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Rootstock Potential of Turkish *Lagenaria siceraria* Germplasm for Watermelon: Plant Growth, Graft Compatibility, and Resistance to *Fusarium*

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Abstract: The rootstock potential of Turkish *Lagenaria siceraria* germplasm for watermelon was evaluated. Among 210 accessions, 72 genotypes were selected based on morphological characteristics. Two commercial hybrid rootstocks were also used for comparison. Crimson Tide watermelon cultivar was used as a scion. Emergence rate, hypocotyl morphology, survival rate, and resistance to *Fusarium oxysporum* f. sp. *niveum* (*FON*) were investigated. Grafted plants were grown for 3 weeks in order to investigate the effect of rootstocks on plant growth. Leaf number, shoot dry weight, and root dry weight were determined. Emergence rate was ranked between 72% and 100% in collected genotypes. The highest graft compatibility was 99% while the lowest graft compatibility was 70%. All the grafted plants showed better performance than control plants regarding plant growth. All bottle gourd genotypes were tested against known 3 races of *FON* and all of them showed resistance against it. However, 9 genotypes showed yellowing but reisolation from those plants showed that yellowing was not due to *FON*. Crimson Sweet watermelon cv. susceptible to 3 races of *FON* was grafted onto 10 *Lagenaria siceraria* genotypes with the highest graft compatibility with watermelon. While all grafted plants showed resistance to *FON*, ungrafted Crimson Sweet watermelon cv. was found susceptible to 3 races of *FON*. The results showed that Turkish *L. siceraria* germplasm has powerful rootstock potential for watermelon against *Fusarium* wilt and it is a good resource for rootstock breeding programs.

Key Words: *Lagenaria*, rootstock, grafting, *Fusarium oxysporum* f. sp. *niveum*, survival rate

Türkiye'deki *Lagenaria siceraria* gen Kaynaklarının Karpuz İçin Anaçlık Potansiyeli: Bitki Gelişimi, Aşı tutma ve *Fusarium*'a Dayanıklılık

Özet: Türkiye'nin su kabağı (*Lagenaria siceraria*) genetik kaynaklarının karpuz için anaçlık potansiyeli araştırılmıştır. Çalışma için morfolojik karakterlere göre 210 genotip arasından 72 su kabağı genotipi seçilmiştir. İki tane ticari anaç da karşılaştırma amacı ile kullanılmıştır. Aşı tutma oranını belirleme çalışmasında kalem olarak Crimson Tide karpuz çeşidi kullanılmıştır. Aşı kombinasyonlarında çıkıştaki homojenlik, hipokotil morfolojisi, aşı tutuma oranı ve *Fusarium oxysporum* f. sp. *niveum* (*FON*)'a dayanıklılık belirlenmiştir. Ayrıca, aşılanmış bitkiler, anaçların bitki gelişimine etkilerini araştırmak için saksılarda 3 hafta süreyle yetiştirilmiştir. Yaprak sayısı, bitki kuru ağırlığı ve kök kuru ağırlığı tespit edilmiştir. Fide çıkışındaki homojenlik % 72 ile % 100 arasında değişmiştir. En yüksek aşı tutma oaranı % 99, en düşük aşı tutuma oranı ise % 70 olarak tespit edilmiştir. Aşılanmış olan bitkiler kontrol bitkilerine oranla daha iyi gelişme göstermişlerdir. Bütün su kabağı genotipleri *FON*'un üç ırkına da dayanıklı bulunmuştur. Su kabağı genotiplerinden dokuzunda sararma gözlenmiş, ancak yapılan inceleme sonucunda sararmanın *FON*'dan kaynaklanmadığı belirlenmiştir. *FON*'un üç ırkına duyarlı olan Crimson Sweet karpuz çeşidi, yüksek aşı tutma oranı gösteren 10 su kabağı genotipi üzerine, anacın *FON*'a dayanıklılık üzerindeki etkisini araştırmak için aşılanmıştır. Aşılanmış bitkilerin hepsi *FON*'a dayanıklı bulunurken, aşılanmamış bitkiler *FON*'un 3 ırkına da duyarlı bulunmuşlardır. Sonuçlar, Türkiye su kabağı genetik kaynaklarının karpuz için Fusarium'a karşı güçlü bir anaç potansiyeline sahip olduğunu ve ıslah programları için iyi bir kaynak olduğunu göstermiştir

