Pak. J. Bot., 49(2): 421-426, 2017.

EFFECTS OF SALINITY STRESS ON CHLOROPHYLL AND CAROTENOID CONTENTS AND STOMATA SIZE OF GRAFTED AND UNGRAFTED GALIA C8 MELON CULTIVAR

GARIP YARSI[1*], AYSEL SIVACI[2], H. YILDIZ DASGAN[3], OZLEM ALTUNTAS[4], RIZA BINZET[5] AND YELDEREM AKHOUNDNEJAD[3]

[1]*Plant and Animal Production Department, Vocational School of Silifke, University of Mersin, 33940, Turkey*
[2]*Biology department of Science and Art Faculty, University of Adıyaman, Adıyaman, Turkey*
[3]*Horticulture department of Agriculture Faculty, University of Adana, Adana, Turkey*
[4]*Horticulture department of Agriculture Faculty, University of Inönü, Malatya, Turkey*
[5]*Biology department of Science and Art Faculty, University of Mersin, 33343, Mersin, Turkey*
[*]*Corresponding authors email address: ggyarsi@gmail.com*

Abstract

Salinity is known as the most important abiotic stress that decreases crop production and plant growth, and changes the anatomy and morphology of plants. In this study, the growth rate of grafted and ungrafted melon plants were studied under salinity stress. Maximus F_1, Shintoza F-90 F_1 and Nun 9075 F_1 (*Cucurbita maxima* x *Cucurbita moschata)* were used as a rootstock and Galia C8 melon cultivar was used as a scion. In this study, the stomata size and chlorophyll and carotenoid contents were investigated. According to the results, chlorophyll and carotenoid contents and stomata length and width of upper and lower surface of leaf were generally reduced under salinity stress.

Key words: Grafting melon, Salinity stress, Stomata size, Pigments.

Introduction

The melon cultivation is intensive in Turkey. But the melon cultivation is restricted by monoculture agriculture and soil-borne pests and diseases such as Fusarium spp. and nematodes in the melon cultivation area. In recent years, the applications of pesticides have been reduced in view of the importance of organic farming. One of ways to reduce the applications of pesticides is to use the soil-borne pest and disease resistant rootstocks. For this purpose, especially hybrids of *Cucurbita maxima* and *Cucurbita moschata* are used as rootstocks in melon cultivation. Because the rootstocks are resistant to biotic and abiotic stress, the production with grafted seedlings has been increased. The melon production was about 1.7 million tons in Turkey in 2015 (Anon., 2015). Some characteristics as plant height, leaf damage, yield, survival, vigor have been used to identify salinity tolerance criteria (Sahannon, 1984; Gama *et al*., 2007).

The problem of soil salinity which is likely to increase in the future as a result of global warming has attracted the researchers to focus on this important issue. The use of grafted plants will be important in resistance to salinity stress.

In Turkey, biotic and abiotic factors are limiting crop production as well as in other producing countries. Therefore, in recent years, the studies have been concentrated on finding out of genotypes which are resistant to drought and salinity stress, and ensuring better growing in these circumstances (Yasar, 2003; Saruhan *et al.,* 2008; Dasgan & Koc, 2009; Kusvuran, 2004; Kusvuran *et al.,* 2007; Yagmur, 2008; Aktas, 2002). Sonmez (1990) reported that 4 million hectares of land was affected by salt in Turkey. Çevik (1986) reported that the total area of land in Turkey is 78 million hectares; 36% of this land is cultivated, and 3.2% of 36% has salinity problems.

There are reports that grafted melons increased plant growth, total and early yield; the tolerance to low temperatures and resistance to pests and diseases in soil; and prolonged the plant's economic life by uptaking water and nutrients. (Yarsi & Sari, 2006; Yarsi *et al.,* 2012; Yetisir & Sari 2003; Zijlstra *et al.,* 1994; Blanco & Folegatti, 2005; Edelstein *et al.,* 2005; Colla *et al.,* 2006; Dasgan & Akhoundnejad, 2012).

