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A Research on Grafted Vine Ratio and Vegetative Growth of 'Ora', 'Prima' And 'Early Sweet' Grape Cultivars Grafted on Certain Rootstocks

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Abstract

This research was conducted in 2014 at the Department of Horticulture of Mustafa Kemal University.'Ora', 'Prima', 'Early Sweet' grape cultivars were grafted on '41B', 'SO4' and '1103 P' American rootstocks using omega (Ω) grafting method. Ambient temperature and humidity values were recorded during the term of the trial. Bud burst ratio (%), callus formation ratio (%), callus formation degree (0-4), rooting ratio (%), rooting degree (0-4), first grade grafted vines (%), shoot length (cm) and shoot diameter (mm), shoot node number (n), mean leaf area (cm^2), total leaf area (cm^2), total dry weight (g), chlorophyll content and nutrient element (N, K, Mg, Ca, Fe, Mn) content were analyzed in the research. Differences were observed between rootstocks and cultivars on the basis of analyzed characteristics. 1103 P rootstock yielded higher values than 41B and SO4 rootstocks in terms of bud burst ratio, callus formation ratio, callus formation degree, total leaf area, rooting ratio. 1103 P (88,89%) was found to be significantly higher in terms of first grade grafted vine ratio than 41 B (61,11%) and SO4 (51,11%) rootstocks. While the influence of rootstocks were not found to be significant in terms of Mg, Ca in nutrient element content of cultivars; statistical differences were observed in terms of N, K, Mn contents.

Key words: Grafted grapevine, Graft success, Growth, Chlorophyll

Özet

Bu araştırma, Mustafa Kemal Üniversitesi Bahçe Bitkileri Bölümünde 2014 yılında yürütülmüştür. '41B', 'SO4' ve '1103 P Amerikan asma anaçları üzerine 'Ora', 'Prima', 'Early Sweet' üzüm çeşitleri omega (Ω) aşı yöntemi ile aşılanmıştır. Deneme süresince, ortam sıcaklık ve nem değerleri kaydedilmiştir. Çalışmada aşı sürme oranı (%), kallus oluşum oranı (%), kallus derecesi (0-4), köklenme oranı (%), kök derecesi (0-4), birinci sınıf fidan randımanı (%), sürgün uzunluğu (cm) ve sürgün çapı (mm), sürgün boğum sayısı (n), ortalama yaprak alanı (cm2), toplam yaprak alanı (cm2), toplam kuru ağırlık (g), klorofil içeriği ve besin elementi (N, K, Mg, Ca, Fe, Mn) içeriği incelenmiştir. İncelenen özelliklere göre anaçlar ve çeşitler arasında farklılıklar görülmüştür. 1103 P anacı sürme oranı, kallus oluşum oranı, kallus derecesi, toplam yaprak alanı, köklenme oranı bakımından, 41 B ve SO4 anaçlarından yüksek değer vermiştir. Birinci sınıf fidan randımanı bakımından 1103 P (%88,89) anacı, 41 B (% 61,11) ve SO4 (% 51,11) anaçlarına göre önemli düzeyde yüksek bulunmuştur. Çeşitlerin besin elementi içeriğinde anaçların etkisi Mg, Ca bakımından önemli bulunmazken, N, K, Mn içerikleri bakımından istatistiksel farklılıklar görülmüştür.

Anahtar kelimeler: Aşılı asma, Aşı başarısı, Büyüme, Klorofil

Introduction

Turkey has a significant past in terms of viticulture, as well as a high grape production potential in our day, due to convenience of ecological conditions. According to the data, 4.185.126 tons of grape is produced in 462.295 ha vineyard area in our country (TUİK, 2012).

Most of the vineyards in our country are contaminated by phylloxera and nematods (Sengel et al., 2012). Grafting is an indispensable operation of Turkish viticulture. Grafted vines or field grafting are used in establishing the new plantations (Çelik, 2012). There is an intense need for selection of American rootstocks suitable to ecological areas and grown grape cultivars, as well as determination of compatibility and affinity situations of formed grafting combinations. (Çelik and Odabaş, 1994). This issue plays a key role in viticulture. An important part of production of vine

saplings in Turkey is provided by Aegean region. Besides, dominance of grapevine importation in our country has continued in the recent years (Çelik, 2012). Therefore, emphasis should be placed on researches and subsidies intended for grafted vine production in different agricultural areas. Measures, intended for increasing the number and capacities of nurseries establishments in Mediterranean region, should be taken. Sapling production of grapevine cultivars, which are important for the region and which can be traded, should be supported.