Anahtar Sözcükler: *Lagenaria*, anaç, aşılama, *Fusarium oxysporum* f. sp. *niveum*, aşı tutma oranı

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Introduction

Cultivated *Lagenaria siceraria* (Malign) Stanley is commonly known as the white-flowered bottle gourd. A vigorous climber, the white-flowered bottle gourd has been cultivated as an annual and monoecious and 5 wild perennial dioecious species (Decker et al., 2004).

Turkey is not the center of genetic diversity for *L. siceraria* but the landraces of *L. siceraria* show great diversity, particularly in fruit size and shape. Long before plastic equipment and tools were used intensively by people, a number of different landraces had been commonly cultivated for several uses such as food, musical instrument, decorative purposes, and as containers, which is in line with the characteristic of the fruit, in most small cities and villages of Turkey. Therefore, *L. siceraria* is not an economically cultivated species in Turkey. This species is grown only in some small regions of Turkey for human consumption and decorative purposes.

Bottle gourd fruits are generally consumed as a vegetable in Africa and Asia. Immature fruits are consumed by boiling, frying, or stuffing like the fruit of *Cucurbita pepo*. Its mature fruit is often scooped out and the skin is used as a container, bowl, music instrument, for decorative purposes, or, in some cases, as fishing floats. Shoots, tendrils, and leaves are also cooked and the seeds are removed for oil extraction or for use in cooking. Tendrils and young leaves are also used for some medical purposes (Tindall, 1983). An important horticultural utilization of *L. siceraria* is as rootstock for watermelon against soil-borne diseases and low soil temperature and to increase the plant growth and the absorption of water and plant nutrition. Grafting of watermelon onto bottle gourd was first performed in Korea and Japan in the late 1920s (Lee, 1994). *L. siceraria* is one of the species used as rootstock for watermelon and it shows a high compatibility rate with watermelon (Lee, 1994; Oda, 1995; Yetişir and Sari, 2003).

Turkey is the world's second largest watermelon producing country after China, with 4×10^6 t per year (FAO, 2005). In the Çukurova region, southern Turkey, watermelon is cultivated mostly under low tunnels for early production. Watermelon cultivation has been carried out intensively for many years in this region. One of the most serious problems of watermelon production in this part of the country is a decrease in yield due to soil-borne diseases, in particular *Fusarium*, and successive cropping. One of the most effective means controlling *Fusarium* wilt of watermelon is crop rotation, suggesting that watermelon should not be cultivated at least for 5 years in the same field infested with the *Fusarium* wilt pathogen (Messiaen, 1974). For this reason, the producers have to pay at least twice more for field rent for watermelon cultivation. Combined breeding programs could be applied to control soil-borne diseases (McCreight et al., 1993). However, developing new cultivars resistant to diseases is time-consuming and enhances the chances of the resistant cultivars becoming susceptible to new races of pathogens. On the other hand, grafting onto resistant rootstocks may enable the control of soil-borne diseases and have positive impact on yield and quality (Lee, 1994; Oda, 1995; Lee and Oda, 2003). Grafting was used widely in watermelon to control soil-borne disease such as *Fusarium* wilt (Lopez-Galarza et al., 2004; Miguel et al., 2004) and to improve the mineral nutrition uptake (Pulgar et al., 2000), but the reasons for grafting have increased dramatically over the years. For instance, grafts have been used to induce resistance against low (Bulder et al., 1990) and high (Rivero et al., 2003) temperatures, against iron chlorosis in calcareous soils (Romero et al., 1991), to improve salt tolerance of plant (Colla et al., 2006), to enhance nutrient absorption (Ruiz et al., 1997), and to improve water use (Cohen and Naor, 2002)

