: Araştırmadan elde edilen sonuçların, minitab (McKenzie ve Goldman, 2005) istatistik paket programı kullanılarak varyans analizi yapılmıştır. Varyans analizi sonucunda ekstraktlar arasında etki bakımından farklılık tespit edilenlerde, farklı ortalamaların tespiti mstat programında Duncan Testi ile yapılmış ve harflendirilmiştir.

3. SONUÇLAR VE TARTIŞMA

3.1. Erginlere rezidüel etki: Bitki ekstraktlarının 24 saat, 48 saat ve 72 saat' lik üç maruz bırakma süresinde *Callosobruchus maculatus* (F.) erginlerine rezidüel etkisine bakıldığında bitki çesidi ve uygulama konsantrasyonları interaksiyonunun istatistiki olarak önemli olmadığı ($P < 0.05$) tespit edilmiştir. Aynı bitkiye ait tüm uygulama konsantrasyonlarının (bitkilerin esas etkisi) meydana getirdiği ölüm oranlarına bakıldığında, bitkilerin zararlıya kalıntı toksisitesi bakımından

ısırgan=serbetçi otu>sütleğen>fesleğen şeklinde sıralandığı tespit edilmiştir. Konsantrasyonların esas etkileri (aynı konsantrasyondaki tüm bitkiler dikkate alındığında) karşılaştırıldığında, doz artışına bağlı olarak ölüm oranlarında da artış olmuş ve %10 konsantrasyonda en yüksek ölüm oranı (%7.91) tespit edilmiştir (Tablo 2.).

Tablo 2. Bitki ekstraktlarının 24 saat maruz bırakma süresinde *Callosobruchus maculatus* (F.) erginlerine rezidüel etkisi

Bitkiler	Ergin Ölüm Oranı (%) ± Standart Hata				
	Ekstrakt konsantrasyonları (% w/w)				
	2.5	5	10	Kontrol	Bitkiler
Isırgan	6.66±1.66	8.33±1.66	10.00±2.89	0.00±00.0	8.31 ±1.39 A*
Fesleğen	1.66±1.66	3.33±1.66	5.00±2.89	0.00±00.0	3.34 ±0.97 B
Sütleğen	3.33±1.66	5.00±0.00	6.67±3.33	0.00±00.0	5.02±1.08 AB
Şerbetçi Otu	5.00±0.00	6.66±1.66	10.00±0.00	0.00±00.0	7.13±1.14 A
Konsantrasyonlar	4.16±0.83 b**	5.83±0.83 ab	7.91±1.29 a	0.00±0.00 c	

*Bir sütunda bulunan büyük harfler aynı ise istatistiksel ($P<0.05$) bir farklılık yoktur.

**Bir satırda bulunan küçük harfler aynı ise istatistiksel ($P<0.05$) bir farklılık yoktur.

Aynı bitkiye ait tüm uygulama konsantrasyonlarının 48 saat sonundaki kalıntı toksisitesi incelendiğinde bitkilerin zararlıya toksik etki bakımından ısırgan=şerbetçi otu>sütleğen>fesleğen şeklinde sıralandığı tespit edilmiştir (Tablo 3.).

Tablo 3. Bitki ekstraktlarının 48 saat maruz bırakma süresinde *Callosobruchus maculatus* (F.) erginlerine rezidüel etkisi

Bitkiler	Ergin Ölüm Oranı (%) ± Standart Hata				
	Ekstrakt konsantrasyonları (% w/w)				
	2.5	5	10	Kontrol	Bitkiler
Isırgan	6.66±1.66	10.00±0.00	15.00±2.89	3.33±1.66	8.75 ±1.52 A*
Fesleğen	1.66±1.66	3.33±1.66	6.66±1.66	1.66±1.66	3.33±0.94 B
Sütleğen	6.66±1.66	8.33±1.66	10.00±0.00	00.0±0.00	6.25±1.25 AB
Şerbetçi Otu	5.00±0.00	6.66±1.66	15.00±2.89	3.33±1.66	7.50±1.57 A
Konsantrasyonlar	5.00±0.87 bc**	7.08±0.96 a	11.66±1.42 a	2.08±0.74 c	

*Bir sütunda bulunan büyük harfler aynı ise istatistiksel ($P<0.05$) bir farklılık yoktur.

**Bir satırda bulunan küçük harfler aynı ise istatistiksel ($P<0.05$) bir farklılık yoktur.

Aynı bitkiye ait tüm uygulama dozlarının 72 saat sonundaki ortalamasına bakıldığında bitki ekstraktlarının zararlıya rezidüel etki bakımından aralarındaki farklılıkların önemli olmadığı tespit edilmiştir (Tablo 4.).

Taş (2011), sarı kantaron (*Hypericum perforatum* L.), kimyon (*Cuminum cyminum* L.), anason (*Pimpinella anisum* L.) ve kekik (*Origanum onites* L.) bitkilerinden elde edilen metanol ekstraktlarının *Callosobruchus maculatus* (F.) (Col.: Bruchidae) erginlerine karşı kalıntı toksisitesinin oldukça düşük olduğunu bildirmiştir. Adedire ve ark., (2011), yaptıkları çalışmada kaju çekirdeğinin *Callosobruchus maculatus* (F.) üzerindeki insektisidal etkilerini belirlemek amacıyla farklı çözücüler kullanarak (hekzan, petrol eteri ve aseton) ekstraktlar elde etmişlerdir. Bu araştırmacılar yürütmüş oldukları çalışmada, 0.1 ml/20 g börtölce danesi dozunda 96 saat sonunda hekzan (% 100), petrol eteri (% 96) ve aseton (%98) ekstraktlarının yüksek oranda ergin ölümüne neden olduğunu tespit etmişlerdir. Saylam ve Çetin (2017), ısırgan, şerbetçi otu, sütleğen ve fesleğen ekstraktlarının *Callosobruchus maculatus* erginlerine kontakt toksisite ile ilgili çalışmalarında, ısırgan ekstraktının 72 saat maruz bırakma sonunda zararlı ergininde %49 ölüm görüldüğünü belirtmişlerdir. Rezidüel etkisini araştırdığımız bitkilerin kullandığımız en yüksek dozda (% 10) ve en uzun maruz bırakma süresinde (72 saat) % 15' lik ölüm oranı tespit edilmiştir.

Aynı bitki ekstraktlarının kontakt ve rezidüel etkileri arasında farklılıklar görülmekte, böcek vücuduna ekstrakt doğrudan alındığı için kontakt toksisite daha yüksek olmaktadır.

Tablo 4. Bitki ekstraktlarının 72 saat maruz bırakma süresinde *Callosobruchus maculatus* (F.) erginlerine rezidüel etkisi

Bitkiler	Ergin Ölüm Oranı (%) ± Standart Hata				
	Ekstrakt konsantrasyonları (% w/w)				
	2.5	5	10	Kontrol	Bitkiler
Isırgan	6.66±1.66	11.66±1.66	16.66±1.66	3.33±1.66	11.63±1.68 A*
Fesleğen	6.66±1.66	11.66±1.66	18.33±6.00	5.00±0.00	12.17±2.08 A
Sütleğen	8.33±1.66	10.00±0.00	11.66±1.66	3.33±3.33	9.97±1.28 A
Şerbetçi Otu	6.66±1.66	8.33±1.66	15.00±2.88	3.33±1.66	9.99±1.54 A
Konsantrasyonlar	7.08±0.74 bc**	10.41±0.74 b	15.41±1.68 a	3.75±0.89 c	

*Bir sütunda bulunan büyük harfler aynı ise istatistiksel ($P<0.05$) bir farklılık yoktur.

**Bir satırda bulunan küçük harfler aynı ise istatistiksel ($P<0.05$) bir farklılık yoktur.

3.2. Ovisit etki: Bitki ekstraktlarının *Callosobruchus maculatus* (F.) yumurta açılımını engelleme oranı en yüksek konsantrasyonda (%10) ısırgan ve fesleğen ekstraktında yüksek (%45 ve 36), şerbetçi otu ekstraktında ise düşük (16.98) olduğu tespit edilmiştir (Tablo 5.).

Tablo 5. Bitki ekstraktlarının *Callosobruchus maculatus* (F.) yumurtalarında ovisit etkisi

Bitkiler	Yumurta açılımını engelleme oranı (%) ± Standart Hata			
	Ekstrakt konsantrasyonları (% w/w)			
	2.5	5	10	Bitkiler
Isırgan	29.31±3.72	36.21±2.82	44.83±3.45	36.78±2.79
Fesleğen	31.03±5.07	34.48±1.41	41.38±2.82	35.63±2.45
Sütleğen	21.66±3.60	23.33±1.36	38.33±1.36	27.77±2.84
Şerbetçi Otu	7.55±1.54	13.21±1.54	16.98±1.54	12.58±1.57

Taş (2011); yaptığı çalışmada sarı kantaron (*Hypericum perforatum* L.), kimyon (*Cuminum cyminum* L.), anason (*Pimpinella anisum* L.) ve kekik (*Origanum onites* L.) bitkilerinden elde edilen metanol ekstraktlarının *Callosobruchus maculatus* (F.) (Col.: Bruchidae)’un yumurtalarındaki ovisit etkisini incelemiştir; bitki ekstraktı ile muameleye tabi tutulan yumurtaların açılma oranlarında doz artışına bağlı olarak belirli düzeyde azalma olduğunu tespit etmiştir. Yine bu çalışmada yumurtaların açılışı üzerine en etkili ekstraktın anason olduğunu ve uygulanan en yüksek dozda (%8) %33 oranında yumurta açılımını engellediğini bildirmiştir. Sonuç olarak, yumurtalara karşı test edilen bitki ekstraktlarından bazılarında uygulama dozlarının artışı *Callosobruchus maculatus* (F.) yumurtalarının ölüm oranlarının artışına neden olmuştur. Kemabonta ve Okogbue (2002) *Chenopodium ambrosioides* bitkisinden elde edilen ekstraktın %1, %3 ve %5’lik uygulama dozlarını tohumlar üzerindeki *C. maculatus* yumurtalarına uygulamıştır. Yapılan bu çalışmada, ekstraktın uygulama dozunun artışına bağlı olarak *C. maculatus* yumurtalarının üzerine etkisinin de arttığını tespit etmişler ve %5 uygulama dozunda kontrol ile karşılaştırıldığında yumurtalarda % 72.5 ölüme neden olduğunu bildirmişlerdir.

3.3. Yumurta bırakma tercihinin etki: Bitki ekstraktlarının yumurta koyma tercihinin etkisi (Free Choice) bakımından ekstraktlar arasındaki farkların önemli olmadığı tespit edilmiştir. Ekstraktların uygulandığı nohut tanelerinde yumurta bırakma bakımından önemli düzeyde cezbedicilik ya da uzaklaştırıcılık tespit edilmemiştir (Tablo 6.).

Tablo 6. Bitki ekstraktlarının *Callosobruchus maculatus* (F.) disilerinde yumurta bırakma tercihinin etkisi

Bitkiler	Bırakılan Yumurta Sayısı ± Standart Hata	
	Ekstrakt konsantrasyonu (% w/w)	
	5	
Isırgan	62.00±2.51 A	
Fesleğen	42.33±11.69 A	
Sütleğen	53.33±14.23 A	
Şerbetçi Otu	68.00±4.51 A	
Kontrol	73.33±6.02 A	

Tas (2011); sarı kantaron (*Hypericum perforatum* L.), kimyon (*Cuminum cyminum* L.), anason (*Pimpinella anisum* L.) ve kekik (*Origanum onites* L.) bitkilerinden elde edilen metanol ekstraktlarının *Callosobruchus maculatus* (F.) (Col.: Bruchidae) erginlerinde yumurta koyma tercihinde etkisini denemiştir. Ekstraktlar arasında, bırakılan yumurta sayısı bakımından farklılığın bulunmadığını bildirmiştir. Yumurta koyma tercihinde etki denemesinden elde ettiğimiz sonuçlar yapılmış olan çalışmalarla paralellik göstermektedir.

4. KANI

Zararlılarla kimyasal mücadelede yoğun olarak kullanılan sentetik organik insektisitlerin çevre ve insan sağlığına olumsuz etkileri her geçen gün artmaktadır. Mücadelede yoğun olarak kullanılan bu kimyasallar böceklerde kısa sürede direnç oluşumuna neden olmakta ve mücadele her geçen gün zorlaşmaktadır. Bu nedenle yeni mücadele stratejileri ve doğal kaynaklı madde arayışı artmıştır. Özellikle bitkilerden elde edilen ekstraktlar, uçucu yağlar ve benzeri maddeler depolanmış ürün zararlılarının kontrolünde kullanıma potansiyeli taşımaktadır. Araştırmamızda, dört bitki ekstraktının *Callosobruchus maculatus* erginine ve yumurtasına toksisitesi ve yumurta bırakma davranışına etkisi araştırılmış, yumurtaya etkisinin orta düzeyde olduğu, ergine rezidüel etki ve yumurta bırakma davranışına etkisinin düşük olduğu belirlenmiştir. Zararlılarla mücadelede bitki ekstraktları ile ilgili çalışmaların yanında yeni formülasyon oluşturulması, sinerjist etki oluşturacak maddelerle karışımların araştırılması, böceklerde insektisit direncinin azaltılması konularında yapılacak çalışmalar faydalı olacaktır. Bu araştırmalar sonucunda halen zararlılarla mücadelede kullanılmakta olan bitki ekstraktları daha yoğun kullanılacak, çevre ve insan sağlığı korunmuş olacaktır.

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COMPARISON OF GROWTH CURVE MODELS IN HAIR GOAT KIDS

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Abstract

This study was carried out to determine growth curve parameters with Brody, Logistic, Gompertz and von Bertalanffy models by using body weights of Hair goat kids from birth to 12 month ages.

The growth curve parameters (A , B and K) were determined as 30.08 ± 0.99 , 3.35 ± 0.09 and 0.34 ± 0.01 for females and 31.63 ± 0.71 , 3.54 ± 0.22 and 0.37 ± 0.01 for males in Gompertz model, respectively; as 44.30 ± 3.40 , 1.07 ± 0.01 and 0.13 ± 0.01 for females and 40.51 ± 2.43 , 1.09 ± 0.01 and 0.16 ± 0.01 for males in Brody model, respectively; as 27.98 ± 0.83 , 12.20 ± 0.61 and 0.54 ± 0.02 for females and 30.08 ± 0.63 , 13.40 ± 1.58 and 0.58 ± 0.02 for males in Logistic model, respectively; as 31.74 ± 1.16 , 0.75 ± 0.02 and 0.27 ± 0.01 for females and 32.77 ± 0.80 , 0.78 ± 0.04 and 0.30 ± 0.01 for males in von Bertalanffy, respectively.

In terms of model selection criteria with a high degree of accuracy coefficients of determination (R^2) and a low degree of mean square predicted error (MSPE), correlation between live weight and residuals (RESC), Akaike information criteria (AIC) and Schwarz's Bayesian information criteria (BIC) Logistic model was found to be mathematically adequate for describing the growth in Hair goat kids.

Keywords: Goat, Growth Curve Models, Gompertz, Logistic, von Bertalanffy

1. Introduction

Goat breeding is an important production form, in which the areas that are unsuitable for vegetable production (stony area, slope, forest side, weak pastures, fallow, stubble, infertile land) are evaluated, which is transformed into animal products such as meat, milk, fleece, hair, and skin, and which is living resource of low-income families (Kaymakçı et al., 2000).

Goat milk, which has the nearest value to the breast milk, has become a product that is popular in the market. In case that goat milk is presented to the market as cheese, yoghurt, and ice cream after processing, its value increases much more. Goat meat is an important breeding branch to meet the need for red meat. Goat breeding, due to these features of it, brings more value added in sheep and goat breeders.

In the recent years, the factors such as forbidding goat grazing, drops experienced in sheep and goat prices, weakness of pastures due to insufficient rainfall, and immigration from the village to the cities are of the possible reasons for decrease of goat population. After the year 2009, it is seen that with the rise of goat prices and opening the forestry areas to grazing in the following years, the number of goat has begun to rise again and, in 2015, that it is slightly over 10 million. The increase in goat population in respect of years is an indicator of that the importance of hair goat is again understood, and that goat breeding again becomes widespread in terms of meat production.

In 2015, 2 million goats were slaughtered and about 34 thousand tons of meat were produced. Especially in our country, this is the indicator of the importance of goat meat in red meat production, which is necessary in meeting protein need. That goat meat is delicious and nutritious, that it is traditionally being produced for years, and that its price is attractive compared to the other meats increase the demand for goat meat.

In order to determine of feeding programs in farm animals, identify optimum slaughtering age, automatically perform herd management, and be able to predict the effects of selection methods applied, mathematical models that reveals growth relationships are utilized (Keskin and Tozluca, 2001). The information, obtained in the different ages and different periods and difficult to interpret, calculating growth curve, can be biologically interpreted by less parameters (Akbas et al., 1999).

In hair goat breeding, growth is one of important features having economic growth and can be defined as the variation occurring in body sizes of living creatures until reaching adolescence age. In a certain interval, in order to scientifically study and assess the variation in body weight and body size of the living creature, the models of growth curve are utilized (Çolak et al., 2006; Bayram and Akbulut, 2009). As a result of controls, a model of growth curve (for the weight and body measurements of the living creature), whose validity was accepted, can be used in the prediction of a growth in a certain time and, depending on this, in the early selection. The most important benefit of this application is that it eliminates the obligation that a certain time must pass to be able to observe the values worked on them (Efe, 1990; Tekel, 1998).

The shape of growth curves differs according to the sort, race, sex of the living creature, environmental conditions, and feature examined (Bilgin and Esenbuğa, 2003). Therefore, in calculation of growth curve, linear models alone remain inadequate but nonlinear models are also needed (Akkol et al., 2011). In the calculation of growth curves, the linear (linear, quadratic and cubic) and nonlinear (Brody, Logistic, Richards, Gompertz, von Bertalanffy, Weibull vb.) models are commonly used.

While there are many studies about growth curve, for the different goat races Mukundan et al., 1982; Gonzales et al., 1992; Çıtak et al., 1998; Kuzu and Eliçin, 2001; Özdemir and Dellal, 2009; Gaddour et al., 2012; Gaddour and Najari, 2013; Mousa et al., 2014), the number of studies carried out on hair goats is limited (Ayдын, 2005; Barıtcı et al., 2009; Tatar et al., 2009).

Due to the fact that the studies regarding growth carried out on hair goats are insufficient, it is necessary to increase on this study. With this study carried out on hair goats, calculating the parameters of growth curve, it was aimed to mathematically express growth.

2. Material and Method

2.1. Material

The material of the study consists of a total of 71 goat kids (33 males and 38 females) belonging to the race of hair goat bred in a private breeding farm in the Apasaraycık (lat. 37° 23' N, long. 32° 28' E and 1122 m above sea level) neighborhood in the district Çumra of the province Konya.

In Apasaraycık neighborhood, hair got breeding is carried out based on pasture as an extensive agricultural branch and the goats and male-goats bred are presented to the sale in Çumra and the other places as sacrificial.

2.2. Method

Weighing the goat kids was started by installing ear number to the goat kids in the second week of the month March. The goat kids recorded were digitally weighed in 50 g of precision and their weights were identified. In the months following the March 2015, as in the first weighing month, in the second week of every month, weighing process of the goat kids were continued and living weights were recorded over 12 months.

In this study, the models of growth curves of Brody, Logistic, Gompertz, and von Bertalanffy growth curve, among nonlinear models, were used (Table 2.1).

In comparison of the models in terms of compliance wellness, mean square predicted error (MSPE), determination of coefficient (R^2), Akaike's information criteria (AIC), Schwarz's Bayesian information criteria (BIC), and correlation between live weight and residuals (RESC) were used.

Table 2.1 Growth curve models

Model	Function
Brody	$Y_t = A(1 - Be^{-Kt})$
Gompertz	$Y_t = Ae^{-Be^{-Kt}}$
Logistic	$Y_t = A/(1 + Be^{-Kt})$
von Bertalanffy	$Y_t = A(1 - Be^{-Kt})^3$

(A) is the asymptotic weight or maximum growth response (g); (B) is the biological constant; (K) is the growth rate; (t) is the age in days; Y_t is the body weight (g) at age (t).

3. Results and Discussion

As a result of application of the models of Gompertz, Brody, Logistic and von Bertalanffy growth curve to the data of living weight in hair goats, the growth rate parameters obtained (A, B, and K) and standard errors belonging to them were given in Table 3.1.

Table 3.1. Growth curve parameters in different models for female and male hair goats (mean ± standard errors)

Model	Sex	Growth Curve Parameters		
		$\bar{A} \pm S_{\bar{A}}$	$\bar{B} \pm S_{\bar{B}}$	$\bar{K} \pm S_{\bar{K}}$
Gompertz	Female	30.08±0.99	3.35±0.09	0.34±0.01
	Male	31.63±0.71	3.54±0.22	0.37±0.01
Brody	Female	44.30±3.40	1.07±0.01	0.13±0.01
	Male	40.51±2.43	1.09±0.01	0.16±0.01
Logistik	Female	27.98±0.83	12.20±0.61	0.54±0.02
	Male	30.08±0.63	13.40±1.58	0.58±0.02
von Bertalanffy	Female	31.74±1.15	0.75±0.01	0.27±0.01
	Male	32.77±0.80	0.78±0.03	0.30±0.01

As also seen from Table 3.1, parameter A expressing asymptotic living weight in Gompertz model was identified as 30.08 in the female goat kids and 31.63 in the male goat kids; parameter B, as 3.35 in the female goat kids and 3.54 in the male goat kids; and parameter K, as 0.34 in the female goat kids and 0.37 in the male goat kids. In the studies carried out on hair goats, It was observed that these values were similar to the data of parameter A reported for Gompertz function (Aydın, 2005; Tatar et al., 2009); that they were higher than the data of parameter B (Yeni, 2003; Aydın, 2005; Tatar et al., 2009); and that they were similar to the data of parameter K (Tatar et al., 2009).

In the table, parameter A of Brody model expressing asymptotic living weight was identified as 44.30 in the female goat kids and 40.51 in the male goat kids; parameter B, as 1.07 in the female goat kids; parameter K, 0.13 in the female goat kids and 0.16 in the male goat kids. It was observed that these values were higher than parameters A and B obtained for Brody function, reported for hair goats in the study carried out by Tatar et al. (2009), and lower than parameter K. It was seen that parameters A and B, identified by using Brody function as a result of the study carried out for hair goats by Barıtcı et al. (2009) were lower than the values reported in this study, while parameter K were higher than the values reported in this study.

In Table 3.1, parameter A expressing asymptotic living weight in Logistic model was identified as 27.98 in the female goat kids and 30.08 in the male goat kids; parameter B, as 12.20 in the female goat kids and 13.40 in the male goat kids; and parameter K, as 0.54 in the female goat kids and 0.58 in the male goat kids.

When the parameter A expressing asymptotic living weight of von Bertalanffy model is examined, it was identified that it was 31.74 in female goat kids and 32.77 in male goat kids; Parameter B, 0.75 in the female goat kids and 0.78 in the male goat kid; and parameter K, 0.27 in the female goat kids and 0.30, in the male goat kids (Table 3.1). It was observed that the results of Bertalanffy model were lower than the values of parameters A, B, and K obtained for von Bertalanffy function Barıtcı et al. (2009) reported in the study carried out on the hair goats.

The results belonging to the statistics of determination of coefficient (R^2), mean squares predicted error (MSPE), correlation between live weight and residuals (RESC), and Akaike information criterion (AIC), Schwarz's Bayesian information criteria (BIC) used in the determination of the model showing the most compliance to the data of living weight belonging to hair goats, are given in Table 3.2.

Table 3.2. Goodness-of-fit statistics (R^2 , MSPE, AIC, BIC and RESC) in different models for hair goats

Model	Sex	Goodness-of-fit statistics				
		R^2	MSPE	AIC	BIC	RESC
Gompertz	Female	97.79	1.36	6.33	7.78	-0.07
	Male	98.04	1.64	7.61	9.07	-0.08
Brody	Female	96.20	2.48	13.68	15.33	0.14
	Male	96.27	3.19	15.51	16.96	0.15
Logistik	Female	98.38	0.95	2.10	3.56	-0.09
	Male	98.67	1.08	3.02	4.47	-0.09
von Bertalanffy	Female	97.41	1.63	8.41	9.87	-0.02
	Male	97.64	1.99	9.81	11.26	-0.04

In Table 3.2, parameter R^2 expressing determination coefficient of Gompertz model was identified as 97.79% in female goat kids and 98.04% in the male goat kids. These values are similar to the parameter R^2 obtained for Gompertz function Tatar et al reported in the study they carried out on hair goats. It was observed that this value was higher than R^2 parameters Yeni (2003) reported in the study he carried out on hair goats.

In the table, parameter R^2 expressing determination coefficient of Brody model was identified as 96.20% in the female goat kids and 96.27% in the male goat kids. It was observed that these values were lower the datum of parameter R^2 Barıtcı et al. (2009) and Tatar et. (2009) reported in the study they carried out on hair goats. Determination coefficient of Logistic model, i.e. parameter R^2 , was obtained as 98.38% in the female goat kids and 98.67% in the male goat kids. It was observed that these values were higher than parameter R^2 reported in the studies carried out on hair goats (Yeni, 2003; Barıtcı et al., 2009; Raji et al., 2015).

Determination coefficient of von Bertalanffy model was obtained as 97.41% in the female goat kids and 97.64% and male goats. These values are near to the values reported in the studies carried out on the studies carried out on hair goats (Barıtcı et al., 2009).

In order to show the compliance of growth curve models (Gompertz, Brody, Logistic and von Bertalanffy) to the real data, the growth curves drawn for the male and female goat kids are like Graph 3.1 and Graph 3.2.

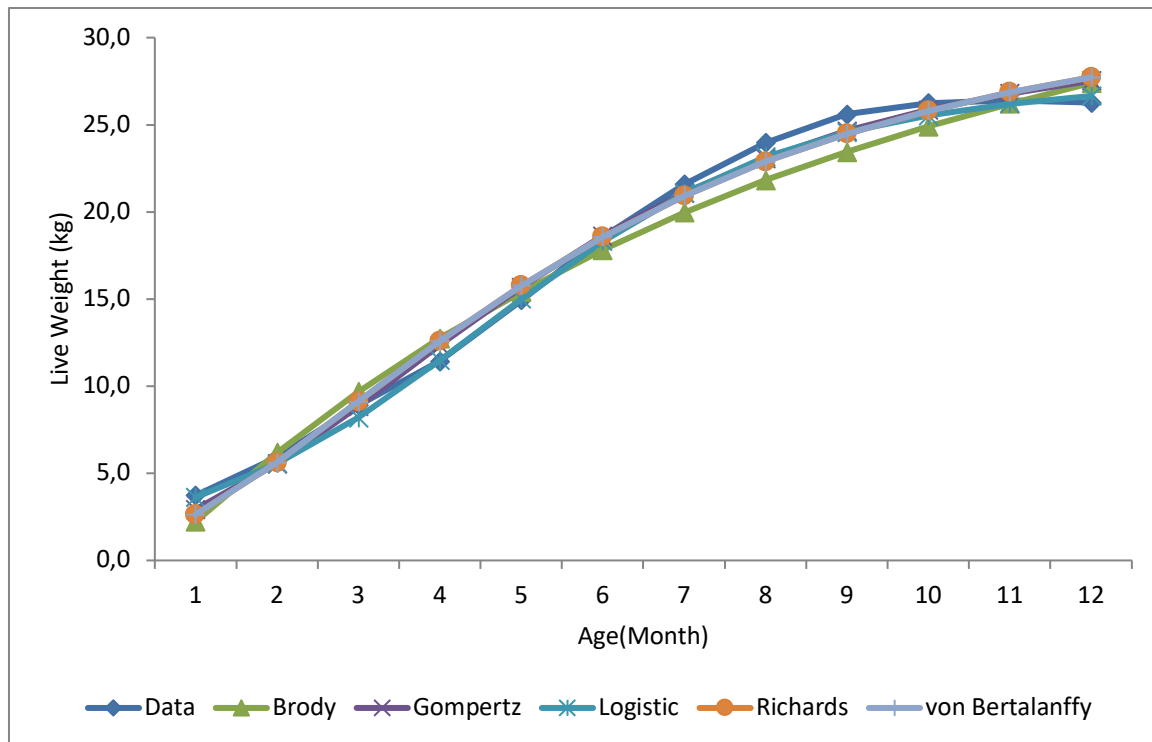


Figure 3.1. Growth curves in different models for female hair goats

As will be seen from Graph 3.1 and 3.2, it is seen that the growth curves predicted by the different models (Gompertz, Logistic and von Bertalanffy) are in compliance with the real data. Brody model showed less compliance to the real data in both female and male goat kids.

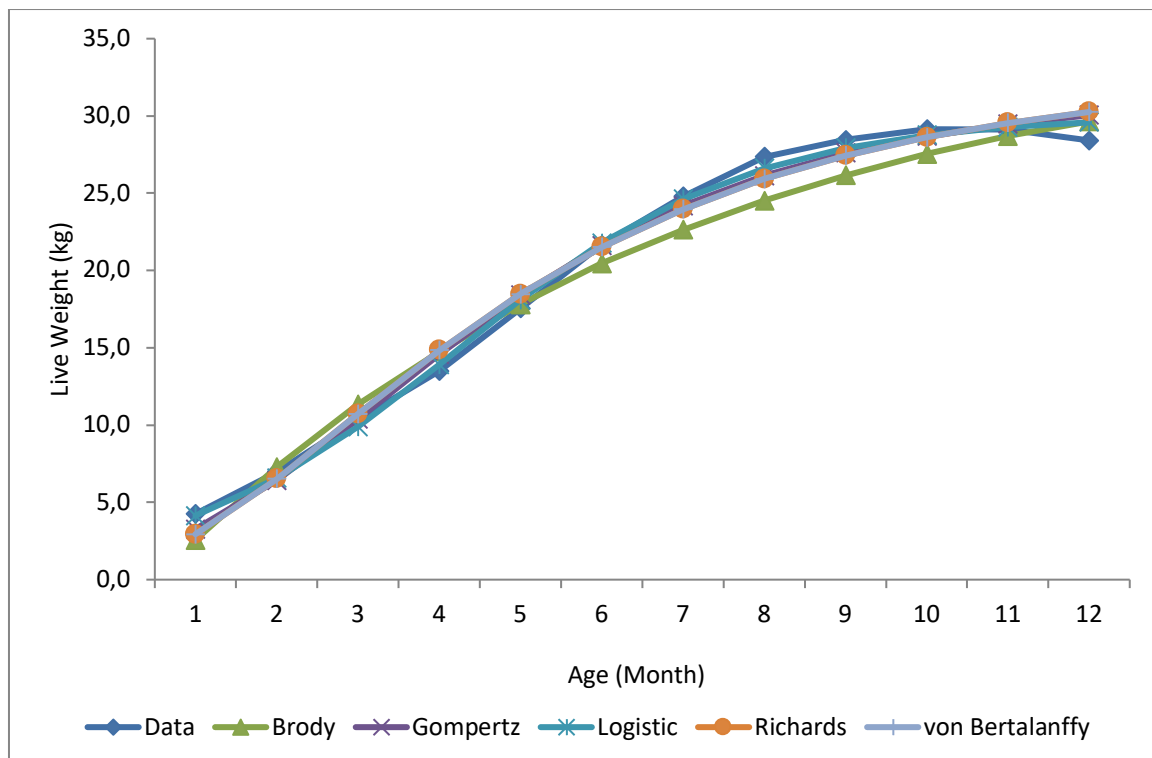


Figure 3.2. Growth curves in different models for male hair goats

4. Conclusion and Suggestions

In evaluating whether or not growth curve models showed good compliance with the real data, the different criteria [(determination of coefficients (R^2), adjusted determination coefficient (adjusted R^2), mean squares of prediction errors (MSPE), correlation between live weight and residuals (RESC), Akaike's information criteria (AIC), Schwarz's Bayesian information criteria (BIC), and Durbin Watson (DW)] can be used. In this study, in the comparison of models in terms of compliance wellness, the values of mean squares of prediction errors (MSPE), determination of coefficient (R^2), Akaike's information criteria (AIC), Bayes information criteria (BIC), and correlation between live weight and residuals (RESC) were used.

In this study, it is seen that determination of coefficients identified for the different models are generally near to each other (determination coefficients are respectively for the female and male goat kids: 97.79% and 98.04% for Gompertz; 96.20% and 96.27% for Brody; 98.38% and 98.67% for Logistic; and 97.41% and 97.64% for von Bertalanffy). However, when it is evaluated with the other compliance wellness criteria, in the variation of living weight depending on the age, the highest value of R^2 and the lowest values of MSPE, AIC, and RESC in the Logistic model with the values of 98.38%, 0.95, 1.18 and -0.09 in the females and the values of 98.67%, 1.08, 2.78 and -0.09 in the males, respectively, were reached. Due to the fact that Brody model had the values of MSPE, AIC, BIC and RESC, higher than the other models, it was concluded that it did not show a good compliance.

As a conclusion, in this study carried out to define the growth curves of 4 different mathematical models in the female and male-goat kids, due to the fact that determination coefficient (R^2) is high, that the values of MSPE, AIC, BIC and RESC are low, and that parameters can be predicted near to the real values, it can be said that Logistics model provides better compliance. Thanks to this, using Logistic model, living weights in any period will be able predict with the least error and, in the early selection studies, in determining optimum slaughtering age, and evaluating health condition of the herd, these models can be utilized.

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INFLUENCE OF CAPSAICIN APPLIED TO SEEDS ON THE EMERGENCE AND SEEDLING GROWTH OF TOMATO AND EGGPLANT

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Abstract

Tomato and eggplant seeds were treated with capsaicin at different doses prior to sowing to determine the effect of capsaicin on emergence and seedling growth. The doses of capsaicin applied were 0 (control), 0.1, 1, 10, 25, 50, 100 and 200 ppm. There was no emergence at eggplant seeds treated with 100 and 200 ppm capsaicin, while emergence was not observed at tomato seeds treated with 200 ppm capsaicin. At tomato, the seedling fresh weight and length at all capsaicin doses were more than control and highest value of them was obtained from seeds treated with 50 ppm capsaicin. Although the difference among treatments did not statistically important, highest leaf number, seedling diameter, fresh weight, length and root length were determined at seeds treated with 25 ppm capsaicin in eggplant. According to the results of this research, it could be said that capsaicin has a potential as priming agent, especially at low doses.

Keywords: *Solanum lycopersicum*, *Solanum melongena*, Seed treatment, Emergence, Seedling

INTRODUCTION

Tomato and eggplant are warm season vegetables that are intensively cultivated both in the open field and greenhouse in many parts of the world and also in Turkey. Tomato and eggplant growing area are commonly established using seedlings. Seedling quality is one of the important factors affecting desirable plant establishment and vegetable crop yield. The main purpose of the commercial seedling producer is to obtain high emergence rate as well as healthy and homogeneous seedlings in short time at low cost. The time required to obtain tomato seedling is approximately 25-45 days depending on the growing season (winter, summer), seed quality and growing conditions in the commercial seedling growing. Also, eggplant seedling reaches the desired size for selling in 28-55 days. The profitability of seedling production plants will increase if it could produce seedlings in a shorter period of time during seedling growing period. In order to achieve this, seedling growing conditions must be manipulated. This can be provided by regulating cultural practices such as climatization, fertigation, irrigation. In addition, some pre-sowing practices have been developed to improve germination and seedling growth. One of these is osmo-priming applications where seeds are allowed to receive limited water and the germination process is started before sowing. This technique

is used to improve the germination and emergence of some vegetable species (Bradford et al., 1990; Pill, 1995)

Capsaicin is the major pungent component of *Capsicum* spp. (Ishikawa et al., 1998; Dias, 2012). Barchenger and Bosland, (2016) stated that it is a secondary metabolite with no known direct function in basic metabolism but can provide adaptive significance in protection against herbivory and/or microbial infection. It does not only add flavor and spice to the food but also is using for medical or therapeutic purpose due to pharmacological and physiological effects in human since ancient times (Kogure et al., 2002; Luo et al., 2011). However, the reports on the utilization of capsaicin for the agricultural purpose are very limited. Among them, for example, it has been stated that the capsaicin can be used in weed management due to its allopathic effect by Gonzales et al., (1997). It has been shown to promote resistance to certain fungal pathogens due to an increase in some plant defense enzyme levels, such as chitinase (Crombie, 1999). It was indicated that capsaicin of having antifungal and nematicide properties might be useful as a biopesticide (Krakruan et al., 2008; Neves et al., 2009; Aza-Gonzales et al., 2011). Capsaicin is considered as the repellent against some bird, animal, and insect (Curtis et al., 2000; Bosland and Bosland, 2001; Chinn et al., 2011). However, as far as we know, there is no information about the effects of capsaicin on the emergence and seedling development of tomato and eggplant. The objective of this study was to investigate the effect of exogenous capsaicin application on emergence and seedling quality of tomato and eggplant.

MATERIALS AND METHODS

H-2274 variety of tomato and Aydın Siyahı variety of eggplant as plant materials and synthetic capsaicin (V9130 N-Vanillylnonanamide, Sigma-Aldrich Chemie GmbH, Steinheim, Germany) as treatment material were used. 0.2 g capsaicin was dissolved in one liter of deionized water containing 30% ethanol to obtain a 200 ppm stock solution by considering previous researches (Bosland and Bosland, 2001; Kraikruan et al., 2008). The capsaicin solutions having different doses by dilution of this stock solution were prepared (0, 0.1, 1, 10, 25, 50, 100 and 200 ppm). Hygienic containers, with the dimension of 17x12x6 cm where seeds would be treated with capsaicin solutions, were put into sodium hypochlorite solution (1%) for 10 minutes, then 3 times rinsed with distilled water and dried on the paper towel. The double layers of towel paper were laid in the bottom of containers and wetted with 50 ml capsaicin solution having different doses. The containers were closed and kept at room temperature for 24 h. (Figure 1). After treatments, seeds were washed in a sieve and rinsed under running tap water for 1 min and dried on paper towel at room conditions until reaching the initial seed weight. To evaluate emergence and seedling growth, seeds treated with capsaicin (also control seeds) were sown to container filled with commercial seedling growing media (Klasmann TS1, Dr Tarsa Inc. Antalya, Turkey, pH: 6.0, N: 140 ppm, P₂O₅: 160 ppm, K₂O: 180 ppm, Mg: 100 ppm). The experiment was set up as randomized block design with four replicates and each replication included 50 seeds. After sowing, the containers were watered and kept in an unheated greenhouse where the temperature was 15/38°C during the experiment (Figure 2). The seedlings

having fully opened cotyledons was recorded as emergence and the counts were done every day at the same time of day.



Figure 1. Treatment of seeds with capsaicin solutions.



Figure 2. Seedling growing containers

Mean emergence time (MET) were calculated by using the following formula (Demir and Okcu, 2004).

$$\text{Mean emergence time} = \frac{\sum nd}{\sum n}$$

Where, n =Number of seeds which emergence on day d , d =Number of days counted from the beginning of emergence.

After emergence was complete, to determine seedling quality characteristics, ten seedlings were left in each repeat and application and the others removed from the containers. Seedlings samples were taken 47th day after sowing to determine the effect of capsaicin on seedling quality. The roots of the seedlings were carefully washed under running water to remove the growth medium and dried with paper towels to remove the surface water and their fresh weight was recorded. Stem diameter was measured with a digital caliper just 1 cm above cotyledons. The seedling length was determined by based on distance between shoot apex and growth medium line. Root length was measured and true leaf number was recorded.

RESULTS

No emergence was observed in the tomato seeds treated with 200 ppm capsaicin (Table 1). The lowest emergence percentage (15%) was determined in seeds treated with 100 ppm capsaicin. There was no statistically significant difference among applications in term of the mean emergence time (except 100 ppm). Although the differences among the number of leaves ranged from 5.11 to 6.23, the stem diameter ranged from 6.49 to 7.69, the root length ranged from 16.22 to 20.44 cm were not significant, the seedlings of seeds treated with 50 ppm capsaicin had the maximum number of leaves and stem diameter. The seedlings of seeds treated with different doses of capsaicin had more seedling fresh weight and seedling length than control. Also, the highest seedling fresh weight and length were determined in seeds treated 50 ppm of capsaicin.

Table 1. The effect of capsaicin doses on emergence and seedling quality in tomato.

Capsaicin doses	Emergence percentage (%)	Mean emergence time (day)	Leaf number	Stem diameter (mm)	Fresh weight (g)	Seedling length (cm)	Root length (cm)
0	71 a	10.63 a	5.11	6.74	10.91 b	17.33 c	17.66
0.1	68 a	10.51 a	5.89	7.48	15.86 ab	21.66 bc	20.44
1	60 a	8.42 a	5.11	6.49	11.02 b	22.22 abc	17.10
10	58 a	9.61 a	5.77	6.49	17.35 ab	24.55 ab	20.44
25	63 a	10.49 a	5.44	7.02	18.11 ab	26.33 ab	16.22
50	43 ab	9.55 a	6.23	7.69	22.88 a	28.44 a	18.10
100	15 b	3.37 b	6.16	7.39	14.74 b	23.60 abc	18.93

Within columns, values followed by different letters are significantly different ($P<0.01$).

The eggplant seeds treated with 100 and 200 ppm capsaicin could not germinate (Table 2). The differences among the applications in terms of criteria related to the emergence and seedling quality were not statistically significant. But the highest values dealing with seedling quality criteria were obtained from seeds treated with 25 ppm capsaicin.

Table 2. The effect of capsaicin doses on emergence and seedling quality in eggplant.

Capsaicin doses	Emergence percentage (%)	Mean emergence time (day)	Leaf number	Stem diameter (mm)	Fresh weight (g)	Seedling length (cm)	Root length (cm)
0	80	13.14	5.10	4.91	9.55	15.99	13.98
0.1	91	14.15	4.44	4.62	6.84	13.77	13.55
1	96	15.41	4.66	5.09	8.51	15.55	12.66
10	77	11.92	4.55	5.23	8.20	13.88	15.00
25	90	13.80	5.66	6.28	14.60	17.22	16.99
50	85	15.09	5.11	5.56	13.18	16.88	15.99

Within columns, values followed by different letters are significantly different ($P<0.01$).

DISCUSSION

Emergence did not occur in the tomato seeds treated with 200 ppm capsaicin and in eggplant seeds treated with 100 and 200 ppm capsaicin (Table 1, 2). This finding agrees with the results of Kato-Noguchi and Tanaka (2003) who observed that high concentration of capsaicin had inhibiting effect in six different plant species. In mentioned work, it has been determined that capsaicin suppressed germination of lettuce seeds and inhibited the growth of their root and shoots at a concentration greater than 3, 0.1 and 0.3 mM, respectively. Similarly, Siddiqui and Zaman (2005) reported that *Capsicum* leachates inhibited the germination of *Vigna radiata* seeds and also negatively

affected root and shoot growths at 50 or 75%. Barchenger and Bosland (2016) also found that high doses of capsaicin treatments (500, 1500 ppm) resulted in reduced and delayed germination at different rates depending on two no-heat pepper varieties. They have stated that germination inhibition could be an autopathic effect of capsaicin. When the results of this study are also considered, it should be noted that the high concentration of capsaicin could be detrimental to germination of tomato and eggplant.

The criteria such as leaf count, stem diameter, height, fresh and dry weight etc. represent seedling quality (Dufault and Schultheis, 1994). The seedlings produced from tomato seeds treated with 50 ppm capsaicin were taller, thicker, had more leaf and fresh weight (Table 1) Although there were no statistically important differences among different capsaicin doses with regard to emergence of eggplant and seedling quality criteria, it has been found that the seedling size was greater than other doses in seedling of seeds treated with 25 ppm capsaicin (Table 2). This result is consistent with our previous research that is showing the low dose capsaicin had the enhancing effect on pepper germination and seedling growth (Arin, 2016) Seed treatments with low doses capsaicin can have stimulatory effects on seedling growth and accelerated the seedling development. This situation may be explained as the low concentration of capsaicin is accelerated by the metabolic activity in plants. It has been shown by Crombie (1999) that the capsaicin causes an increase in the enzyme level in the plant. Further studies are needed to detail and informatively explain this result.

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TRICHOEPITHELIOMA IN TWO AMERICAN AND COCKER SPANIEL DOGS: A CLINICOPATHOLOGICAL STUDY

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ABSTRACT

Trichoepitheliomas (TEs) are benign follicular appendage tumors with differentiation to all three segments of the hair follicle. According to author's knowledge, this is the first report of trichoepithelioma in dog in Kyrgyzstan. To conclude this paper, it reports occurrence of a trichoepithelioma in 2 American and Cocker spaniel dogs. Neoplastic tissue was fixed in 10% neutral buffered formalin and processed in series of alcohol grades. Paraffin-embedded, four-five microns tissues sections were dewaxed and dehydrated stained with hematoxylin and eosin method (H&E) for microscopic diagnoses. In conclusion, histopathology remains the gold standard method for the differential diagnosis for TE. Additionally, TE can be remind in dogs with long hair like as spaniels.

Keywords: Trichoepithelioma, excision, dog

INTRODUCTION

Skin neoplasms and hair follicle tumors represent, respectively, about 30% and 5% from the total of neoplasms diagnosed in dogs (1-3). Canine follicular tumours are uncommon type of keratin-producing tumours in dogs that develop from different structures of hair follicle (4). TEs include approximately 80% of hair follicle tumors in domestic dogs, especially Golden retrievers, Basset hounds and German shepherds (5,6). Three major variants have been described in the literature, namely solitary, multiple and desmoplastic TE (5,7). Tumors were classified as infundibular keratinizing acanthoma, benign or malignant pilomatricoma, trichoblastoma, benign or malignant trichoepithelioma, and tricholemmoma, according to the nomenclature proposed by the World Health Organization (8). Histopathologically, trichoepitheliomas contain branching nests of basaloid cells, horn cysts, and abortive hair papillae. Solitary trichoepitheliomas of more than 2 cm in diameter are called giant solitary trichoepithelioma (9). Treatment for multiple TEs include excision, electrodesiccation, dermabrasion, cryotherapy, radiotherapy, Argon, Carbon dioxide, erbium-YAG lasers (10). According to author's knowledge, this is the first report of trichoepithelioma in dog in Kyrgyzstan. In this paper, it reports occurrence of a trichoepithelioma in 2 American and Cocker spaniel dogs.

CASES HISTORY

Case 1

In our veterinary clinic submitted a 12-year-old male, Cocker Spaniel dog during physical examination observed ulcerated two lesions between ear and eye one of tumor was 0.5 cm diameter, and the other one was 1.0 cm, fistulized and round-oval shape pinkish colored with no other pathological findings. During hospitalization, we performed completely tumors extirpation. Neoplastic tissue was fixed in 10% neutral buffered formalin and processed in series of alcohol grades. Paraffin-embedded, four-five microns tissues sections were dewaxed and dehydrated stained with hematoxylin and eosin method (H&E) for microscopic diagnoses. Histopathological examination showed the following aspects: normal epidermis and the presence of many islands and horny cysts in various size and form (Figure 1A). The inside of these structures filled with lamellar keratin and pigments (Figure 1B) remind a petal-shaped structures of rose well divided with fibrous filaments, surrounded by basaloid cells with intensive stromal reaction. Abortive follicular papilla attempts within the cyst wall. She is followed every month, wound healed completely and doing well when she came for follow up after 1 year.

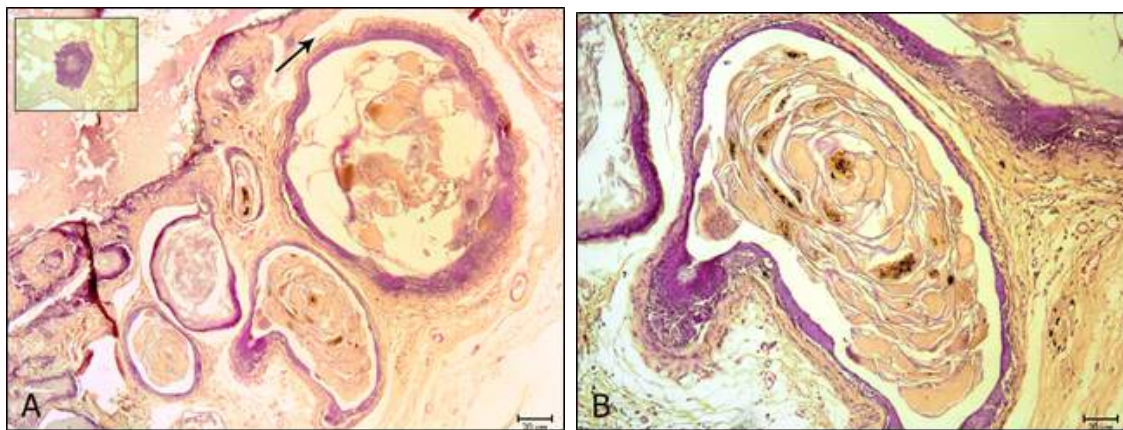


Figure 1. A) Multiple plaques in different size filled with abundant keratinic, horn cysts with calcification and solid fibrous stroma. Well-circumbed, fenced with collagen, often stromal cracking (arrow). In some places there are seen metastatic basaloid compacted group of tissues (small picture). (H&E, barr =20, Case 1). B) Enormous horned cyst remind a petal-shaped structures of rose well divided with fibrous filaments, surrounded by basaloid cells. Cystic space contain layer of keratin with pigments and intensive stromal reaction.

