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# Effects Of Scion-Rootstock Combinations On Ratio And Quality Of The Potted Vine Grafts

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**Abstract**

Different rootstock and scion combinations have different effects on all agronomical and physiological parameters. Determining good affinity, optimizing environmental factors and building successful graft union are very important to obtain successful graft combination and healthy plants. This study was conducted in Manisa Viticultural Research Station in 2014. Crimson Seedless, Cardinal and Michele Palieri grape varieties and 1103 Paulsen (*Vitis berlandieri* x *Vitis rupestris)* and Kober 5 BB (*Vitis berlandieri* x *Vitis riparia)* rootstocks were used as plant materials in this study. Grafts were made by using "omega" graft machine. Data were analyzed into two stages; at the end of callusing phase and sapling production phase. Grafts were placed into callusing room (26 $^0$C and 90-95% relative humidity) for 24 days and callusing levels (0-4), sprouting and rooting ratios (%) were determined at the end of this period. Grafts were rooted under controlled conditions (26±2 $^0$C and 70-75% relative humidity) for six weeks then were transferred shading area for adaptation. Callusing levels (0-4), sprouting and rooting ratios (%), shoot development level (0-4), main shoot length (cm) and diameters (mm), number of nodes on main shoot, chlorophyll content and ratio of grafts were recorded and analyzed statistically . The best result was obtained from the combinations of 'Cardinal/5 BB (80.00%)' and 'Michele Palieri/1103 P (78.33%)' in respect to graft ratio. The lowest graft ratio were obtained 'Crimson Seedless/1103P (46.66%)' combination.

**Key words:** Vine, omega, graft ratio, combination.

**Üzüm Çeşıt – Anaç Kombınasyonlarının Tüplü Asma Fıdanı Randıman Ve Kalıtesıne Etkıleri**

**Özet**

Farklı anaç çeşit kombinasyonları tüm agronomik ve fizyolojik parametreler üzerinde etkilidir. İyi bir aşı kombinasyonu ve sağlıklı aşılı fidan elde etmek için anaç-kalem afinitesinin saptanması çevresel faktörlerin optimize edilmesi ve iyi bir aşı kaynaşmasının sağlanması çok önemlidir. Çalışmada bitkisel material olarak Crimson Seedless, Cardinal ve Michele Palieri üzüm çeşitleri ile 1103 Paulsen (*Vitis berlandieri* x *Vitis rupestris)* ve Kober 5 BB (*Vitis berlandieri* x *Vitis riparia)* asma anaçları kullanılmıştır. Çeşit ve anaçların aşılama işlemi omega aşı yöntemiyle yapılmıştır. Elde edilen veriler; aşılı çeliklerin kaynaşması sonrası ve fidan üretim aşaması olarak iki aşamada değerlendirilmiştir. Aşılı çeliklerin kaynaşması için 24 gün boyunca kaynaştırma odasında (26 $^0$C and %90-95 nisbi nem) bekletilmesinden sonra, kallus düzeyi (0-4), sürme oranı (%) ve köklenme oranı (%) değerleri belirlenmiştir. Altı hafta süreyle kontrollü koşullar altında (26±2 $^0$C and %70-75 nisbi nem) köklendirilen fidanlar, dış koşullara adaptasyon için gölgeleme ortamına alınmıştır. Kallus düzeyi (0-4), sürme ve köklenme oranı (%), sürgün gelişim düzeyi (0-4), ana sürgün uzunluğu (cm) ve kalınlığı (mm), sürgün üzerinde boğum sayısı, yapraktaki klorofil miktarı ve fidan randıman değerleri kayıt altına alınarak istatiksel olarak yorumlanmıştır. Fidan randımanı açısından en iyi sonucu Cardinal/5 BB (80.00%) ve Michele Palieri/1103 P (78.33%) kombinasyonlarından elde edilirken, en düşük fidan randıman değeri Crimson Seedless/1103P (46.66%) kombinasyonundan elde edilmiştir.