The use of grafted seedlings in vegetables, particularly in watermelon, has increased dramatically in Turkey. The number of grafted watermelon seedling has increased from 2.5×10^6 to 16×10^6 in the last 3 years (Atasayar, 2006). At present, there are no rootstocks bred for watermelon in Turkey. Thus, rootstocks for watermelon are being imported from other countries. Although there is a rich genetic diversity of *L. siceraria*, no studies have been performed to evaluate the rootstock performance of *L. siceraria* genotypes. In a previous study, we collected and evaluated 210 *L. siceraria* genotypes from ecologically different parts of Turkey. Based on the morphological characteristics of plants and fruits, we form a collection for further studies. The objective of the present study was to evaluate the rootstock potential of a subset of the Turkish *L. siceraria* germplasm for watermelon regarding the graft compatibility, plant growth, and resistance to *Fusarium* wilt.

Materials and Methods

Plant materials and culture conditions

In 2003 and 2004, 3 regions of Turkey were visited and 210 bottle gourds genotypes were collected. The genotypes were grown in 2004 and 2005 and characterized based on morphological traits, and 72 genotypes were chosen as representatives of Turkish *L. siceraria* germplasm. Commercial *Lagenaria* hybrid rootstocks 216 and FRGold were also used for comparison. The names and the sources of the rootstocks are given in the Table. Crimson Tide watermelon cultivar was used as a scion. Seeds were sown in a peat:perlite mixture (1:1 v/v) in plug trays (cell volume 50 ml). Ninety seeds were sown from each genotype and each 30 seeds were regarded as a replicate. Rate of emergence was determined when cotyledon leaves became parallel with the soil surface and presented as a percentage of the total number of seeds sown. Hypocotyl diameter (mm) and length (cm) were measured.

Grafting and survival rate

The hole-insertion grafting technique was used and plants were grafted following the procedure described by Lee (1994) and Lee and Oda (2003). Seedlings were grown in an unheated greenhouse under plastic tunnels. All emerged seedlings were grafted and separated into 3 equal groups as replications (22-30 plant in each replication). Alive grafted plants were counted 15 days after grafting and the survival rate was expressed as a percentage of the total number of the grafted plants.

Plant growth experiment

Nine grafted plants from each rootstock genotype were transplanted in a greenhouse to 2-l pots filled with a peat:perlite mixture (1:1 v/v) amended with 0.4 g N l^{-1}, 0.175 g P l^{-1}, 0.332 g K l^{-1}. An ungrafted Crimson Tide watermelon cultivar was used as the control. The experimental design was a randomized complete block design. Each rootstock was replicated 3 times with 3 plants in each replication. Plants were irrigated by 2-day intervals with the same amount of water. Plants were harvested 3 weeks after transplanting. Leaf number (leaf $plant^{-1}$), shoot dry weight (g $plant^{-1}$), and root dry (g $plant^{-1}$) weight were determined. Harvested plants were separated into roots and shoots and then the leaves were counted. After the roots were washed and cleaned of growth media, both roots and shoots were placed in an oven with circulating air at 70 °C for 48 h and weighed for dry weight.