In this study, 'Ora', 'Prima' and 'Early Sweet' grape cultivars, which are new and early for Mediterranean region, were grafted on '41 B', 'SO4' and '1103 P' rootstocks using omega grafting method, upon which their sapling developments and grafted vine ratio were researched.

Materials and Methods

This research was conducted in 2014 in the Horticulture Department of Mustafa Kemal University. Cuttings of 'Ora', 'Prima', 'Early Sweet' cultivars and cuttings of '41B', 'SO4' and '1103 P' rootstocks were used as materials. Cuttings received on February 17, 2014 were kept in cold storage in polyethylene bags at +4 °C until the time of grafting. One-year-old cuttings with a thickness of 8-9 mm were selected as materials. Rootstock cuttings were kept in water for 24 hours while cultivar cuttings were kept in water for 12 hours before grafting. Cuttigs of grape cultivars were grafted on American rootstocks using omega (Ω) grafting method (on February 20, 2014). Paraffin was carried out after grafting. Grafted cuttings were planted directly in perlite:turf (ratio 3:1) medium. Planting distance was 4X5 cm, while planting depth was 15 cm. The grafted cuttings were irrigated with only tap water at regular intervals during propagation period inside glasshouse condition. In experiment, temperature and humidity values of the environment were recorded (Figure 1). Chlorophyll measurements were made on the marked leaves on shoots (fully-expanded mature leaves in the middle of shoots) in the last week of the experiment. Relative chlorophyll content (SPAD) was determined using a portable chlorophyll meter (SPAD502, Minolta Co. Ltd. Japan). During measurements, three readings, representing different directions, were made on each leaf. Plants were taken from the glasshouse and brought to the laboratory on May 31, 2014. Grafted grapevines were carefully uprooted from rooting medium and the following parameters were examined on the same day. During the study, bud burst ratio (%), callus formation rate at graft surfaces (%), callus grade at graft surfaces (0-4), rooting ratio (%), rooting degree (0-4), first grade grafted vine ratio (%) were examined according to Çelik (1982). Main shoot length (cm), main shoot diameter (average diameter of the second and third internodes) (mm), main shoot node number (n) were also examined. In addition, all leaves, shoots and roots were harvested from vines. Their dry weights (g), (after being heated at 70°C for 48 h), were recorded. Furthermore, total (cm²/ plant) and average (cm²/leaf) leaf area of plants were determined, using an LI-3100C area meter. At the end of the experiment, dried leaf samples were ground in a porcelain mortar. The N content was determined using the Kjeldahl method (Kacar, 1995). Concentrations of K, Ca, Mg, Mn, Fe in dissolved samples were determine by Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES, Varian Series-II).

The experiment was set up randomized block design with three replicates. Each replicate consisted of 10 grafted plants. Variance analyses of obtained data were made by using Mstat-C computer software. Differences between the averages were evaluated by an LSD test at 0.05. Angular transformation was applied to % values.

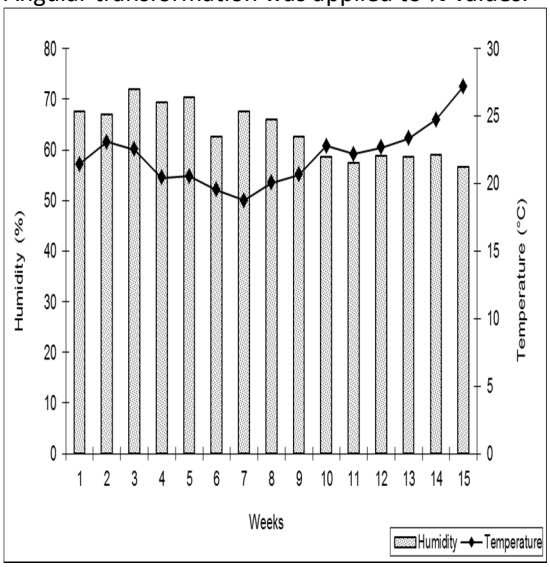

Figure 1. Changes in temperature and relative humidity inside glasshouse during the experiment.