Case 2

The second case is an American Cocker Spaniel, male 10 years old dog, tumor located under the chin 3 cm diameter, yellow to pinkish colored, firm consistency (Figure 2). There are observed tumor lesions in the skin of thorax and abdomen. The tumour nodules were performed extirpation. Tumour mass sections were stained with H&E. Histopathologic procedures was performed same above mentioned case 1. Histologically findings in this case revealed small cords of basaloid cells, keratinized, calcified cysts in a desmoplastic stroma. Presense of horny layered cysts in various size and shape calcification were seen, presence of few mitotic figures in the epithelium (Figure 3).

Follow up after 3 weeks showed good healing and the patient is quite comfortable. She is doing well after 1 year as per telephonic follow up.



Figure 2: Yellow to pinkish, indurated nodule under the chin (Case 2) .

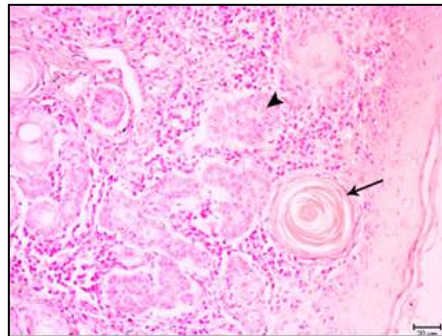


Figure 3. Cornified cysts in varying sizes (arrow). Basaloid cords in the desmoplastic stroma (arrow head). (H&E, barr =20, Case 2).

DISCUSSION

TE is commonly located on the face and hairy skin. In humans, spontaneous trichoepitheliomas are uncommon. In dogs and cats, spontaneous trichoepitheliomas are also uncommon lesions that present as solitary tumors, although multiple tumors may happen rarely (6). Patients were above 10 years old in this study. These cases had multiple TEs.

TE rarely can reach sizes of over 1 cm diameter and can it can be found on the neck, scalp or trunk (11). In dogs and cats, spontaneous trichoepitheliomas are also uncommon lesions that present as solitary tumours less than 2 cm in size, although multiple tumours and masses up to 8 cm may occur occasionally (8). In second case, size of lesions on the thorax and abdomen were small 2 cm. However, lesion of under the chin was bigger than 2 cm, due to this tumor was diagnosed giant TE. TEs in domestic dogs are commonly ulcerated (5). Ulcerative lesions were also observed in both cases.

The distinction of TE from Basal Cell Carcinoma (BCC) is sometimes difficult, clinically and histologically. The lesions are skin coloured, firm papules or nodules of 2-8mm in diameter, slow

growing (10). In case 1, tumour lesions were seen with surface ulceration and serous discharge. In second patient, there were observed multiple TEs, and one of the lesion under the chin was large in size, firm consistency and slowly growing. The definite diagnosis of trichoepithelioma were evaluated by histopatological examination in both cases.

Differential diagnoses for the present cases had included desmoplastic BCC, desmoplastic trichoepithelioma and trichoblastoma with sclerosing stroma. Desmoplastic trichoepithelioma was determined due to trichogenic differentiation and multiple hair follicle compartments within the horn cysts surrounded by dense connective tissue.

Histologically, TE is characterized by a well circumscribed dermal tumour composed of islands, nests and cords of uniform basaloid cells in a cellular fibrous stroma (papillary mesenchymal bodies). The tumour may be associated with epithelial structures resemble hair papillae or abortive hair follicle, small keratocysts (infundibular differentiation) lined by stratified squamous epithelium and foci of calcification (10,13).

Both tumours are composed of nests of basaloid cells with follicular differentiation. Differences between TE and BCC were TE consists of characteristic papillary mesenchymal bodies and horn cysts whereas BCC consists of basaloid tumour islands with peripheral palisading, stromal retraction artefacts, increased mitotic activity and necrosis (10,12). In some cases, histopathologic differentiation between BCC with follicular differentiation and trichoepithelioma may be impossible on the basis of haematoxylin and eosin staining, and such distinction is important for treatment and prognosis (10,13).

On histopathological examination, the lesion is usually well circumscribed, symmetrical and confined to the papillary dermis and upper two-thirds of the reticular dermis (14,15). The two cases examined within the present study exhibited the typical clinical and histopathological features of DTE that have been described by previous studies (14,16-18). The depressed, nonulcerating, and raised angular border that is described in previous studies (14,16-18) was a typical feature in the second case however not the other one. The triad of histopathological characteristics first described by Brownstein and Shapiro (20), i.e., narrow strands of basaloid tumor cells, keratinous cysts and a desmoplastic stroma, was a consistent presence in all three of the current cases. Another feature of DTE is the presence of horn cysts and frequent calcification. In the present study, multiple horn cysts and focal calcifications were observed in both cases. There were no sign of pleomorphism but just individually seen mitotic and apoptotic figures in the epithelium.

Differentials for TEs contain pilomatrixoma, tricholemmoma, and trichofolliculoma (5,21). But each of these tumor is differentiated based on the follicular structure affected. In present case, tumor cells originated from primitive hair follicle and also occasionally with development of the basal layer resulting in rapid keratinization without differentiation of granular cell layer.

Lung and liver are the most common organs of metastasis (22). In clinical and radiographic examinations, there are not seen tumor metastase in internal organs.

Several approaches, including surgical excision, laser surgery, dermabrasion, topical 5% imiquimod, curettage and electrodesiccation, and radiosurgical ablation, have been attempted with some success, but the chances of recurrence for these techniques may be higher than that for local surgical excision (14,23). It is also important to consider that the majority of biopsy specimens obtained during these methods may only be superficial, resulting in a poor pathological evaluation. Moreover, these techniques may not permit histological margin analysis and may not be appropriate for high risk tumors resembling DTE. Local surgical excision is the treatment of choice for DTE and is considered as a first line treatment for the majority of benign tumors. Although complete remission with minimal recurrence can be achieved with this technique, post-surgical complications, including scarring and hypopigmentation, remain the main problem, particularly for the cosmetically sensitive areas such as the hairless areas, where minimizing the occurrence of any complications is extremely important.

CONCLUSION

Herein, we report a rare case of TE in two American and Cocker spaniel dogs, which should be differentiated from malignancy histopathologically. We try to list the key clinical and histopathological characteristics of TE. In conclusion, histopathology remains the gold standard method for the differential diagnosis for TE. Additionally, TE can be remind in dogs with long hair like as spaniels.

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EFFECTS OF MEDETOMIDINE/ISOFLURANE ANESTHESIA ON HEART AND RESPIRATORY RATES, AND BODY TEMPERATURE IN THE COMMON BUZZARD (BUTEO BUTEO)

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Abstract

The purpose of this study was to investigate characteristics of induction; clinical parameters while anesthetized; and timing and quality of induction and recovery with medetomidine/isoflurane anesthesia in the young adult common buzzard (*Buteo buteo*) (n=14). Heart rate (HR), respiratory rate (RR), and body temperature (BT) were measured before and 10 minutes after pre-medication with the parenteral agent and at 5, 15, 30, 60, 120 and 360 minutes during the intubated and extubated periods. Compared to baseline values, a decrease in RR between 5 and 120 minutes was observed in MED-ISO group. Compared to baseline values, decrease in HR between 5 to 360 minutes was noted in animals. Compared to baseline values, a decrease in BT was noted between 5 and 120 minutes in MED-ISO group. The anesthetic effect of the isoflurane started between 2 and 3 minutes (2.35 ± 0.13) after inhalation started. The length of time at deepest anesthesia level ranged from 4 to 7 minutes (5.35 ± 0.24) for group MED-ISO. The medetomidine/isoflurane regime provided a rapid and effective anesthesia and thus might be preferable for raptors requiring urgent anesthesia.

Keywords: Anesthesia, Common buzzard, Isoflurane, Medetomidine

INTRODUCTION

In raptors, general anesthesia can allow veterinarians to rapidly and safely apply emergency procedures, fluid administration, radiography and blood collection, or to make invasive surgical procedures (1,2). Inhalation anesthesia has been considered the safest technique for birds due to rapid induction and recovery, simple adjustment in anesthetic depth, minimal biotransformation and myocardial depression (1,3-5). Medetomidine is a parenteral alpha-2 agonist agent used in veterinary medicine, which induces sedation and analgesia (1,6). Isoflurane is an anesthetic of choice in birds because it has the effect of rapid induction, rapid recovery and minimal myocardial depressant in most species (7-9). Despite the wide use of inhalant anesthetic agents in raptors, the efficacy of these agents is not well documented in this taxon. The purpose of this study was to use clinical parameters while the subjects were anesthetized to compare speed and quality of recovery with medetomidine/isoflurane anesthesia in the common buzzard (*Buteo buteo*) in terms of the speed and characteristics of induction.

MATERIALS AND METHODS

Four-teen common buzzards (*Buteo buteo*) weighing 1.10 ± 0.05 kg (mean $\pm$ SD) were used for the study. The study was reviewed and approved by the Local Institutional and Animal Care and Ethics Committee (no:13/135).

Each bird was received anesthetic regime: medetomidine (Tomidin, Prover, Istanbul, 34000, Turkey, 100 μ g/kg, i.m.) and isoflurane (Forane, Baxter, Deerfield, IL, 60015, USA) 4% in 0.8 L/min oxygen (MED-ISO). In MED-ISO group, 10 minutes following pre-medication with medetomidine, each bird was induced via a face mask (4% isoflurane in 0.8 L/min oxygen) which was maintained following intubation (1.5% isoflurane in 0.8 L/min oxygen). Intubation tube size was 2.5 mm. The feet were taped for operator safety and the birds were placed in dorsal recumbency on a padded table and hooked to an ECG after full effect.

Heart rate (HR) was calculated from electrocardiographic (ECG) records as determined by two P waves (10). Respiratory rate (RR) was determined by direct observation of the movement of the pectoral muscle (11). Body temperatures (BT) were monitored during the anesthesia and recovery periods using a cloacal probe. Vital signs were measured before and 10 minutes after pre-medication (baseline under physical restraint) and at 5, 15, 30, 60, 120 and 360 minutes during the intubed and extubed periods. Birds were extubed at 30 minutes in the isoflurane group.

Additional data collected included time to induction, time to deepest state of anesthesia, and time to recovery. The recovery time was defined as being when the animal had regained all motor and sensory functions. Motor functions were tested as full response to needle prick to legs and to the various areas of the body, a complete ability to hold the head in a normal, alert position, resistance of the head and the neck by palpation against pulling and to attempt to escape from manual restraint. Palpebral and corneal reflexes and response to environmental sounds were used as tests of sensory functions. Satisfactory muscle relaxation was defined as the condition of no control over head and wing movement of the birds. Reflexes were monitored at intervals of 3-5 min during induction and 5-10 min until recovery.

Treatment means (HR, RR, BT, onset of anesthesia, and recovery time) were compared both within at baseline 0 and 5, 15, 30, 60, 120, and 360 minutes by one-way analysis of variance (Tukey's t-test) using IBM SPSS Statistics 21 (IBM Corp., Armonk, NY, USA). The data were expressed as the mean $\pm$ SEM.

RESULTS AND DISCUSSION

All birds became inactive after 10 minutes following medetomidine administration. Alterations in HR, RR and BT throughout the anesthesia are shown (Table 1). Compared to baseline values, a decrease in RR between 5 and 120 minutes was observed in MED-ISO group. Compared to baseline values, decrease in HR between 5 to 360 minutes was noted in animals. Compared to baseline values, a decrease in BT was noted between 5 and 120 minutes in MED-ISO group.

Table 1. Heart and respiratory rate and body temperature (mean $\pm$ SD) for common buzzards (*Buteo buteo*) anesthetized with medetomidine/isoflurane combinations.

Parameters	Time (min)	Heart rate (beats/min)	Respiration rate (breaths/min)		Body temperature ($^{\circ}$ C)	
		P		P		P
Baseline value	0					
Pre-medication	10	Group 1	Group 1		Group 1	
	5	248.4 $\pm$ 90.6	<0.05	48.0 $\pm$ 15.9	<0.001	40.7 $\pm$ 0.6
		105.9 $\pm$ 16.5		41.3 $\pm$ 15.5		40.5 $\pm$ 0.9
Anesthesia	15	95.4 $\pm$ 17.5		20.1 $\pm$ 12.5	<0.001	39.9 $\pm$ 1.0
		92.0 $\pm$ 2.0		17.3 $\pm$ 11.4		39.2 $\pm$ 1.1
	30	81.8 $\pm$ 13.1		17.2 $\pm$ 8.8	<0.001	37.9 $\pm$ 1.9
		99.1 $\pm$ 33.5		24.4 $\pm$ 7.9		37.3 $\pm$ 1.2
	60	156.7 $\pm$ 86.6		35.6 $\pm$ 13.3	<0.001	37.6 $\pm$ 2.2
		380.7 $\pm$ 113.5		44.5 $\pm$ 19.8	01	40.5 $\pm$ 1.1
	120					<0.01
	360		<0.001			<0.05

P (^{a, b}): The differences between the values carrying different letter in the same row are significant (P < 0.05).

The time to induction, time to deepest level of anesthesia, and time to recovery are summarized (Table 2), with the deepest level recorded for each bird. The anesthetic effect of the isoflurane started between 2 and 3 minutes (2.35 ± 0.13) after inhalation started. The length of time at deepest anesthesia level ranged from 4 to 7 minutes (5.35 ± 0.24) for group MED-ISO. No wing flapping and excitation occurred among any of the birds during any phase of anesthesia. No complicated recovery was observed for all the birds. Following cessation of the anesthetic agent, birds were observed to begin regaining consciousness within 50 min.

Table 2. Time of induction, time of deepest anesthesia level, and recovery time induced by medetomidine/isoflurane anesthesia in common buzzards (*Buteo buteo*), (mean $\pm$ SD)

	n	Group 1
Time of Induction (min)	14	2.35 $\pm$ 0.49
Deepest Level (min)	14	5.35 $\pm$ 0.92
Recovery Time (min)	14	225.00 $\pm$ 38.18

The assessment of anesthetic level induced by medetomidine/isoflurane is summarized below (Figure). Five minutes post isoflurane delivery, all birds had achieved stage 4 anesthesia. Muscle hypertonicity was observed in no birds in the medetomidine/isoflurane group. The recovery time ranged from 172 to 290 minutes (225.0 ± 10.20) for the subjects in group 1. All ECG tracings showed a sinus rhythm with normal complexes and no evidence of arrhythmias. No excitement or major unwanted effects were observed in group. No bird died during the study.

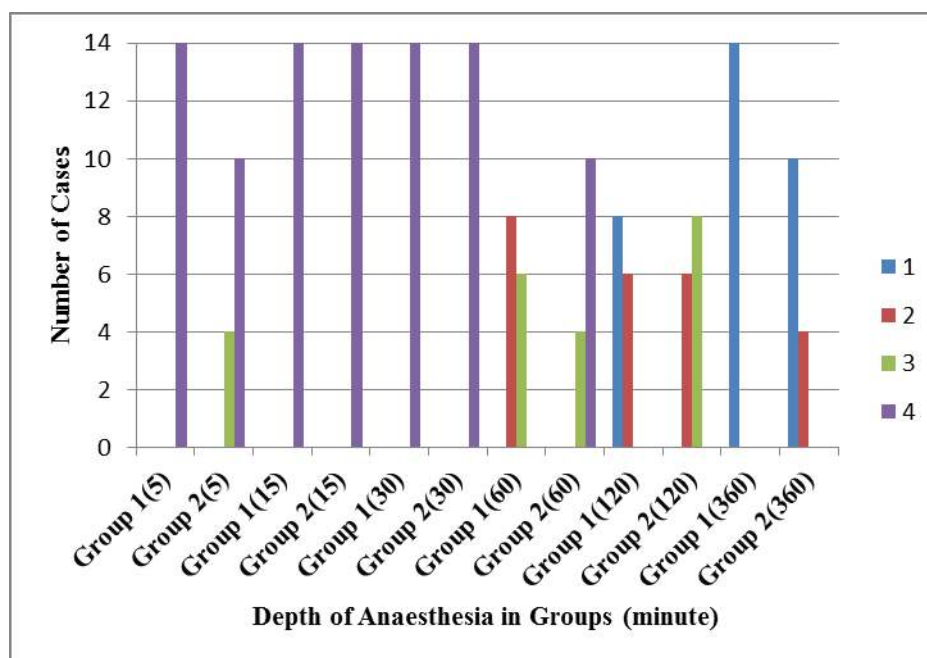


Figure. Assessment of anesthesia quality induced by medetomidine/isoflurane (4% in 0.8 L/min oxygen, 100 µg/kg, i.m., respectively) (1) able to stand, partly responsive to environmental objects, and walks voluntarily when stimulated, (2) unable to stand and tending to stay in lateral recumbency; partial response to needle prick stimuli, and reduced response to environmental stimuli, (3) anesthesia induction; unable to restore body posture, and minimal foot withdrawal response to needle prick; near complete muscle relaxation, (4) deep general anesthesia; no apparent pedal, palpebral and corneal reflexes

Anesthetics and sedatives can cause certain side effects, among which negative cardiovascular side effects are of major concern in avian species. For example, among pekin ducks (*Anas platyrhynchos domesticus*) anesthetized with either halothane or isoflurane heart rate increased and abnormal cardiac rhythms and other ECG changes were observed (12).

Heart rates of restrained, excited birds may be between 184% and 401% higher than that of caged, unexcited free birds at rest (1). Study data are similar to those found in other birds at rest, which may indicate that the animals were under minimal stress. Heart rates decreased from baseline during anesthesia.

A decrease in HR was recorded for all birds during the anesthesia. Bradycardia is attributable to decreased sympathetic activity and enhanced vagal activity, which is a characteristic response to the α -2 adrenoreceptor agonist, medetomidine (13,14). The decreased HR induced in the birds in this study might be the result of medetomidine administration, as it has an α -2 adrenoreceptor agonist effect.

CONCLUSION

In conclusion, isoflurane administration resulted in a satisfactory anesthesia in the common buzzard (*Buteo buteo*). Analgesia and muscle relaxation of birds were good and no adverse side-effects were encountered. Isoflurane for anesthesia of spontaneous breathing common buzzard (*Buteo buteo*) is a reasonable choice for surgical or diagnostic procedures of moderate duration. The isoflurane regime also provided a more rapid and effective anesthesia, and might be more preferable for raptors requiring urgent anesthesia.

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COMPARISON OF LACTONES CONCENTRATIONS DURING FRUIT GROWTH AND DEVELOPMENT IN SOME PEACH AND NECTARINE VARIETIES

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Abstract

There are several thousand varieties of peaches (*Prunus persica* L.) grown worldwide, and they represent a wide range of aromatic compounds including different volatiles. The formation of aroma constituents in fruit growth, development and maturation is a very dynamic process, because volatile substances are continuously synthesized and developed during growth and ripening, so the volatile composition changes both qualitatively and quantitatively. C₆ compounds, aldehydes, esters, alcohols, ketones, terpenes, lactones and some other compounds account for most of the important flavor volatiles in fruits. Many investigations showed that volatile constituent concentrations increased with development of peach and nectarine fruits. Lactones have the specific importance as volatile compound in peaches and nectarines. Lactones are synthesized after fruit growth following June drop and then development through maturity. In the present study, three peach and nectarine varieties commercially grown in Çanakkale - Turkey ('Cardinal' peach, 'White nectarine' and 'Armking' nectarine) were studied for their lactone constituents and concentrations. Analyses were made on aroma isolates from Cardinal peach, White nectarine and Armking nectarine fruits at different growth and maturity stages by using SPME (Solid Phase Micro Extraction) technique by GC/MS (Gas Chromatography/Mass Spectrometer). The detected lactones are γ -hexalactone, γ -heptalactone, δ -octalactone, γ -octalactone, γ -nonalactone, γ -decalactone, δ -decalactone and 7-decen-5-olide. Particularly δ -decalactone and γ -decalactone were most abundant lactones in the varieties. The white nectarine fruits had more lactone constituents than the other varieties. The highest concentrations of total lactones were 399.6 $\mu\text{g/kg}$ in 'White Nectarine' fruits; 329.8 $\mu\text{g/kg}$ in 'Armking' fruits and 286.6 $\mu\text{g/kg}$ in 'Cardinal' fruits. High values of lactones showed that 'White Nectarine' has great importance for flavor improvement in peach breeding programs.

Keywords: *Prunus*, fruit quality, volatiles, chromatography

Introduction

Peach is one of the most preferred temperate fruits worldwide. Annual production of peaches and nectarines was around 25.000.000 tons in 2016. China, Italy, USA, Greece, Spain and Turkey are the most important peach and nectarine producers in the world. The peach is an important fruit crop grown mainly in the Mediterranean, Marmara and Aegean regions of Turkey with an annual production of 510.000 tons in 2016 (FAOSTAT, 2017).

The consumption of fresh fruit is dependent on the fruit quality. The quality of fresh fruit includes many aspects such as appearance, color, texture, flavor, and nutritional value. Among them, flavor is one of the most important quality traits for fresh fruit. Fruit flavor is made up of sugars, acids, salts, bitter compounds such as alkaloids or flavonoids, and aroma volatiles. The flavor of fresh fruit is determined by taste and aroma. Fruit flavors have gained increasing importance because these compounds are important for the characteristic flavors of fruits. Consumer acceptance strongly correlated with flavor acceptance. Various types of fresh fruits produce distinct volatile profiles. Volatile compounds, which are produced by fresh fruits, are mainly comprised of diverse classes of chemicals, including esters, alcohols, aldehydes, ketones, lactones and terpenoids (Dirinck et al. 1989; Baldwin, 2002; Basear and Demirci, 2007; Layne and Bassi, 2008).

Volatile compounds forming the fruit flavor are produced through many complex metabolic pathways during fruit growth, ripening and postharvest storage conditions and depend on many factors related to the genetics of variety, ecological conditions, cultural management, maturity and postharvest treatments. For most fruits, volatile production is closely related to fruit ripening. As direct products of a metabolic pathway or as a result of interactions between pathways or end products, volatile compounds can be classified by the biogenesis: fatty acids (FAs), amino acids, glucosinolates, terpenoid, phenol, and related compounds (Tressl and Albrecht, 1986; Engel et al. 1988; Dirinck et al. 1989; Baldwin, 2002; Basear and Demirci, 2007).

Approximately 100 volatile compounds have been identified in peaches, including alcohols, aldehydes, alkanes, esters, ketones, lactones, and terpenes (Visai and Vanoli, 1997; Wang et al., 2009; Şeker et al., 2013). The major volatile compounds are identified as ethyl acetate, *cis*-3-hexenyl acetate, methyl octanoate, ethyl octanoate, γ -decalactone, benzyl alcohol, γ -caprolactone and δ -decalactone. Among them, lactones, particularly γ -decalactone and δ -decalactone, have been reported as character – impacted compounds in peaches and are associated with C₆-aldehydes, aliphatic alcohols and terpenes, which are responsible for fruity characteristics. A major group of fatty acid - derived flavor compounds are lactones or alkanolides, which are organoleptically important. They have generally γ - (4) or δ - (5) lactone structures and are linear chained, and a few are even macrocyclic. The γ – lactones are found primarily in plants. Sensory important lactones usually have 8 – 12 carbon, and some are very important volatiles in fruits, such as pineapples, peaches, apricots, and strawberry (Basear and Demirci 2007). In addition, due to their low odor threshold, they have a high flavor value in fruits. In plants, lactones are produced in a very low amount by catabolic processes involving the structurally related fatty acids.

In this study, three peach and nectarine varieties commercially grown in Çanakkale - Turkey ('White Nectarine', 'Armking' nectarine and 'Cardinal' peach) were studied for their lactone constituents and concentrations. Analyses were made on aroma isolates from Cardinal peach, White nectarine and Armking nectarine fruits at different growth and maturity stages by using SPME (Solid Phase Micro Extraction) technique by GC/MS (Gas Chromatography/Mass Spectrometer).

Materials and Methods

Plant Materials: Peach and nectarine fruits were harvested from Çanakkale Onsekiz Mart University experimental orchard and commercial orchards located in Çanakkale - Turkey. In this experiment 'White Nectarine', 'Armking' and 'Cardinal' fruits were sampled and used for further analysis

'White Nectarine' is a small size nectarine with yellow skin and flesh. It is clingstone with low flesh ratio. The fruits of 'White Nectarine' has excellent flavour and gaining high market value. The maturity of the fruits is midseason (15 July to 15 August) at commercial orchards (Şeker et al., 2005; Şeker and Gür, 2009; Şeker et al, 2011).

'Armking' is very popular nectarine variety. The fruits are medium size with yellow flesh color. The skin color becomes deep red over yellow. The trees are very productive and the fruits of 'Armking' has excellent flavor. The maturity of the fruits is midseason (10 July to 15 August) at commercial orchards (Şeker et al., 2013).

'Cardinal' is one of the oldest peach variety grown in Turkey. The fruits are medium size with yellow flesh color. The skin color is bright red over deep yellow. 'Cardinal' has high productivity, however the fruits have low flavour. The maturity of the fruits is midseason (10 July to 15 August) at commercial orchards (Şeker et al., 2013).

The trees of the genotypes were planted in 2006, trained in a free goblet shape and spaced 5 × 4 m apart. The soil texture was generally clay-loamy and the reaction was slightly alkaline (pH 7.6). The fruits of the 'White Nectarine', 'Armking' and 'Cardinal' trees grafted on GF677 rootstock were collected in July, in accordance with commercial harvest criteria. The fruits collected did not have any harmful symptoms or suffer from any disease. Five healthy trees from each genotype were selected for the experiment. One hundred fruits from each stage were used for GC/MS. These fruits were then transferred to the laboratories in the Department of Horticulture, the Faculty of Agriculture, Çanakkale Onsekiz Mart University and prepared for chromatography analyses. The periods for fruit growth and development were as follow:

- a)** I. period: 15 May 2017
- b)** II. period: 30 May 2017
- c)** III. period: 14 June 2017
- d)** IV. period: 29 June 2017
- e)** V. period: 14 July 2017
- f)** VI. period: 29 July 2017
- g)** VII. period: 13 August 2017

Volatile extraction and GC/MS conditions: For headspace sampling, SPME fibers coated with polydimethylsiloxane–divinylbenzene (Supelco Co., Bellefonte, PA, USA) were used as described before by Takeoka et al., (1988) and Wang et al. (2009). The fibre was activated according to the manufacturer’s instructions. The method of headspace solid phase microextraction was used for the isolation and concentration of volatiles. For each extraction, 2 g of the pulp and 0.6 g NaCl were placed in a 4 ml capped vial. The vial was placed in a 45 °C water bath with a magnetic stirrer to warm to constant temperature, and the SPME fiber was exposed to the headspace of the sample to adsorb the analytes for 30 min. The fiber was then introduced into the heated chromatograph injector port.

The identification and quantification of volatile components in the samples were performed on a Shimadzu QP2010 Plus GC-MS using the method described by Takeoka et al., (1988); Wang et al. (2009) and Şeker et al., (2013). with a slight modification. Separations were done with a DB-WAX column (60m × 0.2mm, i.d., and 0.25 µm, film thickness; J & W, USA), which was preconditioned at 250°C for a period of 2 hours. Helium was used as the carrier gas (3 ml/min). The analysis was conducted following the program at 40°C for 2 min, 40-150°C (3°C/min), then 150-220°C (10°C/min), and 250°C (5 min). The temperature of the injector was 250°C. The interface between GC and MS was at 250°C. Electron impact ionization was at 70 eV, EI mode, and the filament current was 0.25 mA. The ion-source temperature was 200°C. The scan range was 35-425 aMU.

Results and Discussion

Lactones composition and contents of peach and nectarine genotypes are presented in Table 1. During the investigation 8 lactones were determined in all surveyed genotypes. Those compounds were γ -hexalactone, γ -heptalactone, δ -octalactone, γ -octalactone, γ -nonalactone, γ -decalactone, δ -decalactone and 7-decen-5-olide were observed in the chromatograms.

No lactone compound was detected at the first period of in the fruits of investigated genotypes.

The total lactone contents of ‘White Nectarine’ ranged from 0.0 µg/kg to 399.6 µg/kg (Table 1. and Figure 1.). A lactone compound was observed firstly at the IInd period (30 May) of the research in the ‘White Nectarine’ fruits. The concentration of γ -decalactone was 2.0 µg/kg in this period. Then the concentration increased rapidly and reached to the highest concentration at the VIth period. γ -Decalactone was the dominant lactone in ‘White Nectarine’ fruits. The highest value of γ -decalactone was 198.0 µg/kg in the VIth period. δ -Decalactone was the second major lactone compound in the fruits. The concentration of δ -decalactone was 109.1 µg/kg in the VIth period. The highest concentration of total lactones was 399.6 µg/kg FW in ‘White Nectarine’ in the VIth period. Then lactone concentration was decreased at the VIIth period due to over maturity. The concentration decreased to 333.3 µg/kg.

Table 1. Lactone composition of different peach and nectarines at different fruit growth and maturity

Lactone compounds ($\mu\text{g/kg}$)		PERIODS						
		I	II	III	IV	V	VI	VII
White Nectarine	γ -Hexalactone	-	-	-	4.4	1.2	1.5	1.2
	γ -Heptalactone	-	-	-	-	1.2	1.5	1.2
	δ -Octalactone	-	-	2.7	20.4	71.4	73.9	63.1
	γ -Octalactone	-	-	-	-	7.3	7.5	6.4
	γ -Nonalactone	-	-	-	3.4	1.4	2.4	2.0
	γ -Decalactone	-	2.0	12.8	49.4	191.4	198.0	164.7
	δ -Decalactone	-	-	1.9	78.5	105.5	109.1	90.0
	7-Decen-5-olide	-	-	-	-	5.6	5.7	4.7
Total Lactones		0.0	2.0	17.4	156.1	385.0	399.6	333.3
Armking Nectarine	γ -Hexalactone	-	-	-	3.9	1.1	1.3	0.5
	γ -Heptalactone	-	-	-	-	-	-	-
	δ -Octalactone	-	-	2.4	10.9	62.5	51.8	55.2
	γ -Octalactone	-	-	-	-	6.4	6.6	5.6
	γ -Nonalactone	-	-	0.8	3.0	-	-	0.5
	γ -Decalactone	-	-	8.4	43.2	167.5	171.5	144.1
	δ -Decalactone	-	-	1.7	68.7	92.3	95.5	78.8
	7-Decen-5-olide	-	-	-	-	-	-	-
Total Lactones		0.0	0.0	13.3	129.7	329.8	326.7	284.7
Cardinal Peach	γ -Hexalactone	-	-	-	3.2	0.9	1.1	0.9
	γ -Heptalactone	-	-	-	-	-	-	-
	δ -Octalactone	-	-	2.0	15.0	52.5	54.3	46.4
	γ -Octalactone	-	-	-	-	5.4	5.5	4.7
	γ -Nonalactone	-	-	-	-	-	-	-
	γ -Decalactone	-	-	-	36.3	135.7	145.5	121.1
	δ -Decalactone	-	-	-	-	77.5	80.2	66.2
	7-Decen-5-olide	-	-	-	-	-	-	-
Total Lactones		0.0	0.0	2.0	54.5	272.0	286.6	239.3

I. period: 15 May 2017, II. period: 30 May 2017, III. period: 14 June 2017, IV. period: 29 June 2017, V. period: 14 July 2017, VI. period: 29 July 2017, VII. period: 13 August 2017

As far as ‘Armking’ nectarine is concerned, total lactone content ranged from 0.0 to 284.7 $\mu\text{g/kg}$ (Table 1. and Figure 1.). There was no lactone compound during the first and second period of fruit growth. Lactone compounds were detected in the IIIrd period firstly. δ -Octalactone, γ -nonalactone, γ -decalactone and δ -decalactone were identified in the mass spectral library. The total lactone content was 13.3 $\mu\text{g/kg}$ in ‘Armking’ fruits. γ -Decalactone was the major lactone similar to ‘White Nectarine’ and the concentration was 8.4 $\mu\text{g/kg}$. Then, lactone concentration was rapidly increased in the IVth, Vth and VIth periods due to starting of maturity. The highest lactone content was 329.8 $\mu\text{g/kg}$ in the Vth period. γ -Decalactone and δ -decalactone are the major lactones. 7-Decen-5-olide was not identified in the fruits of ‘Armking’ nectarine during the chromatography analysis.

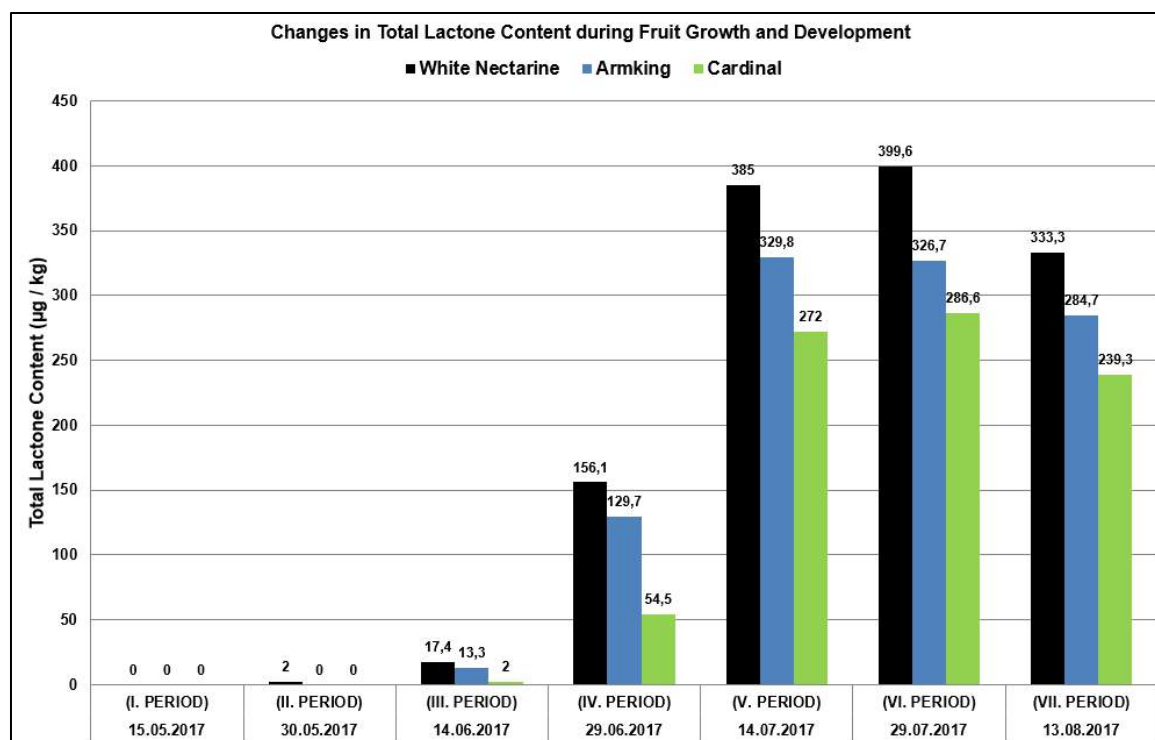


Figure 1. Comparison of total lactone contents in the fruits of ‘White Nectarine’, ‘Armking’ and ‘Cardinal’ fruits during fruit growth and development

‘Cardinal’ is previously described as low flavoured peach variety by Şeker et al (2013). In our experiment, total lactone content ranged from 0.0 to 286.6 µg/kg in the different fruit growth and maturity periods of ‘Cardinal’ variety (Table 1. and Figure 1.). The fruits of ‘Cardinal’ have less amount of volatiles (15%) than the fruits of ‘Armking’ and less volatiles (28%) than the fruits of ‘White Nectarine’. The highest amount of volatiles was found at the maturity level of Vth period.

Lactones synthesized by the pathways of fatty acids such as linoleic acid (C18:2) and linolenic acid (C18:3). The lactone contents found in this research has accordance with the given results by Wang et al., 2009.

Conclusions

Lactones are highly important volatile compounds for market demanding peaches and nectarines. Optimal harvesting time has importance for high lactone levels. Fruit maturity should be observed for lactone development for quality preservation in peaches and nectarines. Besides genetical characteristics, climate, rootstocks, post-harvest applications, storage conditions effects lactones concentrations. Electronic nose technology should be used for fruit quality management Sensorial development and sensory analysis should be improved in fruit quality.

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THE EFFECTS OF DIFFERENT IRRIGATION PERIODS ON SOME SEED CHARACTERISTICS IN MELON (*Cucumis melo* L.)

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Abstract

In vegetable production, the seed is the preliminary propagating material. The high seed quality and the use of certified seeds provide increases in yield from 20% to 100%. It is well known that there is a significant increase in the seed market every year and this increase will continue with acceleration. Turkey dominates 1.7% of the seed market in the world. Konya plain is the vast plain which is the most important seed producing region with 269 911 tones according to the data of 2015 in Turkey. The Konya Plain has limited water resources and an arid and semi-arid climate prevails in the plain. Thus, the efficient using of water resources has a great importance for sustainable agriculture. This study aimed to determine the effects of different irrigation periods on seed yield and some quality parameters in melon for Konya plain which has great importance for both growing and seed production.

The study was conducted at the experimental field of Agriculture Faculty of Selçuk University in 2015 and 2016 for two years. In total, 8 irrigation treatments were established according to 3 different phenological stage [vegetative development period (V), flowering-fruit set period (Ç) and fruit development- maturation period (O)]. Seed yield (g/fruit), seed width (mm), seed length (mm), 1000-seed weight (g), seed nutrient contents, germination rate (%), germination speed, emergence rate (%) and emergence speed were determined. Eventually, seed yield and quality were influenced by irrigation periods in melon and the highest seed yield was obtained from ÇO and VÇO periods.

Key Words: Melon, irrigation, seed yield and quality, nutrient content

1. Introduction

The rapid increase of the world population, climate change and the reduction of agricultural lands are a necessity to increase the efficiency of the unit area in the agricultural products and to develop the high-efficiency varieties having desirable agronomic traits in order to meet the food consumption. Seed either the most important production materials of agricultural production or the fundamental elements that determine the genetic potential. In the last 50 years, it is important to use the new plant varieties and high-quality seed in the increase of agricultural production in the world and Turkey. Thus, the yield increases from 20% to 100% by use of high quality and certified seeds. According to the International Seed Federation (ISF) reports the world commercial seed market reached around 45 billion USD (Anon., 2012). When the data in the past years are analysed, it is clearly reflected that there is a significant increase in the seed market and this increase will continue to be accelerated. The seed sector has a high-profit potential and many countries want to have a voice in this market. Turkey has a share of 1.7% in world seed markets. Konya Plain is the most seed producing area in Turkey with 269,911 tons of production (Anon., 2015). Although Turkey appears to be the most importing countries compared to other seeds, it is among the least exporting countries of vegetable seed markets (Anonim, 2015a).

Because of the unique ecological and geographical diversity, Turkey is a rich country in terms of cucurbitaceous genetic resource. In Turkey, approximately 30.7 million tons of vegetable are produced and 8.2 million tons (26.7%) of this production are belonging to the cucurbitaceous family. Melon is produced 1 813 thousand tons in 774 106 da area (TÜİK, 2017). It has been a vegetable species produced by different growing techniques in each region of our country and consumed intensely by Turkish people.

The available and sufficient water is confronted as one of the scarce sources in the world, especially for arid and semi-arid regions. Water used to compete for agriculture, industry and urban needs has led to the more economical use of water in crop production (Schwarz et al., 2010). Konya Plain which accounts for approximately 8% of Turkey's agricultural land and has an arid climate and quite limited water resources. In long year's average, annual precipitation is 323 mm (only about 90-100 mm fall during the growing season). Therefore, this area depends on irrigation to provide diversity, productivity and quality improvement in crop production. It is clear that irrigation for plant production is an indispensable necessity in Konya plain (Yavuz et al., 2015).

Konya Plain has an available water potential of 4.45 billion m³/year, of which 66% (2.94 billion m³) is over the ground and 34% (1.51 billion m³) is underground water resources (Anonim, 2015b). Mostly underground water resources are used for irrigation in the plain. It is estimated that the actual withdrawn groundwater will be about 1.8 billion m³/year with 1.51 billion m³/year of safe pull-able groundwater potential (Anonim, 2015b). The underground water level falls rapidly and the water quality is deteriorating since water above the permitted amount is withdrawn from underground reserves.

In this study, it was aimed to determine the effects of the irrigation periods on the seed quality of the melon in Konya plain which is an important agricultural area for both growing and seed production of the country.

2. Material and Method

The study was carried out at research and application area of Selçuk University Faculty of Agriculture for two years in 2015 and 2016. Kırkağaç type Dardonos F1 melon variety, which is the most cultivated and consumed open land in our country and Konya, is used as a plant material. A total of 8 irrigation treatments were performed in the study considering of 3 different phenological periods [vegetative growth period (V), flowering-fruit set period (D) and fruit development-maturation period (O)]. These topics; V, Ç and O treatments that are irrigated only in one period, it means no irrigation in the other two periods, VÇ, VO and ÇO which irrigated in two periods, it means no irrigation in the other one periods, VÇO which irrigated t in all three development periods and Rain-fed treatment. The irrigation water was supplied by a drip irrigation system and was measured by flow meters. Irrigation The experiment was laid out in a randomized block design consisting of 24 plots in total (20 plants in each plot) with three replications. The size of the plots was planned as 5x4 m. Each plot consists of 4 plant rows and a lateral line. Seedlings were planted by the distance between 2 and 1 m on May 8 in 2015 and May 11 in 2016. Harvest was carried out on September 7 and September 6, respectively. The seeds taken from the fruits harvested from each plot were completely dried in the shade. Than seed number per fruit, thousand seed weight, total seed weight and seed size were measured in 10 seeds for each fruit.

The emergence rate and emergence speed of 20 seeds obtained from each subject were determined. The seeds were evaluated as emerged when the cotyledons unfolded above the surface of the mixture and daily emergence is recorded.

The germination rate and germination speed were determined in 10 seeds in Petri dishes for three replicates according to the between-paper (BP) technique. Petri dishes were moistened with the addition of 10 mL distilled water. The seeds were kept at 24 °C in the dark condition and the seed germination was started on the 4th day of test and germinated seeds were counted daily till no germination was observed for two consecutive days (Eser et al., 2005; Kurtar et al., 2017).

Germination and seed emergence rate (%) was calculated by dividing the number of seeds emerging from the germinated and soil surface by the total number of seeds planted (Aydın and Atıcı, 2015).

$$\text{Emergence rate} = \text{emergence seed number} / \text{total seed number} \times 100$$

Germination and seed emergence speed were found by dividing the number of seeds emerged in the germinated and soil surface by the seed emergence time (Aydın and Atıcı, 2015).

$$\text{Emergence speed} = n_1/t_1 + n_2/t_2 + n_3/t_3 \dots n_n/t_n \quad n: \text{n. number of seedlings per day } t: \text{time}$$

The Kjeldahl method was used for the total N (%) analysis of the seeds (Kacar and İnal, 2013). In addition, K, Ca, Mg, Fe, Mn, Zn, Na and Cu elements were determined by atomic absorption spectrophotometer from the samples obtained according to the dry combustion method. Phosphorus

analyse was done on a spectrophotometer (Kimbrough and Wakakuwa, 1989). The obtained data were analysed using SPSS packet program and statistically significant averages were subjected to Duncan multiple comparison tests.

3. Results and Discussion

Seed yield and characteristic

Combined variance analysis was performed on the positive result of the homogeneity test result in order to evaluate the trial years together. Therefore, when the significance groups are determined, the average of the two years is evaluated and the results are given in Table 1. Highest seed yield per fruit was obtained from the flowering-ripening period (ÇO) with 37.65 g / fruit. Therefore, in terms of seed yield, melon is water-sensitive during flowering and ripening periods. According to the results, the ÇO and VÇO were included in the same group and the other applications separated into different groups. The seed yield was reduced by 19.2%, 24.2%, 26.4%, 33.5%, 35.4% in VÇ, Ç, V, O, VO applications compared to the ÇO application, respectively. 50% less seed yield was obtained from non-irrigated application, compared to the highest yield per seed yield ÇO application. Drought is an important factor limiting plant growth, development and productivity. It has been reported that the drought that occurred during the seed development period affected the seed quality significantly (Dornbos et al., 1989; Smicklas et al., 1992; Heatherly, 1993; Egli et al., 2005).

Table 1. The effects of irrigation in different growth period, seed yield, 1000 seed weight, seed size and seed width in melon (average of two years)

Application	Seed yield (g/fruit)		1000 seed weight (g)		Seed size (mm)		Seed width (mm)	
	Average	Rate of change (%)	Average	Rate of change (%)	Average	Rate of change (%)	Average	Rate of change (%)
Non-irrigated	18.86 E	50.0	28.83 E	66.1	11.51 A	100	4.83 A	100
V	27.71 CD	73.6	34.11 CD	78.2	11.30 AB	98.1	4.74 AB	98.1
Ç	28.57 CD	75.8	37.18 BC	85.2	11.15 ABC	96.8	4.82 A	99.8
O	25.04 CD	66.5	30.74 DE	70.5	10.90 BCD	94.7	4.58 CD	94.8
V+Ç	30.44 BC	80.8	36.50 BC	83.7	11.48 A	99.7	4.73 AB	97.9
V+O	24.35 D	64.6	35.54 BC	81.5	10.51 D	91.3	4.72 AB	97.7
Ç+O	37.65 A	100	43.60 A	100	10.83 CD	94.1	4.55 CD	94.2
V+Ç+O	34.99 AB	93.0	39.12 B	89.7	10.94 BCD	95.0	4.44 D	91.9
p<0.05	0.001		0.001		0.001		0.004	

Likewise, the highest 1000 seed weight was 43.6 g in the ÇO application irrigated in flowering and ripening period, similar to seed yield per fruit, and statistically separated from other matters. VÇO, VO, VÇ and O were included in the same group. The best results were obtained from irrigated plots during the flowering-fruit set period. The 1000 seed weights obtained from the non-irrigated application decreased by 33.9% compared to the ÇO application. In seed size and seed width, the highest value was obtained from the non-irrigated application. Although the highest seed size and width were obtained in the non-irrigated application, the lowest 1000-seed weight was obtained in the non-irrigated application. This implies that non-irrigated applications produced larger seeds, however, the specific gravity of the seeds is low. There was less difference between the irrigation subjects in terms of seed size and seed width.

Seed germination and Emergence

Germination and emergence rate of the seeds obtained from different irrigation programs were determined as a result of laboratory and controlled greenhouse studies, respectively (Table 2). The results are given by considering the average of the two years. The highest germination rate was obtained from VO application with 89.17%, whereas, it was 51.67% in the non-irrigated plot.

When the average germination rate of the seeds is evaluated; the highest value is observed in the seeds obtained from the VO. According to the results, V, VÇ and VÇO applications were in the same group as the VO application in which the highest germination rate was obtained. Similar to the germination rate, germination speed results showed that the seeds obtained from irrigated plots during the vegetative period gave favourable good results. Interestingly, germination rate and germination speed were found to be lower in O application similar to the control lot.

According to the results of emergence rate; the highest value was obtained from V application at the rate of 91.67%. Likewise, Ç, VO, ÇO and VÇO applications are also in the same group with V application. Among these applications, up to 7.3% change in emergence ratio is observed. The emergence rate obtained from the non-irrigated application decreased by 45.5% compared to the V application which had the highest emergence rate. On the other hand, germination and emergence ability of seeds obtained from the non-irrigated application were lower at half rate.

When comparing the emergence speeds; the irrigation periods produced the similar results, with the exception of O and non-irrigated application. This is indicated that irrigation is an important factor in vegetative development period and flowering-fruit set period for melon.

Table 2. The effects of irrigation in different growth period, seed germination and emergence rate, germination and emergence speed in melon (average of two years)

Application	Germination rate (%)		Germination speed		Emergence rate (%)		Emergence speed	
	Average	Rate of change (%)	Average	Rate of change (%)	Average	Rate of change (%)	Average	Rate of change (%)
Non-irrigated	51.67 DE	57.9	5.51 C	41.0	50.00 B	54.5	1.40 BC	52.4
V	85.83 AB	96.2	11.38 AB	84.4	91.67 A	100	2.58 A	96.6
Ç	80.00 ABC	89.7	6.94 BC	51.5	85.00 A	92.7	1.72 ABC	64.4
O	47.50 E	53.2	5.57 C	41.3	55.00 B	60.0	1.19 C	44.5
V+Ç	67.50 C	75.7	10.33 ABC	76.6	55.00 B	60.0	1.75 ABC	65.5
V+O	89.17 A	100	13.47 A	100	90.00 A	98.1	2.67 A	100
Ç+O	71.67 BC	80.3	7.76 BC	57.6	86.67 A	94.5	1.71 ABC	64.0
V+Ç+O	65.00 CD	72.9	9.60 ABC	71.2	90.00 A	98.1	2.33 AB	87.2
p<0.05	0.001		0.011		0.002		0.043	

Seed Mineral Contents

As a result of the mineral analyses of seeds, N, P, K, Mg, Cu, Fe, Zn and Na contents were not significantly affected from irrigation at different periods, otherwise, Ca and Mn contents were significantly influenced from water stress conditions (Table 3 and 4).