Fusarium inoculation test

Artificial inoculation was performed under controlled conditions (24 ± 1 °C, 16 h light and 8 h dark photoperiod) on 15 seedlings from each genotype at the first true leaf stage for each *FON* race. For artificial inoculation in the laboratory, races 0, 1, and 2 defined in the Çukurova and southeastern Anatolia region by Kurt et al. (2005) were used. A spore suspension containing 1×10^6 conidia ml^{-1} collected from 10-day-old PDA culture of *FON* races 0, 1, and 2 was used as inoculum. Seedlings of the genotypes were grown in a perlite:peat (1:1 v/v) mixture. After removing the 15-day-old seedlings from the pots, the roots were washed with tap water and pruned to 1.0-1.5 cm. The roots were inoculated by the root-dip method for 3-4 min, after which the seedlings were transplanted into multi-pots. The roots of the control plants were dipped into only tap water after pruning. Sugar Baby watermelon cv. inoculated with *FON* races was used as a positive control. The number of healthy plants in each genotype was evaluated at 2-day intervals. The number of plants exhibiting symptoms of *Fusarium* wilt (yellowing, stunting, or wilting) in each pot was counted 2 weeks after inoculation (Lecoq et al., 1991). For grafted plants, 10 *L. siceraria* genotypes showed the highest survival rate were grown in pots (8 cm diameter and 10 cm depth) filled with a mixture of peat and perlite (2:1) and grafted at the first true-leaf stage in order to investigate the rootstock potential of Turkish Lagenaria germplasm against *FON* races. Crimson sweet watermelon cultivar susceptible (Zhou and Everts, 2003) to *FON* was used as scion. When the grafted plants started to grow, they were inoculated with the pathogen by irrigating with 5 ml of conidial suspension. Ungrafted Crimson sweet was used as control plants. To facilitate inoculation, roots were first wounded with a spatula. Each treatment was replicated 3 times with 6 plants. Inoculated plants were kept at 25 ±1 °C. Observations for healthy and dead plants continued for 20 days (Yetişir et al., 2003).

Statistical analysis

Data were subjected to analysis of variance by SAS statistical program (SAS Institute, Version 8) and means were compared by Tukey's test at 0.05 and 0.01 significance levels.

Results and Discussion

Genotypes showed significant variation regarding the seedling emergence rate. The highest emergence rate was found in genotypes 48-07, 07-06, and 80-04, with 100% emergence, while the lowest emergence rate was found in genotype 33-15, with 76%. The hybrid rootstocks, 216 and FRGold, had 63% and 80% emergence rates, respectively. The reason for the low emergence rate of hybrid rootstocks was the age of the seeds. Seeds of these rootstocks were purchased 3 years before the experiment. Although the seeds were stored in low temperature and humidity, the emergence rate was low. Forty-four genotypes had 90% or more emergence rate while 20 genotypes showed 95% or more emergence rate. It means that those genotypes have a homogeneous genetic make-up with regard to this trait because bottle gourd is not a commercially cultivated crop in Turkey, and only a number of landraces are cultivated for some ornamental purposes corresponding to the characteristics of the fruits.

Hypocotyl diameter and length significantly varied based on genotypes. The diameter of hypocotyls ranked from 2.35 mm to 3.80 mm and the mean of the hypocotyl diameter was 3.11 mm. The thickest hypocotyl was determined in 33-13 and 01-01 genotypes, with 3.80 mm, while the thinnest hypocotyl was measured in 35-01 genotypes, with 2.35 mm. Genotypes 80-01 had the tallest hypocotyl, with 5.70 cm, whereas 35-01 had the shortest hypocotyl, with 2.30 cm. Hypocotyl diameter and length of all genotypes were suitable for grafting (Table).

Synchronization in emergence and homogeneity in seedling structure, especially hypocotyls diameter and hypocotyl length, are important criteria affecting grafting effectiveness and success (Oda et al., 1993; Yetişir and Sarı, 2004). Results of the study are in agreement with previous studies performed with 2 *L. siceraria* landraces of Turkey in which the landraces showed higher homogeneous emergence rates and seedling characteristics (Yetişir and Sarı, 2003; Yetişir et al., 2003).

Survival rate of grafted watermelon Crimson Tide is presented in the Table. Significant variation was found among the bottle gourd genotypes regarding the survival rate. The highest survival rate was determined in genotypes 33-15, 31-08, 31-09, and 31-43, with 99.7%, whereas genotype 46-09 had the lowest survival rate, with 70%. Fifty-five of the genotypes had higher survival rates than commercial hybrid rootstocks, while the rest of the genotypes produced equal or lower survival rates than the hybrid rootstocks.