It has been reported that salinity reduces the plant's water uptake and root development. As a result of this, the hormonal balance is affected negatively; photosynthesis and protein synthesis and plant height are decreased as a result of the decrease in nitrate uptake; fresh and dry weight, consequently the number of flowers and yield is decreased. (Shalhevet & Bernstein, 1968; Robinson *et al.,* 1983; Çakırlar & Topcuoglu, 1985; Drew *et al*., 1990; Aktas *et al.,* 2006; Kusvuran, 2010; Topaloglu, 2010; Kulak, 2011; Ozturk *et al.,* 2004).

Some researchers also reported that the salt stress causes a reduction in the amount of chlorophyll. (Akca & Samsunlu, 2012; Dhanapackiam & Muhammad İlyas, 2010; Molazem *et al.,* 2010; Sevengör *et al.,* 2011; Zhani *et al.,* 2012; Turan *et al.,* 2007; Rouphael *et al.,* 2008). It is also reported that stomata size and the number of the plants are affected by stress factors such as drought, salt and heavy metal (Özyigit & Akıncı, 2009; Jafri & Ahmad, 1995; Çavuşoğlu *et al.,* 2007). Melons have stomata which are smaller size and more amount of stomata under the salt stress (Solmaz *et al.,* 2011).

The genotypes resistant to salinity which are used as rootstock will be important in future to combat from adverse effects of global warming. In this study, the effects of salt stress on stomata size and amount of chlorophyll and carotenoids of grafted and ungrafted melon plants were investigated.

Materials and Methods

Plant materials: To determine the growth performance under salinity stress, 3 squash rootstock (Maximus F_1, Shintoza F-90 F_1 and Nun 9075 F_1) were used as rootstock and Galia C8 melon varieties was used as a scion. The grafting procedures were performed in Antalya Seedling Company and Grow Seedlings Company. Grafted seedlings were planted in plastic pods which were filled with peat: perlit by 2: 1 ratio. The pods size were 72cmx19.5cm x 15.5 cm (14 liter; No:4). The grafted and ungrafted plants were exposed to a salt concentration of 50 mM NaCl for 5 days and 100 mM NaCl for 5 days then the final concentration of 150 mM NaCl was applied for 10 days. The salt treatments were started when the plants had 3-4 true leaves and the treatment was given every day (Table 1).

The study was carried out at about 26-30°C during the day and 16-20°C night temperature in plastic greenhouse. The humidity inside the greenhouse was measured as an average of 55-65% in the same period. For each replicate, 4 plants in one pot were used as one replication and for salt and control treatments 3 replicates were used separately. Plants were watered with nutrient solution having 177.2 ppm N; 52.70 ppm P, 240.44 ppm K, 53.46 ppm Mg, 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 (Suyum *et al.*, 2012).

Table 1. The source of rootstocks and scion

Rootstocks	**Company**	
Maximus F_1	Agromar	*C. maxima* X *C. moschata*
Shintoza F-90 F_1	Fito tohumculuk	*C. maxima* X C. moschata
Nun 9075 F_1	Nunhems	*C. maxima* X *C. moschata*
Scion		
Galia C8	Hazera	Melon (*Cucumis melo* L.)

Grafting: Tube grafting method was used. The grafting was done when rootstocks and scions created the first true leaves.

Planted: Seedlings were planted in equally sized plastic pots which contained a pearlite-peat (2:1) mixture. After planting, the leaves of the rootstock were taken from time to time and it was permitted only the growth of the scion.

Stomata size: Leaves from the plants (in the same period and were taken from the same location from each plant) were put in plastic bottle filled by 70% ethyl alcohol. Then, the cross-sections of the upper and lower of the leaves were placed in lamellar. Stomatal length and width of upper and lower parts of the leaves was measured with a light microscope. Photographs were also taken.

Determination of total chlorophyll *a*, chlorophyll *b* and carotenoids: One gram of leaf samples taken from melon varieties extracted in acetone and filtered. Then, samples were centrifuged at 3000 rpm (De Kok & Graham 1989). 662 nm and 645 nm absorbance for total chlorophylls, and 470 nm for carotenoids were read on spectrophotometer (Schimadzu UV-1800) and the amounts were calculated according to Lichtenthaler & Wellburn (1983). The analyses were repeated three times.