When the Ca content was examined, the highest value was obtained from VÇO application with 1360 ppm. The non-irrigated application gave the lowest Ca value with 1125 ppm. These findings indicated that the amount of Ca in the seeds was found to be lower in arid conditions. There isn't statistically

significant effect of drought on the other nutrients content. Mineral content rates in applications have been found between 5.71-5.32% in N, 0.74-0.58% in P, 0.87-0.81% K and 6014-5237 ppm in Mg. It is possible to say that plant nutrient uptake from the soil is negatively affected under dry conditions. Moreover, leaf senescence in plants exposed to arid conditions comes from the depletion of Ca (Seymen et al., 2017). In a study of melons, amount of Ca in leaf and rood declines in the arid conditions (Kuşvuran et al., 2011). The lack of Ca in the root and leaf indicated that the seed is affected by arid conditions.

Table 3. The effects of irrigation in different growth period on the N, P, K, Ca and Mg content in melon seed (average of two years)

Application	N (%)		P (%)		K (%)		Ca (ppm)		Mg (ppm)	
	Av.	Rate of c. (%)	Av.	Rate of c. (%)	Av.	Rate of c. (%)	Av.	Rate of c. (%)	Av.	Rate of c. (%)
Non-irrigated	5.32	93.1	0.59	79.7	0.85	97.7	1125.43 C	82.7	5667.04	94.2
V	5.71	100	0.68	91.9	0.81	93.1	1217.84 A-C	89.5	6014.16	100
Ç	5.65	98.9	0.63	85.1	0.82	94.2	1320.21 AB	97.0	5879.83	97.7
O	5.41	94.7	0.74	100	0.84	96.5	1266.56 A-C	93.1	5575.42	92.7
V+Ç	5.71	100	0.63	85.1	0.87	100	1271.78 A-C	93.5	5491.85	91.3
V+O	5.59	97.9	0.64	86.4	0.83	95.4	1195.42 BC	87.8	5672.18	94.3
Ç+O	5.63	98.6	0.59	79.7	0.82	94.2	1262.24 A-C	92.7	5237.86	87.1
V+Ç+O	5.57	97.5	0.58	78.3	0.83	95.4	1360.33 A	100	5421.60	90.1

Table 4. The effects of irrigation in different growth period on the Cu, Fe, Zu, Mn and Na content in melon seed (average of two years)

Application	Cu (ppm)		Fe (ppm)		Zn (ppm)		Mn (ppm)		Na (ppm)	
	Av.	Rate of c. (%)	Av.	Rate of c. (%)	Av.	Rate of c. (%)	Av.	Rate of c. (%)	Av.	Rate of c. (%)
Non-irrigated	21.08	83.9	84.06	93.4	108.03	96.5	36.99 A	100	2214.13	100
V	23.92	95.3	89.99	100	105.33	94.0	36.36 AB	98.3	2220.08	99.7
Ç	21.77	86.7	83.83	93.1	101.09	90.3	33.56 BC	90.7	2158.63	97.2
O	21.94	87.4	88.95	98.8	111.95	100	35.42 AB	95.7	2176.18	98.0
V+Ç	24.24	96.5	82.47	91.6	106.50	95.1	30.87 CD	83.4	2072.37	93.3
V+O	20.77	82.7	83.55	92.8	107.88	96.3	34.17 AB	92.3	2156.03	97.1
Ç+O	23.93	95.3	79.68	88.5	102.07	91.1	29.87 D	80.7	1930.04	86.9
V+Ç+O	25.10	100	73.14	81.2	96.56	86.2	30.32 D	81.9	2073.07	93.3
p<0.05	0.152		0.163		0.291		0.001		0.659	

The effects of the droughts on the micronutrient were examined and different changes were observed in Mn. The highest Mn content was obtained from the non-irrigated application with 36.9 ppm. The increase of the irrigation causes to decrease of Mn content in the seeds. In the seeds obtained from irrigation applications in ÇO and VÇO periods, the lowest Mn content values were obtained with 29.87 and 30.32 ppm respectively. Other micronutrients were not affected by dry periods. Microelement content has been found between 25.1-20.77 ppm in Cu, 89.99-73.14 ppm in Fe, 111.95-96.56 ppm in Zn and 2220-1930 ppm in Na. In general, an increase in the content of micronutrient of melon seeds has occurred in arid conditions. The drought conditions can prevent the uptake of Mn, Fe and Zn ions and are seen the lack of these ions in the plants (Havlin et al., 1999). Under drought or salt stress, micronutrient elements (such as Mn, Fe and Zn) accumulate in the plants and show differences in their ability to change from plant to plant. It has been reported that some plants have decreased while some have increased of micro element uptake in arid conditions (Seymen et al., 2017).

4. Conclusion

Today, when the effects of global warming and pollution are taken into consideration, the reduction of usable water resources necessitates more conservative use of water in agriculture because of available water resources are decreasing day by day. In this context, current studies concentrated on the most efficient use of water in agriculture. For the sustainability of irrigated agriculture with limited water resources; it should be preferred to grow crops with low water consumption, or the crops in the existing plant pattern should be irrigated with limited water at appropriate times.

In this study, yield parameters and germination - emergence performances of melon seeds obtained under limited irrigation conditions were varied. It is quietly important that the determine the effects of different irrigation periods on seed characteristics for widely grown plants in Konya Plain where seed production is the highest, in contrast, has limited water sources in Turkey.

Despite the fact that the drought has positive effects on the seedling width and length of the melon, the seeding weight and seed yield per fruit have been adversely affected. Besides, the irrigation applications during the vegetative development period and flowering-fruit set period had a seriously positive effect on the quality characteristics of the seed. On the other hand, in the case of irrigation only during fruit development-ripening period, the physical and quality characteristics of the seed did not show any significant difference from the seeds grown in arid conditions. In addition, only irrigation applications during O period produced low germination and emergence performances of the seeds. Drought caused significant changes in Ca and Mn contents of melon seeds. Ca content decreases while Mn content increases.

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EDIBLE LEGUMES AND GLOBAL CLIMATE CHANGE

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ABSTRACT

Global climate changes resulted by various harms such as acidification of soil or hurricane, drought, flooding etc. factors that are affecting all the living organisms by direct or indirect ways. By view of sustainability, water consumption is 11 times more in chicken meat and 18 times more in pork while CO₂ footprint is 0.5 kg in legumes and 9.5 kg in cows. Water efficiency of pulses compared by the other protein sources that 50 liters for 1 kg while that value is 4325 lt for chicken, 5520 lt for mutton and 13000 lt for beef. Pulses are able to fix nitrogen by symbiotic living with *Rhizobium* bacteria. So, pulses need to less organic and synthetic fertilizer which act an essential part to decrease in greenhouse gas emissions. It is estimated that, almost 190 million hectares of pulses in worldwide provide to 5-7 millions of tons of nitrogen in soils. Rotation programs including pulses decreases depletion and erosion risk of soil. Rotation of crops or intercropping with pulses presents more soil carbon sequestration potential than mono-crop growing. Additionally, pulses are known as "climate smart" plants that are simultaneously adapt to change in climate and reducing its effects. Furthermore, there is a broad genetic diversity of pulses which provides and makes it easy to improvement of the desired varieties. It is mandatory to take precautions for climate change which affects agricultural ecosystems and production, global food security, environment etc. components of sustainability, immediately. Present paper describes importance of legumes on changing environment.

Keywords: Agro-ecosystem, agricultural sustainability, global climate change, legume, nitrogen fixation.

INTRODUCTION

Legumes are most utilized plants by 20.000 species and one of the most important crops over the world, represents important effects on agriculture, environment, animal and human feeding and health. By view of world production, legumes have the third place following cereals and oilseeds having 27 % of crop production in the world while second food provider for human after cereals. Additionally, they have 33 % of dietary protein nitrogen of human and livestock need and primary source of amino acids. The most important legumes are bean, chickpea, cowpea, lentil and pea. Furthermore, peanut and soybean are main vegetable source legumes by 35 % contribution to processed vegetable oil over the world (Ashraf et al., 2010; Kudapa et al., 2013; Mantri et al., 2013; Azooz and Ahmad, 2015).

Majority of the grain legumes worldwide have limited genetic structure which are utilized for increased and improved yield and quality to develop new cultivars. Diversity of the cultivated crops and wild types are essential to enrichment of genetic base and use as commercial species (Singh et al., 2014). World population is expected to reach 9.6 billion in 2050 which means need for 70 % more

food production (Varshney and Roorkiwal, 2013). Legumes are one of the oldest cultivated plant group in the world (Materne et al., 2011) and some of them adapted to cool season (broad bean = faba bean, lentil, lupin, pea, chickpea, grass pea = lathyrus, vetch) in addition to warm climatic conditions adapted crops (pigeon pea, cowpea, urd bean = *Vigna mungo*) that are grown under hot and humid conditions (Singh et al., 2011). Due to many advantages of legumes which are mainly summarized by protein, oil, fibre, micronutrient, symbiotic associations with arbuscular mycorrhizal fungi, biological fixation of nitrogen, soil structure developer characteristics etc. features make the legumes as an essential crops for rotation programs.

Almost 90 % of arable lands where the crops grown are under one or more environment welded stresses. It is estimated that more than 50 % of crop loss is welded by abiotic stress in the world (Rodziewicz et al., 2014). Present paper reviews the global climate changes and importance of legumes for sustainable agricultural systems and environment – friend production systems.

Global Climate Changes and Agriculture

Changes in climate have several impacts which may be a vital task on affected countries due to various pressure on earth and human. The impacts are differ on climate, natural resources, biodiversity, ecosystem in addition to both positive and negative effects like changing biophysical relations, unintended of habitats, desertification and common alteration in natural world. In general, global warming has effects on plants related with respiration and some other biogeochemical treatments. Therefore, climate change may be evaluated under two titles; i) Greenhouse gas emission (CO_2 , CH_4 , N_2O), ii) Screening of adaptation (Amedie, 2013). Figure 1 shows greenhouse emission levels in 2004 (IPCC, 2007; Amedie, 2013).

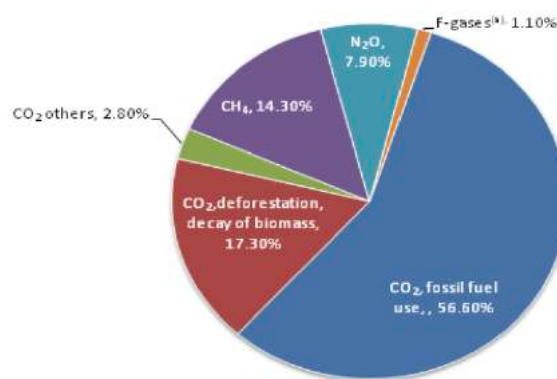


Figure 1. Main characteristics of climate change (Source: IPCC, 2007; Amedie, 2013). F-gases includes Hydrofluorocarbons (HFCs), Sulphurhexafluoride (SF_6) and per fluorocarbon (PFCs).

As it be predicted, change in climate causes to direct and indirect effects. Direct effects can be related with photosynthesis, using of nutrients, plant growth, yield and quality while indirect effects can be related with symbiotic relations, plant morphology, decomposition, mass flow, diffusion etc. components. Changes in atmosphere gives rise to changes in soil biotic and abiotic process as well. Therefore, the situation need to be evaluated by multidisciplinary sciences.

Abiotic Stress and Legumes

Main abiotic factors which are effective on legumes may be summarized by drought, salinity, waterlogging, extreme temperature, soil acidity and nutrient deficiency. These factors cause to huge losses in the global scale (Latef and Ahmad, 2015). As it same in the other plants, breeding of legumes are summarized under four process: 1) Variation creating (hybrid techniques, mutation), 2) Selection during early generations, 3) Evaluation of the selected lines, 4) Releasing of varieties (Toker and Mutlu, 2011). The mentioned stages may be realized by biotechnology, omics (proteomic, genomic, transcriptomic, metabolomic) screening for resistance genes, using of cultivated and wild genotypes (Latef and Ahmad, 2015).

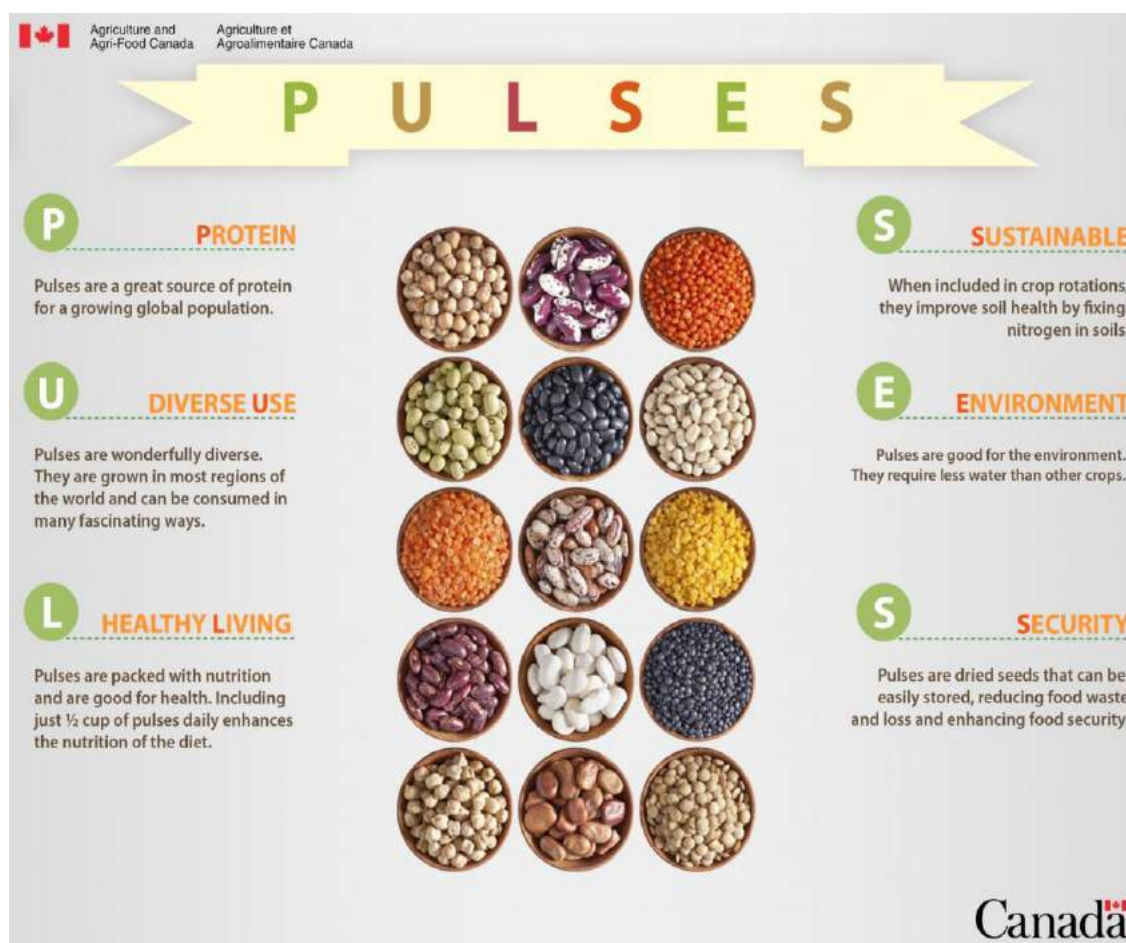


Figure 2. Main status of pulses which are essential for human and animal food (Source: Anonymous, 2018)

Figure 2 (Anonymous, 2018) presents the main characteristics of pulses that are indispensable for sustainable functional food production and agricultural systems. The figure explains stimulation of wider adaptation.

Climate changes caused to new tendencies in plant breeding programs causing to biotic and abiotic stress factors such as drought, water lodging, aluminum tolerance, nitrification inhibition, and decrease in lignin concentration in addition to increasing demand for ethanol and energy production. From this perspective, legumes are the essential crops because of the many advantages which make them as an eco-friendly crops (Jank et al., 2011). It is revealed that, researches to modification of

contents in minor bioactive components should be associated with evaluation of plant behavior against to biotic and abiotic stress factors that are effective on protein and nutrition quality – basic component of legumes as well (Burstin et al., 2011).

Report of FAO and ICARDA (Imtiaz et al., 2010) may summarized in the following lines. Changes in temperatures and precipitations have both negative and positive effects on legumes. Some benefits are; increase in water usage efficiency and photosynthesis, reduction of stomatal conductance and transpiration while negative effects on crop growing, terminal drought, intermittent drought and fragile ecosystem. Accepted characteristics in breeding for drought tolerance are; canopy temperature, stomatal conductance, carbon isotope discrimination (^{13}C), chlorophyll content and fluorescence, early flowering-vigor and maturity, root length, biomass, yield and yield components.

CONCLUSION

Every single agricultural areas may be faced by global climate change soon or late. That may cause to effects on farmer, private sector, customer, country and the world as well. Main tasks to avoid the negative effects of climate change can be focus on application of sustainable agricultural practices that are starting from effective fertilization and irrigation, energy consumption and developing of the well adapted plant varieties. For these purposes, there is need for the research programs to identify germplasm, developing of morpho-physiological tools for acceptable tolerance for heat and drought, determination of the optimum sowing dates, shortening of the vegetation period by early flowering and maturing, breeding for a wide adaptation, screening for morpho-physiological characteristics under various environment conditions. There are many legume species that are well adapted for various soil and climate conditions and they are also suggested for rotation programs due to be one of the a best choices for ecosystem, soil, environment and human health. As a conclusion, changes in climate is a truth of the world and there is need for more researches and increased yield and quality on legumes to combat with the negative climatic affects and application of sustainable agricultural principles.

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KIRGIZİSTAN'DA SEBZECİLİĞİN DURUMU, SORUNLARI VE ÇÖZÜM ÖNERİLERİ

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Özet

Bir tarım ve hayvancılık ülkesi olan Kırgızistan'da 1.185.000 ha alanda tarım yapılmaktadır. Kırgızistan'da en soğuk bölge Issık-köl olup bunu Talas bölgesi takip etmektedir. Yağışın en fazla düştüğü bölge Çüy bölgesi, en düşük düştüğü bölge ise Narın bölgesi olarak tespit edilmiştir. Sebzeçilik yapılan alan ise 48-49.000 ha arasında değişmektedir. En fazla sebze üretimi yapılan bölge Jalal Abad olup en fazla üretimi yapılan ürünler ise sırasıyla domates, soğan ve havuç olarak belirlenmiştir. Kırgızistan'ın sebzeçiliğinin en önemli sorunları ise arazilerin küçük olması, tohumluk üretiminin yeterli olmaması, yeni tekniklerin yeterince uygulanmaması ve üretim döneminin sınırlı olmasıdır.

Anahtar Kelimeler: Kırgızistan, Sebze Üretimi, Verim, Sorunlar.

Current Status, Problems of Vegetable Production in Kyrgyzstan and Proposal of Possible Solution

Abstract

In Kyrgyzstan, an agricultural and livestock country, agriculture is being carried out on 1,185,000 hectares. The coldest region in Kyrgyzstan is the Issyk-Köl, followed by Issyk-Köl the Talas region is the second coldest region in Kyrgyzstan. The region where the most received rain region is Çüy and the region where the lowest received rain region is determined as Narın region. The field of vegetable growing areas ranges between 48-49,000 ha. Most vegetables produced region is Jalal Abad with following vegetables; tomatoes, onions and carrots. The most important problems of the vegetables production of Kyrgyzstan are the small size of the production areas, the insufficient production of seed, the inadequate implementation of new techniques and the limited production period.

Keywords: Kyrgyzstan, Vegetable Production, Yield, Production Problems.

GİRİŞ

Artan nüfus ile birlikte beslenme ihtiyacı küresel ölçekte olduğu gibi ulusal ölçekte de ilgilenilmesi gereken en önemli sorunların başında yer almaktadır. Bilindiği gibi beslenme ihtiyacı insanın ilk ve en temel ihtiyaçları arasında yer almaktadır. Artan nüfusa yeterli gıda temin edilmesi görevi tüm dünya da olduğu gibi ülkeler özelinde çiftçilerin görevidir. Tarımsal alanların sınırlarının maksimum noktaya ulaştığı düşünülecek olursa birim alandan daha fazla üretim elde etme çalışmaları ya da vejetasyon periyodunu genişletme çalışmaları giderek önem kazanmaktadır. Bununla birlikte tarımsal üretim birçok kişinin temel geçim kaynağı durumundadır. Özellikle ekonomilerinde tarımın önemli yeri olan ülkeler için üretim ayrı bir önem arz etmektedir. Sebzeler, insan sağlığını dorudan etkileyen vitaminler, mineral maddeler ve antioksidant maddeleri içermekte olup, tarım ve beslenmenin dışında sanayide ve farklı sektörlerde hammadde olarak da kullanılmaktadır. Sebzeçilik, birim alandan yüksek verimin alınan ve gelirin yüksek olduğu bir tarımsal üretim dalıdır (Paksoy, Türkmen, & Direk, 2008). Bitkisel üretimde

birim alanda ortalama verim tarla bitkilerinden buğdaygillerde 396 kg/da, yumrulu bitkilerde 1366 kg/da olarak gerçekleşirken, temel sebzelerde bu değer ortalama 1886 kg/da değerine ulaşmaktadır (Anonim, 2016a). Ekonomisi tarıma yüksek oranda bağımlı ülkeler sebze yetiştiriciliği oldukça önemlidir.

Kırgızistan 39-48⁰ kuzey ve 47-75⁰ doğu enlemlerinde yer alan Orta Asya'nın 6 önemli ülkesinden birisidir. Azerbaycan, Kazakistan, Özbekistan, Tacikistan ve Türkmenistan gibi ülkeler ile birlikte Kırgızistan Orta Asya'nın sebze üretimi açısından potansiyel öneme sahip tarım merkezleri arasındadır. Ülke batı-doğu yönünde uzanan Tien Shan sıradağları ile 3 ana bölgeye ayrılmıştır (Ali, Lumpkin, & Farooq, 2005). Bu 3 ana bölge iklim ve diğer sosyoekonomik özellikleri bakımından kendi içerisinde 7 bölgeye (Çüy bölgesi, Celal – Abad bölgesi, Narın bölgesi, Talas bölgesi, Oş bölgesi, Isık - Göl bölgesi, Batken bölgesi) ayrılmaktadır. Ortalama yüksekliği 1000 m'nin üzerinde olan Kırgızistan'ın Fergana vadisi, Talas ve Çuy bölgelerinde bu ortalama yükseltinin altında kalan lokasyonlar da bulunmaktadır. %65'i dağlık bölge olan Kırgızistan topraklarında irili ufaklı yaklaşık 3000 göl ve çeşitli uzunluklara sahip olan 1582 adet nehir ile su açısından oldukça önemli bir rezerve sahipti. Nitekim bu durum toplam yüz ölçümünün % 4'üne tekabül etmektedir. Çoğu nehir kaynağını Tien Shan dağlarından almaktadır. Yükseltinin fazla olduğu dağlık alanlarda 600-900 mm'yi bulan yağış genellikle kar olarak düşmektedir. Dağlık alanların güney eteklerinde ise 200-335 mm yağış, yüksek vadilerde ise 100-150 mm yağış ortalamasına sahiptir. Bu kapsamda ülke genelinde yıllık ortalama yağış 300-500 mm arasında meydana gelmektedir. Daha çok kar yağışı olması ve tepelerden sızan suların nehirleri oluşturması nedeniyle bu durum birçok sebze grubu için sulama yapılması gerekliliğini ortaya koymaktadır. Kırgızistan iklimi genellikle kurak geçen yaz ayları ve soğuk geçen kış ayları ile karakterize edilebilir. Fakat yükseklik, dağların uzanışı ve yağışa bağlı olarak yüksek oranda lokal varyasyon göstermektedir. Temmuz ayında yükseltinin düşük olduğu yerlerde ortalama sıcaklık 27 °C gözlenmektedir. Ortalama don olmayan gün sayısı vadilerde 150 ile 212 arası iken dağlık bölgelerde 85 ile 150 gün arasında değişmektedir. Vejetasyon periyodu 200-240 gün arasında değişmektedir (van Gelder, 2004). Bu yüzden Kırgızistan'da ekonomik değeri olan ve faydalı nitelikte 1600 tür içerisinde üretimi 40 önemli tarımsal ürün yetiştirilmektedir (Abdivasiev, 2006). Bu bitkiler içerisinde Orta Asya'daki bu ülkelerde domates, soğan, havuç, lahana ve hıyar gibi sebzeler çoğunlukla üretilmektedir (Mavlyanova, 2012). Kırgızistan da bu üretim trendi içerisinde yer almaktadır.

20.000.000 ha olan Kırgızistan yüzölçümünün 10.555.000 hektarını tarım arazileri oluşturmaktadır. Ülkede 9.370.000 ha alan çayır ve meralar, 1.185.000 ha alan da tarım için kullanılmaktadır. 790.600 ha alan sulu tarımda ve kalan 395.300 ha alan ise kuru tarımda kullanılmaktadır. Ayrıca 2016 yılı verilerine göre 5,4 milyon olan toplam nüfusun yaklaşık 1,58 milyon kişi tarım ile ilgilenmektedir. Kırgız Cumhuriyeti'nin ekonomisi ağırlıklı olarak tarıma bağımlı olduğu görülmektedir. Tarım sektörü Gayri Safi Yurt İçi Hasıla'nın %20'sini oluşturmakta, faal işgücünün de çoğunluğu tarım sektöründe istihdam edilmektedir.

Kırgızistan'da 2015, 2016 ve 2017 yılları itibarıyla toplam işlenen alanlar içinde ortalama 48 000 ha alanda yapılan sebze tarımından ortalama 1 050 918 ton sebze üretilmektedir (Anonim, 2016b).

Kırgızistan henüz diğer ülkelerde temel sorun olan gübre, tarım ilaçları, tohumluk açısından tarafından kirletilmemiş durumdadır. Çiftçilerin eğitimi ve modern tarım teknolojilerinin kullanımında istenilen seviyeye ulaşamaması, çiftçilerin örgütlenememesi, üretim planlaması yapılamaması ve Türkiye tarımının da en büyük sorunlarından olan gelişmiş tarımsal üretim yapan ülkelere nazaran ortalama tarımsal arazilerin küçük olması gibi sorunlardan ciddi şekilde etkilenmektedir (Dogan, Arslan, & Berkman, 2015; Uçak, 2011). Özellikle Kırgızistan'da tarımsal araziler Sovyetler Birliğinin dağılmasıyla küçük aile işletmeleri şeklinde kırsal alanlarda devam ettirilmektedir. Tohumluk

ihtiyacının büyük kısmı Avrupa, Rusya, Çin ve Özbekistan gibi ülkeler karşılamaktadır. Bu da çiftçilerin üretimde girdi maliyetlerini arttırmaktadır. Dışarıdan alınan tohumlar dışında ekimi yapılan tohumların da verim, hastalık, zararlılara, sıcağa, kurağa ve tuzlu topraklarda karşı geliştirilmiş ya da bu alanlarda iyi performans verecek çeşitlerin tarımsal üretimde kullanılması gerekmektedir (Mavlyanova, 2015).

Bu araştırmada Kırgızistan'ın iklimsel özellikleri bölgelere göre irdelenmiş ve sebze tarımına uygunluğunun altı çizilmeye çalışılmıştır. Böylece ülkede sebze tarımının arzu edildiği kadar gelişmemesinin muhtemel nedenleri ve sebze tarımını geliştirebilmek için çözüm önerilerinde bulunulmaya çalışılmıştır.

Kırgızistan'da Tarımsal Üretim Yapılan Bölgelerin İklim Özellikleri

Ülkenin tüm alanının %90'ı deniz seviyesine göre ortalama 1500 m yüksekte yerleşmekte olup, ülkenin yarısından fazlasını (%65) dağlar kaplamaktadır. Buna rağmen Kırgızistan 1.185.900 hektar tarım arazisine sahiptir. Bu tarım arazilerinin tamamı etkin bir şekilde işlenememekle birlikte bu tarım arazilerine ait uzun yıllar ortalaması alınan iklim değerleri KC istatistik kurumundan elde edilmiş olup **Tablo 1**'de verilmiştir. Kırgızistan'ın iklimi kurak iklimler kuşağı olan soğuk step iklimi olarak tanımlanabilir. Gece ve gündüz sıcaklıkları arasında ciddi farklılıklar bulunmaktadır. **Tablo 2**. incelendiğinde genel olarak istisnai bölgeler bulunmakla birlikte yıllık en sıcak ayların Mayıs, Haziran, Temmuz, Ağustos ve Eylül ayları olduğu görülmektedir. Sebze yetiştiriciliği açısından uygun olan aylar Nisan-Eylül aylarını kapsamaktadır. İlkbahar geç donları nisan ayı içerisinde gerçekleşirken, sonbahar geç donları da ekim ayı içerisinde görülmektedir. Yıllık olarak yağışın da en düşük olduğu zamanlar bu aylara tekabül etmektedir (**Tablo 1.**). Bu aylarda sıcaklı bölgelere bağlı olarak -12 ile 42 derece arasında değişmektedir. Uzun yılların ortalamasına göre vejetasyon süresi içerisinde gözlenmiş en düşük sıcaklık Nisan ayında -12 °C ile Bişkek bölgesinde, en yüksek sıcaklık değeri ise 42,8 derece ile temmuz ayında Bişkek bölgesinde gözlenmiştir. Çüy (Bişkek), Clal abad, Oş, Batken ve Talas bölgelerinde çeşitli desenlerde açıkta sebze yetiştiriciliği gerçekleştirilebilir. Bu 5 aylık vejetasyon süresi içerisinde ortalama sıcaklık değerleri 9,8- 25,6 derece arasında seyretmektedir. Bu da birçok sebze grubunun yetiştirilebileceği anlamına gelmektedir. Yapılacak olan açıkta yetiştiricilikte ortalama sıcaklık değerleri incelendiğinde en dikkat edilmesi gereken dönem nisan ve eylül aylarında meydana gelen düşük sıcaklıklardır. Bölgelerde sürekli ve sürdürülebilir verimlilik için yetiştiricilikte bitkinin ihtiyaç duyduğu suyu yağışlar ile alması mümkün değildir. Bölgelerde başarılı bir sebze yetiştiriciliği için sulamanın zorunlu olduğu görülmektedir. Ekim ayında birçok bölgede 0 derecenin altında sıcaklıklar gözleneceği için açıkta sebzeçilik yapılmasının tehlikeli olacağı düşünülmektedir. Belirtilen zaman dilimi göz önüne alınarak yetiştiricilik yapılmalı ve yetiştiriciliğe kışlık sebze türleri eklenerek geçiş döneminin de biraz uzatılıp etkin bir şekilde kullanılabileceği göz önünde bulundurulmalıdır. Yetiştiricilik yapılan süreç içerisinde tarımsal üretim yapılan bölgelerdeki yağış miktarlarının düşük olduğu **Tablo 2.**'deki veriler incelendiğinde görülmektedir. Kırgızistan genelinde tarımsal arazilerin %8'inde sulu tarım, %4'ünde ise kuru tarım olarak yapılmaktadır.

Sıcaklık ve yağış ile birlikte sebze yetiştiriciliğini etkileyen diğer bir önemli faktör ise rüzgârdır. Rüzgâr yaprakların yüzeyindeki nemi uzaklaştırması ve dolayısıyla transpirasyon ve fotosentezi desteklemesi bakımından oldukça önemlidir. 2000-2007 yılları arasında rüzgâr hızı tüm bölgelerde 4m/s ve aşağısında görülürken aynı bölgelerde 2008-2010 yılları arasında oluşan rüzgârlarda bir dalgalanma meydana gelmiş ve hız 15 m/s'ye hıza çıkmıştır. Vejetasyon dönemindeki rüzgâr hızına bakıldığında rüzgâr hızının 4 - 15 m/s arasında değiştiği ve birçok sebze türünün yetiştiriciliğinde sorun teşkil etmeyeceği düşünülmektedir.

Tablo 1. Kırgızistan'da 7 bölgeye ait uzun yılların ortalamasına dayanan yıllık en yüksek, en düşük ve ortalama sıcaklık değerleri

Aylar	Bişkek			Oş			C.Abad			Batken			I.Göl			Narın			Talas		
	Min	Ort.	Mak.	Min	Ort.	Mak.	Min	Ort.	Mak.	Min	Ort.	Mak.	Min	Ort.	Mak.	Min	Ort.	Mak.	Min	Ort.	Mak.
°C																					
Ocak	-31	-3,6	19,2	-6	-3,8	2	-7,8	-3,1	1,7	-6,7	-2,8	1,2	-16	-10,2	-4,7	-21	-16	-10	-11	-7,2	-2,4
Şubat	-34	-2,3	25,3	-5	-1	4	-5,8	-0,4	4,6	-4,7	-0,5	3,7	-14	-8,1	-2,9	-18	-12,8	-7,4	-10	-5,5	-0,6
Mart	-21	4,3	30,5	2	6,4	12	1,6	7	12,5	1,2	5,8	10,5	-5,8	-0,3	4,8	-7,8	-3,2	1,4	-3,5	1,4	15,7
Nisan	-12	11,9	34,7	6	14,1	18	8,5	14,8	21,1	7,6	13,3	19,1	1,7	8,2	14	1,2	7	12,8	3,9	9,8	21,3
Mayıs	-5	16,7	35,6	11	18,9	25	13	19,7	26,5	11,5	18	24,6	6,8	13,1	18,8	5,5	11,4	17,4	8,5	14,9	26,6
Haziran	2,4	21,3	40,9	16	23	31	16,5	24	31,1	15,2	22,6	30	10,4	17,1	32,1	8	14,4	20,9	12,3	19,4	29,9
Temmuz	7,4	23,9	42,8	18	24,9	33	18,1	25,6	33,1	17,3	24,9	32,5	12,5	19,4	25,5	10,3	17,2	24,2	14,3	21,7	27,6
Ağustos	5,1	22,3	39,5	17	23,1	32	16,1	23,8	31,5	15,4	23,2	31,1	11,4	18,7	25	9,8	17,1	24,4	12,3	19,9	22,6
Eylül	-2,8	17,5	36,8	11	18,5	36,8	11,1	19,1	27,1	10,3	18,3	24,6	6,7	13,8	20,2	5,6	12,7	19,8	7,1	14,8	20,2
Ekim	-11	10,8	34,5	6	12	27	5,3	12,5	19,7	5,1	11,8	18,5	0,1	6,7	12,7	-0,3	5,9	12,1	1,4	8	14,6
Kasım	-32	3,5	27,9	-2	4,8	13	-0,4	5,4	11,2	-0,1	4,8	9,8	-7,1	-1,6	3,4	-8,6	-3,7	1,3	-4,3	0,9	6,1
Aralık	-29	-1,3	23,3	-4	-1	5	-4,7	-0,4	4	-4	0,-3	3,4	-12	-7,2	-2,3	-17	-12,4	-7,5	-8,7	-4,4	0
Yıllık ort.		10,4			11,7			12,3			11,6			5,8			3,1			7,8	

(Anonim, 2018)

Tablo 2. Kırgızistan’da 7 bölgeye ait uzun yılların ortalamasına dayanan yıllık ortalama yağış değerleri

Aylar	Yağış (mm)						
	Bişkek	Oş	C.Abad	Batken	I.Göl	Narın	Talas
Ocak	26	35	37	40	13	8	21
Şubat	30	44	44	39	14	11	22
Mart	48	55	58	57	24	19	38
Nisan	74	52	62	51	39	29	56
Mayıs	63	47	52	47	54	47	54
Haziran	35	18	23	16	51	57	34
Temmuz	15	12	12	8	51	36	18
Ağustos	11	6	5	3	47	21	8
Eylül	16	8	9	5	35	17	12
Ekim	40	38	43	32	30	14	30
Kasım	40	32	35	30	19	11	30
Aralık	29	32	36	39	13	8	27
Yıllık ort.	427	379	416	367	390	278	350

(Anonim, 2018)

Kırgızistan’da Ekonomik Durum ve Tarımın Payı

Kırgızistan İstatistik Kurumu verilerine göre 2016. Yılı için 20,73 milyar dolar olmuştur. Kırgızistan’ın ekonomisinde son 20 yılda tarımın payı önemli yer işgal etmiştir. 2016 yılında ise GSYİH’nin %14,54 ini oluşturmuştur. Ancak, son yıllarda hizmet ve sanayi sektörünün gelişmesiyle beraber tarımın payı azalmaktadır. Kırgızistan’da toplam nüfusun (5 400 000) yüzde %29,3’ü (1 580 000) tarım alanında çalışmaktadır.

Sovyet Birliği yıkılmasından sonra bağımsızlık kazanan Kırgızistan 1991-1995 yılları arasında tüm sektörlerde olduğu gibi tarım sektöründe de büyük bir kriz dönemi geçirmiştir. 1995 yılında tarım sektörünün GSMH’nin içindeki payı %43,9 iken, 2005 yılında %33,3 ve 2015 yılında ise %15,9’unu oluşturmuştur. Kırgızistan’da özel mülkiyete dayalı küçük aile işletmelerinin hakim olduğu bir tarımsal yapı mevcuttur. Tarım sektöründe 1990 yılında başlatılan reformlar sonucunda 1991 yılında 2000 kollektif-işletme, 1994 yılında 20 000 kooperatif oluşturulmuş ve 2001 yılında bu sayı 250 000 den fazla küçük aile işletmeleri haline dönüşmüştür. Buna bağlı olarak, 1994 yılında işletme başına 15 ha iken, 2002 yılında 3 ha olmuştur. Kırgızistan İstatistik Kurumu 2015 yılı verilerine göre toplam 401 419 küçük yapıli tarımsal işletme bulunmaktadır.

En büyük üretim alanı ve miktarına sahip olan üç büyük bölge sebze satışının gerçekleştirilmede de lider konumdadır. Çüy, Batken ve Oş bölgeleri üretime paralel olarak en yüksek sebze satışının da gerçekleştiği bölgeleridir (Tablo 3).

Tablo 3. Üretilen sebzelerin satış rakamları, ton

Bölgeler	2014	2015	2016
Batken	35460	30864	55222
Jalal-Abad	177582	282706	250591
Issık-köl	3132	4674	3337
Narın	1813	1203	1951
Oş	96537	152173	118735
Talas	36611	36966	39038
Çüy	215973	277227	255446
Bişkek	431	132	252
Oş (şehir)	2394	5205	6319

Anonim (2016b)

Kırgızistan'da Sebze Üretim Alanları ve Üretim Miktarları

Kırgızistan'da çeşitli bölgelerde yapılan 2015, 2016 ve 2017 yıllarına ait sebze üretim alanları ve üretim miktarları, bölgelere göre üretim alanları ve miktarları sırasıyla **Tablo 4 ve 5.**'te verilmiştir.

Sovyetler birliğinin dağılmasının ardından diğer Orta Aysa ülkelerinde olduğu gibi Kırgızistan'da da tarımsal üretim faaliyetleri azalmış ve sekteye uğramıştır. Kırgızistan ve Orta Asya'da ülkeleri üretim faaliyetlerini geliştirmek için ve arttırmak için belirli sebze türlerine yönelmişlerdir. Bu kapsamda Orta Asya ülkelerinin üretim deseninde lahana, domates, karpuz, hıyar, soğan ve havuç gibi sebzeler yer alır iken Kırgızistan'da bu sebzelere ek olarak pancar ve sarımsak da yetiştirilmektedir. Kırgızistan lahana, domates, karpuz, hıyar, soğan, havuç pancar ve sarımsak üretim miktarları **Tablo 4.**'te detaylı olarak verilmektedir. 1990'lı yılların başında bağımsızlığını kazanan Kırgızistan'ın bu dönemdeki sebze üretimi 404 bin ton civarında iken bu rakam 1999 yılında 719 bin tona ulaşmıştır (van Gelder, 2004). Bu durum 2015 yılı ve sonrasında 1 milyon ton üzerine çıkmıştır. Sebze üretim miktarları Kırgızistan'da 1990'lı yıllardan 2000'li yıllara kadar olan veriler incelendiğinde 2 kat artış göstermiştir. 1999 yılında hasat edilen alan Kırgızistan'da 47.308 hektar iken bu alan 2006 yılında 43.310 hektar ve 2015 yılı sonrasında ortalama 48 bin hektar civarındadır. 2006 yılı ve 2015 yılı ve sonrasındaki üretim alanları kıyaslandığında 5 bin hektarlık bir fark görülmektedir. 2015 yılından sonra bu alanlarda kayda değer bir artış görülmemesinin sebebi ülkenin çoğunluğunun günlük alanlardan oluşması ve dolayısıyla tarımsal üretim yapılacak arazi açısından maksimum değere ulaşmasıdır.

Tablo 4. Kırgızistan'da yetiştirilen sebzelerin toplam alanı (Ekilen Alan = 1000 hektar, Verim = 1000 ton)

Sebzeler	Ekilen Alan	Verim	Ekilen Alan	Verim	Ekilen Alan	Verim
	2015		2016		2017	
Soğan	9,1	192,3	8,6	183,3	9,1	202,4
Havuç	8,2	188,6	7,9	181	7,9	183,8
Lahana	6,8	147,5	6,6	145,4	6,6	147,2
Hıyar	5,4	110,4	5,9	117,1	6	118,3
Domates	11,4	226,7	11,6	234,7	11,5	229
Pancar	1,1	20,9	1,2	22,3	1,2	22,8
Sarımsak	3,1	42,3	3,1	42,7	3,6	52,7
Biber	3,5	121,8	3,8	138	3	127,7
Toplam	48,6	1050,5	48,7	1064,5	48,9	1083,9

Anonim (2016b)

Diğer Orta Aysa ülkelerinde olduğu gibi Kırgızistan genelindeki üretim alanları incelendiğinde; Domates üretim alanı ve miktarı açısından zirvede yer almıştır. Üç yıllık ortalama 11.000 hektar alandan ortalama 230.000 ton domates üretilmiştir. Domatesin akabinde yetiştiriciliği yapılan en önemli sebze soğandır. Ortalama 8900 hektar alandan 192.600 ton soğan üretilmiştir. Tablolar dikkatle incelendiğinde genellikle kışlık sebzelerin yetiştirildiği görülmektedir. Domates ve hıyar gibi düşük sıcaklığa oldukça hassas olan sebze türleri ise daha çok yaz aylarında ve seralarda yetiştirilmektedir. Üretim alanı 6000 hektarın altında olan sebzeler pancar, sarımsak ve biberdir. Üretim alanı düşük olan bu sebzeler içerisinde biber üretimi 100.000 tonun üzerindedir. Bu da yüksek verim ve yetiştiriciliğinin çiftçiler tarafından iyi yapıldığının bir göstergesidir. **Tablo 4.**'te dikkat çeken diğer bir veri de hıyar üretim alanının biber üretim alanından iki kat daha büyük olmasına rağmen üretim miktarının biberden daha az olmasıdır.

Tablo 5.'te bölgelerdeki tarım alanları ve toplam sebze üretim miktarlarını göstermektedir. **Tablo 5.** incelendiğinde en çok üretim alanına sahip bölgeler 10.000 hektarın üzerinde tarım arazisi ile Çüy ve Calal abad bölgeleridir. Oş bölgesindeki üretim alanında yıllara göre iniş ve çıkışlar gözlenmekle birlikte üretim alanı 10.000 hektar civarındadır. **Tablo 5.**'ün geneli incelendiğinde tüm üretim alanlarında iniş ve çıkışlar gözlenmekle birlikte yıllara göre sabit kalmıştır. Üretim miktarları açısından 2015 ve 2016 yılları arasında Batken ve Talas bölgelerinde bir sıçrama olmuştur. Diğer bölgeler de üretim alanlarında olduğu gibi dalgalanmalar ile birlikte ortalama 1 milyon ton üretim potansiyeline sahiptir. En fazla üretim bu 7 bölge arasından Çüy bölgesindedir. Yıllar göz önüne alındığında Çüy bölgesindeki üretim 385.085 ton ile başlayıp artarak 425.433 tona ulaşmıştır. Akabinde Jalal Abad bölgesi 265.944 ton üretimle başlayıp miktarı 290.017 tona çıkarmıştır. Bu iki bölgeyi takip eden ve kayda değer tarımsal üretim alanlarına sahip olan diğer bölge ise Oş bölgesidir. Yaklaşık 10 000 hektar tarımsal üretim yapılan araziden toplam 160.000 ton sebze üretilmektedir. Üç büyük bölge Kırgızistan ana üretim yüklenicileri konumundadır.

Tablo 5. Kırgızistan'da Bölgelere göre tarım alanları ve üretim miktarları (Ekim alanı = Hektar, Üretim = Ton)

Bölgeler	Ekilen Alan	Verimi	Ekilen Alan	Verimi	Ekilen Alan	Verimi
	2015		2016		2017	
Batken	2980	49825,6	3213	55272,7	3279	56354,2
Celal-Abad	11825	265944,3	11837	297479,5	11431	290017,5
Isık göl	2300	40020	2611	45490	2580	45215,6
Narın	519	5849,13	514	5926,4	509	5879,8
Oş	10034	176445,46	9386	166169	9801	178132
Talas	3757	72284,68	3932	84074,3	3936	84432,3
Çüy	20012	386347	19978	414898,2	20419	426695,7
Toplam	51427	996.716,17	51471	1.069.310,1	51955	1.086.727

Anonim (2016b)

Kırgızistan Sebzciliği Sorunları ve Çözüm Öneriler

Tarımsal üretimin Kırgızistan'da en büyük sorunlarının başında bağımsızlığın kazanılmasının ardından arazilerin bireyler ve kırsal kesimde yaşayan aileler arasında paylaşılarak bölünmesidir. Arazilerin bölünmesi ve küçülmesi tarımsal üretim açısından Türkiye'de olduğu gibi Kırgızistan'da büyük bir sorun teşkil etmektedir. Bu durum Türkiye'de olduğu gibi Kırgızistan Cumhuriyeti tarafından kontrolü altında toplulaştırılması ve mevcut arazilerin bölünmesinin engellenmesidir.

Arazi sorununu ardından en büyük problemlerden biri de tohumluk ihtiyacıdır. Sovyetler birliğinin dağılmasının ardından bu durum sektöre uğramış ve Orta Asya'daki diğer ülkelerin bazılarında olduğu gibi Kırgızistan da tohumluk temininde de yüksek oranda ya da tamamen dışa bağımlı durumdadır. Yeni çeşitlerin geliştirilmesi, üretilmesi ve kullanılması ciddi oranda zarar görmüştür. Bölgeye adaptasyonu yüksek, hastalıklara ve kurağa dayanıklı tohumluğun kullanılması gerekmektedir. Dünya Sebze Merkezi bölgede genetik kaynakların toplanması, yeni çeşitlerin geliştirilmesi ve yaygınlaştırılması çalışmalar başlatmıştır. Kırgızistan bu çalışmalara Dünya Sebze Merkezi ile iletişime gerek dahil olmalı ve tohumluğunu üretecek kapasiteye ulaşarak üreticiye kendi tohumluğunu düşük maliyet ile temin edebilecek duruma gelmelidir. Bunun için hâlihazırda bulunan araştırma enstitüleri ve benzer kurumlar ile özel sektör temsilcileri teşvik edilerek desteklenmelidir.

Arazi ve tohumluğun ardından en önemli eksiklik modern tarım tekniklerinin uygulanması, eğitimi ve teknik donanım eksikliğidir. Üretim kırsal kesimde hala insan gücüne ve dolayısıyla girdi maliyetinin yüksek olmasına sebep olmaktadır. Küçük arazilere sahip aile işletmelerinin işgücünden yararlanma ya da buna bütçe ayırma gücü bulunmadığı için araziler yeterli verimlilikte ve miktarda işlenememektedir. Ayrıca modern tarım tekniklerinin de bilinmemesi birim alandaki verimi etkilemektedir. Bu durumun en önemli çözümü Kırgızistan'da eğitim veren yükseköğretim kurumlarının bu eğitim eksikliğini kapatacak iş gücünü yetiştirmesi ve modern tarım tekniklerinin uygulanabilmesine ön ayak olmasıdır. Makineleşme konusunda çiftçiler kamu kurumları tarafından desteklenebilir, üretici birlikleri oluşturulabilir.