All bottle gourd genotypes showed resistance against 0, 1, and 2 races of *FON*. However, 9 genotypes showed yellowing symptoms. Plant tissues were reisolated from the hypocotyl of the yellowing plants and examined for the spores or mycelia of *FON* but no sign of *FON* was found. Crimson sweet watermelon cultivar was grafted on 10 *Lagenaria siceraria* genotypes (33-15, 31-08, 31-09, 48-07, 07-04, 07-06, 07-42, 09-01, and 31-48) that showed the highest survival rate in order to investigate the effect of rootstock on *Fusarium* wilt resistance. All grafted plants used in this study were resistant to 3 known races of *FON*. Ungrafted plants, however, showed *FON* symptoms such as yellowing and retarded growth (Figure) and were susceptible to all 3 races.

Leaf number was significantly affected by rootstock. On average, the grafted plants produced more leaves than the ungrafted controls. Among the grafted plants, 48-13 and 07-10 had the highest leaf numbers, with 25.5 leaves plant^{-1}, while the lowest leaf numbers were recorded in 01-15 and 216 commercial rootstock, with 17.0 and 17.5 leaves plant^{-1}, respectively. In terms of leaf number, most of the genotypes exhibited superior performance as compared to the commercial rootstocks tested. Shoot dry weight significantly varied between rootstocks. The highest shoot dry weight was produced by 31-26, with 7.9 g plant^{-1}, while the lowest shoot dry weight was produced by control plants and 33-09, with 5 g plant^{-1}. Similarly, root dry weight was significantly affected by rootstocks as well. The lowest root dry weight was found in the control plants, while 27-01 accumulated the highest root dry weight. Sixty-six of the *L. siceraria* rootstock genotypes produced more root dry weight than the commercial hybrid rootstocks (Table).

The rootstocks of the families *Lagenaria* and *Cucurbitaceae* were resistant to *FON*, and watermelon that was grafted onto these rootstocks showed superior performance regarding the plant growth parameter such as root and shoot fresh and dry weight as compared to the ungrafted control plants (Yetişir and Sarı, 2003). Vigorous roots of the rootstocks exhibited superior tolerance to serious soil-borne diseases such as those

Table. Origin of genotypes, rate of graftable seedlings, survival rate, and resistance of *Lagenaria siceraria* genotypes to 3 races of *Fusarium oxysporum* f. sp. *Niveum*.