Table 2. Stomata size of upper and lower leaf surfaces and % changing compare to the control of grafted and non-grafted melon plants grown under salinity stress (150 mM NaCl)

	Rootstocks	**Control Plants**		**Salt application**			
lower leaf surfaces		**Width (µm)**	**length(µm)**	**Width (µm)**	**% change relative to control**	**length (µm)**	**% change relative to control**
	Ungrafted	15.00±0.6	19.35±0.8	12.44±0.9	-17.06	19.22±1.0	-0.67
	Maximus F_1/Galia C8	15.76±0.9	19.61±1.0	15.01±1.3	-4.76	17.79±1.2	-9.28
	Shintoza F-90 F_1/Galia C8	15.27±1.2	20.21±1.0	15.02±0.9	-1.64	19.12±1.5	-5.39
	Nun 9075 F_1/Galia C8	14.87±1.4	19.26±1.0	14.17±1.4	-4.71	17.87±1.1	-7.21
Upper leaf surfaces		**Width (µm)**	**length(µm)**	**Width (µm)**	**% change relative to control**	**length (µm)**	**% change relative to control**
	Ungrafted	15.57±1.1	20.15±1.3	15.08±0.9	-3.15	21.57±0.6	+7.05
	Maximus F_1/Galia C8	15.41±1.3	20.95±1.2	14.68±1.2	-4.74	19.70±1.1	-5.97
	Shintoza F-90 F_1/Galia C8	15.47±0.9	20.65±1.2	14.76±0.8	-4.59	17.54±1.4	-15.06
	Nun 9075 F_1/Galia C8	14.53±0.8	20.18±1.2	14.84±1.4	+2.13	20.26±1.4	+0.39

Data collection and statistical analysis: All of the analyses were repeated thrice. To determine the differences between means were used *t*-test (with significance at $p<0.05$).

Results and Discussion

Stomata Size: The lower leaf surface's length and width were reduced in varying proportions under salt stress (Table 2). This decrease was 17.06% of stomatal width in ungrafted plants while stomatal length was 0.67%. This decrease in grafted plants for stomata width were *Maximus F_1/Galia C8* (4.76%), *Shintoza F-90 F_1/Galia C8* (1.64%) and *Nun 9075 F_1/Galia C8* (4.71%), respectively. Stomata's length was decreased, too. The data in Table 2 shows that the stomatal length of lower leaf surface was a contraction of between 0.67% and 9.28%.

The data (Table 2) show that the stomata size of upper leaf surface were generally affected by salt stress on both grafted and non-grafted plant; but the salt stress has increased the stomata width and length by 2.13% to 0.39% of *Nun 9075 F_1/Galia C8*. While the reduction in width was 3.15% in un-grafted plants, the increase was 7.05% in the stomata length.

The decrease in stomatal size of plants can be explained as an adaptation mechanism to stress conditions. In a study carried out by Solmaz *et al.* (2011), it was reported that the stomata size was smaller and the number of stomata was increased in melon under salt stress. It was stressed that plants created a protection mechanism against salt stress (Fig. 1).

Chlorophylls and carotenoids: Data (Table 3) shows that chlorophyll *a*, chlorophyll *b* and carotenoid contents are decreased due to salt stress. Salt stress decreased the amount of chlorophyll *a* and *b* in both grafted and ungrafted plants. While chlorophyll *a* content of Maximus F_1/ Galia C8 was 13.95 mg g^{-1} FW ($p< 0.05$), as receiving the highest value, the lowest value was with Nun 9075 F_1/ Galia C8 (12.00 mg g^{-1}) and ungrafted (12.02 mg g^{-1}) under salinity ($p<0.05$). Chlorophyll *b* contents were the highest in Maximus F_1 / Galia C8 (3.61 mg g^{-1} FW) and in Shintoza F-90 F_1 C8 (3.64 mg g^{-1} FW) under salinity. When the value of carotenoids was observed, the salt applications did a difference, statistically. Nun 9075 F_1 / Galia C8 grafted combination was the highest value of carotenoids with 4.55 mg g^{-1}FW ($P> 0.05$). In similar studies, it is reported that salt stress reduced chlorophyll content (Sevengör *et al.*, 2011) and Zhani *et al.*, 2012 in pepper *(Capsicum frutescens* L.) Akca & Samsunlu (2012) in walnut. Yasar *et al.* (2008) in green bean, Malik *et al.* (2010) in cucumber.