Diğer önemli sorunlardan biri de üretimin mevsimsel olmasıdır ve süreklilik arz etmemesidir. Kış aylarında sebze üretimi açısından dışa bağımlılık ciddi oranda artmaktadır. Bu da sebze fiyatlarının 10 kat gibi artışlar ile yükselmesine, halkın alım gücünün düşmesine ve sebze tüketim miktarının düşmesine sebep olmaktadır. Bu durumu en önemli çözümü ise kışın üretim yapabilecek alanların oluşturulması ve her mevsim taze sebze üretimi sağlanmasıdır. Bu da sera ve topraksız tarım uygulamalarını gündeme getirmektedir. Seraların ve topraksız üretim yapılarının kurulabilmesi ve işletilebilmesi için gerekli iş gücünün de yükseköğretim kurumları tarafından yetiştirilerek bu ihtiyaca karşılık vermesidir.

Sonuç olarak en önemli çözüm tarım açısından Kırgızistan'da birey ile başlamaktadır. Tarımsal üretim bilincine sahip bireyler mevcut sorunlar ile mücadele edebilecek, modern yöntem ve teknikleri temin edebilecek ve uygulayabilecek nitelikte olması tarımsal gelişimi hızlandıracaktır. Ekonomideki tarımın payı %20 civarında olan bir ülke için bu oldukça önemlidir. Kalifiye yetişmiş ziraatçılar iyi tohumu, iyi makineyi ve iyi uygulamaları talep edeceği ve bu durum tarımsal üretim ve diğer sektörler (makineleşme, zirai mücadele, ıslah çalışmaları, dış satım) açısından da bir talep oluşturacağı ve zincirleme bir gelişimi başlatacağı düşünülmektedir.

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BAZI JAPON GRUBU ERİK (*Prunus salicina* L.) ÇEŞİTLERİNDE ELLE YAPILAN MEYVE SEYRELTMESİNİN KALİTE ÜZERİNE ETKİSİ

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Özet

Japon grubu (*Prunus salicina* L.) erik meyve türü son yıllarda tüketiciler ve dolayısıyla üreticiler tarafından çok talep görmektedir. Bu nedenle de ülkemizde yetiştiriciliği günden güne artmaktadır. Pek çok meyve türünde olduğu gibi erik meyve türünde de çok fazla çiçeklenme olmakta ve tozlanma ve dölleme de sorun olmadığı zaman bu çiçeklerin çoğu meyve bağlamaktadır. Fazla ürün yükü meyve kalitesini ve ağacın fizyolojik durumunu etkilediği gibi bir sonraki yılın ürününü de etkileyebilmektedir. Seyreltme, meyve ağacı üzerinde normalden daha fazla bulunan tomurcuk, çiçek veya meyvelerin farklı yöntemlerle ağaçtan uzaklaştırılması işlemidir. Seyreltme ile hem meyve iriliği ve rengi artırılmakta hem de dal kırılmalarının önüne geçilmektedir. Bu çalışmada Japon grubu erik çeşitlerine ait Red Beauty, Golden Plamza ve TC Sun çeşitlerinde hiçbir uygulama yapılamayan kontrol ile %50 ve %70 küçük meyve seyreltmesinin verim ve kalite üzerine etkisi araştırılmıştır. Sonuçta en yüksek meyve ağırlığı TC Sun erik çeşidinde %70 seyreltme yapılan uygulamada 120.6 g olarak belirlenmiştir. Çeşitlerin SÇKM içerikleri ise %16.33 ile 13.5 arasında değişmiştir.

Anahtar Kelimeler: Erik, elle seyreltme, meyve ağırlığı, SÇKM

Hand Thinning Application Effects On Fruit Quality In Some Japanese Group (*Prunus salicina* L.) Plum Trees

Japanese group (*Prunus salicina* L.) plum fruit variety has been very popular in recent years by consumers and therefore producers. For this reason, cultivation of Japanese group plum fruit in our country is increased day by day. As well as in many fruit species, plum fruit also has a lot of flowering, and when there is no problem in fertilization and pollination during reproductive stage, fruits are produced from most of these flowers. Due to the excess amount of product loading, fruit quality and the physiological state of the tree can be affected this year as well as the product of the next year. Thinning is the process of removing buds, flowers, or fruits from the tree with different ways because any of them are found in a tree more than normal capacity. Thinning both increase fruit

quality (frit size and color) and prevent tree from branch breakage. For investigating thinning effects on fruit yield and quality, Japanese group plum varieties Red Beauty, Golden Plamza and TC Sun are thinned at 50% and 70% in terms of small fruits. Trees without thinning application are used as control in this study. As a result, the highest fruit weight was determined as 120.6 g in TC sun plum with 70% thinning. The soluble solid content of varieties varied between 16.33% and 13.5%.

Keywords: Plum, Hand Thinning, Fruit Weight, Soluble Solid Content

GİRİŞ

Erik meyve türü, Rosales takımının Rosaceae familyasından *Prunus* cinsi içerisinde yer alan sert çekirdekli bir meyve türüdür. *Prunus* cinsine ait dünya üzerinde 200'e yakın tür belirlenmiştir. Türkiye'de ki çeşitlerinde içinde bulunduğu Avrupa-Asya türleri kendi arasında; *Prunus cerasifera* Ehrh. (can erikleri); *Prunus domestica* L. (Avrupa erikleri) ve *Prunus salicina* Lind. (Japon erikleri) olmak üzere üç türü içermektedir (Özvardar ve Önal, 1990). 12.050,800 tonluk dünya erik üretiminin 8.033,196 tonluk kısmı Asya kıtasında üretilmekte, bunu Avrupa ve Amerika kıtaları izlemektedir (Anonim, 2016).

Türkiye'nin 2017 yılı erik üretim miktarı 291.934 ton olmuştur (TÜİK, 2017). Yetiştiriciliği yapılan standart ve yöresel erik çeşitlerinin bir çoğu *Prunus domestica* ve *Prunus cerasifera* türlerine aitken son yıllarda Japon grubu (*Prunus salicina*) erik çeşitleri ile sofralık üretime yönelik yeni bahçelerin kurulması üretimde önemli düzeyde artışa neden olmuştur.

Günümüzde meyve yetiştiriciliğinde yüksek verim yeterli olmamakta, irilik, şekil vb. gibi meyve kalite kriterleri de oldukça önem arz etmektedir. Erik meyve türünün de içerisinde yer aldığı sert çekirdekli meyve ağaçları genellikle bol miktarda çiçek açmakta ve ağaçlarda tozlanmanın ve yetiştirme koşullarının iyi olduğu dönemlerde açan çiçeklerin büyük bir oranı meyve bağlamaktadır. Meyve yükünün fazla olduğu dönemlerde gerek fotosentez sonucu oluşan besin maddeleri, gerekse de kökler vasıtasıyla alınan su ve suda erimiş besin maddeleri meyvelerin gelişmesi için harcanmaktadır. Bu nedenle ağaç gelişimi zayıflar ve bir sonraki yıl oluşacak çiçek tomurcukları azalır. Ağaç üzerindeki meyve sayısındaki artışla birlikte meyvelere giden besin maddesi miktarında azalışlar meydana gelir. Bunun sonucu olarak da meyveler yeterli iriliği alamayarak küçük kalırlar. Ayrıca ağaç üzerindeki meyveler tarafından karbonhidratların tüketilmesi sonucu ağaç yeteri kadar karbonhidrat depolayamamakta ve kış soğuklarından zarar görebilmektedir. Meyve yetiştiriciliğinde, oluşan bu çiçeklerin belli bir oranının meyve tutması arzu edilir (Westwood, 1995). Çeşitli yöntemlerle çiçek veya meyve seyreltmesi yaparak, bu olumsuzlukların ortadan kaldırılması mümkün olabilmektedir. Seyreltme ile meyve iriliği ve renginin artırılması yanında; dal kırılmalarının önlenmesi, periyodisitenin kontrol edilmesi, kış soğuklarına dayanıklılığının artırılması, hastalık ve zararlılarla mücadelede başarının artması, hasat ve boylama giderlerinin azaltılması gibi birçok yarar sağlanabilmektedir (Bangerth ve Quinlan, 2000, Webster, 2002, Wertheim, 2000, Williams ve Marini 2002). Seyreltme, elle, mekanik veya bitki büyümesini düzenleyici maddelerin ve bazı insektisitlerin kullanımı ile kimyasal olarak çiçek ve meyvelerin seyreltilmesi şeklinde yapılmaktadır (Rom, 2001).

Denemede kullanılan elle meyve seyreltmesi üreticiler için ağaç üzerinde ürün yükünün açıkça belirlenmesi açısından önemlidir. Elle seyreltmenin en önemli dezavantajı ise işçilik maliyetini artırmasıdır (Webster, 2002).

Bu çalışmanın amacı son yıllarda iç ve dış pazar talebi artan Japon grubu erik çeşitlerinde aşırı meyve tutumuna bağlı kalite kayıplarının önüne geçmek amacıyla elle yapılan meyve seyreltmesinin verim ve kalite üzerine etkilerini araştırmaktır.

MATERYAL VE YÖNTEM

Materyal

Deneme Kahramanmaraş Sütçü İmam Üniversitesi Ziraat Fakültesi uygulama alanında bulunan 2007 yılında kurulan erik parselinde yürütülmüştür. Denemede materyal olarak Japon grubu eriklerden Red Beauty, Golden Plamza ve TC Sun çeşitleri kullanılmıştır. Tesadüf parselleri deneme desenine göre kurulan denemede her çeşitten 3 ağaç seçilmiş her ağaçtan da her uygulama için 3 er dal belirlenmiştir. Dallara 0, %50 ve %70 düzeylerinde küçük meyve seyreltmesi yapılmıştır. Elle seyreltme uygulamaları meyvelerin çapı 10-15 mm ye ulaştığı zaman uygulanmıştır. Denemede, hasat edilen meyvelerde pomolojik analizler yapılmıştır.

Yöntem

Denemede; meyve ağırlığı (g), meyve eni (mm), meyve boyu (mm), meyve yüksekliği (mm), meyve eti kalınlığı (mm), çekirdek ağırlığı (mm), çekirdek eni, çekirdek boyu ile suda çözünür kuru madde miktarı (%), pH, meyve kabuk üst rengi ve meyve eti rengi kriterlerine bakılmıştır.

BULGULAR VE TARTIŞMA

Denemeye ait olgunlaşmış meyvelerin pomolojik analiz sonuçları aşağıda verilmiştir;

Meyve ağırlığı (g), Meyve eni (mm), Meyve boyu (mm), Meyve yüksekliği (mm)

Çalışmada incelenen çeşitlerin meyve ağırlığı, meyve eni, meyve boyu ve meyve yüksekliğine ait veriler ve istatistik analiz sonuçları Tablo 1’de verilmiştir. Bu özellikler bakımından çeşitler arasında istatistiksel anlamda %5 seviyesinde önemli farklılık saptanmıştır.

Meyve ağırlığı üzerine seyreltme uygulamalarının etkisi incelendiğinde en yüksek değere TC Sun çeşidinde %70 elle seyreltme uygulamasında 120.6 g ile ulaşıldığı bunu Golden Plamza çeşidinin yine %70 seyreltme uygulamasının (91g) takip ettiği belirlenmiştir (Tablo 1). Çeşitler meyve eni, boyu ve yüksekliği açısından değerlendirildiğinde yine en yüksek değerlere TC Sun çeşidinin %70 seyreltme uygulamasıyla (sırasıyla 59.7 mm, 60.4 mm, 61.0 mm) ulaşılmıştır (Tablo 1).

Avan (2015) Kahramanmaraş ekolojik koşullarında yapmış olduğu adaptasyon çalışmasında Red Beauty çeşidinin meyve ağırlığını 40.91 g, TC Sun çeşidinin ise 41.91 g olarak belirlemiştir. Van ekolojik koşullarında yapılan bir adaptasyon çalışmasında ise TC Sun çeşidinin eni 42.82 mm, boyu 47.45 mm, yüksekliği 39.57 mm, meyve ağırlığı ise 52.45 g olarak tespit edilmiştir (Bostan, 1997). Son (2010) Black Beauty, Black Amber ve Fortune erik çeşitlerinin meyve ağırlığını sırasıyla 83.35, 65.14 ve 82.58 g olarak, meyve boyunu 45.46 ile 52.47 mm, meyve enini ise 50.48 ile 52.16 mm aralığında tespit etmişlerdir.

Bu çalışmalarla karşılaştırıldığında yapmış olduğumuz seyreltme uygulamalarının çeşitlerin meyve irilikleri üzerine olumlu etki yaptığı görülmektedir.

Tablo 1. Deneme çeşitlerine ait meyve ağırlığı (g), meyve eni (mm), meyve boyu (mm), meyve yüksekliği (mm), değerleri

Çeşitler	Seyreltme oranları	Meyve ağırlığı (g)	Meyve eni (mm)	Meyve boyu (mm)	Meyve yüksekliği (mm)
Red Beauty	kontrol	74,8 b	49.7 ab	48.08 bc	46.1 b
	%50	78,4 b	51.5 ab	48.8 bc	47.1 b
	%70	76,7 b	50.3 ab	48.7 bc	47.7 b
Golden Plamza	kontrol	73,9 b	50.8 ab	45.6 c	45.9 b
	%50	70.2 b	46.3 b	48.4 bc	45.6 b
	%70	91.0 ab	52.3 ab	50.3 bc	51.1 b
TC Sun	kontrol	86.4 b	50.5 ab	50.9 bc	48.0 b
	%50	85.5 b	56.7 ab	56.6 ab	50.3 b
	%70	120.6 a	59.7 a	60.4 a	61.0 a
		0.10	0.11	0.22	0.01

Ö.D.: Önemli değil; $p < 0.05$

Meyve eti kalınlığı (mm), Çekirdek ağırlığı (g), Çekirdek eni (mm), Çekirdek boyu (mm)

Çalışmada incelenen çeşitlerin meyve eti kalınlığı, çekirdek ağırlığı, çekirdek eni ve çekirdek boyuna ait verilerin istatistik analiz sonuçları Tablo 2’de verilmiştir. Uygulamaların meyve eti kalınlığı üzerine etkisine bakıldığında en kalın etli meyvelerin 21.9 mm ile TC Sun çeşidinin %70 seyreltme yapılan uygulamasından elde edildiği, bu özellik bakımından en düşük değere ise 14.0 mm ile Red Beauty çeşidinde %50 seyreltme uygulamasının sahip olduğu belirlenmiştir (Tablo 2).

Tablo 2. Deneme çeşitlerine ait meyve eti kalınlığı (mm), çekirdek ağırlığı (g), çekirdek eni (mm) ve çekirdek boyu (mm) değerleri

Çeşitler	Seyreltme oranları	Meyve eti Kalınlığı (mm)	Çekirdek Ağırlığı (g)	Çekirdek Eni (mm)	Çekirdek boyu (mm)
Red Beauty	kontrol	15.1 b	1.3 c	9.0	17.9 b
	%50	14.0 b	1.5 c	9.3	20.0 ab
	%70	15.6 b	1.5 c	9.0	20.3 ab
Golden Plamza	kontrol	18.6 ab	2.7 b	9.0	19.1 ab
	%50	15.6 b	3.0 b	8.8	19.8 ab
	%70	17.4 ab	2.6 b	11.5	20.0 ab
TC Sun	kontrol	17.7 ab	2.7 b	9.6	19.7 ab
	%50	18.9 ab	3.4 ab	10.7	22.6 ab
	%70	21.9 a	4.0 a	11.6	23.7 a
		0.16	0.04	ÖD	0.63

Ö.D.: Önemli değil; $p < 0.05$

Avan (2015) yapmış olduğu adaptasyon çalışmasında Red Beauty çeşidinin meyve eti kalınlığını 20.02 mm, TC Sun çeşidinin ise bu özellik bakımından değerini 15.34 mm olarak tespit

etmiştir. Bu değerleri çalışmamızın kontrol değerleri ile karşılaştırdığımızda Red Beauty çeşidinin çalışmamız sonucunda daha düşük değere sahip olduğu TC Sun çeşidinin ise daha yüksek meyve eti kalınlığına sahip olduğu belirlenmiştir.

Çeşitler çekirdek ağırlığı, çekirdek eni ve boyu açısından değerlendirildiğinde en yüksek değerlerin (sırasıyla; 4.0 g, 11.6 mm, 23.7 mm) TC Sun çeşidinin %70 seyreltme uygulamasından elde edildiği görülmektedir. Genel olarak çekirdek ağırlığı bakımından çeşitlerin kontrol uygulamaları diğer iki uygulamaya göre daha düşük değerlere sahip olmuştur (Tablo 2). Yapılan seyreltme uygulamalarının TC Sun çeşidinde kontrole göre oldukça belirgin fark yarattığı görülmektedir (Tablo 2).

Meyvelerin % SÇKM ve pH içerikleri

Çalışmada incelenen çeşitlerin SÇKM ve pH içeriklerine ait veriler ve istatistik analiz sonuçları Tablo 3’de verilmiştir. % SÇKM içeriği bakımından çeşitler arasında istatistiksel anlamda %5 seviyesinde önemli farklılık saptanmıştır. TC Sun çeşidinin %70, %50 ve kontrol uygulamaları SÇKM içeriği bakımından diğer iki çeşitten daha yüksek değerlere (sırasıyla; %16.3, 16.1 ve 16.0) sahip olmuştur (Tablo 3). pH değerleri açısından tüm uygulamalar ve çeşitler aynı grupta yer almışlardır.

Avan (2015), tarafından Kahramanmaraş koşullarında yapılan adaptasyon çalışmasında SÇKM içeriği bakımından Red Beauty çeşidi %14.90, TC Sun çeşidi %19.60 değerlerine sahip olurken, pH içeriği bakımından Red Beauty çeşidinin 2.86, TC Sun çeşidinin ise 3.44 değerine sahip olduğu belirlenmiştir.

Westwood (1978) yetiştirilen çeşide ve ekolojiye bağlı olarak erik çeşitlerinin SÇKM içeriğinin % 14-16, Diaz-Mula ve ark. (2009) ise 10-15 aralığında değişebileceğini bildirmişlerdir.

Tablo 3. Çeşitlerin % SÇKM ve pH değerleri

Çeşitler	Seyreltme Oranları	SÇKM (%)	pH
Red Beauty	Kontrol	14.7 b	3.25
	%50	13.5 c	3.26
	%70	15.4 ab	3.27
Golden Plamza	Kontrol	15.4 ab	3.22
	%50	15.6 ab	3.27
	%70	15.8 ab	3.19
TC Sun	Kontrol	16.0 a	3.37
	%50	16.1 a	3.15
	%70	16.3 a	3.11
		0.0076	ÖD

Ö.D.: Önemli değil; $p < 0.05$

Meyve kabuk rengi, Meyve et rengi

Çalışmada incelenen çeşitlerin meyve kabuk rengi ve meyve et rengine ait veriler ve istatistik analiz sonuçları Tablo 4’de verilmiştir.

Çeşitler meyve parlaklığını ifade eden L renk değeri açısından değerlendirildiğinde en parlak meyveler TC Sun çeşidinin %70 ve %50 seyreltme uygulamaları ile Golden Plamza çeşidinin kontrol ve %50 seyreltme uygulamalarına ait olmuştur. Rakamlar yükseldikçe kırmızı rengin yoğunluğunu ifade eden a* değeri bakımından en yüksek değerler Red Beauty çeşidinin %50 seyreltme (8.9), kontrol (8.06) ve %70 seyreltme(8.03) uygulamalarına ait olmuştur. Sarı rengi ifade eden b değeri açısından en yüksek değerler TC Sun ve Golden Plamza çeşitlerine ait olurken bu renk açısından en düşük değerlere Red Beauty çeşidinin tüm uygulamalarından elde edilen meyvelerin sahip olduğu belirlenmiştir (Tablo 4).

Kahramanmaraş ekolojik koşullarında yürütülmüş olan bir çalışmada en parlak meyveler (L* 61.35) TC Sun çeşidinde elde edilirken, en mat meyveler (L* 29.55) Red Beauty çeşidinde elde edilmiş, en kırmızı meyveler Red Beauty (a* 15.64) çeşidinde, en yeşil meyveler TC Sun (a* 5.06) çeşidinde saptanmış, koyu sarı meyveler TC Sun (b* 38.68) çeşidinde elde edilirken, açık sarı meyveler Red Beauty (b* 9.49) çeşidinde belirlenmiştir (Avan, 2015). Meyve kabuk rengi açısından her iki çalışmanın sonuçları benzerlik göstermektedir.

Çeşitler meyve et renginin parlaklığını ifade eden L değeri ve sarı-yeşil rengi ifade eden b değerleri açısından istatistiksel olarak aynı grupta yer almışlardır. Meyve etinin rengi açısından çizelge incelendiğinde rakamlar artıkça kırmızılığı ifade eden a değeri açısından ise en yüksek değerin Golden Plamza çeşidinin %50 seyreltme uygulamasına ait olduğu belirlenmiştir (Tablo 4).

Tablo 4. Çeşitlerin meyve kabuk ve meyve et rengi değerleri

Çeşitler	Seyreltme oranları	Meyve kabuk rengi			Meyve et rengi		
		L	a	b	L	a	b
Red Beauty	Kontrol	18.40 c	8.06 a	2.87 c	37.56	0.56 ab	18.41
	%50	20.22 bc	8.9 a	3.01 c	35.11	-1.90 b	15.0
	%70	18.52 c	8.03 a	2.29 c	31.07	-0.38 ab	13.73
Golden Plamza	Kontrol	49.62 a	-0.58 b	21.42 a	39.62	-0.43 ab	16.73
	%50	47.14 a	2.0 ab	20.9 a	41.08	4.76 a	14.41
	%70	38.5 ab	-2.08 b	21.5 a	43.13	-2.43 b	14.56
TC Sun	Kontrol	36.74 abc	-4.91 b	15.0 b	26.55	-0.85 ab	15.03
	%50	50.17 a	-4.86 b	22.65 a	40.0	1.98 ab	16.71
	%70	52.66 a	-3.14 b	24.5 a	48.84	2.18 ab	19.0
		0.04	0.53	<0001	ÖD	0.0040	ÖD

Ö.D.: Önemli değil; p<0.05

SONUÇ

Son yıllarda ülkemizde hem iç pazarda hem de dış pazarda Japon grubu erik çeşitlerine talebin artması üreticileri bu meyve türünün yetiştiriciliğine yöneltmiştir. Üreticilerin bu meyve türüne olan ilgisi bu ürünün yetiştiriciliği sırasında ortaya çıkan sorunlara da çözüm önerilerinin aranmasını beraberinde getirmiştir.

Erikte hava şartlarının normal gittiği yıllarda genellikle çok fazla miktarda meyve tutumu olmakta ve ağaçlar üzerlerindeki tüm meyveleri beslemek durumunda kaldıkları için elde edilen meyveler küçük ve kalitesiz olmaktadır. Bu durum aynı zamanda ertesi yılın ürün yükünü de olumsuz etkilemektedir. Tüketicilerin meyvelerde görünüş ve yapısal kaliteye verdikleri önem, tat ve besin kalitesine göre daha fazladır. Dolayısıyla meyve dış görünüşünü iyileştirecek uygulamalar, pazarlanabilirlik ve karlılık anlamında da önem kazanmaktadır. Bu nedenle erik meyve türünde verim ve kaliteyi artırmak için seyreltme uygulamaları önerilmektedir.

Çalışmamızda üretimi her geçen gün artmaya devam eden Japon grubu erik çeşitlerinde meyve kalitesini artırmak için elle meyve seyreltmesi yapılmıştır. Materyal olarak kullanılan Red Beauty, Golden Plamza ve TC Sun çeşitlerine 0, %50 ve %70 elle seyreltme işlemi uygulanmıştır.

Seyreltme uygulamalarının çeşitlerin meyve ağırlığı üzerine etkilerine bakıldığında en olumlu etki TC Sun çeşidinin %70 seyreltme uygulamasından elde edilmiştir, yine çeşitler arasında meyve eni, boyu ve yüksekliği bakımından en etkili seyreltme uygulaması TC Sun çeşidinde %70 elle seyreltme uygulamasında gerçekleşmiş olup uygulamaların bu özellikler açısından diğer çeşitler üzerine etkileri arasında çok büyük farklılıklar gözlenmemiştir. Meyve eti kalınlığı, çekirdek ağırlığı, çekirdek eni ve çekirdek boyu açısından da en yüksek değerler TC Sun çeşidinde %70 elle seyreltme uygulamasına ait olmuştur.

Uygulamaların çeşitlerin SÇKM içerikleri üzerine etkisine bakıldığında tüm çeşitlerde %70 elle seyreltme uygulaması en yüksek SÇKM oranını vermiş, çeşitlerin pH değerleri üzerine uygulamaların etkisi önemsiz bulunmuştur. Meyve kabuk rengi dikkate alındığında TC Sun çeşidinin L değerini gösteren parlaklığı üzerine %70 ve %50 seyreltme uygulamaları etkili olmuştur. Bunun dışında uygulamaların meyve kabuk rengi ve meyve et rengi üzerine çok büyük etkilerinin olmadığı görülmüştür.

Sonuç olarak özellikle kaliteli meyve eldesi için yapılan kültürel işlemlerden biri olan elle seyreltme uygulamasının Japon grubu erik çeşitlerinde olumlu etkilerinin olduğu belirlenmiştir. Ancak elle seyreltme uygulamaları fazla işgücü gerektirdiği için maliyeti artırmakta buda üreticiyi maddi açıdan olumsuz etkilemektedir. Türkiye’de erik meyve türünde seyreltme ile ilgili çalışmalara rastlanmamıştır. Bu çalışma ile erik meyve türünde yapılacak meyve seyreltmeleri ile kalitenin artacağı ortaya konmuştur. Bundan sonraki yapılacak olan çalışmalarda diğer seyreltme yöntemleri de denenerek üreticiyi işçilik maliyetinden kurtaracak daha avantajlı ve kolay uygulamalar ile net sonuçlar ortaya konmalıdır.

Teşekkür

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CUMHURİYET DÖNEMİNDE TÜRKİYE’DE PATATES ZİRAATI (1923-1950)

N. Yurtoğlu⁵

Özet

Bu araştırmada 1923 ile 1950 yılları arasında Türkiye’nin çeşitli bölgelerinde yetiştirilen yumru bitkiler arasında yer alan patatesin üretim ve ekim alanları miktarı ile ekonomiye olan yansımaları ele alınmıştır. Konu, 1923-1950 yılları arasında Türkiye’de patates üretim faaliyetleri ile sınırlandırılmış ve bu başlık etrafında incelenmiştir. Patates üretim çalışmaları ele alınırken sayısal veriler üzerinde değerlendirilmelerde bulunulmuştur. Çalışmanın kaynak materyalini, Cumhuriyet arşivi belgeleri, resmi yayınlardan; istatistik yıllıkları ve dönemin süreli yayınları arasında bulunan çeşitli ekonomi ve tarım dergilerinin makaleleri oluşturmaktadır. Konu incelenirken dönemin Türkiye’inde yetiştirilen ve türleriyle farklı şekilde adlandırılan patates çeşitleri göz önüne getirilerek gerekli değerlendirmeler yapılmıştır. Çalışmada elde edilen sonuç şudur: 1923 ile 1950 yılları arasındaki 27 yıllık dönemde halkın ve ordunun beslenmesi açısından gerekli sanayi bitkilerinden biri olarak kabul edilen patatesin ülkenin iklim ve toprak özelliği bakımından farklı bölgelerinde yetiştirilmesine özen gösterilmiştir. Ekonomik açıdan önem arz eden bu patateslerin bir kısmı üretimi gerçekleştiren ailelerin beslenme ihtiyacını karşılarken, kalanı da gelir elde etmek için piyasaya sürülmüştür. Türkiye’nin iklim ve toprak özelliği bakımından patates ziraatına elverişli bulunması bir yandan ülkenin bütün yörelerini patates tarımına teşvik ederken öbür taraftan II. Dünya Savaşı süreci ve sonrasında halkın ve ordunun beslenme ihtiyacının giderilmesini sağlamıştır.

Anahtar Kelimeler: Patates Ziraatı, Yumru Bitkiler, Sanayi Bitkileri, Beslenme, Cumhuriyet Dönemi

POTATO AGRICULTURE IN TURKEY IN THE REPUBLIC PERIOD (1923-1950)

Abstract

This study deals with the amount of production and cultivation areas of potato, which is among the tuber crops grown in various regions of Turkey, from 1923 to 1950 and its reflections on economy. The subject is limited to and addressed under the title of potato production activities in Turkey from 1923 to 1950. Evaluations on potato production activities have been made based on numeric data. The source material of the study consists of Republic archive documents and official publications such as statistical annuals and articles from various economy and agriculture magazines of the period. The relevant evaluations have been made considering the species of potato cultivated in Turkey in that period. The study has found out that attention was paid to growing potato, which was regarded as one of the necessary industrial crops for nutrition of the people and the army, in different regions of Turkey in terms of climate and soil characteristics in the 27-year period from 1923 to 1950. While some of those potatoes, which were economically important, met the nutrition requirements of the families producing them, the rest were placed on the market to earn income. The suitability of Turkey’s climate and soil characteristics for potato production both encouraged all regions of the country to grow potato and allowed meeting the nutrition needs of both the people and the army in the process and aftermath of the World War II.

Key Words: Potato Agriculture, Tuber Crops, Industrial Crops, Nutrition, Republic Period

Giriş

Dünyada buğday, pirinç ve mısırdan sonra en önemli temel gıda mahsulü durumunda bulunan yumru bitkilerden olan patates, çağlar boyunca toplumları ve kültürleri değiştirirken toplumlar da patatesi değiştirmiştir. Güney Amerika’da gelişen antik uygarlıklarının özellikle de And Dağlarındaki İnkaların kültürlerinde patates ve yumrulu bitkilerin ne kadar önemli bir yer tuttuğu bilinmektedir. İnkalar ve öncülleri, hasat ettikleri patates yumrularını, And dağlarında hemen her gece sıfırın altına düşen sıcaklıkta yere sererek dondurmuş, ardından da ayaklarıyla çiğneyerek ve elle sıkarak sularını akıtıp birkaç gün içinde kurutmuştur. Elde edilen bu işlem sayesinde toksin maddelerinden arındırılan

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patates, suyunun önemli bir kısmını kaybedip kurutularak toprak altı depolarında uzun süre bozulmadan saklanabilmiş, bu aynı zamanda patatesin çok daha kolay taşınabilme imkânına da kavuşmasını da sağlamıştır (Çetiner, 2016a).

Patatesin ilk defa Kanarya adalarına getirilip yetiştirildiği, oradan 1567'de Belçika'nın Anvers ve 1574'de Fransa'nın Rouen limanlarına sevk edildiği bilinmektedir. Patatesin üretim için Kanarya adalarına 1562 yılında geldiği tahmin edilmektedir. Bu tarih Pizarro'nun Peru'yu keşfettiği 1532 yılından 30 yıl sonrasını işaret etmektedir. Hâlbuki mısır, biber, domates, tatlı patates ve kasava gibi diğer Yeni Dünya bitkileri Kristof Kolomb'un daha 1492 yılındaki ilk seferinde ya da hemen sonrasında bulunmuştur. Bu gecikmenin nedeni Peru'nun ve diğer patates yetiştirilen bölgelerin daha sonra keşfedilmesi ve patatesin bölgeyi işgal eden İspanyollar tarafından benimsenmemesine bağlanmıştır (Çetiner, 2016). Patates 1850 yılından itibaren Rusya'dan Kafkasya yoluyla Türkiye'ye girerek ilk kez Doğu Anadolu ve Karadeniz Bölgesi yaylarında yetiştirilme imkânına kavuşmuştur.

Patatesin Adapazarı Ovasında yetiştirilip buradan Anadolu'ya yayılmasında Hüdavendigar (Bursa) Valisi Ahmet Vefik Paşanın (1823-1891) büyük rolü olmuş, Paşa patatese adeta büyük rağbet etmiştir. Toprak kokan bir ürün olan patatesin köylüler tarafından fazla ilgi görmediği, ancak daha sonra 15 yıl süreyle öşürden muaf tutulmak suretiyle bölgeye yayılmasına çalışıldığı, bu süreden sonra tarla ziraatı halinde yetiştirilmeye başlandığı bilinen bir gerçektir. 1908 -1910 yıllarında Marsilya'dan sağlıklı patates tohumlarının getirilmesiyle verimde önemli artışlar elde edilmiş, patatesin zamanla faydalı ve kazançlı bir bitki olduğu anlaşılmıştır. Bunun üzerine, patates tarımı Türkiye'de hızla yayılmaya başlamıştır (Benlioğlu, 1948).

1912 yılında 14.000 hektar araziye patates ekiminden 59.500 ton patates elde edilirken, hektar başına alınan verim 4.250 kg olmuştur (Çavdar, 1971). 1913 yılında ise 16.000 ton araziye patates ekiminden 42 milyon kuruş değerinde 71.000 ton ve 1914 yılında 20 bin hektar araziye patates ekiminden 63 milyon kuruş değerinde 92.000 ton patates elde edilmiştir (Eldem, 1994a).

Birinci Dünya Savaşı ve mütareke dönemlerine rast gelen 1914 ile 1919 yılları arasında İstanbul'da patates perakende satış fiyatları aşırı biçimde yükselmiştir. 1914 yılında 1 kuruş olan patatesin kıyyesi (1,3 kg'ı) 1915'de 1,6, 1916'da 3, 1917'de 14, 1918'de 27 ve 1919'da 16 kıyyeye yükselmiştir (Eldem, 1994b).

1923-1950 Yılları Arasında Türkiye'de Patates Üretim Faaliyetleri

Cumhuriyetin ilk yıllarından itibaren bir yandan patates ziraatına önem verilirken, öbür yandan yurtdışından satın alınan patateslerin hastalık taşıma riskine karşı tedbir olmak üzere bazı liman ve gümrük kapılarında sağlık kontrolüne tabi tutulduğu görülmektedir⁶ (BCA, 1925).

Milli Mücadele yıllarında bilhassa Batı Anadolu Bölgesinin Yunanlılar tarafından işgal edilip, köylerinin yakılıp yıkılması ve tarım ürünlerinin tahrip edilmesi üzerine, üretim azalmış ve dış ülkelerden çeşitli tarım ürünlerinin yanı sıra patates ithalatı da gerçekleştirilmiştir. 1923 yılından 1931 yılına kadar olan toplamda dokuz yıllık dönemde İngiltere, İtalya, Fransa, Hollanda, Mısır başta olmak üzere çeşitli ülkelere tutarı 1.724.000 lira olan 20.930 ton patates satın alınmıştır. 1923 yılında satın alınan patates tutarı 367.000 lira iken, 1924'te 320.000, 1925'te 84.000, 1926'da 68.000, 1927'de 63.000, 1928'de 352.000, 1929'da 303.000, 1930'da 160.000 ve 1931'de 7.000 lira olmuştur (İGM, 1933; İGM, 1935; İGM, 1939). 1935 yılının 1.000 liralık ithalatı dışında 1932-1938 döneminde patates ithalatı yapılmamıştır (İGM, 1936; İGM, 1939; İGM, 1940).

Bu dönemde borsa dışında başlıca ticaret mallarının yıllık ortalama fiyatına göre, 1926 yılında Adapazarı piyasasında Baş Kelle türü patatesin fiyatı 9.03 ile 10.71 kuruş arasında, Orta Kelle 6.60 ile 6.65 arasında; Sıra Kelle ise 3.15 ile 384 kuruş arasında seyretmiştir. 1927 yılına gelindiğinde bu fiyatlar Baş Kellede 11, Orta Kellede 8.04 ve Sıra Kellede 5.45 kuruş olmuştur (İGM, 1930; İGM, 1931). Sekizinci mıntıka ya da orta yayla olarak bilinen Amasya, Elazığ, Malatya, Sivas ve Tokat

⁶ Marsilya'dan ithal edilecek patateslerin İzmir Balçova Kooperatif Şirketi Üyeleri ile ihtiyaç sahibi ziraatçılara dağıtılması ve gümrük vergisinin de Ziraat Vekâleti'nce karşılanması hakkında bilgi almak için Bk. (BCA, 1924).

illerinde 1934 yılı itibariyle 2.247 hektar araziden 11.466 ton patates elde edilmiştir (İGM, 1935). Ayrıca 1938-1940 yılları arasında 6.40 ile 6.55 kuruş arasında bulunan birinci sınıf patatesin toptan ortalama fiyatı 1941 yılında 9.84 kuruşa, 1942 yılında 29.58 kuruşa ve 1943 yılında zirve yaparak 31.18 kuruşa yükselmiştir. 1944 ile 1948 döneminde birinci sınıf patatesin toptan ortalama fiyatı 23.85 kuruş ile 27.96 kuruş arasında gidip gelmiştir (İGM, 1949; İGM, 1950).

II. Dünya Savaşı'ndan (1939-1945) önce Türkiye'de ortalama patates üretimi 179.000 tonun üzerine çıkmış, patates yetiştirilen bölgelerde hayvancılık alanında, ispiro ve nişasta sanayinde gelişmeler yaşanmıştır⁷ (Zeytinoğlu, 1978). Islah edilmiş 2.000'e yakın çeşidi olduğu bilinen patatesin deniz seviyesinden yükseldikçe tür olarak vasıflarını koruma özelliği artmıştır. Bu nedenle en iyi tohumluklar 800-1000 metre yükseklikten elde edilmiştir. Ovalara ve rakımı düşük vadilere indirilen patateslerin bir iki yıl içinde özelliklerini kaybettiğinin görülmesi, çiftçilerin tohumluklarını her yıl yayladan getirmelerini zorunlu hale getirmiştir (Benlioğlu, 1948).

1933 ile 1946 döneminde tohum ıslah ve deneme istasyonları, tohum üretme çiftlikleri ve deneme tarlaları faaliyeti neticesinde 637.455 kg patates tohumu üretilmiştir. Bu üretimin sadece 1941 yılında 129.319 kg'yi bulduğu gözlenmektedir (İGM, 1948). 1940-1946 dönemi arasında bulunan 1942 yılında 7.704 ton ve 1946 yılında 3 ton patates tohumluğu çiftçiye dağıtılmıştır (İGM, 1945; İGM, 1948).

Bu arada Ziraat Bankası aracılığıyla Bulgaristan'a sipariş edilen 100 ton patates tohumluğunun muayene ve kontrolü ile ülkeye giriş işleminin Svilegrad'da yapılması, 24 Nisan 1942 tarih ve 2/17740 sayılı Bakanlar Kurulu Kararıyla kabul edilmiştir (BCA, 1942). Ayrıca tarımı geliştirmek için aynı yıl içerisinde Bolu ili dâhilindeki bütün çiftçilere patates ve mısır tohumluğu dağıtıldığını, adı geçen ilin Ziraat Müdürlüğü'nün 28 Nisan 1942 tarihinde Başbakanlığa yazdığı bir yazıdan anlaşılmaktadır (BCA, 1942).

Aynı yılda üzerinde patates üretilen ve üretilecek arazinin her bir dekarı için çiftçilere iki lira prim verilmesi ve bu ödeme için Ziraat Vekâleti emrine 1.320.000 lira tahsisine dair Koordinasyon Heyeti Kararının uygulanmaya konulması, 18 Ağustos 1942 tarih ve 2/18631 sayılı Bakanlar Kurulu Kararı ile kabul edilmiştir (BCA, 1942).

Bu dönemde Ordu ilinde çıkarılan ekmeğe %35 oranında patates karıştırıldığı ve üretilen ekmeğin bir örneğinin Başbakanlığa sunulduğu Ordu Valiliğinin adı geçen kuruma yazdığı bir yazıdan anlaşılmaktadır (BCA, 1942).

1943 yılına gelindiğinde Türkiye'de patates üretiminin çoğunluğu 16 ilden elde edilmektedir. Üretim sıralamasına göre bu iller; Kayseri, Konya, İzmir, Bursa, Afyon, Seyhan, Kastamonu, Trabzon, Niğde, Antalya, Ordu, Kocaeli, Sivas, Zonguldak, Kütahya ve Bolu'dur. Kayseri 38.100, ton ile üretimde ilk sırada yer alırken, bunu 21.800 ton ile Konya, 20.874 ton ile İzmir izlemiştir (İGM, 1943; İGM, 1945).

Türkiye'nin birçok bölgesinde çeşitli isimler adı altında patates ziraatı yapılmıştır.⁸ Adapazarı'nda Deli Osman, Sarı Patates, Beyaz Patates Karakız; Bolu'da Bolu Patatesi; Kayseri'de Kırmızı; Ödemiş'te Kırmızı Göz, Ak Göz, Kaşlı Göz; Erzurum'da Hususi Bir; Trabzon'da Dirodyum, Rus Beyazı ve Karagöz bu patates türlerinden bir kısmına örnek olarak verilebilir (Benlioğlu, 1948; İlisulu, 1955).

Bu dönemde Trabzon'un yanı sıra Ordu ve Çoruh vilayetlerinde de patates ziraatı yapılmış, bir dekardan alınan patates ürünü Adapazarı dışında Türkiye'nin kurak bölgelerinde 500 kg'yi geçmediği

⁷ Ancak II. Dünya Savaşı koşulları nedeniyle Ticaret Vekâleti'ne verilmiş olan el koyma yetkisinin bakla, burçak, fiğ, her çeşit küspe ve hayvani yağların yanı sıra patatesten de, uygulanması ile ilgili 238 sayılı Kararın yürürlüğe konulması, 24 Aralık 1941 tarih ve 2/17113 sayılı Bakanlar Kurulu Kararı ile tespit edilmiştir (BCA, 1941); Ayrıca, savaş döneminde hububat, bakliyat, patates, pirinç un ve ezmelerinden pasta ve benzeri maddelerin yapılıp satılmasını yasaklayan 255 sayılı Kararın uygulamaya konulması, 21 Ocak 1942 tarih ve 2/17199 sayılı Bakanlar Kurulu Kararnamesi ile kabul edilmiştir (BCA, 1942).

⁸ Türkiye'nin çeşitli vilayetlerinde 1927 yılında kg cinsinden üretilen Patates miktarı hakkında bilgi almak için Bk. (İGM, 1929).

halde Karadeniz sahillerinde bakımı yapılmak suretiyle 1500-2000 kg'ye kadar çıkmıştır (Derin, 1952).

1944 yılında Ankara Merkez Mücadele Enstitüsü tarafından ülkenin çeşitli yerlerinden patates örnekleri getirilerek deneme tarlalarında yetiştirilmiştir. Neticede birçok hastalıklı bitki türü elde edilmiştir. Solanum virüs-1-18 şeklinde numaralanmış 18 farklı virüs türünden Türkiye'de en yaygın olanı; virüs-1, yaprak kıvrıcılığı yapan virüs-3 ve yine patates yapraklarını kıvrıran virüs-14'ün yaygınlaşmış olduğu tespit edilmiştir. Hastalıklı bitkiler kısa boylu, dik gelişmesi, yapraklarının açık renkte ve kıvrık olmasıyla tanınmış, yazları sıcak geçen çevrelerde virüslerin yaygınlaştığı belirlenmiştir (Bremer, 1949).

Bu dönemde Alanya civarında ortaya çıkan Pseudococcus Citri (Risso) adındaki yeni bir patates zararlısı ambarlardaki patates filizlerini çürütüp kurumalarına neden olduğundan, tohumluk patatesleri Albolineum gibi yağlı ve patatese zararı dokunmayacak bir ilaca yatırıp Methyl Bromid gazından geçirip temizledikten sonra dikmek uygun görülmüştür (Türkşen, 1949).

Bu arada sıcak ülkelerden bilhassa ABD'de büyük oranda yetiştirilerek Türkiye'ye ilk kez getirilen tatlı patatesin İzmir Bornova Ziraat Okulunda başarı ile üretildiği görülmektedir. Yumruları adi patatesten daha büyük, düzgün yuvarlak biçiminde olmayan veya yumurta şeklinde bulunan bu patatesin terkiibide bol miktarda nişasta ve %7-8 oranında şeker yer almaktadır. Ayrıca yaprak ve sapları süt veren inekler için güçlü bir besin kaynağı teşkil eden bu patates türünün Ege, Marmara, Karadeniz ve Güney bölgelerinde yaygınlaşması öngörülmüş olup çeşitleri şunlardır: (Ekinci, 1948).

1. İzmir Bornova Ziraat Okulunda yetiştirilen bir tür olan *Sarı, Büyük Yumrulu Tatlı Patatesin* yumrularının ağırlığı 1 kg 'ye yakın olup, yapısı unlu, şekerli ve tatlıdır.
2. Yumruları ince ve uzun, yapısı sarı, geç yetişen lezzetli *Sarı Malağa Tatlı Patates*, cinsi,
3. Yumruları iri, pembe ve etli şekilde bulunan, erken yetişen çok verimli *Pembe Malaga Tatlı Patates* türü,
4. Yumruları uzun ve ince, kabuğunun rengi mor ya da kırmızı olan *Mor veya Kırmızı Renkli Patates*, Etinin rengi beyaz, kabuğuna yakın kısmı pembedir. Nişasta bakımından fakir olmasına rağmen şekerli ve güzel bir kokusu vardır.

Türkiye'de sadece İzmir ve civarı ile Hatay'da yetiştirilen tatlı patates ABD, İspanya, Fas, Cezayir, Tunus ve Doğu Akdeniz'in çevre ülkelerinde yetiştirilmiştir (Ekinci, 1952).

Bu arada sel yüzünden mahsulleri hasara uğramış Amasya bölgesi çiftçilerine ödünç olarak 61 ton tohumluk patates dağıtılması, Bakanlar Kurulunun 5 Nisan 1949 tarih ve 3/9246 sayılı Bakanlar Kurulu Kararı ile kabul edilmiştir (BCA, 1949).

Patates mahsulü alanında yapılan çalışmalar semeresini vermiş, üretim her geçen yıl artırılmaya gayret edilmiştir. 1949-1950 yılında 75.447 hektar patates ekim sahasından 605.220 ton patates elde edilmiştir (Madran, 1953; DİE, 1973). Bunun yanı sıra Türkiye'de 1942 yılında hektar başına 4.726 kg patates elde edilirken 1943'de bu rakam 4.533 kg'ye, 1944'de 3.421 kg 'ye, 1945'de 3.207 kg'ye, 1946'da 4.612 kg'ye, 1947'de 5.209 kg'ye, 1948'de 6.909 kg'ye, 1949'da 6.165 kg'ye ve 1950 yılında 8.022 kg'ye yükselmiştir (DİE, 1963; DİE, 1948; Köylü, 1954; Cillov, 1965).

1947 ile 1949 yılları arasında dış piyasalarda birinci sınıf patatesin ortalama fiyatı 26- 27 kuruş iken 1950 yılında bu rakam 16.02 kuruşa, ikinci sınıf patatesin fiyatı 18-19 kuruş iken, 1950 yılında 9.88 kuruşa inmiştir (İGM, 1950).

Türkiye'de 1949 yılı itibarıyla 414.509 ton patates üretilirken Dünya'da 30.900.000 ton üretimle Polonya birinci sırada, 29.386.000 ton ile Almanya ikinci sırada, 11.201.000 ton ile ABD üçüncü sırada yer almıştır. Aynı yılda dünyada toplam patates üretimi 145.900.000 ton civarındadır. Dünya üretim miktarın 98.321.000 tonu sırayla Polonya, Almanya, ABD, Fransa, Büyük Britanya, Çekoslovakya ve Türkiye'den elde edilmiştir (İGM, 1952; İGM, 1953).

1950 yılına gelindiğinde Türkiye’de en fazla patates üreten il sıralamasının değişikliğe uğradığı bilinmektedir. En çok patates üreten 26 il içerisinde 127 bin ton ile Konya ilk sırada yer alırken, bunu 68 bin ton ile Erzurum, 32 bin ton ile Kayseri, 28 bin ton ile Trabzon ve 25 bir ton ile Yozgat takip etmiştir. Aynı yılda Erzurum’da ortalama patates fiyatı kg’de 15.25 kuruş iken Kayseri’de 15, Trabzon’da 25.25 ve Yozgat’ta 13.30 kuruş olmuştur (İGM, 1950).

Tablo 1’de 1925 ile 1950 yılları arasında Türkiye’de patates ekim alanı, elde edilen ürün miktarı ile hektar başına verim gösterilmiştir.