Results and Discussion

Bud burst ratio in grafted vines was found to be significant in terms of rootstock averages. 1103 P rootstock yielded higher bud burst ratio than SO4 and 41 B rootstocks. Cultivar averages were not found to be different in terms of this characteristic (Table 1).

In terms of callus formation rate and callus formation degree at graft surfaces, variation between rootstock averages were found to be statistically significant and 1103 P rootstock

yielded a higher value (100,0 % and 3,86 respectively) than the remaining two rootstocks (Table 1). While a study yielded 97,30% callus formation rate at graft surface on 1103 P rootstock (Baydar and Ece, 2005), another study yielded 94,2% (13 weeks after grafting) (Kamiloglu, 2005). In the study conducted by Hamdan and Salimia (2010), it was determined that callus formation rate at graft surface yielded values between 1.05 and 3.85 (10 weeks after grafting) according to cultivars on 1103 P rootstock.

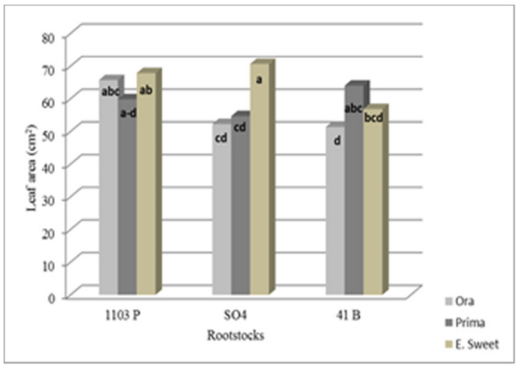

Figure 2. Leaf Area in Some Grafted Scion/Rootstock Combinations

Table 1. Some Parameters of Grafting Success in Different Scion/Rootstock Combinations.

	Bud burst ratio (%)	Callus formation ratio (%)	Callus formation degree (0-4)	Rooting ratio (%)	Rooting degree (0-4)	First grade grafted vine (%)
Cultivar						
Ora	87,78 (72,45)	94,44 (82,05)	3,52	94,44 (79,78)	2,47 b	61,11 (53,71) b
Prima	84,44 (69,90)	90,00 (76,31)	3,73	93,33 (80,00)	3,10 a	68,89 (56,98) ab
Early Sweet	88,89 (75,41)	96,67 (83,86)	3,53	97,78 (85,91)	2,83 ab	71,11 (59,82) a
Rootstock						
1103 P	96,67 (83,86) a*	100,00 (90,00) a	3,86 a	100,00 (90,00) a	3,30 a	88,89 (72,96) a
SO4	84,44 (68,36) b	93,33 (80,00) b	3,44 b	93,33 (78,87) b	2,51 b	51,11 (45,67) b
41 B	80,00 (65,54) b	87,78 (72,22) b	3,48 b	92,22 (76,82) b	2,60 b	61,11 (51,88) b
ANOVA						
Cultivar	ns	ns	ns	ns	**	**
Rootstock	**	**	**	**	**	**
Cultivar x Rootstock	ns	ns	ns	ns	ns	ns

*Values not associated with the same letter are significantly different (P<0.05); ** Significant at 0.05 level; ns: not significant

Table 2. Vegetative Growth Parameters in Some Grafted Scion/Rootstock Combinations.