The changing percentage of chlorophyll *a* was -31.33% for ungrafted, -22.02% for Maximus F_1/Galia C8, -27.31% for Shintoza F-90F_1/Galia C8 and -34.78% for Nun 9075 F1/Galia C8, whereas changing percentage of chlorophyll *b* were -35.56% for ungrafted, -15.20% for Maximus F_1/Galia C8, -27.63% for Shintoza F-90F_1/Galia C8 and -22.96% for Nun 9075 F_1/Galia C8 and the change percentage of carotenoids content were -23.10% for ungrafted, -18.51% for Maximus F_1/Galia C8, -29.35% for Shintoza F-90F_1/Galia C8 and -15.22% for Nun 9075 F1/Galia C8.

Table 3 shows that chlorophyll *a* and chlorophyll *b* of Maximus F_1 / Galia C8 grafted plants combination were less affected and carotenoids in Nun 9075 F_1 / Galia C8 combination was less affected by salt stress

Conclusion

It is concluded that salinity had adverse effect not only on the amount of chlorophyll and carotenoids, but also on stomatal size of lower and upper leaf surfaces. It was found that the salinity stress decreased chlorophyll *a*, chlorophyll *b* and carotenoid contents of both grafted and un-grafted plants. But the un-grafted plants generally were more effected than grafted plants (except Nun 9075 F_1/Galia C8 for chlorophyll *a* and Shintoza F-90F_1/Galia C8 for carotenoids). The regional genotypes which are resistant to salinity should be investigated and the studies must be done on rootstocks characteristics in melons.

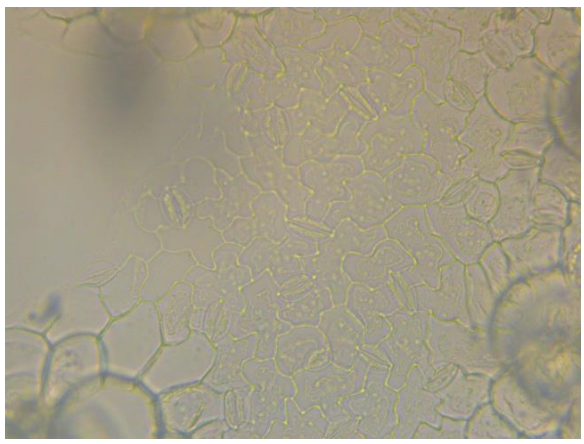
Acknowledgments

We would like to thank Antalya Seedling Company and Grow Seedling Company for their support. This Project was supported by Scientific Research Projects Unit (KMYOBAP 2011/0005) of Adiyaman University.

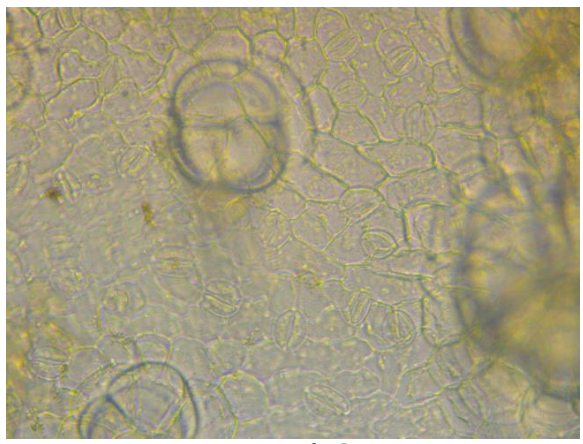
Table 3. Chlorophyll *a*, chlorophyll *b* and carotenoids contents of grafted and non-grafted melon plants grown under salinity stress (150 mM NaCl).

	chlorophyll *a*		chlorophyll *b*		carotenoids	
	no salt	salt	no salt	salt	no salt	Salt
Ungrafted	17.81±0.2[a]	12.02±0.9 [b]	4.96±0.5 [a]	3.33±0.5[b]	5.02±0.4 [a]	3.76±0.2 [b]
Maximus F_1/Galia C8	17.83±0.8[a]	13.95±0.4[b]	5.02±0.4 [a]	3.61±0.6 [a]	5.51±0.5[a]	4.26±0.2 [a]
Shintoza F-90F_1/Galia C8	17.65±0.5[a]	12.83±0.9[b]	5.03±0.2 [a]	3.64±0.3[a]	5.87±0.1 [a]	4.08±0.1 [a]
Nun 9075 F_1/Galia C8	18.40±0.8[a]	12.00±1 [b]	4.52±0.4[a]	3.40±0.7 [a]	5.61±0.4 [a]	4.55±0.3 [a]