**Anahtar kelimeler:** Asma, omega aşısı, fidan randımanı, kombinasyon.

## Introductıon

To establish a new vineyard, it is necessary to have qualified grafted, well rooted and healthy vine saplings. The demands for planting materials can provided by the improvement and effective use of techniques that allow the rapid expansion of propagating stocks . On the other hand, phylloxera has so viciously attacked worldwide to the European grapevine cultivars (*Vitis vinifera L.*) and continues to spread from vine to vine (Sabir, 2011). Today; growers have to graft *V.vinifera* cultivars onto resistant rootstocks that was bred from

various North American species (Baydar and Ece, 2005; Lowe and Walker, 2006; Sabir, 2011).

There are many factors affect the production of sapling in viticulture like genetic and environmental factors. Different rootstock and scion combinations have different effects on all agronomical and physiological parameters. Nowadays, because of the increased awareness about the use of rootstocks which are resistant to biotic and abiotic stress factors; growers started to use rootstocks for grape cultivation. It is also important to build successful graft union by determining good affinity and optimizing environmental factors to obtain high graft ratio and healthy vine.

There are many reports on effects of rootstock on leaf area, photosynthesis rate, chlorophyll content, stomatal conductance, carboxilation efficiency and quantum yield (Candolfi-Vasconcelos et al. 1997, Bica et al. 2000, Keller et al. 2001). This is the result of interaction between rootstock and scion more than scion or rootstock itself (Baveresco, 2000). Rootstock effects may be favor of the scion photosynthesis rates. Chlorophyll content of the leaves varied by genotype, age of the plant, leaf structure and environmental factors like heat, light, water and gases (Çelik, 2011). Also the rootstocks affect photosynthesis and dry matter partitioning of scion cultivars which influence vegetative growth and yield. Chlorophyll content also an indicator of nitrogen in leaves (Fiella et al. 1995, Brunetto et al. 2012).

The aim of this research was to determine the effects of different grape variety-rootstock combination on callusing levels, sprouting and rooting ratios, shoot development level, main shoot length and diameters, number of nodes on main shoot, chlorophyll content and graft ratio of the potted vine grafts.

## Materials and Methods

### Material

This study was carried out at Viticultural Research Station, Manisa, in 2014. Crimson Seedless, Cardinal and Michele Palieri grape cultivars and 1103 Paulsen (*Vitis berlandieri* x *Vitis rupestris)*, Kober 5 BB (*Vitis berlandieri* x *Vitis riparia)* rootstocks were used as plant propagation materials in this study.

**1103 Paulsen:** 1103 Paulsen (1103 P) (*V.berlandieri* X *V.rupestris*) has moderate to vigorous growth. It has proven suitable to be planted in humid and clay-limy soils. It is also suggested for arid soils and drought conditions. It has higher success of rooting and affinity ratio when it compares to other rootstocks.

**Kober 5 BB:** Kober 5 BB (*V.berlandieri* X *V. rupestris*) rootstock adapts to humid and compact clayish soils. It tolerates up to 20% active lime and nematodes. It has good rooting but the affinity rate is low (Çelik, 2011).

### Methods

The single-bud scions of Crimson Seedless, Cardinal and Michele Palieri were grafted on the cuttings of 1103 Paulsen (*Vitis berlandieri* x *Vitis rupestris)* and Kober 5 BB (*Vitis berlandieri* x *Vitis riparia).* All materials were stored in +4 $^0$C, 70 to 80% humidity conditions in cold storage room. All cuttings were prepared in length 35 to 40 cm and omega grafting was performed on scion/rootstock pairs which have approximately the same diameter. Grafts were properly dipped into paraffin wax (55-60 $^0$C) and they stored for callusing 24 days at 26 $^0$C, 80-85% humidity in callusing room. Grafted cuttings were put into plastic containers filled sawdust. After this period, callusing level (0-4), sprouting ratio (%) and rooting ratio (%) values were recorded. Grafted cuttings were dipped again into paraffin wax (65-75 $^0$C) and then planted into black polyethylene bags which contained a mixture; pine bark, sifted soil, farm manure, perlite, peat, woodchip (2:1:1:1:1:1) (Ilgın et al., 1990). All potted grafts were rooted under controlled conditions (26±2 $^0$C and 70-75% relative humidity) after six weeks and then they were transferred to under net coated tunnels (shading) for adaptation to outdoor conditions after two weeks from transfer to shading area. Shoot development level (0-4), main shoot length (cm), main shoot diameter (mm), number of nodes on main shoot, root development level (0-4), average root number, average root length (cm), chlorophyll content (SPAD) in leaves and graft ratio (%) values were measured in potted grafted plants.