	Shoot length (cm)	Shoot node number (n)	Shoot diameter (mm)	Mean leaf area (cm^2/leaf)	SPAD	Total leaf area (cm^2/plant)	Total dry weight (g)
Cultivar							
Ora	25,84	9,52 a	3,69 a	57,12	22,31	473,1	2,04
Prima	22,69	9,51 a	3,39 b	59,53	21,99	440,0	2,22
Early Sweet	22,73	8,46 b	3,37 b	65,13	23,49	463,5	1,99
Rootstock							
1103 P	27,52 a*	9,71	3,64	64,49	22,30	536,3 a	2,40
SO4	19,74 b	8,68	3,40	59,88	22,19	415,9 b	1,84
41 B	24,00 a	9,10	3,41	57,42	22,30	424,4 b	2,01
ANOVA							
Cultivar	ns	**	**	ns	ns	ns	ns
Rootstock	**	ns	ns	ns	ns	**	ns
Cultivar x Rootstock	ns	ns	ns	**	ns	ns	ns

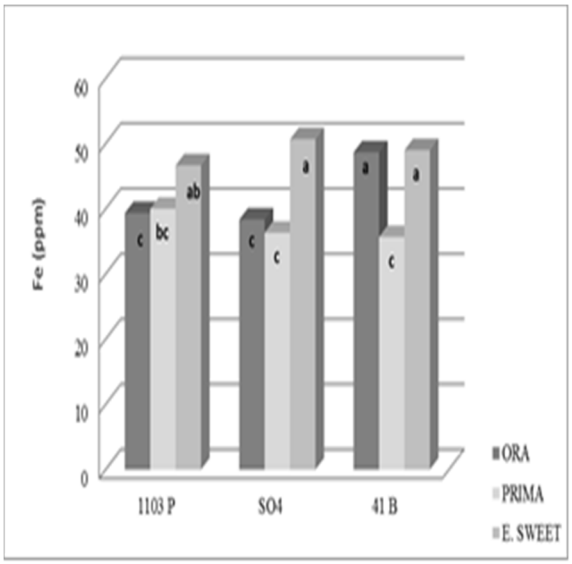

Figure 3. Fe Content in Some Grafted Scion/Rootstock Combinations

Rooting ratios of American grapevine rootstocks can differ greatly (Kısmalı and Karakır, 1990). Rooting ratio in rootstock cuttings was statistically significant at a level of 5%. SO4 (93,3 %) and 41 B (92.2 %) rootstocks in the same group yielded lower values than 1103 P (100,0 %) rootstock. The highest value (3,30) in terms of rooting degree was also obtained from 1103 P rootstock. Kamiloglu (2005) also determined that 1103 P yielded higher values than 5BB and 110 R rootstocks in terms of rooting degree according to average rootstock values. Abu-Qaoud (1999) reported that 1003 P rootstock yielded higher values than 41 B, 140 Ru and 110 R rootstocks in terms of rooting rate and root numbers. According to average values of cultivars, the highest root development was obtained from 'Prima' while the lowest root development was obtained from 'Ora' (Table 1).

Table 3. Nutrient Contents in Some Grafted Scion /Rootstock Combinations.

	N (%)	K (%)	Ca (%)	Mg (%)	Fe (ppm)	Mn (ppm)
Cultivar						
Ora	2,78 a	0,32	1,86	0,55	42,11 ab	102,56
Prima	2,26 b	0,28	1,71	0,53	37,33 b	125,33
Early Sweet	2,80 a	0,26	1,86	0,51	48,78 a	116,56
Rootstock						
1103 P	2,32 b	0,26 b	1,95	0,54	42,00	133,4 a
SO4	2,73 a	0,28 b	1,73	0,51	41,78	114,8 b
41 B	2,79 a	0,32 a	1,76	0,54	44,44	96,2 c
ANOVA						
Cultivar	**	ns	ns	ns	**	ns
Rootstock	**	**	ns	ns	ns	**
Cultivar x Rootstock	ns	ns	ns	ns	**	ns

*Values not associated with the same letter are significantly different (P<0.05);
**Significant at 0.05 level; ns: not significant

The ratio of first grade grafted vine has an important place among parameters analysed during grafted vine production. This feature can be influenced by used rootstock, cultivar and propagation techniques and ecological conditions. In our study, the effect of rootstocks on this characteristic was found to be significant at a level of 5%. 1103 P (88,89 %) yielded the highest value. This rootstock was statistically followed by 41 B (61,11 %) and SO4 (51,11 %), which were in the same group. In terms of cultivar averages, the highest value obtained from 'Early Sweet' (71,11 %) cultivar while the lowest value was obtained from 'Ora' (61,11 %) cultivar (Table 1). Baydar and Ece (2005) identified in their study that there was not a statistically significant difference between rootstocks and cultivars in terms of first grade grafted vine yield. Values obtained by researches from SO4 and 1103 P (respectively 37.85%; 27.09%) were found to be lower than the values obtained from this study. It is considered that this difference was caused by cultivation environment and cultivation technique.