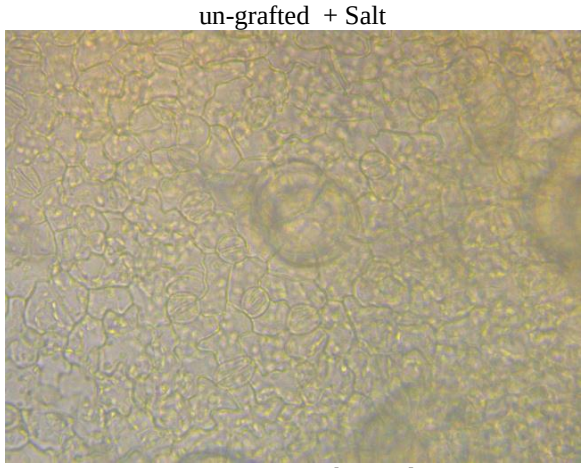
Means followed by the same letter are not significant according to *t*-test (confidence limit 95 %).



un-grafted + Salt

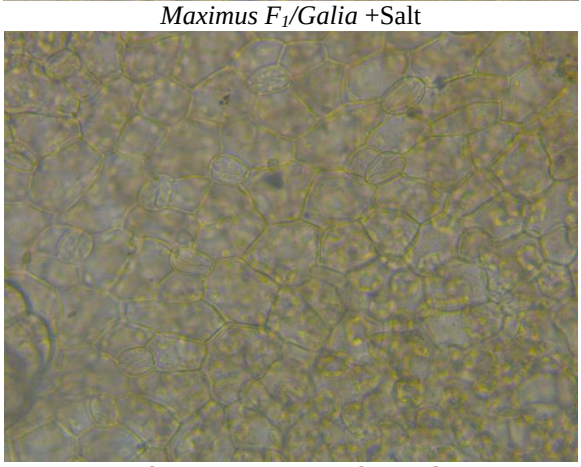


un-grafted

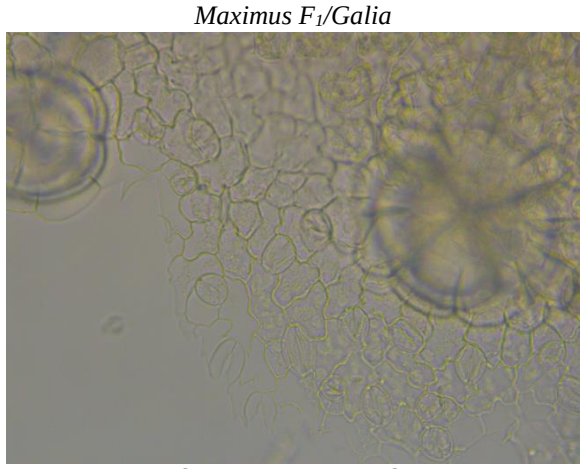


Maximus F₁/Galia +Salt

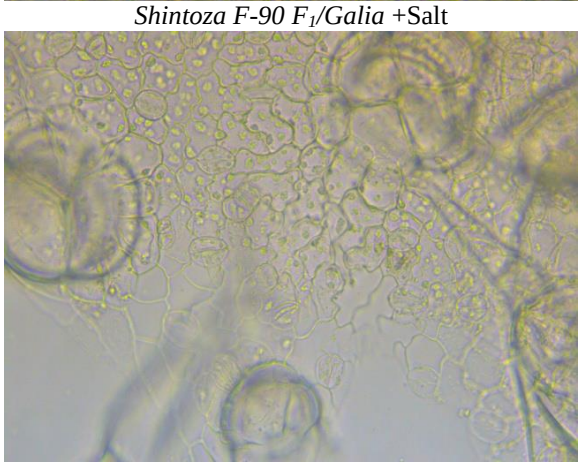
Maximus F₁/Galia



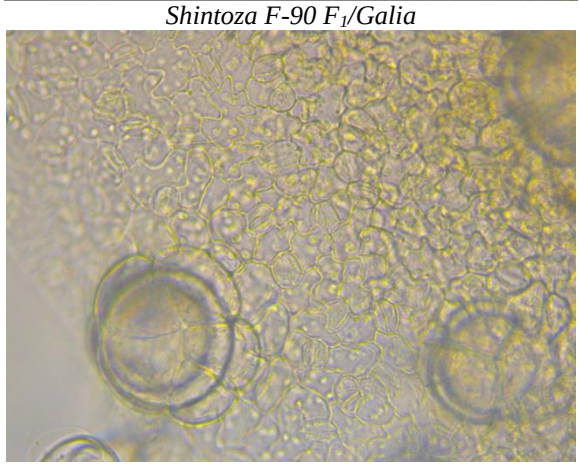
Shintoza F-90 F₁/Galia +Salt



Shintoza F-90 F₁/Galia



Nun 9075 F₁/Galia + Salt



Nun 9075 F₁/Galia

Fig. 1. Stomata photos of lower surface grafted and ungrafted Galia C8 melon under salt stress and control plants.

References

Akca, Y. and E. Samsunlu. 2012. The effect of salt stress on growth, chlorophyll content, proline and nutrient accumulation, and K/Na raitoin in walnut. *Pak. J. Bot.*, 44(5): 1513-1520.

Aktas, H. 2002. Biberde tuza dayanıklılığın fizyolojik karakterizasyonu ve kalıtımı. Ç.Ü. Fen Bilimleri Enst. Doktora Tezi, Adana, 105 sayfa.

Aktas, H., K. Abak, L. Ozturk and İ. Cakmak. 2006. Effect of zinc supply on growth and shoot concentrations of sodium and potassium in pepper plants under salinity stress. *Turk. J. Agric. For.*, 30: 407-412.

Anonymous, 2015. FAO statistical database 2015, Available at: www.fao.org.

Blanco, F.F. and M.V. Folegatti. 2005. Estimation of leaf area for greenhouse cucumber by linear measurements under salinity and grafting. *Sci. Agric.*, 62(4): 305-309.

Cakırlar, H. and S.F. Topçuoglu. 1985. Stres Terminolojisi. Çölleşen Dünya ve Türkiye Örneği. Atatürk Üniversitesi. Çevre Sorunları Araş. Merkezi. Erzurum.