Tablo 1. Türkiye’de Patates Ekim Alanı, Elde Edilen Ürün Miktarı ve Hektar Başına Alınan Verim (1925-1950)

Yıllar	Ekilen Alan (Hektar)	Üretim Miktarı (Ton)	Hektar Başına Verim (Kg)
1925	25.550	72.602	2.842
1926	26.574	76.170	2.866
1927	13.580	20.739	1.527
1928	26.400	49.497	1.875
1929	66.200	133.500	2.017
1930	31.400	114.246	3.638
1931	45.400	109.944	2.422
1932	30.100	73.976	2.458
1933	35.502	106.859	3.010
1934	65.239	213.154	3.267
1935	46.644	105.734	2.267
1936	54.625	184.823	3.383
1937	53.180	171.796	3.230
1938	55.687	181.675	3.262
1939	63.436	259.538	4.091
1940	68.227	319.345	4.681
1941	72.875	274.909	3.772
1942	92.970	439.553	4.728
1943	64.190	290.947	4.533
1944	56.044	191.737	3.421
1945	52.189	167.350	3.207
1946	57.388	246.671	4.612
1947	62.469	325.410	5.209
1948	63.764	454.356	7.126
1949	67.241	414.509	6.165
1950	75.442	606.221	8.022

Kaynak: İGM, 1939; İGM, 1941; İGM, 1948; İGM, 1949; İGM, 1950; İGM, 1951; İGM, 1952; İGM, 1959; DİE, 1963; DİE, 1973; DİE, 1990; DİE, 1995; DİE, 1998; DİE, 2002; TÜİK, 2006; TÜİK, 2011.

Tablo 1’e göre, 1925 yılında 25.550 hektar olan patates ekim alanı 49.892 hektar artışla 1950 yılında 75.442 hektara; 72.602 ton olan patates üretimi 533.619 ton artışla 1950 yılında 606.221 tona; 2.842 kg olan hektar başına alınan patates verimi 5.180 kg artışla 8.022 kg’ye yükselmiştir.

Böylece 1925 yılından 1950 yılına kadar patates ekim alanında %195, 27, üretim miktarında %734, 99 ve hektar başına verimde %182, 26 oranında bir artış sağlanmıştır.

Sonuç

Amerika'nın keşfinden sonra Avrupalı insanın hayatına giren ve oradan da dünyaya yayılarak tüm insanlığın beslenmesinde önemle rol oynamaya başlayan patatesin, Türkiye'de 1850 yıllarından beri ekildiği bilinmektedir. Cumhuriyetin ilk yıllarından itibaren yeni Türkiye'nin önemle üzerinde durduğu konulardan birinin patates ziraatı olduğu, Türkiye'nin dış ülkelere patates ithalatı yapması ve yurtdışından satın alınan patateslerin hastalık taşıma riskine karşı bazı liman ve gümrük kapılarında sağlık kontrolünden geçirilmesinden anlaşılmaktadır.

Ülkenin hemen her döneminde önemini koruduğu bildiğimiz patates ziraatının deniz seviyesinden yükseldikçe özelliğini muhafaza etmesi, bir yandan iyi patates tohumluğunun 800-1000 metre yükseklikten elde edilmesini sağlarken, öbür yandan çiftçilerin tohumluklarını her yıl yayladan karşılamalarını zorunlu hale getirmiştir. Türkiye'de patates mahsulünün ülkenin orta, batı, kuzey ve güney çevrelerinde yoğunlaştığı gözlenmektedir. Bu çevreler Kayseri, Konya, İzmir, Bursa, Afyon, Adana, Kastamonu, Trabzon, Niğde, Antalya, Ordu, Kocaeli, Sivas, Zonguldak, Kütahya ve Bolu illeri olup en fazla patates ziraatının yapılması ve bol miktarda ürün elde edilmesiyle bilinmektedir. Türkiye'de farklı isimlerle ülkenin farklı yörelerinde yetiştirilen patates mahsulünün zararlılarına karşı da mücadele başlatılarak ürünün rekoltesinin yükseltilmesine gayret edilmiştir. Alınan tedbirler, zararlılarıyla yapılan mücadeleler ve üretimine gösterilen özen sayesinde patatesten her geçen yıl ekilen arazi miktarı, hektar başına alınan verim ve ton bazında elde edilen üretim artırılmıştır.

Fiyatının ekonomik bulunması nedeniyle bilhassa düşük gelirli aileler tarafından tercih edilerek bir beslenme unsuru haline gelen patates bitkisi, aynı zamanda hububat ürünlerine de alternatif teşkil etmiştir. Ayrıca patatesin insan sağlığına da faydalı bir besin türü olduğu, bilinen bir gerçek haline gelmiştir. **Kalp, sindirim, bağırsak, cilt ve saç sağlığını korumada etkisinin yanı sıra birçok vitamini bünyesinde barındırıp** enerji sağlama ve stresi önlemede de patates ürünleri tercih edilen bir besin kaynağı olmuştur.

Neticede itibarıyla Türkiye'nin hemen her bölgesinde yetiştirilen patates türleri, gerek ülkenin gıda ihtiyacını gidererek önemli bir beslenme kaynağı teşkil etmesi, gerekse ispiroto ve nişasta sanayine destek sağlaması, milli ekonomiye önemli ölçüde katkılar sağlanmasına yol açmıştır.

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ESTIMATION OF CROWN DIMENSIONS FOR CRIMEAN PINE IN THE KASTAMONU REGION OF TURKEY

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Abstract

In this study, it is aimed to develop models to predict crown diameter (*CD*), crown projection area (*CPA*), crown length (*CL*) and crown height (*CH*) for Crimean pine (*Pinus nigra* J.F.Arnold subsp. *pallasiana* (Lamb.) Holmboe) stands in Kastamonu region, Turkey. For this purpose, field measurements were made on 107 sample trees taken from the stands at different densities, ages and sites. The data obtained from 75 sample trees (70% of total data) were used for model fitting, while the data obtained from 32 sample trees (30% of total data) were used to test the validity of the fitted models. While the equations using various tree parameters such as diameter at breast height (*dbh*) and tree height (*h*) as independent variables were fitted and evaluated, the equations using only *dbh* as an independent variable were found the most appropriate models to estimate *CD*, *CPA* and *CL* with coefficients of determination of 0.905, 0.905 and 0.475, respectively. In the development of model for *CH* estimation, the equation using *h* as an independent variable was found the most successful model with the coefficient of determination of 0.835. With the help of these models developed, crown dimensions of Crimean pine can be reliably estimated in Kastamonu region of Turkey.

Key Words: Crown diameter, Crown projection area, Crown height, Crown length, *Pinus nigra*

INTRODUCTION

The crown of a tree is closely related to the photosynthesis capacity, and thereby crown size is one of important parameters in estimating the growth of individual trees and the whole stand (Kramer and Kozlowsky, 1979; Hemery et al., 2005). It is stated that the stem development of a tree is affected by development of its crown (Sprinz and Burkhart, 1987; Biging and Dobbartin, 1995; Pretzsch et al., 2002; Hemery et al., 2005; Çatal and Carus, 2018). Crown dimensions are also key variables in biomass estimates because of high correlation between crown size and biomass amount. In some studies, crown dimensions were used as independent variables in biomass estimation models as well as diameter at breast height and tree height (Carvalho and Parresol, 2003; Yu et al., 2010; Keyser et al., 2010; Affleck et al., 2013; Zou et al., 2015). Besides, crown dimensions serve as an important tool for calculating competition indices of individual trees (Opie, 1968; Bella, 1971; Kahriman and Yavuz, 2012).

Diameter at breast height (*dbh*) and height (*h*) values of single trees are common stem characteristics measured in forest inventory (Avery and Burkhart, 1983). *dbh* is a main parameter that can be easily measured and closely related to many other tree characteristics (Vanclay, 1994). To obtain information about stand structures and volume, *dbh* and *h* values of single trees are of great importance (Davis et al., 2001; Van Laar and Akça, 2007). Although crown dimensions are other important parameters in forestry researches and applications, direct measurement of them is laborious, time consuming and costly in forest inventory activities. Therefore, little attention has been shown due to the difficulties in measuring and modeling of crown shapes and dimensions in the past (Spurr, 1952; Honer, 1972; Honer and Collins, 1974). Crown dimensions can be predicted using regression models containing *dbh* and *h* values as independent variables, since they show high correlation with these stem dimensions (Ottorini et al., 1996; Hemery et al., 2005). Crown sizes can also be estimated by means of low-level aerial photographs and terrestrial laser scanning (Mitchell, 1975; Mitchell, 1980; Özdemir, 2013).

Although crown size is an important parameter in predicting tree growth (Biging and Dobbartin, 1995; Pretzsch et al., 2002), biomass (Carvalho and Parresol, 2003; Yu et al., 2010; Keyser et al., 2010; Affleck et al., 2013; Zou et al., 2015) and competition indices (Opie, 1968; Bella, 1971; Iwasa et al., 1984; Grote, 2003), there are limited studies containing crown dimensions' modeling in Turkey (Demirci, 2000; Mısır, 2003; Çatal, 2009; Ercanlı, 2010; Kahriman, 2011; Özdemir, 2011; Çatal and Carus, 2018). In this study, modeling the crown dimensions for Crimean pine stands located in Kastamonu region of Turkey was aimed. For this purpose, the relationships between crown dimensions with diameter at breast height and tree height were investigated, and regression equations were fitted to explain these relations.

MATERIAL AND METHODS

In Turkey, *Pinus nigra* J.F. Arnold is one of the most valuable and a widespread tree species with 4.3 million ha total forest area which equals to about 19% of the whole forest lands (General Directorate of Forestry, 2015). *Pinus nigra* subsp. *pallasiana* (Lamb.) Holmboe (Crimean pine) is one of five subspecies of *P. nigra* and widely distributed in Anatolian and Black Sea regions and on the northern side of the Taurus Mountains in both pure and mixed stands (Akman et al., 2003; Mamikoğlu, 2007).

This study was carried out in pure Crimean pine stands of Kastamonu Regional Directorate of Forestry located in the Black Sea region of Turkey (Figure 1). Total land area of the region is 1.91 million ha, and about two-thirds of the region (1.26 million ha) is covered with forests (General Directorate of Forestry, 2015). Crimean pine is the most common tree species with 0.38 million ha distribution area in the region (General Directorate of Forestry, 2006).



Figure 1. Study area

For this study, measurements were made on 107 sample trees taken from pure and even-aged Crimean pine stands within the study area. The stands investigated for field measurement represent available range of densities, sites and diameter classes. Diameter at breast height (*dbh*), tree height (*h*), crown diameter (*CD*), and crown height (*CH*) were measured on all sample trees. The measurements of *h* and *CH* were made with a Vertex 3 hypsometer, while *CD* measurements were made with a measuring tape along the north-south and east-west directions. *dbhs* were measured with calipers to the nearest 0.1 cm. To calculate crown length (*CL*), crown height (*CH*) was subtracted from tree height (*h*) for each sample tree. Crown projection area (*CPA*) of sample trees were also calculated by following equation using the *CD* values.

$$CPA = \frac{\pi}{4} CD^2$$

Distribution of CD , CPA , CL and CH values with dbh and h obtained from sample trees were given in Figure 2 and Figure 3, respectively. As seen on the Figure 2, CD , CPA and CL showed well correlation with dbh , while CH with h .

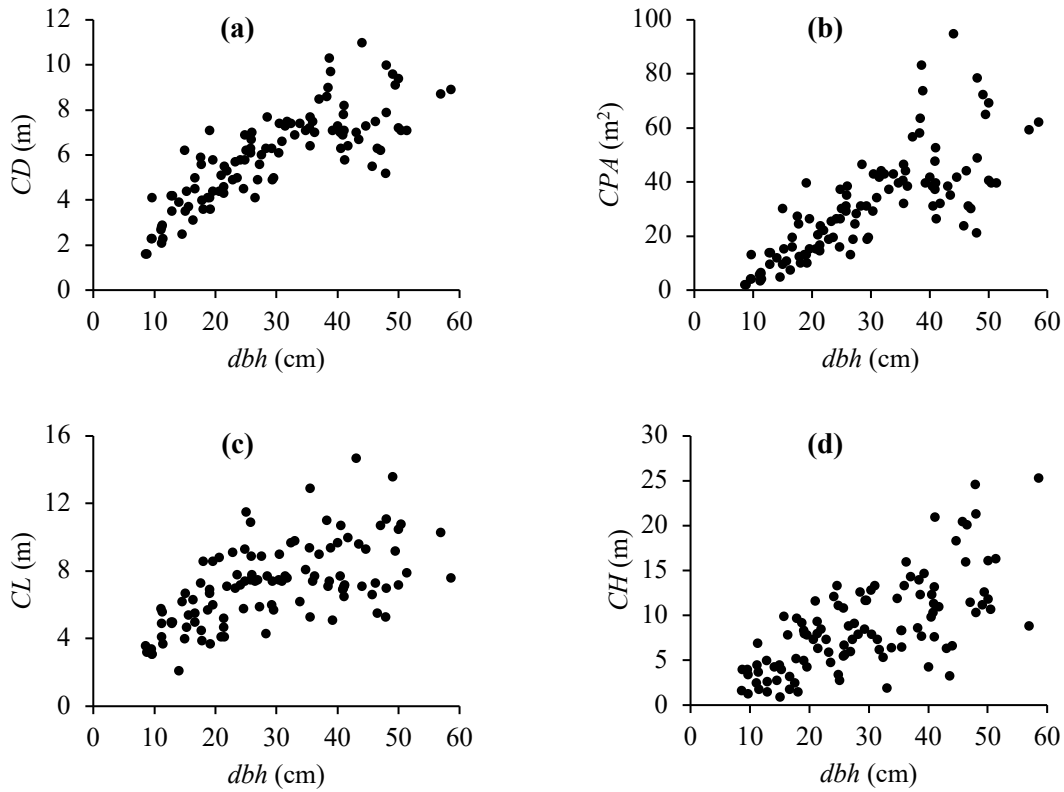


Figure 2. The relationships between (a) CD , (b) CPA , (c) CL , and (d) CH with dbh

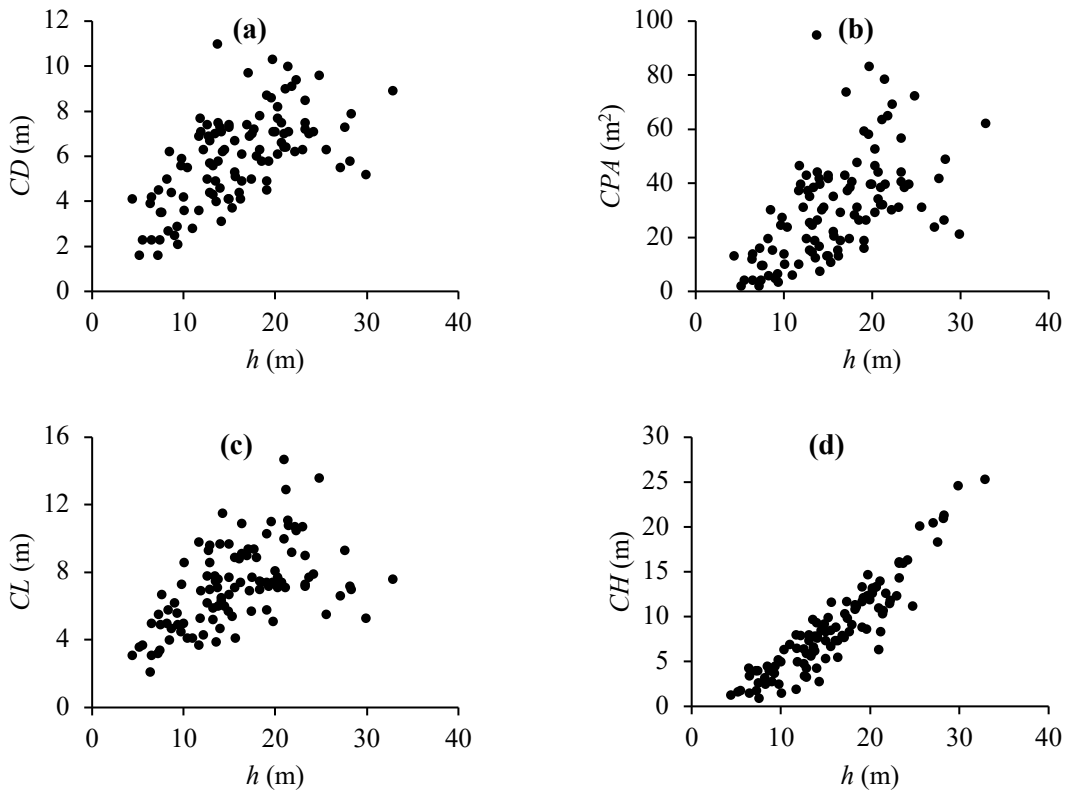


Figure 3. The relationships between (a) CD , (b) CPA , (c) CL , and (d) CH with h

The data obtained from sample trees (n=107) were randomly divided into two groups such as fitting and control data. The first group including the measurements of 75 sample trees (70% of total data) was used as model development data, while the other group comprising measurements of remaining 32 sample trees (30% of total data) were used to test the validation of fitted models. The summary statistics for fitting and control data were given in Table 1.

Crown dimension models were developed by fitting regression equations given in Table 2. In these equations, *dbh* and *h* were used as independent variables separately for four crown dimensions such as *CD*, *CPA*, *CL* and *CH*. Thus, a total of 20 models were fitted for each crown dimension.

Table 1. Descriptive statistics of the data groups

Variable	Min.	Max.	Mean	Std. Dev.
<i>Fitting data (n=75)</i>				
Diameter at breast height (<i>dbh</i> ,	8.5	58.5	28.6	12.6
Height (<i>h</i> , m)	5.2	32.9	15.4	5.6
Crown diameter (<i>CD</i> , m)	1.6	10.0	5.9	1.9
Crown projection area (<i>CPA</i> , m ²)	2.0	78.5	30.3	17.6
Crown length (<i>CL</i> , m)	2.1	14.7	7.0	2.3
Crown height (<i>CH</i> , m)	0.9	25.3	8.4	4.8
<i>Control data (n=32)</i>				
Diameter at breast height (<i>dbh</i> ,	8.7	51.3	30.6	13.3
Height (<i>h</i> , m)	1.3	24.6	9.6	5.9
Crown diameter (<i>CD</i> , m)	1.6	11.0	6.0	2.2
Crown projection area (<i>CPA</i> , m ²)	2.0	94.5	32.3	22.7
Crown length (<i>CL</i> , m)	3.1	13.6	7.5	2.6
Crown height (<i>CH</i> , m)	4.4	29.9	17.2	6.8

Table 2. Models used to fit crown dimensions*

N	Equation	Form	No	Equation	Form
1	$y = b_0 + b_1x$	Linear	6	$y = b_0b_1^x$	Compound
2	$y = b_0 + b_1\ln(x)$	Logarithmic	7	$y = b_0x^{b_1}$	Power
3	$y = b_0 + b_1/x$	Inverse	8	$y = e^{b_0+b_1/x}$	S
4	$y = b_0 + b_1x + b_2x^2$	Quadratic	9	$y = e^{b_0+b_1x}$	Growth
5	$y = b_0 + b_1x + b_2x^2$	Cubic	10	$y = b_0e^{b_1x}$	Exponential

* b_0 , b_1 , b_2 , and b_3 are model parameters; x refers to *dbh* or *h* as independent variables, and y refers to *CD*, *CPA*, *CL* or *CH* as dependent variables.

For evaluation of the fitted models and deciding the best ones, two goodness-of-fit statistics were used such as coefficient of determination (R^2) and root mean square error (*RMSE*). The goodness-of-fit statistics are described as;

$$R^2 = 1 - \frac{\sum(y_i - \hat{y}_i)^2}{\sum(y_i - \bar{y})^2}$$

$$RMSE = \sqrt{\frac{\sum(y_i - \hat{y}_i)^2}{n - p}}$$

In these equations, y_i , $\hat{y}_i$ and $\bar{y}_i$ are the observed, predicted, and mean values of the dependent variable, respectively; n is the number of data used for fitting; p is the number of parameters.

The validities of the fitted equations were tested using predicted and observed crown dimension values of 32 sample trees in control group by Student's *t*-test. Statistical analyses were performed in IBM SPSS Statistics 23 software. In addition to the statistical evaluations, curves fitted and found to be successful for crown dimensions' estimates were investigated graphically.

RESULTS AND DISCUSSION

A total of 80 equations were fitted to four crown dimensions, 20 equations for each. Further, *dbh* and *h* were separately considered as independent variables (ten times each as in Table 2) within these 20 equations. All equations fitted were found to be statistically significant at 0.05 level. However, Equation 4 (Quadratic) and Equation 5 (Cubic) with both independent variables had some non-significant ($p>0.05$) parameters for all crown dimensions' estimates. Additionally, Equation 1 (Linear) with *dbh* for *CH* and with *h* for *CPA* estimates and Equation 2 (Logarithmic) with *h* for *CL* estimates had also non-significant parameters.

Among the statistically successful equations, the equations fitted with *dbh* for *CD*, *CPA*, *CL* and *CH* predictions accounted for about between 72.2-90.5%, 72.2-90.5%, 36.3-47.5% and 37.0-47.5% of the total variance in *dbh* and crown dimensions relationships, respectively. Besides, the equations fitted with *h* for crown dimensions' predictions accounted for about between 52.2-61.5%, 51.8-61.5%, 27.6-44.6% and 71.5-83.5% of the total variance in *CD*, *CPA*, *CL* and *CH* relationships with *h*, respectively. These results showed that the equations fitted with *dbh* were more successful than the ones fitted with *h* for *CD* and *CPA* predictions. However, the equations fitted with *h* were superior than the ones with *dbh* for *CH* estimates. For *CL* predictions, all equations had low estimation success.

Consequently, Equation 8 (S) with *dbh* as independent variable achieved the highest success in *CD*, *CPA* and *CL* estimates, while Equation 1 (Linear) with *h* as independent variable was for *CL* estimates among all equations tested. Parameter estimates and goodness-of-fit statistics (R^2 and *RMSE*) for these equations were given in Table 3. When the table is examined, it is seen that the equations for *CD* and *CPA* had higher R^2 , while the equation for *CL* had relatively lower R^2 . The *RMSE* values for the equations were also quite low.

Table 3. Parameter estimates and goodness-of-fit statistics of the most successful equations

Crown Dimension	Equation No	R^2	<i>F</i>	<i>RMSE</i>	b_0	b_1
Crown diameter (<i>CD</i>)*	8	0.905	696.015	0.731	2.4049	-15.8050
Crown projection area (<i>CPA</i>)*	8	0.905	696.186	8.038	4.5680	-31.6134
Crown length (<i>CL</i>)*	8	0.475	65.990	1.775	2.3418	-10.2294
Crown height (<i>CH</i>)**	1	0.835	369.826	1.969	-3.7045	0.7848

The independent variables are **dbh* and ***h*.

The validities of the selected equations were tested using Student's *t*-test. In these analyses, predicted crown dimension values of 32 sample trees in control group were compared with observed ones. The test results showed that there were no statistically significant differences between observed and predicted values at the 0.05 level.

For each crown dimension, relationships between observed and predicted values of the sample trees in fitting data group were presented for the selected equations in Figure 4. When the figure is examined it is seen that the relationships for *CD* and *CPA* were quite strong, while observed and predicted *CL* values showed weak relationships due to the low estimation success of selected equation. The success rank of the equations according to the relationships between predicted and observed values was *CD*, *CPA*, *CH* and *CL*, respectively.

When the residuals for the predicted values obtained from the selected equations for crown dimensions were examined, it is seen that the residuals were quite low except *CL* estimates, and there were no significant trends (Figure 4). The residuals for *CD* and *CPA* estimates were much lower for smaller trees, and residuals showed the rising trend with increase of tree sizes. However, the residuals of *CH* and *CL* estimates were similar for almost all crown sizes.

Demirci (2000) developed a regression equation that estimates the *CPA* for Oriental spruce with R^2 value of 0.722. When the *CPA* estimations for Crimean pine from this study were compared with the estimations for Oriental spruce in Figure 5, it is seen that the estimated values of *CPA* for Crimean pine were higher than for Oriental spruce except for low *dbh* values.

Two studies have been conducted on *CD* estimates for some tree species such as Brutian pine (Çatal, 2009), Scots pine, fir and beech (Özdemir, 2011) in Turkey. The *CD* estimations obtained from these studies were compared with estimations for Crimean pine in this study

(Figure 6). The comparisons within Figure 6 showed that *CD* predictions of the present study for Crimean pine were lower than the predictions for beech, while higher than for the other species.

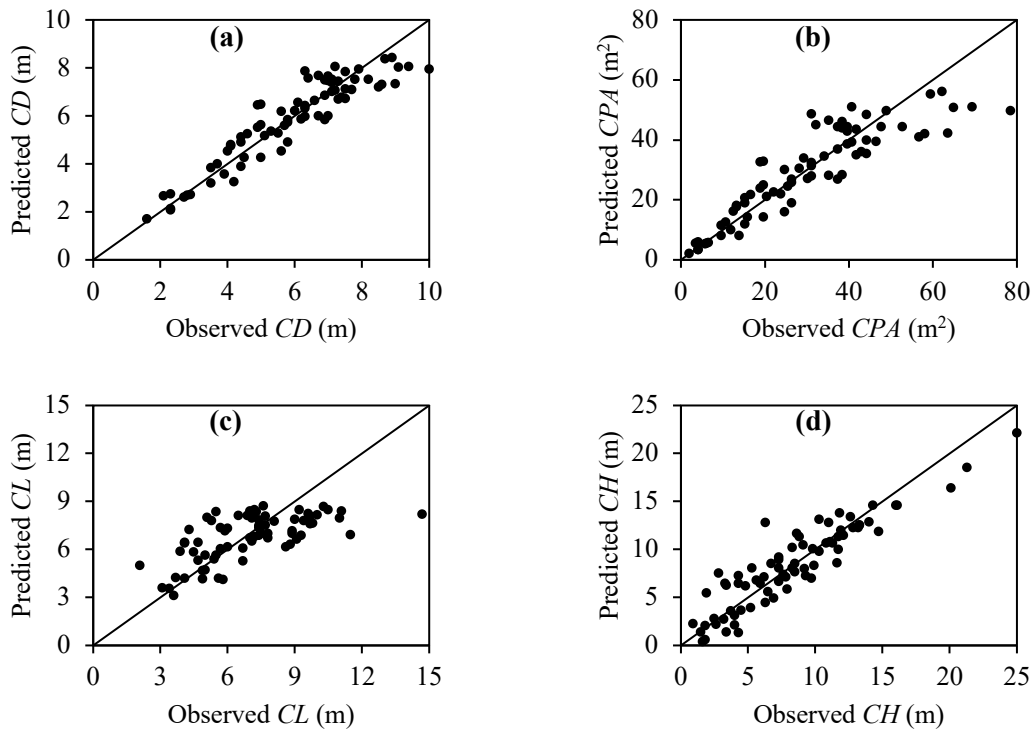


Figure 4. Observed vs. predicted values of (a) *CD*, (b) *CPA*, (c) *CL*, and (d) *CH*

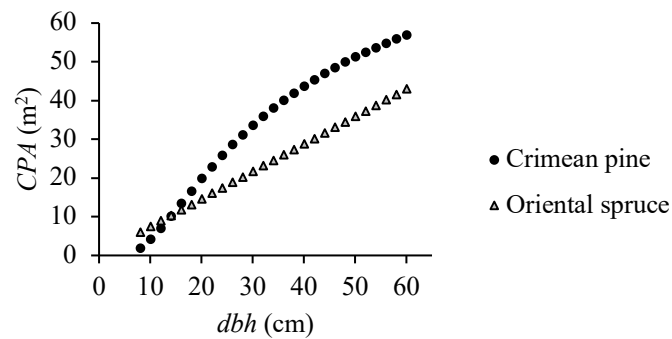


Figure 5. *CPA* estimates for Crimean pine and Oriental spruce

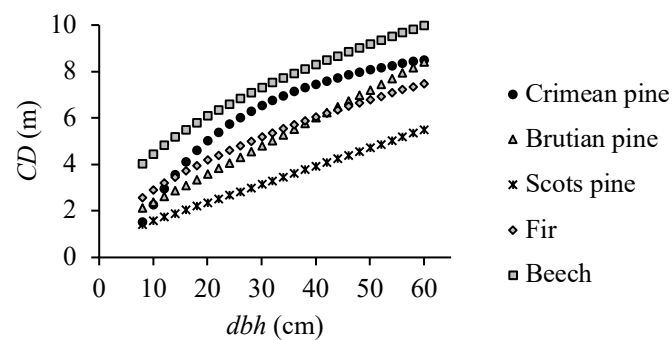


Figure 6. *CD* estimates for Crimean pine and other tree species

CONCLUSIONS

In this study, the relationships between crown dimensions with two stem parameters (*dbh* and *h*) were investigated, and the equations to model these relations were developed for the Crimean pine stands in Kastamonu region of Turkey. In order to develop the equations, 20 equations were fitted for each crown dimension using diameter at breast height and tree height as independent variables. According to the statistical assessments, the most successful equations for crown dimensions are as follows:

$$CD = e^{2.4049-15.8050/dbh}$$

$$CPA = e^{4.5680-31.6134/dbh}$$

$$CL = e^{2.3418-10.2294/dbh}$$

$$CH = -3.7045 + 0.7848h$$

The results obtained in this study are acceptable for Crimean pine stands in Kastamonu region, Turkey. However, it is necessary to investigate whether the results are suitable for other distribution areas of Crimean pine.

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ESTIMATION OF BARK THICKNESS AND BARK VOLUME FOR CRIMEAN PINE IN THE KASTAMONU REGION OF TURKEY

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Abstract

In forestry applications, tree stems of Crimean pine (*Pinus nigra* J.F. Arnold subsp. *pallasiana* (Lamb.) Holmboe) are produced and evaluated without bark, and volumes of tree stems are calculated as under-bark for commercial trades in Turkey. In harvesting process of tree stem, bark is abandoned to forest land. Even if bark is not evaluated as a product, it plays very important role to protect tree stem from insects and fire, and it is essential to contribute to soil as a humus material. Beside, tree bark is one of the potential non-wood products in forestry and can be used in many areas such as landscape, medicine, etc. Because of these aspects, correct estimations of tree bark thickness and bark volume have great importance. In this study, a total of 227 sample trees were selected and felled from Crimean pine stands representing available range of sites, densities and ages in the studied region. Regression equations using diameter at breast height (dbh) as independent variable to estimate bark thickness (b) and bark volume (V_b) were fitted and evaluated. The equations fitted accounted for about the 79% and 95% of the total variance in $dbh-b$ and $dbh-V_b$ relationships, respectively. The selected equations were also investigated in respect to residual distributions and other realistic growth patterns, and found to be appropriate.

Keywords: Tree bark, Volume of bark, Under-bark volume, Allometric equations, *Pinus nigra*

INTRODUCTION

Forests are self-renewable natural resources that provide economic, ecological and socio-cultural functions. Beside, trees are one of the most important components of the forest ecosystem and they have a highly significant role to serve these functions. Various products such as wood, bark, resin, storax oil, pine nuts, etc. could be obtained from the trees (Atıcı, 2009). Tree bark is like a shield that protect the tree stem from external influences such as extreme climate conditions, insects and fire. It is also one of important non-wood products in many areas such as landscape, medicine, etc. (Sönmez et al., 2016).

Tree bark could be used in various applications in forestry, such as *i)* improvement of soil conditions, *ii)* improvement of water quality in basins, *iii)* control of erosion on road slopes, *iv)* to be frost retarding layer at forest roads, *v)* to cover saplings in afforestation of the rocky lands (Görcelioğlu, 1973). Also, they turn into humus by mingling with the soil and takes the form of inorganic material in forest ecosystem (Çepel, 1983).

In Turkey, standing volumes of conifer trees are estimated as over-bark using diameter at breast height (*dbh*), while merchantable tree stems are produced and evaluated without bark and volumes of tree stems are calculated as under-bark for commercial trades (Sönmez et al., 2007). Therefore, correct estimation of tree bark thickness and bark volume is as important as estimating tree volume.

Bark thickness and bark volume are affected from tree and stand characteristics, such as tree species, diameter, height, age, site quality, genetic properties (Fırat, 1973; Kalıpsız, 1984; Carus and Çatal, 2010). Therefore, distribution of sample trees and stands in terms of these characteristics should be conducted carefully for development of equations to estimate bark thickness and bark volume.

The objective of this study was to develop equations estimating bark thickness and bark volume of Crimean pine, using sample trees from various site and stand conditions, within the boundaries of Kastamonu Regional Directorate of Forestry, Turkey. The equations fitted in this study, using only *dbh* as an independent variable, could provide correct predictions about bark thickness and bark volume in the region.

MATERIAL AND METHODS

Pinus nigra J.F. Arnold is one of the most valuable and a widespread tree species in Turkey, with total forest area about 4.3 million ha which equals to about 19% of the whole forest lands (General Directorate of Forestry, 2015). *Pinus nigra* subsp. *pallasiana* (Lamb.) Holmboe (Crimean pine) is one of five subspecies of *P. nigra* and widely distributed in Anatolian and Black Sea regions and on the northern side of the Taurus Mountains in both pure and mixed stands (Akman et al., 2003; Mamikoğlu, 2007).

This study investigated the pure Crimean pine stands within the boundaries of Kastamonu Regional Directorate of Forestry located in the Black Sea region of Turkey (Figure 1).



Figure 1. Geographic location of the study area

Forests cover a total of 1.26 million ha, which is about 66% of the total area of the directorate, and the total growing stock is 201.4 million m³ in the region (General Directorate of Forestry, 2015).

Crimean pine is the most common tree species with 0.38 million ha distribution area in the region (General Directorate of Forestry, 2006).

A total of 227 sample trees were selected and felled in pure and even-aged Crimean pine stands within the study area. Sample trees were selected from 192 sample plots representing available range of sites, densities and diameter classes in the region. To ensure this distribution, site index (*SI*), relative density (*RD*) and quadratic mean diameter (*dq*) of the sample plots were calculated. Dynamic site index model developed by Seki and Sakici (2017) was used for *SI* calculation, and the formula generated by Curtis et al. (1981) was used for *RD* calculation. Distributions of the sample plots in terms of *SI*, *RD* and *dq* are given in Figure 2.

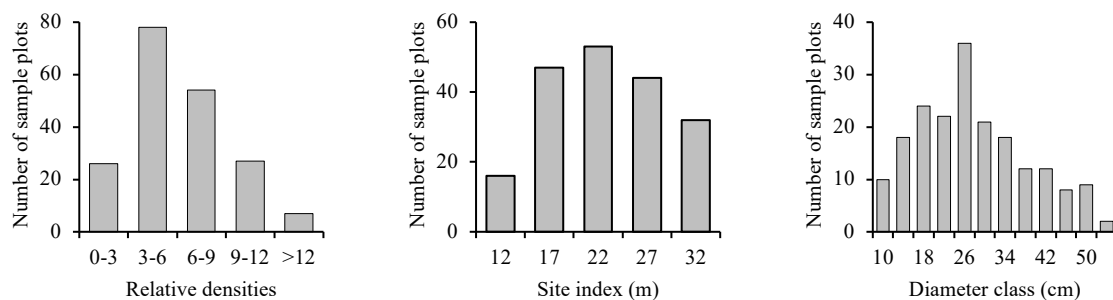


Figure 2. Distributions of sample plots by *RD*, *SI* and *dq*

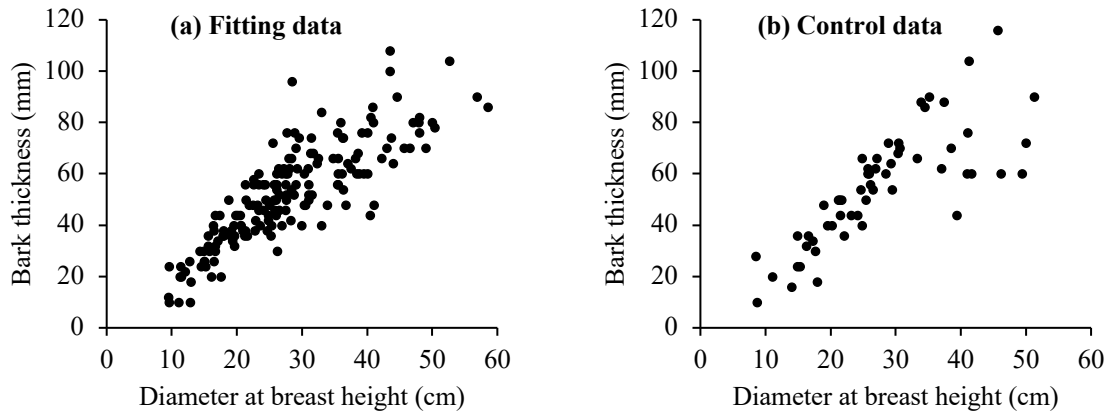
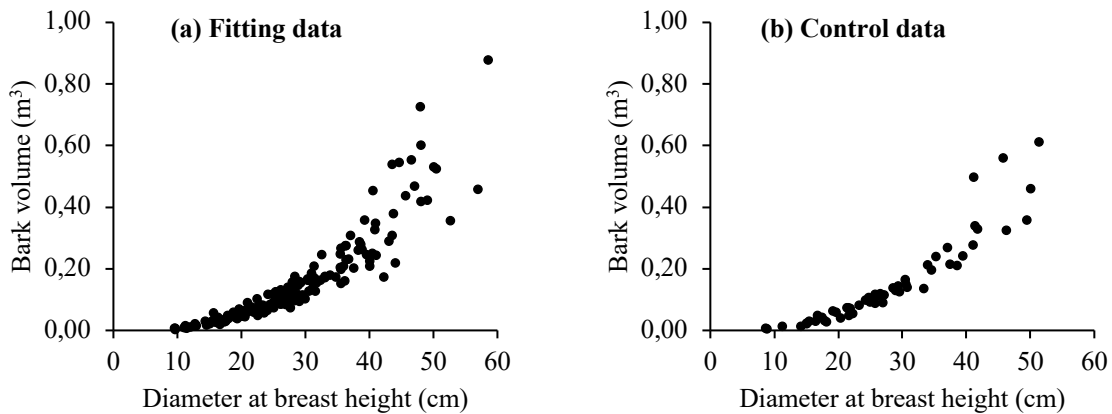
It's an important fact that stand characteristics such as stand density, age, site quality and mean diameter, etc. directly affect the growth rate and other features of trees. Bark thickness is one of these features and shows changes by different stand characteristics. As seen in Figure 2, this study was executed in well distributed Crimean pine stands within the Kastamonu region of Turkey.

Sample trees were felled with a 0.3 m stump, and total height of the trees were measured with a tape to the nearest 0.1 m. Diameters over-bark at stump height (0.30 m), breast height (1.30 m), 2.30 m, and intervals every 1-2 m along the tree stem were measured to the nearest 0.1 cm with calipers. Bark thickness measurements were made with a bark gauge as one-sided at diameter measurement points, and the measured bark thickness values were doubled to calculate bark thicknesses. Diameters under-bark were calculated by subtracting the bark thicknesses from diameter over-bark values. To determine the bark volume of sample trees, over- and under-bark volumes were firstly calculated separately. For volume calculations, tree stems were sectioned to three parts such as stump, logs and top, and log volumes were determined by using Smalian's formula while volumes of top and stump were calculated using conical and cylindrical volume formulas, respectively. Over- and under-bark diameters measured along the tree stems were used for these calculations. By summing the over- and under-bark volumes of stump, logs and top of each sample tree, over- and under-bark volumes were achieved. Finally, the differences between over- and under-bark volumes of the trees gave the bark volumes (V_b). The summary statistics for height (h), diameter at breast height (dbh), bark thickness at breast height (b), and bark volume (V_b) of sample trees were given in Table 1.

Table 1. Summary statistics of the sample trees

Variable	n	Min.	Max.	Mean	Std. Dev.
Height (h , m)	227	4.4	32.9	15.8	5.0
Diameter at breast height (dbh , cm)	227	8.5	58.5	27.9	10.4
Bark thickness (b , mm)	227	10	116	53.1	20.1
Bark volume (V_b , m ³)	227	0.0043	0.8796	0.1543	0.1452

Data obtained from sample trees ($n=227$) were randomly divided into two groups; (i) fitting data ($n=170$, 75% of total data) for model development, and (ii) control data ($n=57$, 25% of total data) for model validation. It was paid attention that sample trees selected for control group represent different diameter values to verify the developed model for the whole ranges. Figure 3 and Figure 4 show the distribution of bark thickness and bark volume of sample trees for fitting and control data groups separately.

**Figure 3.** Distribution of bark thickness values for (a) fitting and (b) control data groups**Figure 4.** Distribution of bark volume values for (a) fitting and (b) control data groups

The bark thickness and bark volume models were developed by fitting regression equations given in Table 2. The independent variable included in the regression models is dbh , while b and V_b were included as dependent variables for bark thickness and bark volume estimates, respectively.

Table 2. Models used to fit b and V_b curves*

No	Equation	No	Equation
1	$y = b_0 + b_1x$	4	$y = b_0 b_1^x$
2	$y = b_0 + b_1x + b_2x^2$	5	$y = b_0 x^{b_1}$
3	$y = b_0 + b_1x + b_2x^2 + b_3x^3$	6	$y = e^{(b_0+b_1/x)}$

* b_0 , b_1 , b_2 , and b_3 are model parameters; x is dbh and y refers to b or V_b for this study.

For evaluation of the fitted models and selection of the best ones, three goodness-of-fit statistics were used such as coefficient of determination (R^2), root mean square error ($RMSE$) and Akaike information criterion (AIC). The goodness-of-fit statistics are described as;

$$R^2 = 1 - \frac{\sum(y_i - \hat{y}_i)^2}{\sum(y_i - \bar{y})^2}$$

$$RMSE = \sqrt{\frac{\sum(y_i - \hat{y}_i)^2}{n - p}}$$

$$AIC = n \ln\left(\frac{\sum(\hat{y}_i - y_i)^2}{n}\right) + 2p$$

where y_i , $\hat{y}_i$ and $\bar{y}$ are the observed, predicted, and mean values of the dependent variable, respectively; n is the number of data used for fitting; p is the number of parameters.

To control the validities of the fitted equations, predicted and observed bark thickness and bark volume values of 57 sample trees in control group were compared separately using Student's t -test. Statistical analyses were implemented in IBM SPSS Statistics 23 software.

It is also an important requirement for the empirical models that they should give biologically realistic estimations. Beside the statistical assessment, curves fitted and found to be successful for b and V_b estimations were investigated graphically.

RESULTS AND DISCUSSION

In the study, b and V_b equations were fitted using regression analysis. Parameter estimates and other statistics such as R^2 , $RMSE$ and AIC were given at Table 3 and Table 4 for b and V_b equations, respectively. As seen on the tables, all the equations were found to be significant ($p < 0.05$) for both b and V_b estimations. In addition, all coefficients of the equations were statistically significant at the 0.05 level.

When the Table 3 is examined, it can be seen that all models for b prediction accounted for about between 64.2% and 78.6% of the total variance in dbh - b relationship. When all statistics were considered, Equation 6 was found to be the most successful model for dbh - b relationship, with the highest R^2 and low residual statistics such as $RMSE$ of 0.9742 and AIC of 789.8.

Table 3. Parameter estimates and goodness-of-fit statistics of bark thickness equations

<i>No</i>	R^2	F	p	b_0	b_1	b_2	b_3	$RMSE$	AIC
1	0.704	400.180	0.000	8.6807	1.5634			-0.8001	804.5
2	0.730	225.680	0.000	-10.2792	2.9743	-0.0230		0.0003	791.1
3	0.735	153.395	0.000	-27.7935	5.0290	-0.0944	0.0007	-0.0086	789.9
4	0.642	301.704	0.000	18.7610	1.0344			0.9081	875.4
5	0.752	509.328	0.000	2.0392	0.9710			0.7279	812.8
6	0.786	618.656	0.000	4.7821	-21.7447			0.9742	789.8

Table 4. Parameter estimates and goodness-of-fit statistics of bark volume equations

<i>No</i>	R^2	F	p	b_0	b_1	b_2	b_3	$RMSE$	AIC
1	0.807	703.384	0.000	-0.2005	0.0127			0.0649	-927.7
2	0.872	569.546	0.000	0.0286	-0.0043	0.0003		0.0530	-997.5
3	0.872	377.846	0.000	0.0497	-0.0068	0.0004	-	0.0534	-996.3
4	0.887	1323.920	0.000	0.0082	1.0939			0.1116	-743.6
5	0.949	3155.362	0.000	0.000033	2.4669			0.0529	-996.1
6	0.905	1596.972	0.000	-0.0951	-			0.0817	-849.8

As seen on the Table 4, all models for V_b prediction accounted for about between 80.7% and 94.9% of the total variance in $dbh-V_b$ relationship. When all statistics were taken into account, Equation 5 was chosen as the most successful model for $dbh-V_b$ relationship, with the highest R^2 and low residual statistics such as $RMSE$ of 0.0529 and AIC of -996.1.

To confirm the validity of the fitted equations, predicted bark thickness and bark volume values of the sample trees in control group were compared with observed ones using Student's t -test. Results of the t -test showed that there were no statistically differences between observed and predicted values ($p>0.05$), and the equations are appropriate to be used for bark thickness and bark volume estimates of Crimean pine in the region.

Statistical assessments showed that Equation 6 and Equation 5 were the most appropriate models for bark thickness and bark volume estimates, respectively. For these equations, observed and predicted values of the sample trees in fitting group were illustrated in Figure 5. As seen in the figure, there were no significant trends in residuals. The residuals were much lower for the values of low dbh than for larger trees. It's an expected situation that residuals in predictions show the rising trend with increase of dbh values. Also, Equation 6 and Equation 5 for b and V_b estimates had also biologically realistic curves.

The final mathematical forms of the Equation 6 and Equation 5 for bark thickness (b) and bark volume (V_b) estimates, respectively, are given as follows:

$$b = e^{(4.7821-21.7447/dbh)}$$

$$V_b = 0.000033 dbh^{2.4669}$$

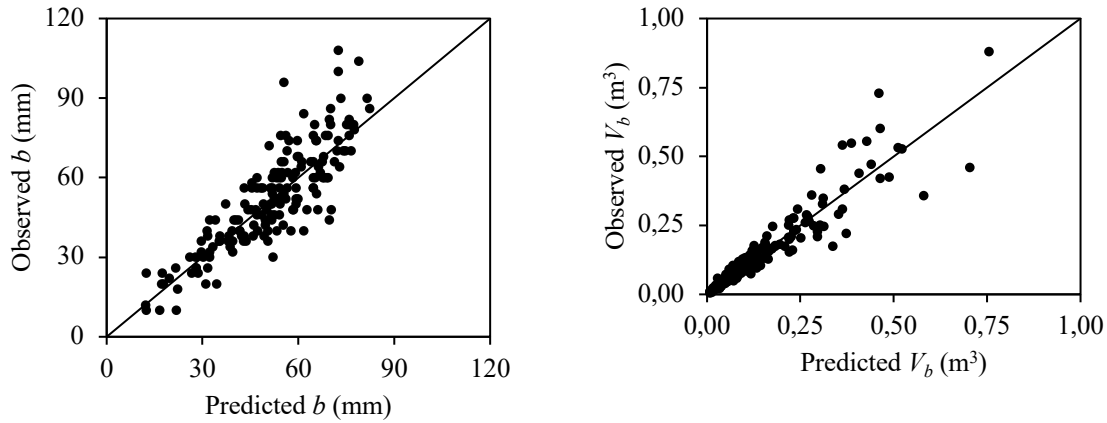


Figure 5. Observed vs. predicted values of b and V_b

Yavuz (1996) developed V_b equation for Crimean pine in Taşkoprü Forest Enterprise, which is one of forest enterprises of Kastamonu Regional Directorate of Forestry. In this study, dbh was used as an independent variable and the model fitted accounted 93% of the total variance with standard error of 0.088 cm. The equations of V_b fitted in the present study and Yavuz (1996) were compared with both statistically and graphically. For this purpose, V_b values with dbh from 8.0 cm to 60.0 cm were estimated using models fitted in the present study and Yavuz (1996). Results of Wilcoxon signed-rank test showed that V_b estimations of equation developed by Yavuz (1996) and present study were statistically different from each other ($p < 0.01$). In Figure 6, curves of these equations were compared visually. It can be seen from the figure that the curves show very similar trend until the dbh of 40.0 cm. Then, the equation developed by Yavuz (1996) underestimated V_b for higher values of dbh . The main reasons of this difference could may be due to topographic and site quality differences. In addition, the number of sample trees and the distributions of sites where the samples trees taken have high effect on model structure.

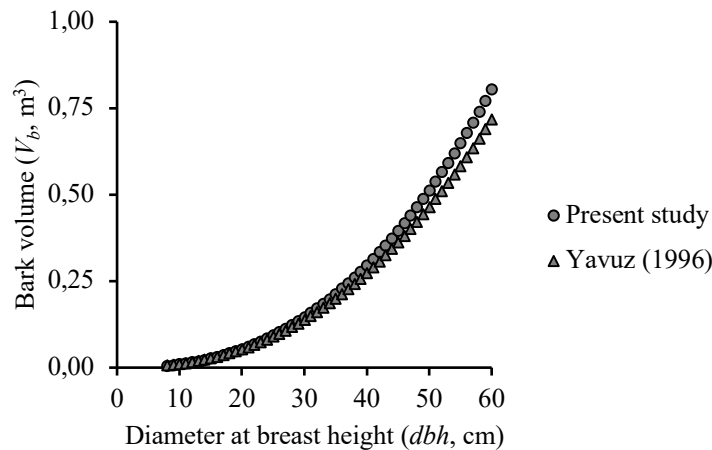


Figure 6. Comparisons of V_b equations developed by the present study and Yavuz (1996)

In Turkey, there are various forest growth and yield studies, while the number of studies on tree bark volume is limited. Because, it is a necessity that sample trees should be cut down to correctly

determine volume of tree bark, and this type of works could not be easy. In this study, 227 sample trees were selected from 192 sample plots representing different sites, densities and ages in the whole region. Because of the number and distribution of the sample trees used and the statistical success of the equations fitted in the study, it's highly recommended that Equation 6 and Equation 5 could be reliably used to estimate V_b and b of Crimean pine, respectively, within the boundaries of Kastamonu Regional Directorate of Forestry, Turkey.