			Hypocotyl					
Genotypes	Origin of genotypes	Rate of graftable seedlings (%)	Diameter (mm)	Length (cm)	Survival rate (%)	Leaf number (leaf plnat^{-1})	Shoot dry weight (g plant^{-1})	Root dry weight (g plant^{-1})
33-15	Mersin	76	3.06	3.40	99.7	23.9	7.5	1.04
31-08	Hatay	89	3.00	3.90	99.7	20.2	5.8	0.66
31-09	Hatay	93	3.56	5.30	99.7	20.3	6.1	0.58
31-43	Hatay	98	3.33	4.10	99.7	24.3	7.8	0.85
48-07	Muğla	100	3.14	2.90	99.0	22.3	7.3	0.89
07-04	Antalya	91	3.43	4.30	99.0	21.6	6.6	1.00
07-06	Antalya	100	3.55	5.10	99.0	22.5	6.7	0.93
07-42	Antalya	98	3.02	3.20	99.0	20.0	6.3	0.80
09-01	Aydın	99	2.69	2.90	99.0	22.6	6.9	0.77
31-48	Hatay	94	2.90	4.80	99.0	23.0	6.3	0.85
07-03	Antalya	90	3.17	4.30	98.7	23.0	6.4	0.78
31-23	Hatay	79	3.50	3.60	98.7	19.8	5.8	0.94
07-10	Antalya	79	2.83	3.20	98.0	25.5	7.6	0.72
31-31	Hatay	99	3.21	4.10	98.0	23.3	6.9	0.89
47745	Gaziantep	97	3.20	3.50	98.0	22.6	6.4	0.54
33-02	Mersin	92	3.14	4.30	98.0	20.9	7.3	1.14
07-33	Antalya	92	2.98	3.30	98.0	23.1	7.7	0.83
20-06	Denizli	96	2.90	2.30	98.0	22.4	6.4	0.81
20-02	Denizli	94	3.55	3.10	98.0	22.3	6.3	0.73
07-02	Antalya	87	3.65	3.70	97.7	23.3	6.9	0.89
33-01	Mersin	90	3.16	3.20	97.7	19.4	5.3	0.79
33-09	Mersin	93	2.93	3.30	97.7	21.6	5.0	0.92
33-06	Mersin	91	3.30	4.60	97.7	23.2	7.7	1.09
31-11	Hatay	98	3.30	4.90	97.7	21.9	5.6	0.75
35-01	İzmir	94	2.35	2.30	97.0	22.6	6.9	1.00
33-25	Mersin	79	2.80	3.10	97.0	21.7	6.5	1.00
07-45	Antalya	83	2.96	5.10	97.0	23.1	6.7	0.76
33-35	Mersin	92	3.49	4.10	96.7	22.2	4.6	0.89
31-47	Hatay	98	2.78	3.80	96.7	21.4	7.0	1.03
33-41	Mersin	89	3.08	3.70	96.3	21.6	5.4	0.85
01-17	Adana	92	2.87	3.30	96.3	20.7	6.8	0.66
33-05	Mersin	90	3.50	3.00	96.3	22.0	7.4	0.74
31-38	Hatay	89	3.74	5.10	96.3	21.5	6.9	0.71
31-16	Hatay	93	3.33	4.90	96.3	23.2	6.2	0.70
31-26	Hatay	94	2.95	4.30	96.3	24.0	7.9	1.02
07-11	Antalya	96	3.03	2.60	96.3	22.3	5.7	0.82
33-13	Mersin	72	3.80	3.40	96.0	22.5	6.5	0.71
09-03	Aydın	81	2.92	2.60	96.0	22.9	6.5	0.73
01-16	Şanlıurfa	90	2.60	2.80	96.0	20.9	6.1	1.00
33-23	Mersin	97	2.80	4.00	95.7	21.5	4.7	0.82
48-10	Muğla	99	3.26	2.70	95.7	24.2	6.8	0.84
33-45	Mersin	86	2.96	3.80	95.0	22.3	6.5	0.90
31-01	Hatay	88	2.95	4.30	95.0	21.8	7.1	0.97
46-03	Kahramanmaraş	94	2.80	2.80	95.0	20.1	6.0	0.72
33-37	Mersin	81	3.00	3.30	94.7	22.2	7.8	1.06
07-49	Antalya	98	3.47	3.70	94.7	22.8	6.9	0.94
46-07	Kahramanmaraş	89	2.96	4.37	94.0	22.3	7.7	0.77

Table. (Continued)

07-39	Antalya	84	3.54	4.10	93.3	21.2	5.5	0.90
07-40	Antalya	92	2.94	4.00	93.0	24.6	7.7	1.04
07-15	Antalya	97	2.55	4.20	93.0	24.8	7.4	0.99
01-13	Adana	96	3.53	3.20	93.0	17.9	5.7	0.78
07-09	Antalya	93	3.21	4.40	92.7	22.2	6.3	0.84
46-10	Kahramanmaraş	89	3.52	5.50	92.3	21.7	7.4	0.70
07-31	Antalya	98	3.00	4.20	92.0	20.7	4.9	0.85
216	Korea	63*	2.80	2.50	91.0	17.5	6.6	0.66
01-11	Adana	90	2.65	2.87	91.0	22.8	6.4	0.73
27-01	Gaziantep	99	3.17	4.04	91.0	19.9	4.5	1.18
31-06	Hatay	82	3.21	5.00	90.3	23.8	6.7	0.93
46-06	Kahramanmaraş	93	3.47	4.60	90.3	20.9	7.2	0.92
FRGold	Korea	80*	3.40	3.20	90.3	18.7	6.5	0.67
33-12	Mersin	91	3.03	3.90	90.0	20.6	6.6	0.87
31-21	Hatay	92	3.03	3.60	89.3	22.7	6.5	0.76
80-01	Osmaniye	93	3.20	5.70	88.3	24.5	5.9	1.00
01-12	Adana	89	3.14	4.10	87.7	20.4	5.9	0.63
33-26	Mersin	96	3.19	3.10	87.0	21.0	7.6	0.74
01-15	Adana	93	2.67	3.20	87.0	17.0	4.8	0.57
80-04	Osmaniye	100	2.84	3.70	86.3	21.1	6.4	0.63
46-01	Kahramanmaraş	91	2.70	3.83	86.3	20.9	6.4	0.96
01-01	Adana	89	3.80	3.40	83.3	61.7	5.8	0.71
33-47	Mersin	88	3.13	3.20	83.3	18.6	5.4	0.93
33-48	Mersin	93	2.70	3.10	81.0	22.5	5.4	1.11
46-09	Kahramanmaraş	78	2.93	3.50	70.0	22.2	5.4	0.96
Crimson Tide		-	-	-	-	15.0	5.0	0.49
Means		91.0	3.11	3.80	94.16	21.9	6.5	0.84
LSD		5.15**	0.72**	0.86**	4.10**	2.20**	1.58**	0.15**