Cavusoglu, K., S. Kılıc and K. Kabar. 2007. Effects of pretreatments of some growth regulators on the stomata movements of barley seedlings grown under saline (NaCl) conditions. *Plant Soil Environ.*, 53(12): 524-528.

Cevik, B. 1986. Toprak Su Koruma Mühendisligi. Çukurova Üniversitesi Ziraat Fakültesi Yayın No: 108, Adana.

Colla, G., Y. Roupahel, M. Cardarelli, D. Massa, A. Salerno and E. Rea. 2006. Yield, fruit quality and mineral composition of grafted melon plants grown under saline conditions. *J. Hortic. Sci. Biotechnol*., 81(1): 146-152.

Dasgan, H.Y. and S. Koc. 2009. Evaluation of salt tolerance in common bean genotypes by ion regulation and searching for screening parameters. *J. Food Agric. Environ*, 7(2): 363-372.

Dasgan, H.Y. and Y. Akhoundnejad. 2012. Field performans of the some selected melon genotypes against to drought stress. *Proceedings of the 9th National Vegetable Symposium*. Konya-Turkey.

De Kok, L.J. and M. Graham. 1989. Levels of pigments, soluble proteins, amino acids and sulfhydryl compounds in foliar tissue of Arabidopsis thaliana during dark-induced and natural senescence. *Plant Physiol. Biochem*., 27: 203-209.

Dhanapackiam, S. and M.H. Muhammad İlyas. 2010. Effect of salinity on chlorophyll and carbohydrate contents of *Sesbania grandiflora* seedlings. *Indian J. Agr. Sci. Technol.*, 3(1): 64-66.

Drew, M.C., P.S. Hole and G.A. Picchioni. 1990. Inhibition by NaCl of net CO_2 fixation and yield of cucumber. *J. Amer. Soc. Hort. Sci.*, 115: 472-477.