The effect of rootstocks on shoot lengths of grafted vines was found to be statistically significant. The differences in vigor suggest a stionic influence caused by rootstock genotypes (Verma et al, 2010). The effect of 1103 P and 41 B rootstocks on shoot length was found to be the highest, while the effect

of SO4 rootstock on shoot length was found to be the lowest. Dardeniz and Şahin (2005) identified in their study that maximum main shoot length was on the rootstock '1103 P' at the end of

10 weeks of shoot growth. In terms of cultivar averages, shoot length was found to be close in Ora, Prima and Early Sweet cultivars. Rootstock X cultivar interaction was not found to be significant in the study (Table 2). Although shoot node number and shoot diameter were not found to be significant according to rootstock averages; in respect of these characteristics, Ora and Prima yielded higher values than other cultivars in terms of shoot node number and Ora yielded a higher value than other cultivars in terms of shoot thickness. Cultivar and rootstock averages were not found to be significant in terms of total leaf area of vines; however, cultivar X rootstock interaction was found to be statistically significant. Average leaf area value was found to be highest in Early Sweet/SO4 combination and the lowest in Ora/41B combination (Figure 2). While a significant difference was not observed on total leaf area of grafted vines according to cultivar averages, it was identified that 1103 P formed more leaf area than other rootstocks according to rootstock averages (Table 2). This variation could be attributed to the genotypic influence of the rootstocks (Verma ve ark., 2010). It was determined that shoot, leaf and root dry weight totals were similar in terms of cultivar and rootstock averages (Table 2). Concentrations of N, K, Ca, Mg, Fe, Mn on leaves harvested are given in Table 3. The use of rootstocks can have an important effect on the mineral nutrition of the grafted variety (Ibacache and Sierra, 2009). However, a significant difference was not observed in Ca and Mg content according to cultivar and rootstock averages as obtained findings were analysed. This finding can be supported with study of Cook and Lider in which rootstocks had no effects on foliage Ca and Mg (Gu, 2003). The effect of rootstocks on N, K and Mn content was found to be significant. N content was founded the highest on 41 B and SO4 rootstocks, Mn content was founded the highest on 1103 P rootstock, and K content was founded the highest on 41 B rootstock. Ibacache and Sierra (2009) and Stino et al. (2011) reported that the effects of rootstocks on N, P and K contents were different. It was determined that a significant change regarding cultivar averages did not occur in K, Ca, Mg and Mn concentrations in terms of analysed elements. However, Prima cultivar yielded lower values than Ora and Early Sweet cultivars in terms of N ve and Fe concentrations. Besides, cultivar X rootstock interaction were found significant regarding Fe contentration. While Fe concentration of Prima and Early Sweet cultivars were affected similarly by rootstocks that they were grafted on, Fe concentration of Ora cultivar was affected differently by rootstocks. As a matter of fact, it was determined that Ora/41 B combination had higher Fe content than Ora/1103 P and Ora/SO4 combinations (Fig 3). Verma et al (2010) showed that Fe content was significantly influenced by a combination of rootstocks.

Conclusion

Selection of suitable scion/rootstock combinations is highly important in production of grafted vines. (Baydar and Ece, 2005). In the study, effects of grafting certain early grape cultivars (Ora, Prima and Early Sweet), which can be recommended for Mediterranean region, on 41 B, SO4 and 1003 P rootstocks on grafted vine yields and grafted vine growths were investigated. 1103 P rootstock yielded higher values than other rootstocks in terms of analysed grafting parameters (bud burst, callus development at graft surfaces, rooting), grafted vine growth (total leaf area, shoot length). 1003 P yielded the highest value among rootstocks and Early Sweet yielded the highest value among cultivars in terms of first grade vine yield.

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