* 3-year-old seeds ** Significant at 1%

Figure. Fusarium inoculated ungrafted Crimson Sweet cv. watermelon plant (left) and the one grafted onto *Lagenaria siceraria* (right).

caused by *Fusarium* (Kota and Ogiwara, 1989) and *Verticillium* (Bletsos et al., 2003; Lee and Oda, 2003). As reported previously (Lee, 1994; Yetişir et al., 2003), *L. siceraria* genotypes and grafted plants showed resistance to *FON* races in our study.

All grafted plants showed a significant increase in plant growth parameters as compared to the ungrafted control plants. Promoted plant growth in the grafted plants can be explained by the interaction of some or all of the following phenomena: increased water and plant nutrient uptake (Pulgar et al., 2000), augmented endogenous hormone production (Zijlstra et al., 1994), enhanced scion vigor (Leoni et al., 1990), tolerance to low soil temperature (Den Nijs and Smeets, 1987), and salinity (Zerki and Parsons, 1992; Colla et al., 2006). In agreement with previous studies (Lee and Oda, 2003; Yetişir and Sarı, 2003), plant growth was promoted by *L. siceraria* rootstocks genotypes. Additional effects of other processes could also play a role in explaining the enhancement in plant growth.

Conclusions

FON is host-specific for watermelon and hence none of the bottle gourd genotypes was infected. Either pathogen could lack a specific pathogenicity function required to cause the disease in the host plant, or the host could lack a specific susceptibility factor, or a substance/substances synthesized in the plant provides resistance against the disease (Biles et al., 1989; Ruiz and Romero, 1999). Biles et al. (1989) reported that the substance associated with *Fusarium* resistance was synthesized in the roots and translocated to other parts of the plant through the xylem. The results of our study showed that the emergence rates of the genotypes varied depending on the homozygosity of the genotypes. Most of the genotypes showed acceptable (90%>) emergence and survival rates (70%-99%). The majority of the genotypes had higher survival rates than the commercial hybrid rootstocks, while the rest of the genotypes produced equal or lower survival rates than the hybrid rootstocks. The rootstock genotypes promoted plant growth and the grafted plants had more leaf numbers, and shoot and root dry weight than the control plants. In addition, most of the genotypes showed superior performance over commercial hybrids regarding the plant growth parameters. All bottle gourd genotypes showed resistance against 3 races of *FON*. The results showed that Turkish *L. siceraria* germplasm has powerful rootstock potential for watermelon against *Fusarium* wilt and it is a good resource for rootstock breeding programs with regard to the traits investigated. However, our findings present limited physiological information regarding the rootstock potential of Turkish *L. siceraria* germplasm, and further research studies need to be conducted to provide comprehensive data addressing the rootstock potential of Turkish *L. siceraria* germplasm on the yield and quality of watermelon.

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