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VIRUS DISEASES OF EDIBLE SEED SQUASH (*Cucurbita pepo*) IN AKSARAY PROVINCE

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Abstract

Cucurbits (the Cucurbitaceae family) include 119 genera and 825 species distributed primarily in tropical and subtropical regions of the world. The major cultivated cucurbit species such as melon (*Cucumis melo* L.), cucumber (*Cucumis sativus* L.), squash (*Cucurbita pepo* L.), and watermelon (*Citrullus lanatus* (Thunb) Matsum.&Nakai) are important vegetable crops worldwide. Squash is grown for fresh consuming, as well as its seeds are used as a snack in Turkey like some Mediterranean countries and Germany, Hungary, Austria and China. Virus diseases are one of the most destructive diseases on squash which is grown for seeds in Aksaray province. In this study, it was aimed to determine the virus infections in major squash growing areas in Aksaray province. Totally 153 plant samples with common virus symptoms like mosaic, curling, blistering, mottling, distortion, shoestring, stunting and vine decline were collected from squash plants during 2014. In this study, DAS-ELISA method is used for identifying the virus infections on the plant samples. According to the results of the DAS-ELISA 84.96 % of plant samples were infected with *Zucchini yellow mosaic Potyvirus* (ZYMV), *Watermelon mosaic Potyvirus-2* (WMV-2), *Cucumber mosaic Cucumovirus* (CMV), *Papaya ringspot Potyvirus*-watermelon strain (PRSV-W) and *Squash mosaic Comovirus* (SqMV). ZYMV was predominant in the research area with the ratio of 66.01 %. WMV-2 was the second important virus disease in the survey area; it was detected on the samples at the ratio of 57.51 %. Also mixed infections of those virus infections were detected commonly in squash. Especially, ZYMV+WMV-2 mixed infections were common. *Cucumber green mottle mosaic Tobamovirus* (CGMMV) was not present in the research area.

Key words: Aksaray, DAS-ELISA, Edible seed squash, WMV-2, ZYMV.

1. INTRODUCTION

Squash is grown for fresh consuming, as well as its seeds are used as a snack in Turkey like some Mediterranean countries and Germany, Hungary, Austria and China. Squash seeds are one of the most nutritionally rich vegetable by-products out there, having a high content of unsaturated fat, protein, beta carotene, vitamin C, vitamin B1, fiber, iron, calcium, and potassium. These seeds were originally a main food for countries like China, United States, India, and Mexico and recently whole world has realized to the health benefits of these seeds. Although edible seed squash has been grown in Turkey for many years, there has been a rapid increase in the production area and quantity since 2004. As a result, in the year of 2017, edible seed squash production has reached 41.326 tons in about 65.000 ha. production area. Virus diseases are one of the most important problems on squash growing.

According to the different estimates, 3-5% of overall vegetable production is lost due to virus infections, but losses can be occasionally very high, where pest control is insufficient, especially in developing countries (Caciagli, 2010). Virus diseases are a worldwide problem for cucurbit production and cause serious economic losses. Indeed, more than 35 different viruses have been isolated from cucurbits (Provvidenti, 1996). These viruses constitute complex and dynamically changing problems as described by Nameth et al. (1986). Edible seed squash is among the major vegetables grown in Aksaray province of Turkey. It occupied 4.495 ha in the province during 2017, with an estimated production of 3.977 tons (Anonymous, 2018). From different parts of Turkey, several virus diseases inducing mosaic symptoms were previously reported including *Cucumber mosaic Cucumovirus* (CMV) (Kureman, 1977), *Watermelon mosaic Potyvirus-2* (WMV-2) (Nogay and Yorgancı, 1984), *Zucchini yellow mosaic Potyvirus* (ZYMV) (Davis and Yılmaz, 1984), *Papaya ringspot Potyvirus-watermelon strain* (PRSV-W) (Erdiller and Ertunç, 1988), *Cucumber vein yellowing Ipomovirus* (CVYV) (Yılmaz et al., 1991), *Cucurbit aphidborne yellows Polerovirus* (Yılmaz et al., 1992), *Melon mosaic virus* (MMV) (Yılmaz et al., 1995), *Tomato ringspot Nepovirus* (TRSV) and *Tomato black ring Nepovirus* (TBRV) only in cucumber (Fidan, 1995), *Squash mosaic Comovirus* only in melon (SqMV) (Çağlar et al., 2004).

In this study, one year of surveys were undertaken in order to evaluate the incidence and distribution of viruses (WMV-2, ZYMV, CMV, SqMV, PRSV-W, and CGMMV) infecting edible seed squash crops grown in the Aksaray province.

2. MATERIAL AND METHODS

2.1 Collection of virus infected squash leaves: Surveys were conducted by collecting symptomatic squash leaf samples from main squash growing fields in 6 different districts (Center, Ortaköy, Gülağaç, Eski, Ağaçören and Sarıyahşi) of Aksaray province during July through September in 2014 (Table 1). Each sample consisted of the youngest fully developed leaf from plants exhibiting symptoms such as mosaic, mottling, vein clearing, blistering distortion, shoestring, stunting or yellowing and fruit discoloration and deformation. All samples were tested for the presence of ZYMV, WMV-2, CMV, PRSV-W, CGMMV and SqMV. All collected samples were placed in plastic bags, and stored in a freezer (-20°C) until use.

2.2. Testing by DAS-ELISA: All collected samples were subjected to DAS-ELISA and were tested for the presence of ZYMV, WMV-2, PRSV-W, CMV, SqMV and CGMMV using the double-antibody sandwich enzyme-linked immunosorbent assay (DAS-ELISA) tests as described by Clark and Adams (1977). The antisera and conjugates were purchased from BIOREBA AG (Reinach, Switzerland) (ZYMV, WMV-2, SqMV, CMV, and PRSV-W), and ADGEN Phytodiagnostics (Neogen Europe Ltd., Scotland, UK) (CGMMV) and used according to the instructions of the companies. The leaf samples were homogenized using a mortar and pestle with the addition of the sample extraction phosphate buffer solution (8.0 g NaCl, 0.2 g KH₂PO₄, 2.9 g Na₂HPO₄.12H₂O, 0.2 g KCl, 0.2 g NaN₃, 20 g polyvinylpyrrolidone-25 per L, pH 7.4) at a ratio of 1:8. Plates (Nunc Microwell, Roskilde, Denmark) were precoated with virus IgG that were diluted in carbonate buffer (1.59 g Na₂CO₃, 2.93 g

NaHCO₃, 0.2 g NaN₃ per L, pH 9.6), and incubated for 4 h at 37°C. After washing the plates with PBST buffer (8.0 g NaCl, 0.2 g KH₂PO₄, 2.9 g Na₂HPO₄.12H₂O, 0.2 g KCl, 0.2 g NaN₃, 0.5 mL Tween-20 per L) three times, samples were added to wells and incubated overnight at 4°C. Alkaline phosphatase conjugated antibody diluted in conjugate buffer (PBST+2% polyvinylpyrrolidone-40 + 0.2% egg albumin (Sigma A-5503) pH 7.4) was added after washing the plates, and incubated for 4 h at 37°C. *P*-nitrophenylphosphate in substrate buffer (97 mL diethanolamine, 0.2 g NaN₃ L⁻¹, pH 9.8) was added to each well and incubated for 30 to 90 min. at dark and room temperature. Absorbance values were measured at 405 nm using an Anthos 2010 Microplate Reader (Biochrom Ltd., Cambridge, UK) at the laboratory. Test was considered as positive when the mean absorbance value of tested sample was greater than twice of healthy control (Abou-Jawdah et al., 2000; Craddock et al., 2001; Ertunç, 1992; Paylan ve Erkan, 2011; Şevik and Arlı-Sökmen, 2003).

Table 1. Surveyed districts and number of collected plant samples

Districts	Number of Samples
Aksaray (Center district)	34
Ortaköy	35
Gülağaç	34
Eskil	20
Ağaçören	15
Sarıyahşi	15
Total	153

3. RESULTS AND DISCUSSION

In this study, totally 153 edible seed squash leaf samples were tested by DAS-ELISA. The relative frequencies of the different viruses infecting squash are reported in Tables 2 and 3. They clearly show that ZYMV and WMV-2 are the most common squash viruses in the research area. According to the results of the DAS-ELISA 84.96 % of plant samples were infected with ZYMV, WMV-2, CMV, PRSV-W and SqMV. ZYMV was the most common virus in the research area with the ratio of 66.01 %. WMV-2 was the second important virus disease in the survey area; it was detected on the samples at the ratio of 57.51 %. They are followed by CMV, SqMV and PRSV-W, 6.53, 3.92 and 1.30% in all tested samples, respectively. CGMMV was not detected in any of the tested squash samples (Table 2). Double virus infection was detected in 77 of all samples. Among double infected plants, 39.86 % were infected with ZYMV+WMV-2, the most frequently detected viruses in the samples (Table 3). Double infections with CMV+ZYMV, CMV+WMV-2 and SqMV+ZYMV were detected as 3.26, 2.61 and 1.96 %, respectively. Triple infections involving different combinations with all viruses were found in only 2 samples. Only one squash sample was simultaneously infected with ZYMV+WMV-2+SqMV+PRSV-W.

Table 2. According to DAS-ELISA tests results, the number of single virus infections

District	No. Tested	Healty	CMV	SqMV	WMV-2	PRSV-W	ZYMV	CGMMV
Aksaray (Center)	34	3	0	1	7	0	10	0
Ortaköy	35	5	0	0	4	0	8	0
Gülağaç	34	4	1	0	6	0	6	0
Eskil	20	5	0	0	1	0	3	0
Ağaçören	15	4	0	0	1	0	2	0
Sarıyahşi	15	2	0	0	2	0	1	0
Total	153	23	1	1	21	0	30	0

Table 3. According to DAS-ELISA tests results, the number of double and multiple virus infections

District	Double virus infections						Multiple virus infections
	ZYMV+ WMV-2	CMV+ WMV-2	CMV+ ZYMV	PRSV-W+ ZYMV	SqMV+ WMV-2	SqMV+ ZYMV	
Aksaray (Center)	11	1	0	0	0	1	3
Ortaköy	14	1	2	0	1	0	2
Gülağaç	12	2	1	1	0	1	3
Eskil	9	0	0	1	0	1	1
Ağaçören	7	0	1	0	0	0	1
Sarıyahşi	8	0	1	0	1	0	2
Total	61	4	5	2	2	3	12

In Aksaray province, edible seed squash is economically important but have a high incidence of virus-like symptoms. Viruses causing mosaic, leaf deformation, fruit deformation and reduced growth were observed in cucurbit plants in the province. Reduced growth and yellowing symptoms caused by mineral deficiency were also observed in some fields. Diseases symptoms were similar to the symptoms previously reported from virus-infected cucurbits fields worldwide (Abou-Jawdah et al., 2000; Alonso-Prados et al., 1997; Davis et al., 2002; Dodds et al., 1984; Lecoq et al., 1981; Luis-Arteaga et al. 1998; Makkouk and Lesemann 1980; Massumi et al., 2007; Provvidenti 1996; Sammons et al. 1989; Yuki et al., 2000). The occurrence and incidence of viruses on cucurbit plants have been studied in different parts of Turkey. The presence of ZYMV, WMV-2, CMV, PRSV-W and SqMV has been reported by different researchers (Çağlar et al., 2004; Davis and Yılmaz, 1984; Erdiller and Ertunç, 1988; Fidan, 1995; Köklü and Yılmaz, 2006; Kureman, 1977; Nogay and Yorgancı, 1984; Özaslan et al., 2006; Yılmaz and Davis, 1985; Yılmaz et al., 1991; Yılmaz et al., 1995). ZYMV and WMV-2 were the most widespread viruses in our study. Similarly, Yılmaz et al., (1992) found that they were the most common viruses among five viruses (CMV, WMV-2, ZYMV, PRSV-W and CABYV) in different provinces of Turkey. Also, a survey was performed by Yeşil (2014) on 334 edible seed squash leaf samples in Konya province, 60.18% ZYMV, 52.99% WMV-2 and 13.77% CMV of 334 samples were determined. In the survey conducted in 33 fields in Gaziantep province of Turkey for viruses infecting cucurbits, ZYMV was found in higher incidence than two other viruses, CMV and *Potato Potyvirus Y* (PVY) (Özaslan et al., 2006).

4. CONCLUSIONS

The presences of ZYMV, WMV-2, CMV, PRSV-W and SqMV on edible seed squash were determined in the province. The results revealed that squash grown in commercial fields commonly were infected with viruses in Aksaray. According to the results of the study, for reducing or eradication of virus diseases in squash production areas in Aksaray province and can be produced more yielded and more quality edible squash seeds the following suggestions must be regarded.

1. First of all, certified and virus-free seed must be used.
2. Except of SqMV, all viruses detected in our study were spread efficiently by aphids and mechanical inoculation (Hollings et al., 1981; Kaper and Waterworth, 1981). Unfortunately, growers in the province are not aware of spreading of viruses from plant to plant and don't know about measures to control virus transmission.
3. Also, weeds have important role on virus epidemiology and are a common problem in vegetable-growing areas in the province. To prevent virus infection, weeds should be controlled
4. As well in other plant crops production, in squash production cultural practices are very important. If all conditions which are necessary for growing healthy plant can be obtained, possibility of chance of phytopathological problems occurrence will be minimum. For this purpose, cultural practices such as sowing, fertilizing and irrigation should be done properly.
5. Virus infected plants should be destroyed promptly to prevent them being sources of further infections.

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SUSTAINABLE CROP AND LANDSCAPE SYSTEMS

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ABSTRACT

All the human activities have diverse effects on natural world. Attempt to combine various ecological theories in common, and by tightly-acceptable design method under a connected form is an essential phenomenon and necessity of people over the world. Designing of landscape provides to human and nature conjugate between health and basic requirements as well as production of field crops. Today, demand for food and gardening has been an increased and growing necessity. There is need for new goals on landscape modelling such as food and/or other products, ecosystem based renewing, natural-green fertilizing and soil improvement, self-protective plant patterns to achieve sustainable agricultural systems. The mentioned tasks are so hard, but essential for new targets of worldview. Potential of landscape as a component of agricultural production area is evaluated by view of its potential on high yield by lower energy-time and cost. In that view, main components of over-yielding polycultures on landscape areas may summarize by; high-diverse yield, maximum self-maintenance and minimum cost, maximum ecological health, healthy plants and minimum competition, over fertility, minimum weed-disease-insect problem and pesticide application, organic fertilizing, sustainable water demand, effective labor which may realize by creating better design factors and management activities. Present paper describes and highlights some strategies, tools, builds a bridge between ecology and garden, and offers specific issues about landscape designing by using field crops. Main purpose of the paper is to give suggestions to ecological principles on landscape designing for health, food and thus sustainability as a whole by considering of resources.

Key Words: Agricultural sustainability, landscape designing, landscape management, renewable ecology, sustainable resources.

INTRODUCTION

Edible landscape also called as “foodscaping” means that growing the plants which are used as food in landscape areas according to their designing characteristics and, oncoming food system type including all people in their homes, spaces in public and/or workplace for production of local foods (Thompson and Sokolowski, 2016). So, the selected plants should be integrated by image and – decorative features and productivity under the present ecological conditions. It is fair that, agricultural areas are the main plant production areas which have wide scales while urbanization is limiting the agricultural areas day by day. Therefore, there is a growing demand for increasing of food which may be supported by urban agriculture applications.

Present paper reviews the main concepts to introduce edible landscape which is related with sustainability principles that may summarized by biodiversity, ecosystem, food security, local economy and life quality in addition to providing of some suggestions about evaluation of urban areas, designing of landscape areas, effective and increased crop productivity.

Advantages of Edible Landscaping

Main benefits of the edible landscapes may summarized by; aesthetic, effective area usage, fresh food, food diversity which are hard to find in markets, food safety, fun, money saving and economy and stress management, health, neighborhood etc. cultural and social phenomenon that have many advantages related with sustainable systems. A well designed model for benefits of edible landscape is presented by Çelik (2017) in Figure 1.



Figure 1. Sustainable benefits of edible landscapes (Source: Çelik, 2017)

Additionally, edible landscaping has many benefits on sustainable agricultural systems basically related with biodiversity, ecology, energy, environment, soil, land conversation (organic carbon and total nitrogen content in the soil), persistent organic pollutants in natural environment, water and wild life as it reported in many studies (Kahraman et al., 2012; Sienkiewicz et al., 2017; Soulard et al., 2017; Krzebietke et al., 2018).

Principles of Edible Landscaping

Principles of edible landscape is similar with ornamental landscape. Designing of edible landscape should be based on the main statues of the area that is including the climatic conditions, well adapted plant species, acceptance by residents, isolation from industry and/or traffic to avoid from heavy metal accumulation and accumulation of toxic level in the used part of plant, easily cultivation and cultural applications (sowing time and density, fertilizing, hoeing, irrigation, pesticide using, vegetation length, harvest, storage etc.), economic value, decorative setting and visual appearance, preference by consumers for easily sales, medical importance.

Urban Agriculture

Urban agriculture (UA) is a trend to provide food production in the urban areas. It was mentioned during 1980's by agro-economists but it was not expanded too much. UA consisted from several activities such as; plant cultivation, aromatic and medicinal plants, fruit trees, growing animals and fish etc. main products to support ecology, cultural and social activities. Therefore, UA includes many disciplines like; development, geography, food security, planning of city, landscape architecture, designing urban, housing, agronomy and farming etc. scientific and professional areas. Starting from 2005, UA has grown in accordance with sustainability of cities and global climate change (Bhatt and Farah, 2009). Main highlights may summarized by; supply for local market, contribution to local economy, environmental vision, food quality and supplementation of household (Redwood, 2009). It is comparatively common on Havana, Cuba, Shanghai, China, Brazzaville and Congo (Mougeot, 2005). Additionally, UA has been a growing interest by several types such as allotment farden, community garden, edible landscaping, rooftop vegetable garden, urban agriculture, urban gardening and urban homesteading (Nolasco, 2013; Grichting and Awwaad, 2015).

Crop Production in Landscape Areas

Decrease in agricultural areas caused to search for alternative issues by farmers to provide demand for food production. Wars for land has been taken place around the world and gave suggestion to reach the lands for food production in urban areas which is related with capitalist practices across financial expenses in crop lands (Harvey, 2007). People lived in the past such as hunters, collectors, foresters and fruit growers had a huge creativity native in human nature for selection and breeding a great number of tree crops variety for many of the climatic conditions of Earth. They took care about sustainability by pay attention on fertility of soil and adaptation for the climate as well. Present day, there are more studies about intercropping trees by horticultural crops by combined designs on agroforestry nature. Crop production in forest and/or urban areas is a remarkable event for human by many advantages such as self-sufficient energy, biogas production, and consumption of their own products while wastes can be used for animal feeding. In some cases, designation of the ornamental plants by crops may be better considering by pollination (autogame or allogame) that is useful for the neighbor's plant varieties. Furthermore, some of the plants called as "nurse crop" due to their protective features for disease and insect control. In some parts of the world, crop plants are grown for providing of basic needs such as fruit, vegetable, timber, hedge, fuel, fertilizer, wrap, medical purpose, fiber, mattresses, repellent, gum, paint, staff for kitchen and purifier. (Girardet, 2001, Hart, 2010). In those areas, some of the strategic or very useful field crops which are used for a great number of uses and easily cultivated are promising such as soybean, bean, pea, oat, corn, sunflower, potato, fodder crops, green manure crops and especially medical and aromatic plants. Coming from old-style culture, farming systems in India includes bean, corn and squash growing in community areas as an aim. For deciding to selection of the crops under intercropping cultivation, people need to take care about the relationships with the threes in addition to the other criteria which are mentioned above (climatic conditions, adaptation, cultural practices etc.) similar with mixed cropping procedures. Crops which

are thought as landscape plants may also be used for honey production. Overall, crop production in landscape areas suggests to human controlling of erosion, water-harvest technology, hydro-electric station which are important for sustainable systems and combat with drought.

Sustainable Application of Landscape Designed by Crop Production

Agriculture in populated places give change to alternative usage of lands to combining various functions in urban areas. Many of the developed countries including United States have been applied the urban agriculture systems as an essential component of cities in accordance with worries about security of food and economy. Landscape architectures and designers are important for support the growing interest to transfer the data and development especially for community farm, garden, rooftop gardening, urban forest and edible landscape as well. Designing of agriculture in urban areas need to be in the property of sustainability principles by take care about functionality, providing of the main requirements and choice of residents etc. multiple features to protection of environment. Table 1 shows an inspired vision for urban agriculture (Lovell, 2010). For all the mentioned essential components of sustainable crop production in landscape architecture, research should work under multidisciplinary and integrate the collected data.

A project report (Valette et al., 2012) focused on sustainable cities vs sustainable agricultures revealed that the term of sustainability seems to disparate from urban or agriculture. In this sense, urban planners think that sustainability includes development of urban in addition to economic policies, environment, society, politics and practices. Furthermore, agriculture is related with urban designs due to be a media of open spaces. In the future, practices should carry about integration of landscape design and agriculture under sustainability basis.

One of the main limiting factor for plant growing is water resources in many parts of the world. So, the integrated systems of landscape and crop production may basically focused on effective water usage and water reserving for sustainability.

Table 1. Urban planning to support various functions of urban agriculture (Source: Lovell, 2010)

Function	Description and Justification	Supportive Planning Strategies
Production	Urban agriculture produces fruits, vegetables, mushrooms, herbs, medicinal plants, meats, milk, cheese, eggs, and other products.	Provide suitable, accessible, and safe land with good solar access and an irrigation source.
Energy Conservation	Producing food locally reduces the embodied energy resulting from inputs, transport, and packaging.	Develop transportation systems and networks to efficiently get food to consumers.
Waste Management	Organic waste products can be composted and used as a fertility resource for growing food and other products.	Identify systems to collect, divert, and transport organic wastes away from landfills to urban agriculture.
Biodiversity	Agricultural systems can support a wide range of species, including some native plants, as crops or associated plants.	Convert some open space areas of low diversity (<i>i.e.</i> , turf) to community gardens and farms.
Microclimate Control	Urban agriculture can positively alter microclimate through humidity control, wind protection, and shade.	Allow edible plantings in built areas to combat the heat island effect and other unfavorable climatic conditions.
Urban Greening	Community and backyard gardens contribute to the greening of urban areas, improving aesthetics and well-being.	Support efforts to convert vacant and derelict lands into productive green spaces for use by residents.
Economic Revitalization	Urban agriculture ventures offer new jobs for neighborhood residents and vitality from improved economics of the community.	Create networks to connect laborers, farmers, and markets to help retain and grow new ventures.
Community Socialization	Community members often find gardening and farming to be a social activity through sharing food, knowledge, and labor.	Along with community garden spaces, integrate other activities and features to encourage socializing.
Human Health	In addition to the known benefits of access to green space, urban agriculture offers healthy food and encourages physical activity.	Explore opportunities to develop community programming around gardening/farming as a healthy lifestyle.
Cultural Heritage	Urban agriculture can provide access to rare ethnic foods that are typically not available in existing markets.	Integrate community garden spaces in areas known to have high immigrant populations, and link with culture.
Education	Children and adults learn about foods, nutrition, cooking, environment, economics, and cultures through urban agriculture.	Offer gardening and urban agriculture activities within existing programs, particularly during summer.

CONCLUSION

Edible landscape may be an essential factor by acting on several areas such as garden on house and/or rooftop, public park, street, community garden, school garden, urban forest, mixed cropping, intercropping and any other open spaces. Natural resources are limited and the urbanized areas are negatively affecting the productivity and natural life in addition to the other mentioned criteria of main sustainable components. Agricultural lands are decreasing on contrary to urban areas which are mostly located on the high quality places. So, human can use the urban areas for food production to human

nutrition. There is need for a well-planned formalize and legitimate of designing landscape areas in cities that is focused on sustainability principles. Designing of landscape for crop production should pay attention on the environment – climate conditions, biotic factors and ecology, following statues for preference of the crops; soil type, adaptation, water consumption, disease and insect control, pesticide using, annual and short cycle, rotation etc. components.

Using of urban areas may not an issue for sustainability, but it is an alternative way as a tool linked between food production and environment. Destroying of environment is a big problem over the world. As environment has a dynamic system, human need to apply eco-friend techniques in addition to provide the food necessities. From this perspective, growing of crops in landscape systems by a well-planned design can contribute to the essential requirements for all the biotic and abiotic factors which are indispensable for sustainable systems.

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ÜNİVERSİTE KAMPÜSLERİNDE SÜRDÜRÜLEBİLİR TASARIM SÜRECİNİN İRDELENMESİ VE SELÇUK ÜNİVERSİTESİNDE SÜRDÜRÜLEBİLİR KAMPÜS TASARIMINA YÖNELİK ÖNERİLER

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ÖZET

Yüzyıllar boyunca gelişimi ve ilerlemeyi hedef almış insan, artan ihtiyaçlar ve teknolojik gelişmeler sonucunda, daha rahat ve güvenli bir yaşam sürebilmek adına hem kendisini hem de çevresini sürekli değiştirmiş ve geliştirmiştir. Teknolojinin bu kadar hızlı ilerlemesi yararının yanında zararını da getirerek çevre kirliliği ve hammadde kaynaklarının tüketilmesi gibi sorunları da beraberinde getirmiştir. Kaynaklar savurganca, hiç tükenmeyecekmiş gibi kullanılmış, doğanın kendini yenileme özelliğine rağmen bilinçsizce tüketimin yoğunluğu sonucunda kendini yenileyemez olmuştur. Sürdürülebilirlik kavramı daimî olma yeteneği olarak ortaya çıkan bir kavramdır. Oluşan bu çevresel sorunların önlenmesinde ve etkilerinin azaltılmasında uzun vadeli çözümler bulmak amacıyla ortaya çıkmıştır. Sürdürülebilir gelişme hedeflerine ulaşmada katkı sağlayan alanlardan biri olarak üniversiteler, çevresel, sosyal ve ekonomik sorunlar karşısında önemli role sahiptir. Bu kuruluşlar araştırma, eğitim ve ortak girişimler yoluyla sürdürülebilir gelişme sürecine önemli katkı sağlamaktadır. Bu çalışmada Dünya’da ve Türkiye’de sürdürülebilir kampüs tasarımının tarihsel gelişimi, sürdürülebilir kampüs peyzaj tasarımının nasıl yapılabileceği, yeşil tasarımların üniversite kampüslerinde uygulanışı, ASLA (Amerikan Peyzaj Mimarları Derneği) ile LEED (Enerji ve Çevre Dostu Tasarımda Liderlik) kriterlerinin karşılaştırmaları, sürdürülebilir kampüs peyzaj planlama ve tasarım örnekleri ve son olarak Selçuk Üniversitesi için sürdürülebilir kampüs önerileri sunulmuştur.

Anahtar Kelimeler: ASLA ve LEED kriterleri, kampüs sürdürülebilirliği, peyzaj planlama, peyzaj uygulama, sürdürülebilirlik, yeşil tasarım.

STUDYING OF SUSTAINABLE DESIGN PROCESS IN UNIVERSITY CAMPUSES AND SUGGESTION FOR SUSTAINABLE CAMPUS DESIGN IN SELÇUK UNIVERSITY

Human beings, who aim to develop and improve during centuries, change and develop themselves bath to live more comfortable life and to keep more secure life in consequence of technological developments and increasing needs. Development of technology has advantage and disadvantage sides, and causes to run out of raw materials and appear environmental pollution. Resources consumed as if they didn’t run out of, so these resources can’t renovate because of unconscious consumption although nature has the ability renovating. Sustainable means habitualness. It comes into existence to reduce the negative effects of environmental problems and to find long term solutions for environmental problems. Universities have significant importance effect for social and financial problems because they are one of the institutions which provide for sustainable developing targets. These institutions provide important effects for sustainable developing process by the way of education, investigation and collaborative venture. In this study, it is showed that the historical development of sustainable campus design Turkey and all over the world, how to do the sustainable campus landscape, implementation of green designs in university campuses, comparisons to ASLA and LEED’s criterions, sustainable campus landscape planning and design examples, and suggestions of sustainable campus design for Selçuk University.

Keywords: campus sustainable, criterions of ASLA and LEED, green design, landscape implementation, landscape planning, sustainable.

1. GİRİŞ

Kampüs planlaması, kampüs peyzaj tasarımı, yeşil tasarım ve bu kavramların üzerinde oluşturulacak alanların, sürdürülebilirlik ve ekoloji başlıklarıyla birleştirilmesi bu araştırmanın temelini oluşturmaktadır.

Üniversiteler, geçmişten bu yana sosyal, ekonomik ve politik hayattaki değişimlerde geniş bir yere sahip olmuştur. Üniversitelerin ulusal ve evrensel boyuttaki bu önemli konumları, sürdürülebilir gelişmeyi farklı ölçeklerde ve tüm alanları ile başarmada anahtar kuruluşlardan biri yapmaktadır. Bu durum, kampüs içinde ve dışında çevresel ve toplumsal sorumlulukları arttırmaktadır. Eğitim ve öğretim bu geniş kapsamlı sorumlulukların yerine getirilmesinde en önemli alanlardır. Üniversiteler, yalnızca dünya liderlerini, karar vericileri, öğretmenlerin çoğunu eğitmekle ve bilgi sınırlarını ilerletmekle kalmaz, aynı zamanda mal ve hizmetlerin büyük işverenleri ve tüketicileri olarak ulusal ve küresel düzeyde önemli bir ekonomik rol oynamaktadır. Üniversitelerden, eğitim, öğretim, araştırma ve bilgi transferi yoluyla sürdürülebilir kalkınmanın aracı ve yenilik merkezleri olması amaçlanmaktadır. Bu anlamda, sürdürülebilir üniversite kampüsleri önem kazanmaktadır (Özdal ve Özyılmaz 2015).

Sürdürülebilir kalkınma kavramı ilk olarak Haziran 1972 yılında İsveç'in Stockholm kentinde yapılan Birleşmiş Milletler (BM) İnsan Çevresi Konferansı'nda kullanılmıştır. Konferansın temel çıktısı olan Stockholm Deklarasyonu'nda (bildirgesinde) çevrenin taşıma kapasitesine dikkat çeken, kaynak kullanımında kuşaklararası hakkaniyeti gözetken, ekonomik ve sosyal gelişmenin çevre ile bağlantısını kuran ve kalkınma ile çevrenin birlikteliğini vurgulayan ilkeler, sürdürülebilir kalkınma kavramının temel dayanaklarını ortaya koymuştur. Sürdürülebilir kalkınma kavramının bugünkü kullanıldığı anlamıyla tanımlanması BM Dünya Çevre ve Kalkınma Komisyonu'nun (WCED-World Commission on Environment and Development) 1987 yılında yayımlanmış olduğu "Ortak Geleceğimiz (Brundtland Raporu)" adlı raporda yapılmıştır. Bu rapora göre sürdürülebilir kalkınma, "bugünün ihtiyaçlarını gelecek kuşakların da kendi ihtiyaçlarını karşılayabilme olanağından ödün vermeksizin karşılamak" olarak tanımlanmıştır. Yukarıda verilen tanımdan yola çıkılarak sürdürülebilir üniversite; kendi faaliyetlerini gerçekleştirirken çevresel, sosyal ve ekonomik açıdan ortaya çıkan olumsuz etkileri en aza indirmek için çalışan ve topluma sürdürülebilir bir yaşam biçimi konusunda öncülük eden yükseköğretim kurumu olarak tanımlanabilir (Günerhan ve Günerhan 2016).

1.1. Dünya'da Kampüs Planlaması ve Tarihsel Gelişimi

Eğitimle sürdürülebilir kalkınma arasındaki ilişki ilk kez 1972 Stockholm Konferansı'nda vurgulanmıştır. Stockholm Bildirgesi'nin 19. Prensibi'nde çevreyi korumak için çevre eğitimi verilmesi konusunda çağrıda bulunmaktadır. 1977'de Tbilisi Çevre Eğitimi Uluslararası Konferansı'nda çevre eğitimi konusunda ilk uluslararası bildirme ortaya konulmuştur. Ardından 1990'da Fransa'nın Talloires bölgesinde düzenlenen konferansın ardından 20 üniversitenin rektörleri on adet aksiyon planının yer aldığı Talloires Bildirgesi'ne imza atmıştır. Bu bildirme daha sonra imzalanan Halifax, Swansea, Kyoto, Copernicus, Tesseloniki bildirgeleri gibi oluşturulan şu ana kadar toplam yükseköğretimde sürdürülebilirlikle ilgili 31'den fazla bildirgeye örnek ve ilham kaynağı olmuştur. Şu anda 50'den fazla ülkeden 400'den fazla yükseköğretim kurumu bu bildirgeyi imzalamıştır. Ekolojik okur-yazarlık/ekosistem bilgi ve anlayışının geliştirilmesi Talloires Bildirgesi'nin önemli temalarından biridir. Üniversitelerin sürdürülebilirlik faaliyetlerini değerlendirmek için Yükseköğretimde Sürdürülebilirliğin Geliştirilmesi Derneği "Sürdürülebilirlik İzleme, Değerlendirme ve Reyting Sistemi"ni oluşturmuştur (Anonim 2016).

1.2. Türkiye'deki Kampüs Planlaması ve Tarihsel Gelişimi

Dünyada, çevre sorunlarının fark edilir ve rahatsız edici düzeye gelmesiyle birlikte; hükümetlerin, çevre komitelerinin, derneklerin ve yerel yönetimlerin başlattığı sürdürülebilirlik kapsamındaki çevreci yaklaşımlar, özellikle son 10 yılda üniversiteler tarafından çok daha yoğun bir şekilde ele alındı. Bu kapsamda 'yeşil kampüs' olma girişimleri başlatıldı. Bu konuda üniversiteler arası sıralama sistemi oluşturan ve yükseköğretim kurumlarının ne kadar çevreci olduğunu saptamaya çalışan en popüler sistemlerden bir tanesi ise Endonezya Üniversitesi tarafından oluşturulan 'GreenMetric' olarak bilinmektedir. Bu sıralama sistemi ile amaçlanan; üniversitelerin iklim değişikliği, enerji ve su sorunu, atıkların geri dönüşümü ve çevreci ulaşım konularına dikkat çekmelerini sağlamak. Ders müfredatlarında daha fazla çevreci ve sürdürülebilirlik konusundaki farkındalıkları artırmak (Anonim 2016a).

Türkiye ilk defa 2012'de listeye girdi. Bu sisteme ilk kez 2012 yılında iki Türk üniversitesi dâhil oldu. Bu sıralamada Sabancı Üniversitesi 144'üncü ve Bilkent Üniversitesi ise 209'uncu sırada yer aldı. 2012 yılındaki sıralamada; sistemden en düşük puan alan ülkeler Endonezya, Avusturya ve Polonya ile

birlikte Türkiye oldu. Bununla birlikte; 2013 yılında sisteme İnönü Üniversitesi ve İzmir ekonomi Üniversitesi eklendi. 2014 yılındaki son sıralamada ise Bülent Ecevit Üniversitesi, Karabük Üniversitesi, Ankara Üniversitesi, Selçuk Üniversitesi, Celal Bayar Üniversitesi sisteme eklenerek toplamda dokuz Türk üniversitesi yer aldı. Bu çalışmalarda Türk üniversitelerinin sıralamadaki yerlerinin çok yüksek olmadığı görülüyor. Bu nedenle; bu konudaki çalışmaların artırılması ve ulusal bilinçlendirme yapılması gerekliliği ortaya çıkıyor. Bu konuda YÖK, Çevre ve Şehircilik Bakanlığı ile üniversitelerden bu konularda uzman öğretim üyeleri birlikteliğinde ‘Ulusal Üniversiteler Sürdürülebilirlik Stratejik Planı’ şeklinde planlar hazırlanarak bir yol haritası oluşturulması gerekiyor (Anonim 2016a).

1.3. Sürdürülebilir Gelişmede Üniversite Kampüsleri

Ülkemizdeki kamu binalarının büyüklüğü düşünüldüğünde üniversite kampüsleri önemli bir alan oluşturmaktadır. Sürdürülebilir Yeşil Üniversite Kampüsü Oluşumu çalışmaları ile çevreye duyarlı, enerji tasarruf yöntemlerini kullanan, sürdürülebilir kalkınmaya katkı sağlayacak, başta ülke ekonomisi ve doğası olmak üzere tüm akademisyenlere, üniversite öğrencilerine, mezunlarına daha iyi hizmet veren yerleşkeler oluşturulması ve çeşitli boyutlarda başarı hikâyelerinin anlatılmasıyla ve çevresel farkındalık göstergeleri ve teknik uygulamalarla kaynak korunumu, atık azaltılması çevre ve enerji konularında ülkemize hizmet etmek hedeflenmektedir. Hedef kitle olan üniversitelere kampüslerini “Yeşil Kampüs” haline dönüştürebilmek için AASHE standartlarından esinlenilmektedir. Üniversitelerin akademisyenlerine sürdürülebilirlik konusunda bilgi ve tecrübe aktarımında bulunulacak, onların katkılarının alınmasıyla ülkemize özgü “Sürdürülebilir Üniversiteler için Çevre Yönetimi” modeli geliştirilecektir. Tüm bu çalışmalar, üniversite öğrencilerine gelecek nesillere de aktarmak üzere yaşamları boyu “Sürdürülebilir Yaşam Stili” kazandırma konusunda yol gösterici olacaktır (Anonim 2017a).

2. KAMPÜS PEYZAJI VE YEŞİL TASARIM

Kentlerde; meydanlar, kamu kurumlarının bahçeleri, kıyısal alanlar, kent parkları ve üniversite kampüsleri yeşil alan yaratmak için önemli potansiyel alanlardır. Nitekim ilk üniversitelerin önemli bir bölümü ile günümüzde kurulan üniversitelerin neredeyse tamamına yakını kampüs üniversiteleri şeklinde kurulmuştur. Dolayısıyla üniversite yerleşkelerinin planlanmasında, peyzaj planlama ve tasarım ilkelerinin de göz önünde tutulması zorunluluğu doğmuştur. Üniversite kampüslerinde açık ve yeşil alanların genelde bir park şeklinde planlanması gerek öğretim elemanları ve gerekse öğrencilerin huzurlu bir ortamda bulunması eğitim ve öğretimin kalitesi açısından önemlidir. Üniversite kampüslerinde, açık ve yeşil alanların bazı önemli işlevleri bulunmaktadır. Bunlar; yapılarla kampüsün arasındaki bütünlüğü sağlamak, sirkülasyon sistemi için gerekli alanı sağlamak, kampus de rekreasyon ihtiyaçlarını karşılayacak dış mekân düzenlemesine olanak tanımak, kampüsün sınırları içinde insanla çevresi arasında ilişkinin kurulmasını sağlamak, kampüsün fiziksel gelişimi karşılamak için rezerv alanlar oluşturmak, kampüse estetik açıdan katkıda bulunmak şeklinde belirtilebilir (Ertekin ve Çorbacı 2010)

3. SÜRDÜRÜLEBİLİR PEYZAJ TASARIMI İÇİN ASLA VE LEED KRİTERLERİNİN KARŞILAŞTIRILMASI

Sürdürülebilir gelişme konusunda ilk çalışanlardan McHarg'a (1969) göre, peyzaj mimarlığı ve planlama disiplinleri, insan için sürdürülebilir gelişim hedeflerine, ancak doğayı ve doğal süreçleri planlama ve tasarım çalışmalarıyla bütünleştirdikleri zaman ulaşabilirler. Ancak McHarg (1969) doğa ve doğal süreçlerin dahil edildiği çalışmaların sonuçlarının, doğanın dinamik süreci de göz önüne alındığında, zaman içerisinde ortaya çıkacağını belirtmiştir. Bir yaklaşıma göre, sürdürülebilir peyzaj tasarımı temel ilkeleri (Gürbüz ve Arıdağ 2013)

- Bölgesel İmkanların Kullanımı: İklim koşulları, güneş-gölge durumu (yaz güneşinden korunma, kış güneşinden yararlanma), rüzgâr durumu (soğuk rüzgarlardan korunma, sıcak rüzgarlardan yararlanma), yağış durumu, bölgesel ve/veya dönüşümlü malzemeler,
- Mevcut Peyzajın En Az Tahribi: En az kazı-dolgu, mevcut bitki örtüsü, yerüstü suları,
- Bozulan Peyzajın Onarımı: Toprağın iyileştirilmesi, zararlı maddeler, uygun olmayan bitkiler olarak öngörülmüştür.

Peyzaj tasarımında bir dış mekân oluştururken öncelikle insana hizmet etmesi, sosyal çözümler üretmesi, ergonomik ve konforlu olması gözetilir. Dış mekân tasarımında da diğer tasarım meslekleri gibi insan hareketi merkeze alınarak kurgulanır. Diğer tasarım mesleklerinden en önemli farkı doğanın içinde olması, doğal koşullardan doğrudan etkilenmesi ve doğa ile beraber hareket etmesidir. Bu durum peyzaj mimarlığında yalnızca insan hareketinin değil, hava-nem hareketinin, su hareketinin, gölge-güneş hareketinin de önemli olduğunu gösterir. Bu günlük hareketler dışında dış mekânda daha

yavaş oluşan hareketler de vardır. Bunlar büyük ölçekteki hareketler olan toprak ve yeryüzü hareketleri, iklim ve ısı hareketleri, vejetasyon hareketleri gibidir. İnsan doğal bir varlıktır ve yaradılışı gereği temel ihtiyaç ve duyularını doğanın verilerinden karşılamak ister. Peyzaj tasarımı doğa hareketlerinin gözlenmesi ve bu hareketlerle iletişim halinde yaşamın içine alınabilmesi için tasarımın doğanın kendisi ve doğanın hareketleri ile birlikte oluşturulması gerekir (Gülbüz ve Arıdağ 2013).

3.1. Selçuk Üniversitesinin Mevcut Durumu

1962'de M.E.B.'e bağlı olarak açılan Selçuk Eğitim Enstitüsü ve Yüksek İslâm Enstitüsü ile üniversiteye sahip olma yolunda ilk ciddi adım atılmıştır. Bu ilk adımın güçlendirilerek geliştirilmesi için 1968'de Konya'da Üniversite'yi Kurma ve Yaşatma Derneği kurulmuş ve nihayet duyulan yakın ilgi, gösterilen üstün gayretler sonucu bugünkü Mühendislik-Mimarlık Fakültesi'nin nüvesini teşkil eden Mühendislik-Mimarlık Yüksekokulu kurulmuştur (Anonim 2017b).

Üniversiteye geçiş süreci ise 1975 yılında gerçekleşmiştir. 11 Nisan 1975'te yürürlüğe giren '4 Üniversitenin Kurulması ile İlgili 1873 Sayılı Kanunla' yurdumuzda dört üniversitenin kurulması öngörülmüş ve Selçuk Üniversitesi de bu kanuna istinaden kurulmuştur. 1976-1977 eğitim-öğretim yılında Fen Fakültesi ve Edebiyat Fakültesi olmak üzere 2 fakülte, 7 bölüm, 327 öğrenci ve 2 kadrolu öğretim üyesi ile faaliyete geçen Selçuk Üniversitesi, 1982 yılına kadar kayda değer bir gelişme gösterememiştir (Anonim 2017b).

Selçuk Üniversitesi için atılım yılı 1982 olmuştur. 20 Temmuz 1982 tarih ve 41 sayılı Kanun Hükmündeki Kararname ile ilk etapta üniversitenin çekirdeğini oluşturan Fen ve Edebiyat Fakülteleri birleştirilerek Fen-Edebiyat Fakültesi'ne, Selçuk Yüksek Öğretmen Okulu'nun Eğitim Fakültesi'ne, Konya Devlet Mühendislik-Mimarlık Akademisi'nin, Mühendislik-Mimarlık Fakültesi'ne, Konya Yüksek İslâm Enstitüsü'nün İlâhiyat Fakültesi'ne dönüştürülmesine karar verilmiştir. Ayrıca Hukuk, Tıp, Ziraat ve Veteriner Fakülteleri ile Sağlık, Fen ve Sosyal Bilimler Enstitüleri'nin kurulmuş, Yabancı Diller Yüksekokulu kaldırılarak Konya Meslek Yüksekokulu'na dönüştürülmüş, Kız Sanat Yüksek Öğretmen Okulu, Kız Sanat Eğitim Yüksekokulu'na dönüştürülmüştür (Anonim 2017b).

Kampüs profili

Selçuk Üniversitesi, '41 sayılı Kanun Hükmündeki Kararname' ile bir anda 8 fakülte, 4 yüksekokul ve 3 enstitü seviyesine ulaşmıştır (Anonim 2017b).

2000'li yılların sonuna kadar bilimsel alan başta olmak üzere fiziki, sosyal, kültürel ve sportif alanlarda hızlı bir yükseliş yaşayan Selçuk Üniversitesi'nin 2011 yılı itibariyle bünyesindeki fakülte sayısı 24'e yükselmiştir. Ancak 2011 yılı Aralık ayında Bakanlar Kurulu kararı ve Cumhurbaşkanımız Sayın Abdullah Gül'ün onayıyla Selçuk Üniversitesi Meram yerleşkelerinde bulunan Meram Tıp Fakültesi, Ahmet Keleşoğlu Eğitim Fakültesi ve İlâhiyat Fakültesi Konya' daki ikinci devlet üniversitesi olan Konya Üniversitesi'ne bağlanmıştır. 26 Nisan 2013 tarihli Resmi Gazete' de yayımlanan Bakanlar Kurulu kararı ile Seydişehir Ahmet Cengiz Mühendislik Fakültesi, Seydişehir Meslek Yüksekokulu, Seydişehir Sağlık Hizmetleri Meslek Yüksekokulu, Ereğli Mühendislik ve Doğa Bilimleri Fakültesi, Ereğli Eğitim Fakültesi ile Konya Ereğli Kemal Akman Meslek Yüksekokulu Necmettin Erbakan Üniversitesi'ne bağlanmıştır.

Bugün bünyesinde 21 fakülte, 6 enstitü, 6 yüksekokul, 22 meslek yüksekokulu, 1 devlet konservatuvarı bulunan Selçuk Üniversitesi, 70.000'i aşkın öğrencisi ile Türkiye'nin en büyük eğitim kurulları arasında yer almaktadır (Anonim 2017b).

Eğitim kurumlarının mekân düzenlemelerine bakıldığında, ilk kurulan eğitim kurumlarından Selçuk Eğitim Enstitüsü ve Yüksek İslâm Enstitüsü'nün Meram'da kendileri için yapılan binalarda eğitim vermeye başladıkları görülmektedir. Ancak daha sonra kurulan fakülteler kent içinde farklı yerlerde başka kurumlara ait geçici binalarda eğitime başlamışlardır. Açılan fakülte ve bölüm sayılarının artmasıyla mevcut binalar yetersiz hale gelmiş, tüm fakültelerin bir alan içinde toplanması gereksinimi duyulmuş ve bunun sonucu olarak 1979 yılında hazineye ait arazinin tahsisi ve şahıs arazisinin kamulaştırılmasıyla kent merkezine 20km uzaklıkta Afyon karayolu üzerinde 9200 da'lık bir alan üzerinde kampüs sahası oluşturulmuştur (Büyüksahin & Çınar 2012).

Kampüs yerleşim planına bakıldığında, yaygın tip yerleşim sistemine dayalı yerleşim özelliklerini taşıdığı görülmektedir. Binalar Dış Hekimliği Fakültesi ve Rektörlük bölgesi dışında düşük yoğunlukla, topografyadan etkilenmeden rastlantısal bir biçimde yerleşmektedir. Merkezde konumlandırılmış olan ortak kullanımlar bölgesi (kafeterya, rektörlük, Süleyman Demirel Kültür Merkezi, kütüphane) etrafında akademik bölgenin ve barınma bölgesinin geliştiği görülmektedir (Büyüksahin & Çınar 2012).