Edelstein, M., M. Ben-Hur, R. Cohen, Y. Burger and I. Ravina. 2005. Boron and salinity effects on grafted and non-grafted melon plants. *Plant & Soil*, 269: 273-284.

Gama, P.B.S., S. Inanaga, K. Tanaka and N. Nakazawa. 2007. Physiologial response of common bean (*Phaseolus vulgaris* L.) seedlings to salinity stress. *Afr. J. Biotechnol*., 6(2): 79-88.

Jafri, A.Z. and R. Ahmad. 1995. Effect of soil salinity on leaf development, stomatal size and its distribution in cotton (*Gossypium hirsutum* L.). *Pak. J. Bot.*, 27(2): 297-303.

Kulak, M. 2011. Farklı Tuz Uygulamalarının Adaçayı (*Salvia officinalis* L.)'nın Gelişimi Üzerine Etkisi. Kilis 7 Aralık Üni. Fen Bilimleri Enst., Yüksek Lisans Tezi, Kilis, 59 s.

Kuşvuran, S. 2004. Kavunda (*Cucumis melo* L.) Tuz Stresine Toleransın Belirlenmesinde Antioksidant Enzim Ektivitesi ve Lipid Peraksidasyonundan Yararlanma Olankaları. Ankara Üniversitesi, Fen Bil. Ens., Yüksek Lisans Tezi 110 sayfa.

Kuşvuran, S. 2010. Kavunlarda kuraklık ve tuzluluğa toleransın fizyolojik mekanizmaları arasındaki bağlantılar. Çukurova Üniversitesi, Fen Bilimleri Enst. Doktora tezi, 356 s.

Kuşvuran, S., N. Üzen, H.Y. Daşgan and K. Abak. 2007. Farklı Bamya Genotiplerinin Tuz Stresi Altında Göstermiş Oldukları Tepkilerin İncelenmesi. V. Ulasal Bahçe Bitkileri Kongresi, Erzurum

Lichtenthaler, H.K. and A.R. Wellburn. 1983. Determinations of total carotenoids and chlorophylls a and b of leaf extracts in different solvents. *Biochem. Soc. Trans.*, 11: 591-592.

Malik, A.A., W.G. Li, L.N. Lou, J.H. Weng and J.F. Chen. 2010. Biochemical/physiological characterization and evaluation of *In vitro* salt tolerance in cucumber. *Afr. J. Biotechnol*., 9: 3284-3292.

Molazem, D., E.M. Qurbanov and S.A. Dunyamaliyev. 2010. Role of proline,Na and chlorophyll content in salt tolerance of corn (*Zea mays* L.). *Amer. Eurasian J. Agric. Environ. Sci.*, 9(3): 319-324.

Ozturk, A., A. Unlukara, A. İpek and B. Gurbuz. 2004. Effect of salt stress and water deficit on planth growth and esssential oil content of lemon balm (*Melisa officinalis* L.). *Pak. J. Bot.*, 36(4): 787-792.

Özyigit, İ.İ. and S. Akınci,. 2009. Effects of some stress factors (Aluminum, Cadmium and Drought) on stomata of roman nettle (*Urtica pilulifera* L.). *Not. Bot. Hort. Agrobot. Cluj.*, 37(1): 108-115.

Robinson, S.P., W.J.S. Downton and J.A. Millhouse. 1983. Photosynthesis and ion content of leaves and isolated chloroplasts of salt-stressed spinach. *Plant Physiol*., 73(2): 238-242.

Rouphael, Y., M. Cardarelli and G. Colla. 2008. Yield, mineral composition, water relations, and water use efficiency of grafted mini-watermelon plants under deficit irrigation. *Hort. Sci*., 43(3): 730-736.

Saruhan, V., N. Üzen, M. Eylen and Ö. Çetin. 2008. Toprak Tuzluluğunun Kültür Bitkilerine Etkileri ve Alınabilecek Somut Önlemler. İklim Değişikliği Sempozyumu, 13-14 Mart, Ankara

Sevengor, S., F. Yasar, S. Kusvuran, and S. Ellialtıoglu. 2011. The Effect of salt Stress on growth, chlorophyll content, lipid peroxidation and antioxidative enzymes of pupkin seedling. *Amer. J. Agri. Res*., 6(21): 4920-4924.