This study was designed as to be complete randomized block with three replicates. Each treatment had twenty grafted plants. SAS statistical program was used to analyze the interactions between combinations. Statistical differences were considered significant using DUNCAN test (P<0,05).

## Results

Data were analyzed into two stages as the end of graft union phase and sapling production phase.

### Graft parameters before planting

Callusing level of combinations were found statistically important. Michele Palieri/1103 P and Michele Palieri / 5 BB combinations were in the same statistical group which they had the highest value (3.73 – 3.70) of callusing. The lowest callusing

level was obtained from Crimson Seedless/1103 P (2.96) combination (Figure 1).

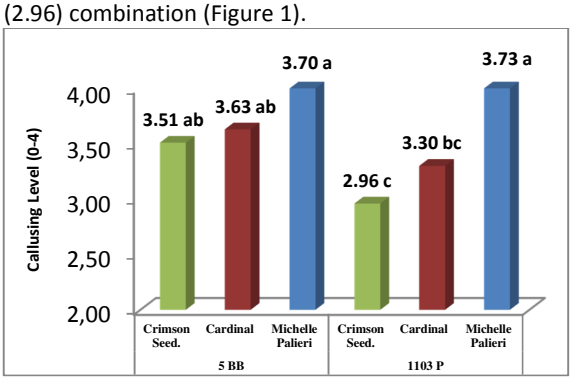


**Figure 1.** Callusing level (0-4)

Values for the sprouting ratio (%) are presented in Figure 2. The results for sprouting ratio were found significant for all graft combinations. The highest values were obtained from Michele Palieri/5 BB (35.00%) and Crimson Seedless/1103 P (35.00%) combinations and the lowest value were obtained from Crimson Seedless/5 BB combination (10.00%). These differences may be caused from diversity of scion types, health of bud, temperature within the callusing case, and the use of rooted rootstocks.

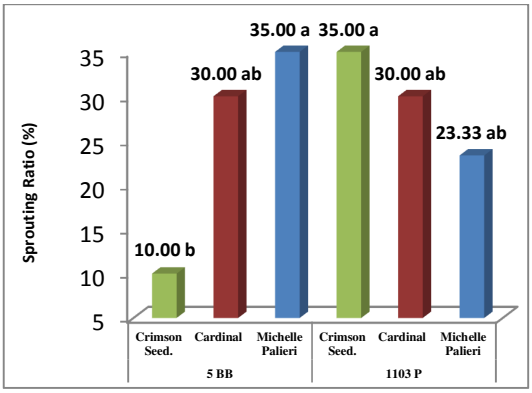


**Figure 2.** Sprouting ratio (%)

As for rooting ratio (%) (Figure 3), the highest value was obtained from graft combination of Cardinal/1103 P (85.00%) and Crimson Seedless/1103 P (78.33%). It is clear from the data that all 5 BB combinations are less successful than 1103 P combinations in respect to rooting capacity in callusing room.

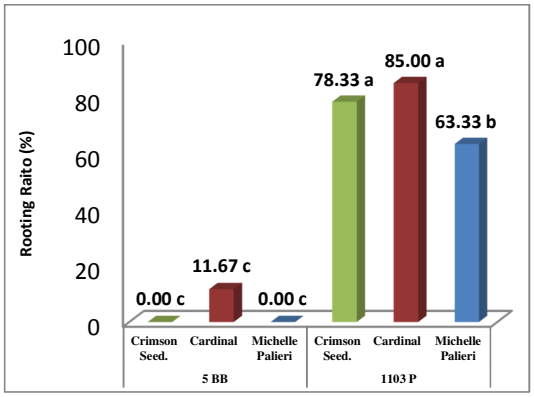


**Figure 3.** Rooting ratio (%)

This experiment also gave the highest graft ratio (final take) percentage in Cardinal/5 BB (80.00%) and Michele Palieri/1103 P (78.33%) combinations respectively (Figure 4). The lowest graft ratio percentage was determined in Crimson Seedless/1103 P. It can be clearly seen that this result is quite similar to callusing level data. This lowest graft ratio may have been caused by lowest callusing level in this study.