Kampüs yaşayanlarının ortak kullanacakları bu bölgede mekânlar eğitim, yönetim ve temel ihtiyaç amaçlı mekânlar ile rekreatif amaçlı mekânlar olarak iki grupta ele alınabilmektedir. Kampüste ortak

kullanım mekânlarından rektörlük, mediko-sosyal, kütüphane, bilgisayar merkezi (Bilmer), yemekhane ve mekânlarının planlama kriterlerine uygun olarak kampüsün kolay ulaşılabilir merkezi bölgesinde, ana ulaşım aksı üzerinde ve birbirlerine oldukça yakın olarak tasarlandıkları görülmektedir. Kampüste yaşayanların alışveriş, yemek, dinlenme, oyun oynama ve internet erişimi gibi ihtiyaçlarına cevap veren sosyal tesis (Gökkuşluğu) kampüsün girişine çok yakın, ana ulaşım aksı üzerinde ancak merkezden uzakta konumlanmıştır (Büyüksahin & Çınar 2012).

Kampüs bünyesinde ortak kullanım mekânlarının ikinci grubunu oluşturan rekreatif amaçlı ortak kullanım mekânlarından spor için tasarlanmış mekânların kampüste bir noktada toplanmış oldukları görülmektedir. Bu alanda bir spor salonu, olimpik yüzme havuzu ve açık spor alanları (voleybol, basketbol, futbol) bulunmaktadır. Planlama kriterlerine göre spor alanları gürültüden soyutlanmış ana ulaşım aksından uzakta konumlanmıştır (Büyüksahin & Çınar 2012).

Ortak kullanım mekanlarında rekreatif gruba dahil olan kültürel amaçlı mekanlardan Süleyman Demirel Kültür Merkezi; kampüs arazisinin merkezi bölgesinde geniş bir alan üzerinde 496 kişilik (Malazgirt Salonu) ve 876 kişilik (30 Ağustos Salonu) olmak üzere iki konferans salonu geniş bir fuaye ve sergi alanı ve bir kafeterya barındırmaktadır. Bu kültür merkezi sosyal ve bilimsel birçok etkinliğe ev sahipliği yapmakta öğrenci ile akademik ve idari personeli sosyal aktiviteler kapsamında bir araya getirebilmektedir. Düzenlenen konferanslar, tiyatrolar, sempozyumlar, fuarlar da kampüste yaşayanlarla kent halkının birlikte olmaları ve fikir alışverişinde bulunabilmeleri için ortam hazırlamakta kültür merkezi de bu sosyal ilişkiye ev sahipliği yapmaktadır. Kültür merkezi işlevi dolayısıyla hem kentten katılanlar için girişe yakın hem de kampüste yaşayanlar için ana ulaşım aksı üzerinde kampüs genelinde merkezi bir konumda tasarlanmıştır. Kültür merkezindeki salonlar, aktiviteler için gerekli kapasiteyi barındırabilecek ölçüde olsalar bile bina etrafında gerekli otopark düzenlemesi yapılmadığı, yapılan düzenlemenin yeterli sayıda aracın park etmesine olanak tanımadığı görülmektedir. Özellikle kent halkının da katıldığı büyük organizasyonlarda otopark problemi ciddi bir sorun teşkil etmektedir (Büyüksahin & Çınar 2012).

Yeşil tasarım uygulamaları

Üniversite kampüslerinde ise yapılar dışında kalan açık alanların önemli bir bölümü yeşil alanlara ayrılmıştır. Kampüslerdeki açık ve yeşil alanlar, kampüsün ulaşım sistemini, sınırlarını, giriş kapılarını, bahçeleri, açık hava oturma alanlarını, spor ve oyun alanlarını, anıt, çeşme ve işaret levhalarını, kampüs mobilyaları ile kampüs alanının doğal özelliklerini (kayalıklar, ormanlık alanlar, küçük göller) içermektedirler. Kampüs bünyesinde ortak kullanım için ayrılmış açık alanlar incelendiğinde kullanım amaçlı bir tören alanı ve bir park tasarlandığı ayrıca binaların arasında bırakılmış ancak bu amaçla planlanmamış alanlarında kullanıldığı görülmektedir. Tören alanı fakültelerin bulunduğu bölge ile diğer ortak kullanım mekânlarının planlandıkları merkezi bölge arasında ana ulaşım aksı üzerinde tasarlanmıştır. Geniş bir alan üzerinde ağaçlarla ve yeşil doku kullanımıyla zenginleştirilen alan; yarışmalarda, festivallerde, sosyal etkinliklerde kullanılmakta kampüs halkının bir araya geldikleri bir ortam oluşturmaktadır. Bu alanın da konum olarak olumlu planlandığı ancak alanda ağaçlandırmanın yetersiz olduğu, yaz mevsiminde güneşin etkisinin kullanımı olumsuz yönde etkilediği bu sebeple alanın yıl boyu kullanıma yönelik planlanmadığı görülmektedir. Bahar şenliklerinde, festivallerde eğlencelerin düzenlendiği bir diğer alan da kütüphane ile yemekhane arasında kalan yeşil alandır. Bu mekânda da yeterli ağaçlandırma yapılmamasına, mekânın gölgelenmesinin düşünülmemesine karşın kampüste yaşayanların hem merkezi konumu hem taşıtla bölünmeyen yayalaştırılmış durumu ile rekreasyon aktiviteleri için tercih ettiği mekân olmuştur (Büyüksahin & Çınar 2012).

4. SELÇUK ÜNİVERSİTESİ KAMPÜSÜ SÜRDÜRÜLEBİLİR KALKINMA İÇİN YEŞİL TASARIM ÖNERİLERİ

Selçuk Üniversitesi Alaaddin Keykubat Kampüsü için sürdürülebilir kalkınmaya yönelik aşağıdaki çözüm önerileri sunulmuştur.

Yeşil kampüs projesi kapsamında, öğretim üyelerimizin danışmanlığında, mezun, personel ve öğrencilerimizin de katıldığı bir süreç çerçevesinde, çevre düzenlemelerinin ekolojik, sosyal ve ekonomik boyutlara dikkat edilerek gerçekleştirilen eğitimler verilebilir.

Sürdürülebilir peyzaj anlayışımıza uygun olarak gerçekleştirilen tasarım ve uygulama çalışmaları, genel olarak, 8 başlık altında toplanabilir.

- Sert zemin düzenlemeleri

Drenaj problemi olmaması amacıyla su geçirimsizliği yüksek, mekân algısını ortaya çıkaran, kampüs içerisinde öğrencilerin kullanabileceği ve belirli noktalarda bisiklet park ve kiralama alanlarının olduğu bisiklet yollarının planlanması, bisiklet zeminlerinin solar panellerle döşenmesi ve buradan elde edilen enerjinin kampüs içerisinde kullanıma sunulması, engelli kullanıcılarının rahat dolaşımına imkân sağlayan rampa, görme engelliler için hissedilebilir zemin uygulamalarının yapılması ve doğal hayatın sürdürülebilirliğine mümkün olduğunca katkı sağlayan iklime uygun malzeme kullanımı ve detay çözümleri planlanmalıdır.

- Bitkisel düzenlemeler

Konya iklim yapısına uygun olan, mümkün olduğunca az su tüketen, planlanacak alana uygun olarak seçilen ve mekânı karakterize eden herdem yeşil veya yaprak döken bitki türlerinin tercih edilmesi ve bu bitkilerin, kampüs içerisinde bitkisel düzenleme ilkelerine uygun bir biçimde yerleşiminin yapılabilmesi.

Kampüs içerisinde yer alan yurtların besin ihtiyacını ve rekreasyonel yaşamı desteklemek amacıyla hobi bahçelerinin kurulması öngörülebilir. Doğal yaşamı koruma ve koruma bilincini aşılama amacıyla bitki dikim etkinliklerinin yapılması, bu etkinliklerde bitki dikimini teşvik edici, eğitici yarışmaların yapılması.

- Sulamaya ilişkin düzenlemeler

Bitkisel materyalin yaşamlarının devamı için gerekli sulama suyunun temini ve su tüketiminin azaltılması amacıyla, otomatik sulama ve damlama sulama sistemlerinin kurulması, bu yöntemlerin seçiminde bitki türlerine göre sulama tercihlerinin göz önünde bulundurulması bu bağlamda alan özelliklerine uygun sulama sistemi ve ekipmanın da göz ardı edilmemesi, kampüs içerisinde kullanılan atık suların ve yağmur sularının değerlendirilmesi, bu kapsamda atık suların dönüşümü ile ilgili çalışmaların yapılması. Bina içlerinde yer alan musluklarda su tasarrufunu sağlayan özel başlıkların kullanılması.

- Aydınlatmaya ilişkin düzenlemeler

Solar panellerden güneş enerjisi ile elde edilen elektrik enerjisinin aydınlatmada kullanılabilmesi, aydınlatma ürünleri olarak düşük tüketimli (çoğunlukla LED teknolojisini kullanan), uzun ömürlü, ekonomik, estetik ve güvenli ürünlerin tercih edilmesi. Ev tipi rüzgâr tribünlerinin kurulması ve bu tribünlerden elde edilen enerjinin aydınlatmada kullanılması.

- Kent mobilyaları ve yardımcı elemanlara ilişkin düzenlemeler

İklim koşulları sebebiyle yapısal malzemelerin soğuğa ve kuraklığa dayanıklı, uzun ömürlü, kullanıcı dostu olarak seçiminin yapılması, bu seçimlerde ergonomik kullanım koşullarının göz önünde bulundurulması ve engelli kullanıma da uygun olarak tasarlanabilmesi, yerleşke içerisinde eğitici ve yönlendirici tabelalarının yerleştirilmesi, bu tabelalarda gece de görüşü ve okumayı sağlayabilecek aydınlatma elemanlarının güneş enerjisinden elde edilen enerji ile sağlanması.

- Atık yönetimi ve geri dönüşüme ilişkin düzenlemeler

Kampüs içerisinde atık yönetim tesisinin kurulması, belirli noktalara cam, kâğıt, plastik atık konteynerlerinin yerleştirilmesi, bina içerilerine de geri dönüşüm kutularının yerleştirilmesi. Yağmur sularının belirli noktalarda toplanılıp yeşil alanlarda kullanılması. Bina içlerinde geri dönüşüme uygun olan gri suyun sulamada kullanılması, atık suyun da arıtma işleminden sonra kullanımının gerçekleştirilmesi.

- Yaban hayatının korunmasına ilişkin düzenlemeler

Kampüs içerisinde var olan kuş türlerinin kışın soğuktan korunmasını sağlamak amacıyla kuş evlerinin yapılması, köpekler ve kediler için belirli noktalara hayvan barınaklarının yapılması.

- Peyzaj bakımına ilişkin düzenlemeler

Biçilen çimlerin varillere konularak kompostlama işleminin yapılması ve buradan elde edilen doğal malzemenin peyzaj bakımında gübre olarak kullanılması, budamadan elde edilen ağaç ve çalı dallarının parçalanarak humus elde edilmesi ve doğal gübre kullanımına teşvik edilmesi.

5. SONUÇ

Üniversiteler gerek istihdam ettiği kişiler gerekse öğrenim gören insanlar olarak oldukça kalabalık bir nüfusa, bir o kadar da yol, bina ve otopark gibi yapısal alanlara sahiptirler. Çeşitli birimlerinden hizmet alan kişiler de sayıya eklendiğinde üniversiteler, oluşturdukları kirleticilerle bulundukları alanlara sağladığı yararların yanı sıra, hem doğal çevreye hem de sosyal çevreye doğrudan ya da dolaylı olarak negatif yönde etkilerde bulunmaktadır. Bu sebeple, üniversitelerin sürdürülebilir olmaları hem kendi kirletici unsurlarını en aza indirmek açısından hem de toplumdaki insanlara öncülük etme ve örnek olma açısından son derece önemlidir.

Sürdürülebilirlik kavramı uzun bir süreçtir. İlerleyişi ve yaklaşımları köklü bir şekilde değiştirmeyi hedeflemektedir. Bu değişim sürecinde herhangi bir zorlukla karşılaşılması için çalışanlara, öğrencilere ve toplumdaki diğer insanlara konunun önemini iyi anlatılması ve kararlılıkla yol alınması en önemli husustur.

Bu çalışma, sürdürülebilir peyzaj tasarımı için gerekli olan planlama ve tasarım kriterlerinin incelenerek Konya Selçuk Üniversitesi peyzaj planlama ve uygulama çalışmalarının gelişimine katkı sağlaması amacıyla oluşturulmuştur. Bu kapsamda Dünyada ve Türkiye'deki sürdürülebilir kampüs planlaması ile ilgili detaylı literatür araştırması yapılmış ayrıca planlamada yer alan çeşitli tasarım uygulamaları da sürdürülebilirlik ilkeleri göz önünde bulundurularak incelenmiştir. İnceleme aşamasında ASLA ve LEED kriterleri de Konya Selçuk Üniversitesi önerilerine altlık oluşturmuştur.

Sürdürülebilir peyzaj planlama çalışmaları içerisinde yer alan sert zemin düzenlemeleri, bitkisel düzenlemeler, sulamaya ilişkin düzenlemeler, aydınlatmaya ilişkin düzenlemeler, kent mobilyaları ve yardımcı elemanlara ilişkin düzenlemeler, yaban hayatının korunmasına ilişkin düzenlemeler ve peyzaj bakımına ilişkin düzenlemeler olmak üzere sekiz kategoride incelediğimiz kampüs içerisinde yeşil alanların sürdürülebilirliğini sağlamak amacıyla kriterler belirlenmiş ve öneri olarak sunulmuştur.

İrdelenen her ölçüt, konuyu ayrıntılı anlamak için örneklendirmek amacıyla İstanbul Teknik Üniversitesi ve Boğaziçi Üniversitelerinin yeşil kampüs planlamalarını, sürdürülebilir alanlar için neler yapıldığı incelenmiş ve bilgi niteliğinde yazılmıştır.

Öneri aşamasında Konya Selçuk Üniversitesi Alaaddin Keykubat Kampüsü var olan genel durumu; topoğrafik yapısı, bitki örtüsü, ulaşım ve çevresel verilerin genel durumu ortaya konulmuş ve daha sonra her bir özellik belirlenen kriterler doğrultusunda ayrı ayrı incelenmiştir.

Konya Selçuk Üniversitesi Alaaddin Keykubat Kampüsünün sürdürülebilir yeşil alan planlamasında göz önüne alınması gereken kriterler, geleceğe yönelik tasarım çalışmaları bakımından önem taşımaktadır. Geliştirilmesi planlanan bu örnek çalışma, sürdürülebilir kampüs tasarımı sürecinde önceliklerin belirlenmesi için bir çerçeve oluşturmuştur. Ortaya konulan öncelikler doğrultusunda belirlenen vizyon ve misyon, kapsamlı ve sürdürülebilir bir şekilde ortaya konulmuştur.

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EFFECTS OF SILICON APPLICATION ON PLANT GROWTH AND CHLOROPHYLL CONTENT OF MELON (*Cucumis melo* L.) GROWN UNDER SALINITY STRESS

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ABSTRACT

Salinity stress is known as one of the most important stress factors that affect yield and plant growth. In this study, the effects of silicon on chlorophyll content and growth performance of melon plants under salinity stress was carried out. The seeds were sown in a liter pot filled with peat and perlite (2:1). Silicon and salt were applied when seedlings had 2 or 3 true leaves. The silicon was given as 0.5 mM, 1 mM and 2 mM concentration and the plants were exposed to salt stress (50 mM-100 mM-150 mM, two days for each concentration and 200 mM for final concentration). Plants were watered with a nutrient solution prepared to be as 177.2 ppm N; P 52.70 ppm, 240.44 ppm K, Mg 53.46, 120.30 ppm Ca; 3:36 ppm Fe; 0.85 ppm Mn; 0:45 ppm B; 0:50 ppm Zn; 0,10 ppm Cu and 0.05 ppm Mo. The experiment has conducted a plant in a pot, and 15 plants in each replication with four replications. In this study, a number of leaves, shoot and root length, totally fresh and dry weights, chlorophyll content was investigated. While decreasing of chlorophyll content of 200 mM NaCl application was -61.94 %, as receiving the highest value, the value of 2 mM Si²⁺ + NaCl application was -34.58%. While the lowest plant fresh weight of 200 mM NaCl application was 9.99 g, the applications of 1 mM Si²⁺ + NaCl, 2 mM Si²⁺ + NaCl, 0.5 mM Si²⁺ + NaCl were 33.63 g, 33.48 g and 11.49 g, respectively. According to the results, plant biomass and chlorophyll content generally were less affected by salt stress by increasing silicon concentration. According to the results, plant biomass and chlorophyll content generally were less affected by salt stress by increasing silicon concentration.

Keywords: Silicon, salt stress, melon, plant growth, chlorophyll content

INTRODUCTION

Turkey's melon production is about 1.7 million tonnes (Anon., 2015). The production areas are mostly carried out in salty soils. In this case, the salinity stress in the melon growing is a very important factor in Turkey. In general, salinity stress inhibits and/or reduces the uptake of certain beneficial elements such as calcium and, as a result, leads to ion imbalance (Huang and Redman, 1995a) In Turkey, salinity in the soil is one of the most important factors that decrease plant productivity. In Turkey, inefficient areas of the country's surface area covers about 2% and saline soils in these unproductive areas constitute approximately 74% (Kendirli et al., 2005)

Salinity indicates direct effects of plants on osmotic and ionic stress, while indirect effect is due to structural deterioration and toxic compounds occurring in plants as a result of these stress factors (Botella et al., 2005; Hong et al., 2009). Salt stress generally affects many biological phenomena such

as growth, development, germination, cell division, photosynthesis in plants depending on density and duration (Yılmaz et al., 2011). The toxic level of ions originating from the salt negatively affects the membrane stability, enzyme activity, water balance, mineral nutrition, oil storage and synthesis of plant cells (Horoz and Korkmaz, 2014)

When the amount of salt present in the soil solution is increased and the amount of water decreases, the osmotic potential of the plant cells decreases and the division or growth of the plant cells suddenly starts to slow down. Under these stress conditions, stomata usually close, stomata activity decreases, and as a result, photosynthesis slows down. If the stress condition persists, plant growth can become completely stagnant and the plant can suffer great damage (Ashraf, 1994). In Egypt, Gadallah, (1999) reported a decrease in the amount of chlorophyll in foliage under salt stress in a plant study. The reduction in the amount of chlorophyll in plants under salt stress due to the negativity in the general metabolic process has been supported by a number of studies conducted by many researchers. Çiçek and Çakırlar, (2002) Seemann and Critchley (1985) and Yarsi et al.,(2017) reported that the amount of chlorophyll decreases due to the accumulation of ions and the opening and closing of stomata in high salt concentrations, and as a result, the decrease in photosynthesis activity results in the slowing down of plant development.

For plants, salt is an important abiotic stress factor that has a very negative effect on a certain concentration. The amount of salt in the soil can be quite high especially in arid and semi-arid regions where evaporation is more than rainfall (Epstein et al., 1980; Meiri et al., 1981). Despite the fact that silicon is not a basic element among the plant nutrients, recent research emphasizes that it reduces the occurrence of plant diseases and pests and increases the resistance and durability of some plant species (Aksoy, 2006). Increasing the overall effect of saltiness on plants; the formation of small leaves, short height, a decrease of leaf growth and sometimes less leaf formation (Munns and Termaat, 1986; Yarsi et al.,2017). Avcu et al. (2013) stressed that Silicon is more effective in reducing salt stress in its studies comparing Selenium and Silicon with salt stress-reducing effects.

Most of the melon production is carried out in the coastal areas of the Mediterranean Region, Central Anatolia, Southeastern Anatolia, and Eastern Anatolia, and mostly in saline soils. This situation increases the importance of salinity stress in melon cultivation in Turkey. There are different methods of reducing or controlling salinity stress in plants, and silicon application is reported as one of them. However, studies have not enough been conducted on this topic, therefore, the importance of this study is increasing.

MATERIALS AND METHODS

Plant Material and experiment: In this research conducted in greenhouse conditions, seeds were sown in a pot (1-liter capacity) with peat: perlite (2: 1). The perlite was thoroughly washed with distilled water before sowing. Plants were watered following the method of Suyum et al., (2012). Silicon and salt were applied when seedlings had 2 or 3 true leaves. Silicon was given as 0 (control), 0.5 mM, 1 mM, and 2 mM, and salt applications were given as 0 (control), 50 mM, 100 mM for 2 days and the final concentration of 200 mM was reached. After reaching the final concentration, the experiment was continued for 12 days and it was terminated. For each replicate, 15 plants were used as one replication and four replicates were used separately.

Plants harvested: The plants removed from the pots and washed with distilled water.

Stem and root length: The stems and roots of the plants were measured with a ruler.

Fresh and dry weight: The fresh weights were weighed with a scale of 0.001. Then put in the oven at 65°C for 48 hours for dry weights.

Chlorophyll Content: Measured with a Konica Minolta SPAD-502 instrument. Measurements were made from 3 different points of each leaf of 10 plants for each replicate.

Data collection and statistical analysis: All of the data and analyses were repeated thrice. To determine the differences between means were used t-test (with significance at $P < 0.05$).

RESULTS AND DISCUSSION

Chlorophyll content: Table 1 shows that the chlorophyll content was not statistically differences at the first measurement but statistically significant difference was found at the last measurement. At the first measurement, all applications were in the same group. At the last measurement values, it was found that 200 mM salt application was the lowest value with 18.25 and followed by application of 0.5 mM Si + Salt (22.05), 1 mM Si + Salt (22.77) and 2 mM Si + Salt (33.25), respectively. 1 mM Si application had the highest value with 44.67 and it was included in the same group with 0.5 mM Si (41.50), 2 mM Si (41.22) and control (41.85). In this study, salt stress caused the reduction of chlorophyll amount in the melon plants. However, silicone application gave resistance to the decrease in the amount of chlorophyll content of melon plants. Yarşı et al., (2017b) and Koyro (2002) also reported that salt stress reduces the amount of chlorophyll in plants.

Table 1. The effects of silicon applications on chlorophyll content under salt stress (SPAD values)

	First Measurement (SPAD value)	last measurement (SPAD value)	% Change from control
Control	49.28 a	41.85 a	-15,08
0.5 Si	51.07 a	41.5 a	-18.74
0.5 Si+NaCl	49.43 a	22.07 cd	-55,35
1 Si	51.24 a	44.67 a	-12.82
1 Si+NaCl	48.32 a	22.77 bc	-52,88
2 Si	50.58 a	41.22 a	-18,51
2 Si+NaCl	50.82 a	33.25 b	-34,58
200 NaCl	47.94 a	18.25 d	-61,94
D%5	7.94	7.05	

Means followed by the same letter are not significant according to *t*-test (confidence limit 95 %).

Changing % of chlorophyll content: The changing percentage of chlorophyll between the first and last measured values is seen table 1. The highest chlorophyll decrease was found in 200 mM salt application with -61.94%. This was followed by 0.5 mM Si + NaCl (-55.35%), 1 mM Si + NaCl (-52.88%) and 2 mM si + NaCl (-34.58%), respectively. According to these results, salt stress decreased chlorophyll content, but Silicon applications decreased this changing. According to this results, It can be said that silicone application in saline soil affects the yield and quality positively due to the reduction of chlorophyll degradation.

Plant Growth: Table 2 shows that the effect of silicon application on the number of leaves, main body length, root length and stem diameter under the salt stress of melon plants. When Table 2 is examined, it is seen that the effect of silisyum application on the number of leaves is statistically significant. The application of 200 mM NaCl was the lowest with a value of 3.7, followed by 2 Si + NaCl (3.9), 1 Si +NaCl(4.3) and 0.5 Si +NaCl(4.5)respectively. While the application of 0.5 mM Si was the highest with 9.8, the control (8.9), 2 mM Si (8.75) and 1 mM Si with 8.5 were included in the same group.

Table 2. Effect of silicon on the number of leaves, main stem length, root length and stem diameter under the salt stress of melons

Applications	number of leaves	main stem length (cm)	root length (cm)	stem diameter (cm)
Control	8.9 a	50.77 a	20.72 a	8.02 a
0.5 Si	9.8 a	55.35 a	20.1 ab	7.62 a
0.5 Si+NaCl	4.5 c	16.0 b	20.77 a	5.85 b
1 Si	8.5 b	66.55 a	21.97 a	7.25 a
1 Si+NaCl	4.3 c	18.55 b	19.77 ab	6.02 b
2 Si	8.75 ab	58.72 a	20.62 a	7.37 a
2 Si+NaCl	3.9 c	20.03 b	19.97 ab	6.05 b
200 NaCl	3.7 c	15.92 b	16.47 b	5.65 b
D%5	1.1	26	3.68	1.05

Means followed by the same letter are not significant according to *t*-test (confidence limit 95 %).

When we look at the main body lengths, it is seen that silicon application has an effect on decreasing of salt stress. The application of 200 mM NaCl was lowest with 15.92 cm and the 1 mM Si application with 66.55 was the highest. The effect of silicon application on root length was found to be statistically significant. In plants where silicon and salt were applied together, 200 mM NaCl application was the lowest with 16.47 cm. Other applications were 1 Si + NaCl (19.77 cm), 2 Si + NaCl (19.97) and 0.5 Si + NaCl (20.77), respectively. The effect of silicon application on the stem diameter of melon plants grown under salt stress was also found to be statistically significant. While the control (8.02 mm) was in the same group with 0.5 mM Si (7.62 mm), 1 mM Si (7.25 mm) and 2 mM Si (7.37 mm) and 2 mM si + NaCl (6.05 mm), 1 mM Si + NaCl (6.02) and 0.5 mM Si + NaCl (5.85) and 200 mM NaCl application (5.65) were in the same group. The application of salt negatively

affected plant growth. However, silicon has a positive effect on plant growth by reducing the effect of salt stress.

Parida and Das (2005). reported that NaCl decreases the amount of water and adversely affects the ion balance in the cells and adversely affects the plant growth. Yarsi et al., (2017a) reported that the salt stress was effected plant growth as negatively. The results of this study are consistent with the studies of these researchers.

Table 3. The effect of silicon application on fresh plant and dry plant and fresh root and dry root weights in melon.

Applications	fresh plant weights(g)	dry plant weights(g)	fresh root weights(g)	dry root weights(g)
Control	31.28 a	3.4 a	1.84ab	0.50a
0.5 Si	32.07 a	3.44 a	1.87ab	0.53a
0.5 Si+NaCl	11.49 b	1.38 b	0.91c	0.16b
1 Si	33.63 a	3.63 a	2.11a	0.53a
1 Si+NaCl	12.00 b	1.42 b	1.13c	0.24b
2 Si	33.48 a	3.62 a	2.20a	0.64a
2 Si+NaCl	13.05 b	1.46 b	1.20bc	0.25b
200 NaCl	9.99 b	1.35 b	0.66c	0.11b
D%5	6.67	0.91	0.70	0.20

Means followed by the same letter are not significant according to *t*-test (confidence limit 95 %).

The effect of silicon application on the fresh plant weight was found to be statistically significant for melon plants grown under salt stress. The plants where salt and silicon are applied together were in the same group as the values of 200 mM NaCl (9.99 g), 0.5 Si+NaCl (11.49 g), 1 Si+NaCl (12.00 g) and 2 Si+NaCl(13.05 g), while 1 mM (33.63 g), 2 mM Si (33.48 g), 0.5 mM Si (32.07 g) and control (31.28 g) were in a different group. Plant dry weights were similar to plant fresh weights and were statistically significant. 1 mM Si application (1.63 g) had the highest value, while 200 mM (1.35 g) had the lowest value (Table 3). In a study conducted in rice plant (*Oryza sativa* L.), it was determined that the growth of rice seedlings was prevented because of the excess accumulation of sodium chloride ions in leaves growing under salt stress (Gong et al., 2006). Gong et al. (2011) investigated the effect of the application of silicon in beans grown in arid conditions and found that plants applied silicon in aqueous conditions were higher than silicon-applied plants. In our study, it was found that silicon application increased plant biomass.

The effect of silicon and salt application on the plant root fresh weight was found to be statistically significant for melon plants grown under salt stress (Table 3). While the application of 2mM silicon had the highest wet root weight with 2.20 g, this value was followed by the application of 1 mM Si with 2.11 g and it was statistically the same group. These values were determined as 1.87 g and 1.84 g respectively in 0.5 mM Si and control applications in the same group. 2 mM si + NaCl (1.20 g) application was found in different

group as to be statistically, while 1 mM Si + Salt (1.13 g), 0.5 mM Si + Salt (0.91) and 200 mM salt (0.66) were in the same group but different. Root dry weights were similar with the root fresh weights and were statistically significant. 2 mM Si application had the highest value with 0.64 g, while and 200 mM NaCl application (0.11 g) had the lowest value (Table 3).

When the results were examined, it was observed that the application of silicon caused a significant increase in the weight of biomass in melons. In applications where salt was applied, the application of silicon has decreased the negative effect of salt. In parallel with the increased silicon concentration, it was found that both silicon application alone and salt stress were better in plant fresh and dry weight and root fresh and dry weight than control and 200 mM salt applications. Avcu et al. (2013) compared to selenium and silicon in a study under salt stress. He emphasized that silicium is more effective in reducing salt stress. The results of the silicon applications of our study revealed similar results to this study.

CONCLUSION

As a result of the study, it was found that the silicon application contributed positively to the plant growth in both saline-applied and salt-free parcels, and helped plants gain resistance to salt stress. The chlorophyll decreasing% was -61.94% at 200 mM salt application whereas this decreasing was -34.58% at 2 mM Si + Salt application. it was found that silicon application increased plant biomass. It can be said that the Silicon application increased resistance to the stress in certain doses in melon seedlings grown under salt stress. It can be said that silicon hardens the plant tissue, decreases the effect of antioxidant compounds and thus slows down the deformation of the cells.

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EFFECTS OF SILICON APPLICATION ON SOME PLANT NUTRIENTS CONTENT OF MELON (*Cucumis melo* L.) PLANTS UNDER THE SALT STRESS CONDITION

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Abstract

The salinity stress is known as the most important abiotic stresses which restrict plant growth and reduces yield and yield components in crop production. In this study, plant growth, Si²⁺, Na⁺, Cl⁻, K⁺ and Ca²⁺ amount of leaves and roots of the melon seedlings which are silicon application under salt stress were investigated. Melon seeds were sown in a 1-liter plastic pots filled with peat: perlite by ratio 2:1. Silicon was 0 mM-0.5 mM-1 mM and 2 mM concentration and salt (NaCl) started at 50 mM NaCl in the beginning for two days then 2 days as 100 mM, two days 150 mM and reached a final concentration of 200 mM. The study was ended after 12 days of reaching final concentration. In the plants which were applied silicon and NaCl together and only silicon, the Cl⁻ content of root was found higher than the control application. It was found that silicon application reduced transporting of Na⁺ and Cl⁻ to the leaf but caused an increasing amount of K⁺ and Ca²⁺ of the leaves of plants grown under salt stress.

Key Words: Melon, silicon, salt stress, plant nutrient

INTRODUCTION

The stress is factors that affecting the normal development process of plants and thus reducing their efficiency (Gürel and Avcioğlu, 2001). Stress factors affecting plants are divided into two as biotic and abiotic (Yılmaz et al., 2011; Çulha & Çakırlar, 2012; Larcher, 1995). Osmotic stress and salt stress are caused many negative effects on plants physiological and biochemical (Ashraf and Wu, 1994; Munns and James, 2003). Mineral substance stress from abiotic stresses is the stress factor that affects the most usable areas after drought (26%) with a rate of 20%, most of which is salinity, and the world has more than 9 million hectares of salinity (Çulha and Çakırlar, 2012). Reduction of the amount of available water in plants slows down of cell growth. Therefore, plant growth slows down, there is an increasing of Na⁺ and Cl⁻ ions due to osmotic stress. In this case, the intake of useful nutrients such as Ca²⁺, K⁺ and NO₃⁻ is prevented (Hu and Schmidhalter, 2005). It is known that potassium intake will be low in the plant if the sodium ion is high (Ashraf, 2012; Chow et al., 2012; Lazof and Cheeseman, 2012).

In order to protect the plant from the negative effects of salt stress in plants, it activates a number of antioxidant and antioxidative enzymes (Zhu, 2005). Calcium salt stress has a very important effect on

the plant. The application of high-dose calcium from the outside to the plant reduces the permeability of the cell membrane to Na⁺ ion. Therefore, it is prevented of sodium accumulation in the cell and plant by passive intake. (Hoffman et al., 1989).

Caro et al. (1991), in the selection of salt tolerant genotypes in tomato. It is reported that Na⁺ and Cl⁻ levels are the ideal selection criteria. The soils which have high salinity that contains high Na⁺: Ca²⁺, Na⁺: K⁺, Ca²⁺: Mg²⁺ and Cl⁻: NO₃⁻. this situation causes negative changes in physiological and metabolic components of plant growth processes due to ion imbalance (Ali et al., 2012).

Some scientific studies reducing salt stress in melons and some other plants have started to be done in recently(Kuşvuran et al., 2007; Kuşvuran, 2010; Toresano-Sanchez et al., 2010; Avcu et al., 2013; Demir et al., 2013). Kuşvuran (2010), it was investigated the genetic dimension of tolerance to salt and drought. The identification and mapping of the relevant genes are considered necessary to understand the mechanism of resistance to these stress factors. Daşgan et al. (2007), In a study on some melon genotypes, they showed that salt stress appeared in plants in three ways. 1) Due to insufficient water in the plant root area, this situation increases the amount of salt and the plants cannot benefit from enough water. So Plants have a big stress. 2) Increasing Na⁺ and CL⁻ ions around plant root that are caused toxic effects on plants. 3) Nutritional problems occur in plants.

Gong et al. (2011) investigated the effect of silicon application in growing beans under drought. It was found that plants treated with silicon in aqueous conditions were higher than in silicon-applied plants. Çetinsoy and Daşgan (2016) were reported that Se + Si application has an increase in yield in cucumber growing. And the fruits of cucumber treated with Si were 134% more hardness than control.

MATERIAL AND METHOD

This study was carried out at Mersin University Silifke Vocational School in Greenhouse Conditions. In the study, Galia F1 melon cultivar was used as plant material. Melon seedlings were watered by Suyum et al.,(2012). Silicon and NaCl were applied when melon seedlings were 2-3 true leaves. Silicon 0 (control), 0.5 mM, 1 mM and 2 mM, the salt applications were given as 0 (control), 50 mM, 100mM as 2 days and the final concentration of 200 mM was reached. After reaching the final concentration, applications were continued for 12 days and the study was terminated.

Mineral Composition: Ca²⁺, K⁺ and Na⁺ were determined by Kuşvuran (2010) and Cl⁻ was determined by Johnson & Ulrich (1959). Si²⁺ was determined by Çetinsoy and Daşgan (2016).

RESULTS AND DISCUSSION

The nutrition contents of leaves of melon plants are given Table 1. When Table 1 is examined, it is seen that the effect of silicone application on the amount of Na⁺ is statistically significant. In plants where silicon and salt were applied together, the amount of Na⁺ in the 200 mM salt application was measured as 2.02%, while these values were 1 mM Si + NaCl (1.91%), 0.5 mM Si + NaCl (1.79%) and 2 mM Si + NaCl (1.50%), respectively. In the untreated NaCl applications, Na⁺ was the highest content with 0.58% for control, whereas 1 mM Si and 2 mM applications were 0.46%. it can be said that silicon inhibits the transport of Na⁺ to the leaves in certain proportions.

When Si^{2+} contents of leaves were examined, it was found that there were statistically significant differences among the applications. The amount of silicon in the leaves increased by increasing silicon applications. The application of 2 mM Si^{2+} was highest with 1.43% and this value was 0.31% in 200 mM salt application (Table 1).

Table 1. Effects of silicon applications on some mineral contents of leaves under salt stress conditions in melon

Applications	Na (%)	Si (%)	K(%)	Ca(%)	Cl(%)
Control	0,58 e	0,59 d	0,37 c	0,27 e	0.50d
0.5 Si	0,49 f	1,25 b	0,41 b	0,33 d	0.51 d
0.5 Si+NaCl	1,79 c	0,43 e	0,34 d	0,29 e	2.57 b
1 Si	0,46 f	1,25 b	0,4 b	0,43 b	0.52 d
1 Si+NaCl	1,91 b	0,57 d	0,35 cd	0,4 c	2.06 c
2 Si	0,46 f	1,43 a	0,58 a	0,52 a	0.54 d
2 Si+NaCl	1,5 d	0,62 c	0,31 e	0,43 b	2.06 c
200 NaCl	2,02 a	0,31 f	0,20 f	0,21 f	3.39 a
D%5	0,04	0,02	0,02	0,02	0.49

Means followed by the same letter are not significant according to t-test (confidence limit 95 %).

When Table 1 is examined, it is seen that the effect of the silicon application on K^+ amount is important. In plants where silicon and salt were applied together, the amount of K^+ in the 200 mM NaCl application was the lowest with 0.20%. The amount of K^+ was 0.31% in the application of 2 mM Si + NaCl and 0.34% in the 0.5 mM Si + NaCl application and 0.35% in the 1 mM Si + NaCl application. In the non-salted plants, these values were 2 mM Si (0.58%), 1 mM Si (0.40%), 0.5 mM Si (0.41%) and control (0.37%), respectively. Dasgan et al. (2007) and Yarsi et al., (2017) in a study on melon plants, reported that the intake of potassium decreased compared to control under salt stress. The results of our study are consistent with this study.

There were statistically significant differences in the amount of Ca^{2+} of the leaves. The application of 2 mM Si was the highest with 0.52%, while the application of 200 mM NaCl was the lowest with 0.21%. This value was determined as 0.27% for control. When the amount of Cl^- in the leaves was examined, the application of 200 mM NaCl was 3.39% followed by 0.5 mM Si + NaCl (2.57%), 1 mM Si + NaCl (2.0%) and 2 mM Si + NaCl (2.06), respectively. In the plants which were no-salted applications, the amounts of Cl^- were found to be close to each other and they were included in the same group as statistically. It was found that salt application increased the amount of Cl^- in the leaves. However, it was determined that the combined application of salt and silicon decreased the salt accumulation in the leaves.

Table 2. Effects of silicon applications on the mineral content of roots under stress conditions in melons

Applications	Na (%)	Si (%)	K(%)	Ca(%)	Cl(%)
Control	0,77 f	0,34 g	1,57 e	1,3 e	0.50 c
0.5 Si	0,79 f	0,77 d	1,63 c	1,55 c	0.50 c
0.5 Si+NaCl	6,07 b	0,62 f	1,34 g	1,15 g	1.59 b
1 Si	2,05 d	0,82 c	1,92 b	1,73 b	0.52 c
1 Si+NaCl	6,05b	0,7 e	1,6 d	1,24 f	2.19 a
2 Si	1,26 e	3,34 a	1,97 a	2,27 a	0.50 c
2 Si+NaCl	5,08 c	0,92 b	1,61 cd	1,42 d	2.39 a
200 salt	7,02 a	0,76 d	1,54 f	0,89 h	1.32 b
D%5	0,02	0,02	0,02	0,02	0.31

Means followed by the same letter are not significant according to t-test (confidence limit 95 %).

The nutrient contents of the roots are given in table 2. When Table 2 is examined, it is determined that the effect of the application of silicon on the number of nutrients in the roots is statistically different. About Na^+ , in the applications where both silicon and silicon were applied together with salt, 200 mM NaCl had the highest value with 7.02% and control had the lowest value with 0.77%. When we look at the amount of Si^{2+} in the roots, it was seen that 2 mM Si application had the highest value with 3.34%. This value was the lowest at 0.34% in the control group. The value of the silicon, especially the application of 2 mM Si, is very high compared to other applications. It can be described as the accumulation of silicon in the roots by developing a mechanism against the increase of silicon (Table 2). When the amount of K^+ in the roots was examined, it was determined that 0.5 mM Si + NaCl application (1.34%) was the lowest value of in the plants which were applied silicone and salt together. This value was 1.57% in control plants, whereas in other applications 1 mM Si + NaCl (1.6%), 2 Si + NaCl (1.61) and 200 mM NaCl (1.54%) were found. In general, the amount of K^+ in the roots of plants was found higher than control except 0.5 mM Si + NaCl and 200 mM NaCl applications. And the Ca^{2+} , The application of 200 mM NaCl was the lowest with 0.89%. In Control, this value was 1.3%, while all other applications were higher than the control.

When we look at the amount of Cl^- in the roots, the highest value was 2 mM Si + NaCl application with 2.39%. This was followed by 1 mM Si + NaCl (2.19%), 0.5 mM Si + NaCl (1.59%) and 200 mM NaCl (1.32%) application, respectively. On the other hand, in salt-free parcels, the values were close to each other and these applications were in the same group as statistically (Table 2).

CONCLUSION

As a result of this study, It has been determined that silicon application decreases the transport of Na^+ and Cl^- to leaves from the roots of melon seedlings which were grown under salt stress and caused an increase in the amount of K^+ and Ca^{2+} in the leaves. According to these results, it can be said that silicon application increases the resistance against stress in melon seedlings grown under salt stress. This may be explained by the fact that silicon imparts stiffness of plant tissues and thus decelerates the deformation of cells. Furthermore, it can be concluded that silicon application has a positive effect on an adaptation of plants to adverse conditions. It was reported that silicium is effective in decreasing salinity stress in plants such as wheat and rice (Idris et al., 1975; Balasta and Perez, 1989; Horoz and

Korkmaz, 2014). According to the results obtained, 1 mM and 2 mM silicone application can reduce the negative effects of salt for melon growing that is grown under saline conditions. Silicon application may be recommended in soilless culture, especially tomato cultivation and where salty water is used for irrigation.

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THE EFFECTS OF DEFICIT IRRIGATION CONDITIONS ON MORPHOLOGICAL AND PHYSIOLOGICAL DEVELOPMENT IN BLACKBERRY (*Rubus fruticosus* L.)

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Abstract

This study was carried out in a controlled growth room at the University of Selçuk, Faculty of Agriculture and Department of Horticulture. In this study, it was aimed to determine effects of deficit irrigation conditions on morphological and physiological parameters such as shoot length, root length, fresh shoot weight, dry shoot weight, fresh root weight, dry root weight, chlorophyll content, stomatal conductance, membrane permeability and leaf relative water content (LRWC) in blackberry cultivar “Jumbo”. The homogeneous blackberry plants were propagated by nodal tissue culture technique *in vitro* culture condition. The blackberry plants were acclimated outdoor environmental condition after propagation and rooting stages. The blackberry plants were subjected by deficit irrigation conditions with full of field capacity, 80, 60, 40 and 20% of field capacity. The irrigation was performed once every three days. The longest shoot length was found in 40% and 60% of deficit irrigation with 49.94 cm and 51.09 cm, respectively. The similar to shoot length, the longest root were obtained 40% of deficit irrigation (45.93 cm) and 60% of deficit irrigation (46.50 cm). The largest leaf was measured in 60% of deficit irrigation with 20.10 cm². In the physiological parameters, the 60% of the field capacity was found the highest. The decreased water amount affected negatively leaf relative chlorophyll content (34.31 SPAD Units), stomatal conductance (20.45 mmol m⁻²s⁻¹), membrane permeability (72.45%) and LRWC (35.48%) comparison with 60% of the field capacity that was found higher values. As a result, the 60% of the field capacity was found suitable for irrigation of the blackberry.

Keywords: Blackberry, Deficit Irrigation, Morphology, Physiology

1. INTRODUCTION

There are many native blackberry species in many regions of the world. More than 350 of these species have been identified. European blackberries (*Rubus fruticosus* L.) have important roles in the development of today's varieties (Bilginer and Ağaouğlu, 2013). Blackberry *Rubus fruticosus* (Tourn.) L. subgenus *Eubatus* are found in temperate zones around the world. *Rubus* species belong to the *Rosaceae* family (Finn, 2008; Hunkova et al., 2018). Blackberries grow on a perennial roots system and bring them to the canes every two years. These canes are vegetative canes in first years and called primocanes. These canes come into flower and fruit set in the second years and called floricanes which died after fruiting (Finn and Clark, 2012). Blackberries are some of the most consumed berries in the world. While a large amount of fruit is sold in the fresh market, most blackberries are processed into

either quick frozen (IQF) fruit, puree, or juice, preserves, jam, jelly, baked goods, dried products, ice cream and yogurt (Clark and Finn, 2011). Blackberries are a rich source of anthocyanins and other polyphenolic antioxidants (Siriwoharn et al., 2004).

Blackberries have been adapted to a wide range of climate and soil characteristics and many species have spread in Europe, North America, and Western Asia. In Turkey, blackberries are widespread that wild species in almost every region. Our country, blackberry production is 2.739 tons in approximately three hundred hectares area. This production is met it's of %80 in Bursa city (Anonymous, 2018). The importance of blackberry cultivation is enhanced by the fact that our ecology is convenient, easy to grow, short-term fruit-bearing, high efficiency from a unit area, more price than other fruit and it is suitable to use in a wide variety of forms. However, the most important environmental factor of today's problems which drought seriously affects blackberry cultivation.

Drought is at the forefront of natural disasters that cause the most harmful to people and the environment and leads to major losses. Drought stress is one of the most important abiotic stress factors limiting plant life (Kalefetoğlu and Ekmekci, 2005). The most important reason for the drought stress is the decrease of the water potential in the soil. Because of water deficiency, plant turgor decreases, and plant growth is limited (Farooq et al., 2009; Kuşvuran, 2010). The reduced turgor in plant caused to close stomata and photosynthetic activity decline. In addition, water deficiency causes deterioration of some enzyme and photochemical activities in the Calvin cycle (Kocaçalışkan, 2008). Today, drought stress has reached social and economic dimensions with world population growth, climate changes, global warming forest destruction (Anonymous, 2008). As a result, some protections must be taken regarding drought in fruit growing. The shortest and easiest of these protections are the more economical use of water.

In this study, we aimed to determine the effects of deficit irrigation conditions on morphological and physiological parameters in blackberry cultivar “*Jumbo*”.

2. MATERIAL AND METHODS

This study was conducted at the University of Selçuk, Faculty of Agriculture and the Department of Horticulture. Blackberry cultivar “*Jumbo*” was micropropagated in the laboratory for plant tissue culture and water deficit treatment was established in a controlled growth room.

2.1. Production of Plants *in vitro* Conditions

The blackberry plants were produced nodal tissue culture technique. Firstly, micro-cuttings were sterilized and then were transferred into culture tubes in shoot growth medium. In the surface sterilization, the leaves on the shoots were removed and cut off 3- 4 cm long single-nod pieces are separated and cleaned in sterile- distilled water for 30 minutes. Micro-cuttings were kept for 1-2 minutes in 70% ethanol with Tween-20 and were shaken for 20 minutes. in 20% NaOCl in a laminar airflow cabinet. After sterilization, nodal explants were cultured in Murashige and Skoog (1962) basal media with gibberellic acid (1.0 mg l^{-1}) +active charcoal (1.0 g l^{-1}). The nodes in the micro-cuttings growing shoots were transferred multiplication media including MS basal salt + 6- benzyl aminopurine (1.0 mg l^{-1}) +active charcoal (1.0 g l^{-1}). When obtaining enough number of shoots were transferred to MS rooting media including indole- 3 - butyric acid (1.0 mg l^{-1}) +active charcoal (1.0 g l^{-1}).

2.2. Applications of Deficit Irrigation

Blackberry plants were acclimated outdoor environmental condition after rooting stages. And then blackberries were planted in one-liter pots with peat: perlite 3:1 rate. The blackberry plants were subjected by deficit irrigation conditions with full of field capacity, 80, 60, 40 and 20% of field capacity. The irrigation was performed once every three days.

2.3. Analysis of Morphological and physiological parameters

In the study, morphological parameters such as shoot length, root length, fresh shoot weight, dry shoot weight, fresh root weight, dry root weight and physiological parameters such as leaf relative chlorophyll content, stomatal conductance, membrane permeability and leaf relative water content (LRWC) were measured.

2.4. Leaf Relative Chlorophyll content

Leaves were harvested for Chlorophyll Content. Chlorophyll content of leaves was determined using portable chlorophyll reader SPAD-502 (Konica Minolta), measuring absorbance at 650 nm, as a nondestructive method. Three readings were made on each leaf. The results were expressed in SPAD units (Anonymous, 2017).

2.5. Membranes permeability

Leaves of three plants per treatment were harvested 0, 3, 5, 7, 9, 11, 13 and 15 days and cut 1 cm^2 leaf disks. Leaf disks were washed with three changes of double distilled water to remove surface-adhered electrolytes. Leaf disks were placed in culture tubes containing 10 ml of double distilled water and incubated at 25°C on a rotary shaker. The electrical conductivity of the bathing solution (EC_1) was determined by EC-meter after 24 h. Samples were then autoclaved at 121°C for 15 min. and a last electrical conductivity reading (EC_2) was obtained upon equilibration at 25°C . The electrolyte leakage was calculated as $\text{EC}_1 / \text{EC}_2$ and expressed as percent (Lutts et al., 1996).

2.6. Stomatal conductance

Stomatal conductance ($\text{mmol m}^{-2} \text{ s}^{-1}$) was measured with a leaf porometer once a month during the growth season (fifteen leaves in per treatment, measured in two sides in a leaf between 11:00 and 13:00 local time).