Shalhevet, J. and L. Bernstein. 1968. Effects of vertically heterogeneous soil salinity on plant growth and water uptake. *Soil Sci*., 106(2): 85-93.

Shannon, M.C. 1984. Breeding, selection and the genetics of salt tolerance. In salinity tolerance in plants. Strategies for crop Improvement. (Eds.): Stables, R.C. and G.H. Toenniessen. Whiley, New York, pp. 231-254.

Solmaz, I., N. Sari, Y. Dasgan, H. Aktas, H. Yetisir and H. Unlu. 2011. The Effect of Salinity on Stomata and Leaf Characteristis of Dihaploid Melon Lines and Their Hybrids. *J. Food, Agri. Environ.*, 9(3&4): 172-176.

Sönmez, B. 1990. Tuzlu ve Sodyumlu Topraklar. T.O.K.B Köy Hizmetleri Şanlıurfa Araştırma Enstitüsü Müdürlüğü Yayınları, (62):60 s.

Suyum, K., H.Y. Dasgan, N. Sari, S. Kusvuran, G. Aydoner, M. Akyol, Y. Akhoundnejad, İ. Solmaz and A. Bol. 2012. Genotypic variation in the response of watermelon genotypes to salinity and drought stresses. *Proceedings of the Xth Eucarpia Meeting on Genetics and Breeding of Cucurbitaceae*, October 15-18, Antalya-Turkey.

Topaloğlu. 2010. Tuz Stresinin Chili Biberlerinin Pigment ve Kapsaisinoid Değişimi ile Peroksidaz Aktivitesi Arasındaki İlişki. Çukurova Üniveritesi Fen Bilimleri Enst., Yüksek Lisans Tezi, Adana, 131 s.

Turan, M.A., N. Türkmen and N. Taban. 2007. Effect of NaCl on stomatal resistance and proline, chlorophyll, Na, Cl and K concentration of lentil plants. *J. Agron.*, 6(2): 378-381.

Yağmur, Y. 2008. Farklı Asma (*Vitis vinifera* L.) Çeşitlerinin Kuraklık Stres Karşı Bazı Fizyolojik ve Biyokimyasal Tolerans Parametrelerinin Araştırılması. Ege Üniversitesi, Fen Bilimleri Enst. Yüksek Lisans Tezi 108 s.

Yarsi, G. and N. Sari. 2006. Aşılı Fide Kullanımının Sera Kavun Yetiştiriciliğinde Beslenme Durumuna Etkisi. Alatarım, 5(2): 1-8, Mersin-Silifke.

Yarsi, G., N. Sari and H. Yetisir. 2012. Effect of different rootstocks on the yield and quality of grafted melon plants. *Acta Hort.* (ISHS) 936: 411-416.

Yaşar, F. 2003. Tuz Stresi Altındaki Patlıcan Genotiplerinde Bazı Antioksidant Enzim Aktivitelerinin ın vitro ve ın vivo Olarak İncelenmesi. Yüzüncü Yıl Üniversitesi Fen Bilimleri, Doktora Tezi 139 sayfa.

Yasar, F., S. Ellialtıoğlu and K. Yıldız. 2008. Effect of salt stress on antioxidant defence system, lipid peroxidation, and Chlorophyll Content in green bean. *Russ. J. Plant Physiol.*, 55(6): 782-786.

Yetisir, H. and N. Sari. 2003. Effect of different rootstock on plant growth, yield and quality of watermelon. *Aust. J. Exp. Agric*., 43: 1269-1274.

Zhani, K., B.F. Mariem, M. Fardaous and H. Cherif. 2012. Impact of salt stress (NaCl) on growth, chlorophyll content and fluorescense of Tunusian cultivars of chili pepper (*Capsicum frutescens* L.). *J. Stress Physiol. Biochem.*, 8(4): 236-252.

Zijlstra, S., S.P.C. Groot and J. Jansen. 1994. Genotypic variation of rootstocks for growth and production in cucumber; possibilities for improving the root system by plant breeding. *Sci. Hort.*, 56: 185-196.

(Received for publication 12 February 2016)