2.7. Leaf relative water content

In order to determine LRWC, leaves collected from control and drought stress-treated plants were measured for the fresh weight first. The samples were put into culture tube filled double distilled water for 4 h at room temperature for turgid weight (hydration). The turgid weight was measured and leaves were dried in an oven 65 °C for 48 h. The RWC percentage was calculated using the following formula of Sánchez et al. (2004):

$$\text{LRWC (\%)} = (\text{LFW} - \text{LDW}) / (\text{LTW} - \text{LDW}) \times 100$$

where FW is leaf fresh weight, LDW leaf dry weight, and LTW leaf turgid weight.

2.8. Experiment Design and Statistical Analysis

The experiment was carried out according to a completely randomized design model with 3 replications and 10 plants per replicate. The obtained data were subjected to Duncan multiple range test at the 0.05 significance level with SPSS 23 software program (SAS Inc.).

3. RESULTS AND DISCUSSION

Generally, drought stress occurs when the available water in the soil is reduced and atmospheric conditions cause continuous loss of water by transpiration or evaporation (Jaleel et al., 2009). Drought stress, which affects yield and plant growth, is one of the environmental stress factors and triggers some physiological, biochemical and molecular mechanism (Ozfidan et al., 2013). The studies of drought stress help to improve species and cultivars with the determination of physiological and biochemical responses to drought stress. Sustainable plant growth and development depend on the protection of plant water content. In the case of a deficit of water, cell division and development are limited so plants grow slowly (Bertamini et al., 2006). Furthermore, the photosynthesis rate is slowed due to lack of water and plant growth rate is decreased. Cell growth is considered one of the most drought-sensitive physiological processes due to loss of turgor pressure (Karimi et al., 2012). Rostami and Rahemi (2013) reported that cell growth is limited due to loss of leaf turgor pressure. The plant height significantly increased by 40% and 60% of the field capacity in comparison with 20, 80 and full of field capacity. The plant height was measured at 49.94 cm in 40% field capacity and 51.09 cm in %60 field capacity. The lowest plant height was found in 20% of field capacity with 31.00 cm. The root length result was found similar to plant height results and the longest root was obtained from 40% (45.93 cm) and 60% (46.50 cm) (Table-1). The 60% of field capacity treatment had the largest leaf area with 20.10 cm², while the smallest leaf area was determined from 20% of filed capacity with 13.24 cm². Karimi et al. (2012) reported that leaves under drought conditions show that leaf area development is more sensitive than dry weight accumulation in the leaves. Leaf growth is more sensitive than root against drought stress. Decreasing of leaf area helps to plants under lack of water. The excess of carbon in leaves was transferred to root and it improves root and increases root mass. Furthermore, small leaf area has low transpiration rate and lose less water (Taiz and Zeiger, 2002). Water stress limits not only leaf size, but also leaf number (Taiz and Zeiger, 2002). The treatment 60% of field capacity was found both the highest fresh plant weight (59.44 g) and the highest fresh root

weight (63.06 g). The dry plant and dry root weight were defined from treatment 60% of field capacity with 15.71 g and 17.84 g, respectively. Decreased dry matter accumulation of leaves as a result of stress may be attributed to the altered carbon and nitrogen metabolisms (Kluge, 1976). In addition, 60% of field capacity was found better than other treatments in leaf relative chlorophyll content (38.72 SPAD Units), stomatal conductance ($150.70 \text{ mmol m}^{-2}\text{s}^{-1}$), membrane damage (35.12%) and leaf relative water content (77.78%) (Table-2). Water is important for chlorophyll synthesis. Following a heavy rain, the chlorophyll content of plant leaves will often increase, but during a drought, the chlorophyll content will decrease. On the other hand, if the soil is saturated with water, this results in a decrease in the chlorophyll content of the leaves. The water content of the leaf must be high for maximum chlorophyll content. The stomatal conductance (SC) is important for protecting turgor pressure and loss water. Under stress conditions, plants close stomata and stop to gas exchange against to lose water. Membranes are damaged by reactive oxygen species (ROS). The membranes which are damaged, cause to the leaking of ions into intracellular space. Ions damage cells which are responsible for regulators of osmotic potential and enzyme activity.

Table-1. The morphological parameters under deficit irrigation

Water Amount of Irrigation	Plant Height (cm)	Root Length (cm)	Leaf Area (cm ²)	Fresh Plant Weight (g)	Fresh Root Weight (g)	Dry Plant Weight (g)	Dry Root Weight (g)
20% of Field Capacity	31.00 c	38.18 c	13.24 e	21.24 e	34.58 d	6.389 d	8.999 d
40% of Field Capacity	49.94 a	45.93 a	17.46 b	54.19 b	56.43 b	12.75 b	14.96 b
60% of Field Capacity	51.09 a	46.50 a	20.10 a	59.44 a	63.06 a	15.71 a	17.84 a
80% of Field Capacity	41.91 b	40.47 b	16.75 c	42.65 c	56.37 b	9.756 c	14.95 b
Full Field Capacity	39.61 b	40.19 b	14.65 d	35.82 d	43.88 c	9.604 c	12.06 c

Table-2. The physiological parameters under deficit irrigation

Water Amount of Irrigation	Leaf Relative Chlorophyll Content (SPAD Unit)	Stomatal Conductance ($\text{mmol m}^{-2}\text{s}^{-1}$)	Membrane Permeability (%)	LRWC (%)
20% of Field Capacity	34.41 d	20.45 e	72.45 a	35.48 e
40% of Field Capacity	37.50 b	84.28 d	55.74 b	41.89 d
60% of Field Capacity	38.72 a	150.70 a	35.12 e	77.78 a
80% of Field Capacity	36.94 c	125.60 b	42.63 d	72.46 b
Full Field Capacity	35.67 c	100.30 c	50.12 c	66.14 c

4. CONCLUSION

Global warming and climatic changes direct and indirectly affect agricultural production and cause limited agricultural area, low yields, and higher production cost. The decreasing of available water resources for agricultural practices forces the development of new technology and cultural applications in agriculture. Deficit irrigation is one of the applications among them. This research showed that 60% of the full field capacity which was supplied with the result of the morphological and physiological parameters, is suitable for the blackberry water demand.

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THE EFFECTS OF CALCIUM CARBONATE (CaCO₃) TREATMENTS ON QUINCE GENOTYPES IN *IN VITRO* CULTURE CONDITION

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Abstract

The quince is used for rootstock both quince and pear, but it is susceptible to high lime content in the soil. In this study, two quince genotypes were used for plant materials which were selected from quince orchard at the University of Selçuk, Faculty of Agriculture and Horticulture Department. One of these quince genotypes is susceptible and other is tolerant to high lime content. In vitro culture condition was prepared to determined responses of the genotypes against different lime content. Four lime content such as control, 2.5%, 5.0% and 10.0% were treatment on quince genotypes. The plant height, root number, root length, fresh and dry plant weight, leaf relative water content (LRWC), membrane permeability and chlorophyll content were investigated. The genotype-1 which was observed tolerant to the high lime soil in orchard condition was found less susceptible to lime than genotype-2. Under 10.0% CaCO₃, plants height of the genotype-1 was measured at 16.87 mm while the genotype-2 plants' height was measured 10.77 mm. The genotype-1 was rooted in all CaCO₃ treatments, while the genotype-2 only was rooted in control treatment. The membrane permeability was found higher in genotype-2 with 87.74% than genotype-1 with 55.32%. In terms of the plant features examined, the genotype-1 was found promising for both quince and pear rootstock.

Keywords: Lime, In vitro, Quince, Rootstock

1. INTRODUCTION

Fruit trees in soil having higher calcareous face iron (Fe) deficiency-induced chlorosis (Abadía et al., 2004) that results in a decrease in photosynthetic efficiency and electron transport, the prevention of shoot growth and causes fruit yield decreases. Although quince (*Cydonia oblonga* Mill) are one of the most susceptible fruit trees to lime-induced Fe deficiency (Tagliavini and Rombolà, 2001), they are generally cultured in calcareous soils. Moreover, Fe recycling from year to year in fruit trees is also very limited, so much so that most Fe needed for vegetative and reproductive development must be regularly supplied to plants (Rombolà and Tagliavini, 2006). Iron is generally present in its inorganic form in soil, and the solubility of Fe-oxides depends on soil pH. Therefore, Fe availability is limited under calcareous conditions (Tagliavini and Rombolà, 2001). Plants can take Fe from the soil in two ways: reduction (Strategy I) and chelation (strategy II). In particular, strategy I plants, which include fruit trees such as peaches (very susceptible to soil lime) base their ability to

uptake Fe from the soil on 1) the acidification of the rhizosphere via the extrusion of protons, 2) the reduction of insoluble Fe^{+3} to more soluble Fe^{+2} via the activity of ferric chelate reductase (FC-R), and 3) iron transport into root cells by the iron-regulated transporter 1 (IRT1) (Kobayashi and Nishizawa, 2012; Marschner, 2011; Pii et al., 2016).

Thus, the aim of the present work was to investigate the impacts of different CaCO_3 levels on morphological and physiological features of tolerant and susceptible quince genotypes.

2. MATERIAL AND METHODS

This study was conducted at the laboratory for plant tissue culture the University of Selçuk, and the Horticulture Department. The plant materials were taken from quince orchid which contains 15-year-old quince trees.

2.1. Production of Plants *in vitro* Conditions

The quince plants were produced nodal tissue culture technique. Firstly, micro-cuttings were sterilized and then were transferred into culture tubes in shoot growth medium. In the surface sterilization, the leaves on the shoots were removed and cut off 3- 4 cm long single-nod pieces are separated and cleaned in sterile- distilled water for 30 minutes. Micro-cuttings were kept for 1-2 minutes in 70% ethanol with Tween-20 and were shaken for 20 minutes. in 20% NaOCl in a laminar airflow cabinet. After sterilization, nodal explants were cultured in Murashige and Skoog (1962) basal media with gibberellic acid (1.0 mg l^{-1}). The nodes in the micro-cuttings growing shoots were transferred multiplication media including MS basal salt + 6- benzyl aminopurine (1.0 mg l^{-1}). When obtaining enough number of shoots were transferred to MS rooting media including indole- 3 - butyric acid (1.0 mg l^{-1}).

2.2. The application of Lime

The calcareous applications were treated by MS basal salts containing 1 mg l^{-1} IBA and CaCO_3 with four levels with control, 2.5%, 5.0%, and 10.0%.

2.3. Analysis of Morphological and physiological parameters

In the study, morphological parameters such as shoot length, root length, fresh shoot weight, dry shoot weight, fresh root weight, dry root weight and physiological parameters such as leaf relative chlorophyll content, stomatal conductance, membrane permeability and leaf relative water content (LRWC) were measured.

2.4. Leaf relative water content

In order to determine LRWC, leaves collected from control and drought stress-treated plants were measured for the fresh weight first. The samples were put into culture tube filled double distilled water for 4 h at room temperature for turgid weight (hydration). The turgid weight was measured and leaves were dried in an oven 65°C for 48 h. The RWC percentage was calculated using the following formula of Sánchez et al. (2004):

$$\text{LRWC (\%)} = (\text{LFW} - \text{LDW}) / (\text{LTW} - \text{LDW}) \times 100$$

where FW is leaf fresh weight, LDW leaf dry weight, and LTW leaf turgid weight.

2.5. Membranes permeability

Leaves of three plants per treatment were harvested 0, 3, 5, 7, 9, 11, 13 and 15 days and cut 1 cm² leaf disks. Leaf disks were washed with three changes of double distilled water to remove surface-adhered electrolytes. Leaf disks were placed in culture tubes containing 10 ml of double distilled water and incubated at 25 °C on a rotary shaker. The electrical conductivity of the bathing solution (EC₁) was determined by EC-meter after 24 h. Samples were then autoclaved at 121 °C for 15 min. and a last electrical conductivity reading (EC₂) was obtained upon equilibration at 25 °C. The electrolyte leakage was calculated as EC₁/ EC₂ and expressed as percent (Lutts et al., 1996).

2.6. Leaf Relative Chlorophyll content

Leaves were harvested for Chlorophyll Content. Chlorophyll content of leaves was determined using portable chlorophyll reader SPAD-502 (Konica Minolta), measuring absorbance at 650 nm, as a nondestructive method. Three readings were made on each leaf. The results were expressed in SPAD units (Anonymous, 2017).

2.7. Experiment Design and Statistical Analysis

The experiment was carried out according to a completely randomized design model with 3 replications and 10 plants per replicate. The obtained data were subjected to Duncan multiple range test at the 0.05 significance level with SPSS 23 software program (SAS Inc.).

3. RESULTS AND DISCUSSION

Iron is generally present in inorganic form in soil, and the solubility of Fe oxides depends on the soil's pH. Many soil-based properties such as lime and high pH reduce Fe availability and/or uptake, and that leads to the development of Fe chlorosis. Fe deficiency-induced chlorosis is the main limiting factor restricting plants growing worldwide. Calcareous soils possess high carbonate contents, high pH, and high HCO₃ concentrations. Chlorosis related to disturbed Fe metabolism on high Ca-containing soil is generally referred to as lime-induced iron chlorosis (Faust, 1989). The result of bicarbonate presence in calcareous soil is the decrease in Fe uptake and translocation in plants (Wallace et al., 1986). In this context, the morphological and physiological features' results showed that increasing CaCO₃ level negatively affects plant growth and development (Table-1). However, CaCO₃ more affects susceptible genotype (Genotype-2) than resistant genotype (Genotype-1).

The longest plant height was measured 40.89 mm in control of genotype-1 while the shortest plant height was determined in 10% CaCO₃ in genotype-1. In addition, the higher plant height was measured in control of genotype-2 with 25.13 mm. Under abiotic stress condition, plants close stomata and decreasing water uptake and minerals. Thus, stomata status indirectly affects plant growth and development. The plant root content was detected higher root number in genotype-1 than genotype-2. The highest root number was obtained from the control treatment of genotype-1 with 6.33 root per plant. The genotype-2 had the only root in control media when genotype-2 had no rooting in media containing CaCO₃.

Table 1. Morphological and Physiological analysis of quince genotypes

		Genotype-1	Genotype-2	Medium
Plant Height (mm)	Control	40.89a	25.13 a	33.01 a
	2.50 % CaCO₃	25.07 b	13.92 b	19.50 b
	5.00 % CaCO₃	21.46 c	12.28 c	16.92 c
	10.0 % CaCO₃	16.87 d	10.77 d	13.82 d
	Medium	26.07 a	15.55 b	-
Root Number (Piece per Plant)	Control	6.33 a	4.67 a	5.50 a
	2.50 % CaCO₃	4.00 b	0.00 b	2.00 b
	5.00 % CaCO₃	2.56 c	0.00 b	1.28 c
	10.0 % CaCO₃	2.00 d	0.00 b	1.00 c
	Medium	3.72 a	1.17 b	-
Root Length (mm)	Control	19.49 a	12.58 a	16.25 a
	2.50 % CaCO₃	16.72 b	0.00 b	8.36 b
	5.00 % CaCO₃	15.50 b	0.00 b	7.75 b
	10.0 % CaCO₃	6.08 c	0.00 b	3.04 c
	Medium	14.56 a	3.14 b	-
Fresh Weight (g)	Control	0.26 a	0.15 a	0.20 a
	2.50 % CaCO₃	0.24 b	0.11 b	0.17 b
	5.00 % CaCO₃	0.17 c	0.06 c	0.11 c
	10.0 % CaCO₃	0.09 d	0.04 d	0.06 d
	Medium	0.19 a	0.09 b	-
Dry Weight (g)	Control	0.062 a	0.033 a	0.050 a
	2.50 % CaCO₃	0.050 b	0.030 b	0.040 b
	5.00 % CaCO₃	0.037 c	0.020 c	0.030 c
	10.0 % CaCO₃	0.025 d	0.015 d	0.020 d
	Medium	0.040 a	0.020 b	-
LRWC (%)	Control	49.83 a	37.96 a	43.90 a
	2.50 % CaCO₃	36.50 b	28.32 b	32.41 b
	5.00 % CaCO₃	30.09 c	16.06 c	28.07 c
	10.0 % CaCO₃	21.44 d	19.30 d	20.36 d
	Medium	34.46 a	27.91 b	-
Membrane Permeability (%)	Control	24.39 d	18.79 d	21.59 d
	2.50 % CaCO₃	30.70 c	49.50 c	39.60 c
	5.00 % CaCO₃	42.90 b	67.49 b	55.19 b
	10.0 % CaCO₃	55.32 a	87.74 a	71.53 a
	Medium	38.32 b	55.63 a	-
Leaf Relative Chlorophyll Content (SPAD Unit)	Control	26.66 a	14.82 a	20.74 a
	2.50 % CaCO₃	22.36 b	13.57 b	17.97 b
	5.00 % CaCO₃	19.46 c	12.12 c	15.79 c
	10.0 % CaCO₃	18.64 c	11.46 c	15.05 c
	Medium	21.78 a	12.99 b	-

High CaCO₃ level causes to declining root number and root development due to Fe deficiency. The similar results were determined in root length and the longest root was measured in control media for both genotypes. The longest root length was measured at 19.49 mm in genotype-1. Iron deficiency which is due to high lime content, inhibits plant biomass and root capacity. The fresh plant weight was found different between genotypes, the controlled media for both genotypes was determined the

highest fresh plant. The increasing CaCO_3 level decreased fresh plant weight. The dry plant weight showed to similarity with fresh plant weight results. The highest plant dry weight was calculated in control treatments for both genotypes. The dry weight changed between 0.025-0.060g in genotype-1, while the genotypes had variability between 0.015-0.033g in dry plant weight. The LRWC was measured higher in genotype-1 than genotype-2. The highest LRWC was in control media for two genotypes. For genotype-1 LRWC was calculated about 50% in control while the lowest LRWC was calculated in 10% CaCO_3 with 21%. Membrane permeability was determined higher in 10% CaCO_3 than other treatments in both genotypes. The genotype-2 had the 88% membrane permeability while the genotype-1 had 55%. The leaf relative chlorophyll content was found a decrease in increasing CaCO_3 levels. The LRCC was the highest in control groups in both genotypes. Under stress condition, plants close stomata and cause to decrease leaf relative water content and increase membrane permeability for balancing osmotic potential.

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THE EFFECTS OF DIFFERENT CALCIUM CARBONATE (CaCO₃) LEVELS AND IRON SOURCES ON MYROBOLAN 29C ROOTSTOCK IN *IN VITRO* CULTURE CONDITION

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Abstract

This study was conducted at Laboratory for Plant Tissue Culture in Horticulture Department at the University of Selçuk, Konya, Turkey. It was aimed to determine the effects of the different calcium carbonate (CaCO₃) levels on the up taking iron by Myrobolan 29C. The four CaCO₃ levels (500, 1000, 1500 and 2000 mg l⁻¹) and two iron sources (FeNa EDTA and FeSO₄) were used individually and combined. The plants were micropropagated by tissue culture techniques “nodal culture”. The CaCO₃ was applied in two media stages including full strength (bottom) and ¾ of full strength (top). For the root growth, the ¾ of full-strength media was used. The plant height, fresh and dry plant weight, leaf relative water content (LRWC), membrane permeability, chlorophyll content, proline content, and protein content were determined. The FeNa EDTA increased morphological parameters and physiological parameters such as plant height (3.50cm), fresh plant weight (0.420g), dry plant weight (0.059g), LRWC (51.11%), chlorophyll content (13.56 µg g⁻¹ FW) and protein content (17.39 µg g⁻¹ FW). The membrane permeability was higher in 2000mg l⁻¹ CaCO₃ treatment (86.27%). The proline content was found higher in 2000mg l⁻¹ CaCO₃ treatment (278.53 µg g⁻¹ FW) than other treatments

In conclusion, the increasing CaCO₃ levels dramatically decreased plant growth and development in both FeNa EDTA and FeSO₄ conditions. However, FeNa EDTA was more effective than FeSO₄ in plant growth and development.

Keywords: CaCO₃, Iron, Myrobolan 29C, Physiology

1. INTRODUCTION

It is required the optimum environmental condition to be agricultural products not only productive but also quality the most important of these conditions is that the sufficient amount of plant nutrient elements in the soil and they are balanced with each other it is important for the development of plants. When the plant nutrient elements are not found in the soil as balanced, many effects occur when these elements are taken up by the plants and affect the plant growth negatively (Batanay, 2016). One of these problems is an excess amount of lime in the soil. Calcareous lands cover more than 30% of the world's land. Almost all our regions in our country except for the Black Sea Region are characterized by high calcareous soil properties. These soils are often characterized as soils that are

low the availability of nutrient elements due to the fact that P forms complex compounds with Ca and also poor solubility of microelements such as Fe, Mn, Zn, Cu and B at high pH (Marschner, 1995). Therefore, in many parts of Turkey frequently are observed Fe-chlorosis due to a high of soil lime in citrus, pear, peach, quince, apple, apricot and plum. Lime-induced chlorosis is a term often used for chlorosis associated with impaired Fe metabolism in soil containing high Ca (Faust, 1989). Plant species have different sensitivities to Fe chlorosis (Awad et al., 1994; Vose, 1982). In terms of sensitivity to lime-induced chlorosis, fruit species are ordered from sensitive to tolerant peach > pear > sweet cherry > plum > apricot > apple > sour cherry (Wertheim and Webster, 2005).

Fruit cultivation, it has a great importance reduce production costs, alleviate lime-induced nutritional problems, development of fast and long-lasting effective applications. The most important of the measures against lime-induced iron chlorosis is to enrichment iron and other elements in plants through the soil and foliar fertilization at the horticultural production. However, this method is too expensive and not- environmentally friendly method. Another method as an alternative against Fe chlorosis is to find resistant genotypes or breed new genotypes (Erdem, 2008).

It is known that the uptake of iron, which significantly affects fruit yield and quality, can be increased using rootstocks in calcareous soil (Rombolà and Tagliavini, 2006). However, the behaviors of the rootstocks can be different in different ecological conditions and as a result, the rootstocks differently can affect varieties grafted on fruit yield and quality, plant nutrient elements uptake and its use, growth, and developments. For this reason, rootstock selection is one of the important factors in terms of fruit growing (Açıklın et al., 2008).

Myrobolan 29C is a suitable rootstock for all plum and most apricot. Suitable for all soil types, also resistant to calcareous soils (8- 9% active lime) (Anonim, 2018). According to this information was aimed to determine the effects of the different calcium carbonate (CaCO_3) levels on the up taking iron by Myrobolan 29C.

2. MATERIALS AND METHODS

This study was conducted at Plant Tissue Culture Laboratory, Faculty of Agriculture, Department of Horticulture, Selçuk University. The Myrobolan 29C rootstock was used as plant material.

2.1. Micropropagation of Myrobolan 29C

Plantlets of plum rootstock 'Myrobolan 29C' was propagated through *in vitro* nodal explant cultures. The explant sources were surface sterilized with 70% ethanol for 1 min., soaked in 20% (v/v) NaOCl solution with few drops of Tween 20 for 15 min., followed by three rinses with sterile distilled water (Aka-Kacar et al., 2010). After surface sterilization, nodal explants were transferred into initiation medium. The cultures were grown under sterile conditions on a basal salt mixture and vitamin medium (Murashige and Skoog, 1962) supplemented with 3% (w/v) sucrose, 0.7% (w/v) agar, and 0,5mg l⁻¹ GA₃. The four weeks after initiation culture stage, plantlets transferred into MS+1mg l⁻¹ BA media for multiplication stage. The plantlets in multiplication stage were transferred MS+1mg l⁻¹ IBA for rooting media when enough plantlets were obtained. All culture media were adjusted to pH 5.8 with 0.1 N NaOH or HCl prior to the addition of agar and were autoclaved at 1,05 kg/cm² and 121 °C for 15 min. All cultures were incubated at 25± 1 °C with a 16/8 h light/dark photoperiod illuminated by a cool-white fluorescent light (50µmol m⁻² s⁻¹).

2.2. Establishing Stress Condition

The four CaCO₃ levels (500, 1000, 1500 and 2000 mg l⁻¹) and two iron sources (FeNa EDTA and FeSO₄) were used individually and combined. The CaCO₃ was applied in two media stages including full strength (bottom) and ¾ of full strength (top). For the root growth, the ¾ of full-strength media was used. Applications in the study are below.

- 1) Control
- 2) FeSO₄
- 3) FeNa EDTA
- 4) FeSO₄+500mg/l CaCO₃
- 5) FeSO₄+1000mg/l CaCO₃
- 6) FeSO₄+1500mg/l CaCO₃
- 7) FeSO₄+2000mg/l CaCO₃
- 8) FeNa EDTA+ 500mg/l CaCO₃
- 9) FeNa EDTA+ 1000mg/l CaCO₃
- 10) FeNa EDTA+ 1500mg/l CaCO₃
- 11) FeNa EDTA+ 2000mg/l CaCO₃
- 12) 500mg/l CaCO₃
- 13) 1000mg/l CaCO₃
- 14) 1500mg/l CaCO₃
- 15) 2000mg/l CaCO₃

2.3. Measurements of Morphological Parameters

In this study, plants were measured at the end of study for the plant height, fresh and dry plant weight and physiological parameters such as leaf relative water content (LRWC), membrane permeability, chlorophyll content, proline content, and protein content.

3. RESULTS AND DISCUSSION

The growth parameters were significantly affected with CaCO_3 and iron applications in Myrobolan 29C. As shown in the table.1, plant height was markedly decreased when CaCO_3 levels were increased. But FeNa EDTA and FeSO_4 applications such as FeNa EDTA + 500mg/l CaCO_3 , FeNa EDTA + 1000mg/l CaCO_3 , FeNa EDTA + 1500mg/l CaCO_3 , FeSO_4 +1000mg/l CaCO_3 was increased plant height according to single CaCO_3 applications. The highest plant height was obtained from FeNa EDTA (3.50cm) while the lowest plant height was obtained from 2000mg/l CaCO_3 (1.50cm). 500mg/l CaCO_3 , 1000mg/l CaCO_3 , 1500mg/l CaCO_3 and 2000mg/l CaCO_3 applications approximately decreased plant height by about 18% to 35% in comparison with control plants. Similar to our results, plant growth was reduced with the addition of bicarbonate to the media in BA29, MA rootstocks and Conference pear cultivar (Donnini et al., 2008).

Plant fresh and dry weight was found similar. Both of them decreased while the CaCO_3 level was increased. Plant fresh weight ranged from 0.420g (FeNa EDTA) to 0.122g (2000mg/l CaCO_3). In terms of dry plant weight, FeNa EDTA application (0.059g) had about fourfold 2000mg/l CaCO_3 (0.015g). Under calcareous conditions, plantlets were improved fresh and dry weight with FeNa EDTA and FeSO_4 applications. The plant fresh weight result was agreed with Donnini et al. (2008) in BA29, MA rootstocks and Conference pear cultivar *in vitro* conditions. Researchers were reported decreased with bicarbonate treatments in increment of fresh weight.

We found that LRWC is 51.11% in control plants when 2000mg/l CaCO_3 application has the lowest LRWC (12.68%).

Cell membrane stability was reduced when increased CaCO_3 level They also found that iron applications significantly decreased membrane permeability compared with CaCO_3 applications. The 2000mg/l CaCO_3 (86.27%) application had the highest membrane permeability when FeSO_4 (42.38%) and FeNa EDTA (44.70%) had the lowest membrane permeability.

Leaf chlorophyll content was measured high values FeNa EDTA and FeSO_4 application with compared the other applications especially CaCO_3 combinations applications. Increasing of CaCO_3 concentration was decreased chlorophyll content. The lowest chlorophyll content was obtained from 2000mg/l CaCO_3 level ($0.42\mu\text{g g}^{-1}$ FW).

Under CaCO_3 conditions, plantlets were $278.53\mu\text{g g}^{-1}$ FW proline content in 2000mg/l CaCO_3 applications and $265.21\mu\text{g g}^{-1}$ FW 1500mg/l CaCO_3 applications. The lowest proline contents were had control ($23.02\mu\text{g g}^{-1}$ FW) group.

All iron applications increased protein contents in plants compared with alone CaCO_3 applications. The protein content was measured $17.39\mu\text{g g}^{-1}$ FW which was the highest, in the FeNa EDTA. The lowest protein content was found in 2000mg/l CaCO_3 ($2.25\mu\text{g g}^{-1}$ FW).

These results were explained that soil salinity reduces the soil water potential and the ability of plants to take up water. This quickly reduces the rate of cell expansion in growing tissues (Munns, 2011). The plant height results were agreed with Sharma et al. (2013) in rough lemon, Moghbeli et al.

(2012) in *Aloe vera* L., Anjum (2011) in Troyer citrange, Eraslan et al. (2016) in cherry rootstocks, Ghaleb et al. (2010) in citrus rootstocks and Bahmani et al. (2012) in MM 106 apple rootstock.

Under salt stress, plantlets were rooting 78.33% in control medium and they followed it 25mM (68.33%), 50mM (63.33%), 75mM (29.17%) and 100mM (15.00%) respectively. Abdel-Hussein (2006) reported observing that higher concentrations of NaCl caused a significant reduction in rooting percentage. The reduction in rooting percentage might be due to the inhibitory effects of salt on the metabolic activities which associated with cell division, differentiation and elongation (Heszky et al., 1992). In addition, salinity has been shown to reduce the endogenous auxin (IAA) (Khan et al., 1976) and rooting co-factors levels which might lead to reduce root initiation, and these substances (especially IAA) play an important regulatory role in root formation and their development (Abdel-Hussein, 2006; Hartmann et al., 1997). We found that average root number is 5.40 root/ plant in control when 100mM NaCl treatments have the lowest average of root number (1.6 root/plant) (Table-2). While the NaCl concentration was increased, an average of root number decreased. Also, we found similar results in root length like root number and rooting percentage. The longest root length was obtained from control while the shortest root length was obtained from 100mM NaCl treatment. The reduction of root number and length caused by high NaCl concentration might be due to the same reasons which reported above in the discussion of rooting percentage reduction by salinity.

Our fresh plant weight and dry plant weight results are in agreement with Ghaleb et al. (2010), Eraslan et al. (2016), Moghbeli et al. (2012), Sharma et al. (2013), Küçükyumuk et al. (2015). This result is explained with high NaCl levels inhibited leaf expansion, largely due to an inhibition of cell division rather than of cell expansion (Chartzoulakis and Klapaki, 2000).

Table-1. Effect of Effects of Different Calcium Carbonate (CaCO_3) levels and Iron Sources on morphological and physiological parameters

	Plant Height (cm)	Fresh Plant Weight (g)	Dry Plant Weight (g)	LRWC (%)	Membrane Permeability (%)	Chlorophyll Content ($\mu\text{g g}^{-1}$ FW)	Proline Content ($\mu\text{g g}^{-1}$ FW)	Protein Content ($\mu\text{g g}^{-1}$ FW)
Control	2.33 bcde	0.208 def	0.043 c	51.11 a	56.51 l	6.54 d	23.02 j	10.86 bc
FeSO_4	3.00 ab	0.261 ab	0.047 b	24.89 h	42.38 n	12.35 b	36.28 hij	11.64 b
FeNa EDTA	3.50 a	0.420 a	0.059 a	24.58 h	44.70 m	13.56 a	29.17 ij	17.39 a
$\text{FeSO}_4 + 500\text{mg/l CaCO}_3$	2.67 bcd	0.235 bcd	0.038 cd	40.33 c	57.64 k	5.92 ef	41.96 hi	10.54 c
$\text{FeSO}_4 + 1000\text{mg/l CaCO}_3$	2.17 cdef	0.216 cde	0.032 ef	31.52 e	59.37 j	5.02 g	48.20 gh	8.49 e
$\text{FeSO}_4 + 1500\text{mg/l CaCO}_3$	2.08 cdef	0.195 defg	0.028 fgh	28.05 g	66.80 h	4.72 h	60.82 fg	6.35 f
$\text{FeSO}_4 + 2000\text{mg/l CaCO}_3$	2.00 def	0.174 efg	0.027 fgh	21.46 i	66.29 h	3.52 i	154.32 c	2.88 g
FeNa EDTA+500mg/l CaCO_3	2.83 abc	0.277 b	0.040 cd	44.01 b	59.97 i	8.50 c	31.60 hij	10.41 c
FeNa EDTA+1000mg/l CaCO_3	2.33 bcde	0.215 bcd	0.035 de	32.51 d	68.38 g	6.05 e	74.86 ef	10.31 c
FeNa EDTA+1500mg/l CaCO_3	2.17 cdef	0.193 defg	0.031 efg	29.16 f	71.44 e	5.79 f	83.29 e	9.89 cd
FeNa EDTA+2000mg/l CaCO_3	2.00 def	0.186 defg	0.029 fgh	22.01 i	70.25 f	4.70 h	134.77 d	9.24 de
500mg/l CaCO_3	1.92 def	0.168 efgh	0.026 gh	18.67 j	72.68 d	3.42 i	188.01 b	2.49 g
1000mg/l CaCO_3	1.83 ef	0.160 fgh	0.024 h	18.96 j	73.48 c	2.40 j	175.38 b	2.36 g
1500mg/l CaCO_3	1.67 ef	0.142 gh	0.019 i	17.63 k	77.60 b	1.84 k	265.21 a	2.37 g
2000mg/l CaCO_3	1.50 f	0.122 h	0.015 i	12.68 l	86.27 a	0.42 l	278.53 a	2.25 g

Reduction of total chlorophyll under in vitro salt stress conditions was observed in some in other plant species as mentioned by Chartzoulakis and Klapaki (2000) in quince and Sivritepe and Eriş (1999) in grape and Harb et al. (2002) in banana. These results might be described to biosynthesis of chlorophyll was generally inhibited by the depressive effect of stress conditions on the absorption of some ions which were involved in the chlorophyll formation, such as (Mg and Fe) which could be expected as a reason for chlorophyll suppression in leaves and / or an increase of some growth inhibitors, such as ethylene or abscisic acid production which enhances senescence that might be occurred under salt stress condition (Hanafy Ahmed et al., 2002).

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EFFECT OF DIFFERENT PLANT SPACE ON FRESH EAR YIELD AND QUALITY OF SWEET CORN UNDER TEKİRDAĞ ECOLOGICAL CONDITIONS

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Abstract

Sweet corn production and consumption are increasing in Turkey as well as in the world. The present study was conducted to have knowledge about some agronomic traits of sweet corn grown under Tekirdağ ecological conditions. For this purpose, the seeds of four sweet corn varieties (Challenger, SF 201, Vega and Merit) were sown at 5 different distance between plants (14, 18, 22, 26 and 30 cm) while row space was constant (70 cm). The experiment was set up as randomized complete block design with 4 replications and conducted in grower field located Tekirdağ. There were significant differences among varieties and spacing for ear length, ear diameter, yield of fresh ear (husked & dehusked), fresh kernel weight per ear, number of kernels per ear, fresh kernel yield. At 30 cm plant spacing, the highest fresh ear yield (husked & dehusked) were obtained from Vega (respectively 2894.1 kg da⁻¹, 2311.2 kg da⁻¹), while Challenger had highest fresh kernel weight (1385.7 kg da⁻¹). The most suitable planting spacing was determined as 30 cm for all used varieties. The differences in the total soluble solid content of corn (TSS) were found significant only among varieties. Vega variety can be recommended in term of fresh ear yield (husked & dehusked) and TSS for consumption purpose, while Challenger can be preferred for fresh kernel yield.

Keywords: *Zea mays* L. *saccharate* Sturt., sowing distance, variety, kernel

INTRODUCTION

Corn is the first rank among warm season cereals crops with respect to the production area and amount and has the highest yield potential. According to TÜİK data, production area of corn is 659 000 ha and total yield is 5 950 000 ton in Turkey (TÜİK, 2015). Sweet corn, one of seven corn varieties, is an important crop with high sugar, starch and protein content in human nutrition, and it is using as the vegetable. For the fresh consumption of corn, sweet corn is mostly preferring because of its delicious taste and soft, sugary texture when it is compared with other varieties. Beside fresh consumption, it is used as a processed product such as canned or frozen food. The growers are recently interested in the sweet corn production with the parallel to increasing in sweet corn consumption and in factories processing corn in Turkey. In our country, although the corn is known for many years, unfortunately, our knowledge about sweet corn production and production techniques is insufficient.

Plant density, which is one of the many cultivation's techniques such as sowing time, fertilizer dose etc. is one of the important factors that it is affected the kernel and ear yield especially in terms of narrowing or increasing the living area per plant. When the plant density increase, kernel yield per plant decrease due to the insufficient area per plant, but total kernel yield can increase by more plant number per unit area. The determining of this critical limit is required for optimum yield and quality. It has been determined by many researchers that the plant spacing affected the corn yield (Aydın, 1991; Giray, 1994; Mohammadi et al., 2009; Eskandarnejad et al., 2013). Also, the optimum sowing distance can be different according to location and growing conditions (Yıldırım and Baytekin, 2003). On the other hand, to obtain the high yield in corn like other crops, the varieties which are suitable to ecology and demand of consumer has to produce. However, one variety cannot perform same performance under different ecological conditions. It has been observed that the yield and quality of sweet corn varieties are affected by locations and there are important differences among varieties (Sencar et al., 1992; Turgut and Balcı, 2002; Eşiyok et al., 2004; Öktem and Öktem, 2006). Therefore, it is necessary the determining of the ecologically appropriate varieties by local experiments.

In this study, it was aimed to determine the effect of different distance between plants in row on fresh ear yield and some traits of sweet corn varieties which was grown in Tekirdağ conditions.

MATERIALS AND METHODS

The research was carried out in farmer field located Naip village of Tekirdağ province. The altitude of the experiment area is 4 m and the latitude are 40 ° 59 ' North and the longitude is 27 ° 29' East. The soil of experiment field had silt loam texture and pH, EC, organic matter, and lime were 7.4, 0.03%, 1.15%, and 2.8%, respectively.

Challenger (Monsanto), SF201 (Fito Seed) Vega and Merit (May Agro Seed) varieties were used as crop materials.

The experiment was set up as factorial randomized block design with four replications. Each plot was 14 m² (5 m x 2.8 m) and consistent of four rows. The distance between rows was constant (70 cm) and four different spacing between plants in a row was applied (14, 18, 22, 26 and 30 cm).

The seeds were sown on 01 May and all cultivation applications were regularly conducted until from sowing to harvest. Morphological observation and measurement were made on randomly selected 10 plants in the middle two rows.

The results obtained from the experiment were subjected to analysis of variance. Difference among treatment means ($P \leq 0.05$ and $P \leq 0.01$) were tested for significance using LSD.

RESULTS and DISCUSSION

Fresh ear yield

The average of the varieties for fresh dehusked ear yield ranged from 1849,5 kg da⁻¹ (Vega) to 1632, kg da⁻¹ (SF201) (Table 1). When the plant spacing increased, the yield linearly raised. The highest fresh dehusked ear yield was obtained from plants sown in 30 cm plant spacing of Vega with 2311,2 kg da⁻¹. These results are similar to the finding of previously works conducted by researchers who performed deal with different varieties and plant spacing (Yıldırım and Baytekin, 2003; Eşiyok et

al., 2004; Öktem and Öktem, 2006; Eskandarnejad et al., 2013). While the weight of husked ear is important for fresh consumption, the weight of dehusked ear more important for food industry. This is a situation that should be considered for the ear productivity (Eşiyok and Bozokalfa, 2005). As it can be seen from the Table 2, the change of fresh dehusked ear yield according to variety and plant spacing showed similarity to husked ear yield. The plants of Vega variety sown at 30 cm spacing gave the greatest husked ear yield value, whereas least yield was determined at Challenger variety planted at 14 cm spacing.

Table 1. Effect of plant spacing, v, and their interaction on fresh dehusked ear yield (kg da⁻¹)¹

Plant spacing (cm)	Varieties				
	Challenger	SF201	Vega	Merit	Average
14	1307,9 i	1406,4 h	1540,9 g	1351,2 hi	1401,6 d
18	1707,2 f	1556,1 g	1693,9 f	1823,2 de	1664,5 c
22	1588,3 g	1549,9 g	1761,8 def	1758,2 def	1695,1 c
26	1735,8 f	1693,2 f	1939,9 c	1840,5 d	1802,4 b
30	2132,5 b	1959,0 c	2311,2 a	2083,6 b	2121,6 a
Average	1694,3 c	1632,9 d	1849,5 a	1771,4 b	
LSD variety	39,17				
LSD plant spacing	46,15				
LSD int.	87,58				

¹ The differences between the averages indicated by same letter are not significant at 0.01 level.

Table 2. Effect of plant spacing, variety, and their interaction on fresh husked ear yield (kg da⁻¹)¹

Plant spacing (cm)	Varieties				
	Challenger	SF201	Vega	Merit	Average
14	1560,5 i	1715,5 h	1927,2 fg	1635,5 hi	1709,7 d
18	2006,6 ef	1868,7 g	2078,7 de	2172,1 d	2012,4 c
22	1866,8 g	1927,1 fg	2190,1 d	2065,6 de	2031,5 c
26	2094,0 de	2076,0 de	2404,2 c	2164,4 d	2184,7 b
30	2570,4 b	2417,9 c	2894,1 a	2460,3 bc	2585,7 a
Average	2019,7 c	2001,1 c	2298,9 a	2099,6 b	
LSD variety	57,92				
LSD plant spacing	100,58				
LSD int.	129,52				

¹ The differences between the averages indicated by same letter are not significant at 0.01 level.

Fresh kernel yield (kg da⁻¹)

The highest yield was obtained from the plants of Challenger sown at the spacing 30 cm and when the planting spacing decreased, yield generally reduced at all varieties (Table 3). Similarly, Eskandarnejad (2013) and Turgut (2000) has stated that increased plant density reduced seed yield. Also, it has been reported that there is an increase especially in vegetative parts of the plant (stalk, leaves) due to the competition between the plants parallel to the increase in sowing density (Özata et al., 2016).

Table 3. Effect of plant spacing, variety, and their interaction on fresh kernel yield (kg da⁻¹)¹

Plant spacing (cm)	Varieties				
	Challenger	SF201	Vega	Merit	Average
14	849,9 ₁	899,5 _{h1}	846,8 ₁	837,9 ₁	858,5 _d
18	1111,2 _c	996,0 _{efg}	929,8 _{gh}	1131,1 _c	1042,0 _c
22	1031,1 _{def}	991,7 _{fg}	969,1 _{fgh}	1099,1 _{cd}	1022,7 _c
26	1128,5 _c	1083,7 _{cd}	1071,7 _{cde}	1141,5 _c	1106,3 _b
30	1385,7 _a	1243,8 _b	1276,6 _b	1276,5 _b	1295,7 _a
Average	1101,3 _a	1042,9 _b	1018,8 _b	1097,2 _a	
LSD variety	35,109				
LSD plant spacing	47,386				
LSD int.	78,507				

¹ The differences between the averages indicated by same letter are not significant at 0.05 or 0.01 level.

Fresh kernel weight per ear

The differences among varieties in term of kernel weight was found statistically important (Table 4). The kernel weight of varieties was 139,8 g for Challenger, 142,8 g for SF201, 121,7 for Vega and 136,2 g for Merit. Albayrak (2013) also obtained 106,1 g, 85,4 g and 74,3 g kernel weight for Merit, Vega, SF201 under Diyarbakır ecological conditions (respectively). Increasing of plant spacing resulted in high seed weight. This finding agrees with results of other researchers who determined that the large plant spacing leading to an increase kernel weight (White, 1984; Turgut, 2000; Mohammadi et al., 2009).

Table 4. Effect of plant spacing, variety, and their interaction on fresh kernel weight per ear (g)¹

Plant spacing (cm)	Varieties				
	Challenger	SF201	Vega	Merit	Average
14	116,0	121,1	100,8	113,9	112,9 _e
18	132,2	131,8	114,6	127,3	126,5 _d
22	142,9	148,9	121,2	139,1	138,1 _c
26	148,2	153,3	132,0	147,3	145,2 _b
30	159,4	159,1	139,6	153,5	152,9 _a
Average	139,8 _{ab}	142,8 _a	121,7 _c	136,2 _b	
LSD variety	4,38				
LSD plant spacing	5,46				
LSD int.	Not significant				

¹ The differences between the averages indicated by same letter are not significant at 0.01 level.

Number of kernels per ear

It was a statistically significant difference among only varieties with regard to the number of seeds. (Table 5). The ear of Merit was included more seeds than other varieties being the same group (b). This situation can be explained by the fact that the length and diameter of the ear of Merit are

bigger than other varieties. Also, it has been indicated that there is a relationship between ear and kernel by other researchers (Garcia et al., 2009; Panahi et al., 2010).

Table 5. Effect of plant spacing, variety, and their interaction on number of kernels per ear (g)¹

Plant spacing (cm)	Varieties				
	Challenger	SF201	Vega	Merit	Average
14	416,0	483,0	512,0	539,0	487,5
18	472,0	525,0	470,0	513,0	495,0
22	474,0	455,0	506,0	588,0	497,0
26	467,0	464,0	478,0	579,0	505,8
30	481,0	477,0	553,0	571,0	520,5
Average	462,0 b	480,8 b	503,8 b	558,0 a	
LSD variety	48,42				
LSD plant spacing	Not significant				
LSD int.	Not significant				

¹ The differences between the averages indicated by same letter are not significant at 0.01 level.

Ear length

The length of the ear is an important character that affects the yield and increases the marketing value of ear (Eşiyok and Bozokalfa, 2005) Merit reached the highest value of ear length among varieties and the increase in plant spacing has caused an increase in length of ear (Table 6). Similar results were also indicated in literature (White, 1984; Wyatt and Mullins, 1989).

Table 6. Effect of plant spacing, variety, and their interaction on ear length (cm)¹

Plant spacing (cm)	Varieties				
	Challenger	SF201	Vega	Merit	Average
14	18,45	19,28	18,45	20,50	19,17 d
18	19,50	20,30	19,50	21,63	20,23 cd
22	20,45	21,38	20,65	22,65	21,28 bc
26	21,50	22,35	21,58	23,58	22,25 b
30	22,48	23,28	22,70	24,08	23,13 a
Average	20,48 c	21,32 b	20,58 c	22,49 a	
LSD variety	0,633				
LSD plant spacing	1,102				
LSD int.	Not significant				

¹ The differences between the averages indicated by same letter are not significant at 0.01 level.

Ear diameter

Ear diameter of varieties ranged between 47,3 and 49,7 mm (Table 7). The effect on ear diameter of plant spacing was similar with the result of the ear length. These results agree with the report of Anıl and Sezer (2003) who express the cob diameter is changed according to the variety, and

with results of Eşiyok and Bozokalfa (2005) who stated the cob diameter is affected by growing technique.

Table 7. Effect of plant spacing, variety, and their interaction on ear diameter (mm)¹

Plant spacing (cm)	Varieties				
	Challenger	SF201	Vega	Merit	Average
14	43,3	43,8	44,5	41,8	43,3 e
18	45,5	45,5	46,5	44,0	45,4 d
22	48,5	50,0	49,8	47,0	48,8 c
26	50,8	51,8	53,3	50,3	51,5 b
30	52,88	55,0	54,5	53,5	53,9 a
Average	48,2 ab	49,2 a	49,7 a	47,3 b	
LSD variety	0,158				
LSD plant spacing	1,196				
LSD int.	Not significant				

¹ The differences between the averages indicated by same letter are not significant at 0.01 level.

Total soluble solid content (TSSC, %)

It has been stated that a significant portion of water-soluble dry matter in sugar corn is formed by sugars and that the content of sugar in varieties must be high and that the sugar content of corn should be considered in the breeding of new varieties (Eşiyok and Bozokalfa, 2005; Kumari et al., 2008). There were no significant differences among plant spacing and interaction in term of TSSC (Table 8). The highest value of TSSC was obtained from Challenger and Vega varieties with 15,1%. Eşiyok et al. (2004) stated that the TSSC of different varieties ranged from 14,19% to 17,82%.

Table 8. Effect of plant spacing, variety, and their interaction on TSSC (%)¹

Plant spacing (cm)	Varieties				
	Challenger	SF201	Vega	Merit	Average
14	15,2	13,9	14,9	12,2	14,0
18	14,9	14,3	14,9	11,8	14,0
22	15,3	14,3	15,3	11,7	14,1
26	15,1	14,2	15,6	11,9	14,2
30	15,1	14,1	14,8	11,5	13,9
Average	15,1 a	14,1 b	15,1 a	11,8 c	
LSD variety	0,377				
LSD plant spacing	Not significant				
LSD int.	Not significant				

¹ The differences between the averages indicated by same letter are not significant at 0.05 level.

CONCLUSION

Increasing plant spacing increased the values belonging to all examined characters, except the number of kernels per ear and TSSC. The reason why the number of kernel and TSSC were not affected by the planting distance was probably due to the genetic characteristics of the varieties.

According to the result of this experiment conducted in Tekirdag condition, it was concluded that Vega for fresh ear yield (husked & dehusked) and Merit for fresh kernel yield can be preferred.

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