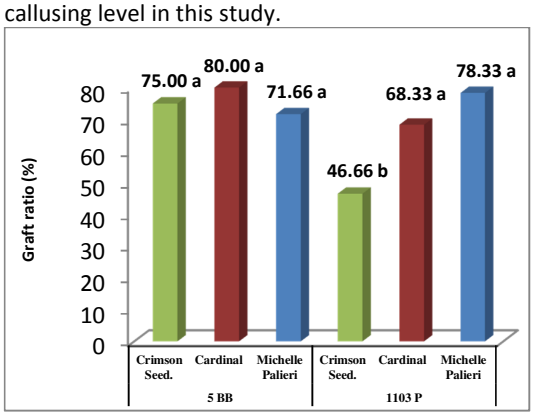


**Figure 4.** Graft ratio (%)

**Growth parameters of potted grafts**

Despite of the fact that all differences on shoot growth data of potted grafts were found statistically significant, differences on root growth were found statistically insignificant.

**Shoot growth data**

As can be seen in Figure 5, the highest shoot development level (0-4) were observed in both Crimson Seedless/1103 P (3.40) and Crimson Seedless, Cardinal/5 BB (3.29) while Cardinal/1103 P (2.85) combination gave the least value. These results also reveal that differences between Cardinal/5 BB combination and others combinations found to be significant.

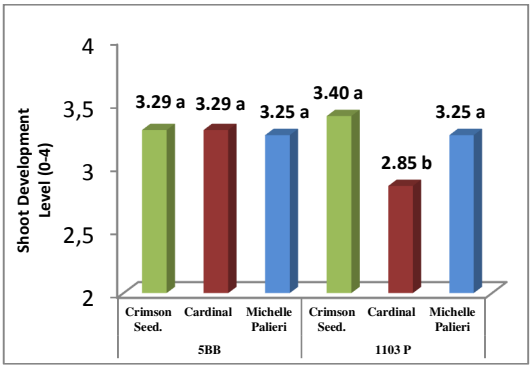


**Figure 5**. Shoot development level (0-4)

Michele Palieri/1103 combination gave the longest shoot length and the lowest shoot length was measured in Cardinal/1103 P combination (Figure 6). These results indicate that growth of grafts could be different in respect to variety and bud viability.

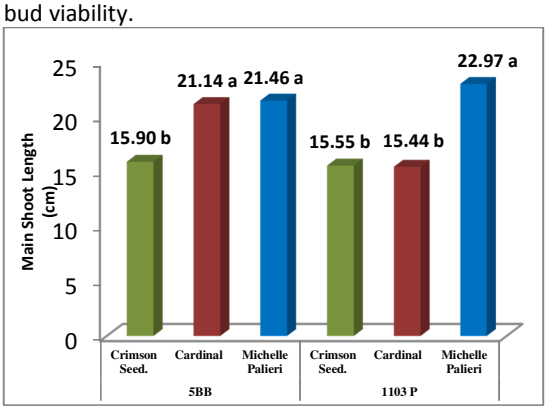


**Figure 6.** Main shoot length (cm)

Shoot diameters were determined significant according to graft combinations (Figure 7). The thickest shoot was determined in Michele Palieri/1103 P (2.27mm) and Michele Palieri/5 BB (2.21mm) combinations while the thinnest was Cardinal/1103 P (1.61mm) combination.

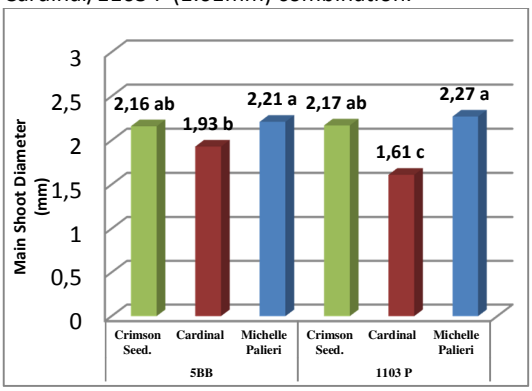


**Figure 7.** Shoot diameter (mm)

Number of nodes on main shoot data was presented in Figure 8. Results showed that number of nodes on main shoot between combinations was significant. The highest number of nodes was obtained from Michele Palieri, Crimson Seedless and Cardinal potted vine grafts for the both rootstock combinations respectively while the lowest one was determined in Cardinal/1103 P (5.30)

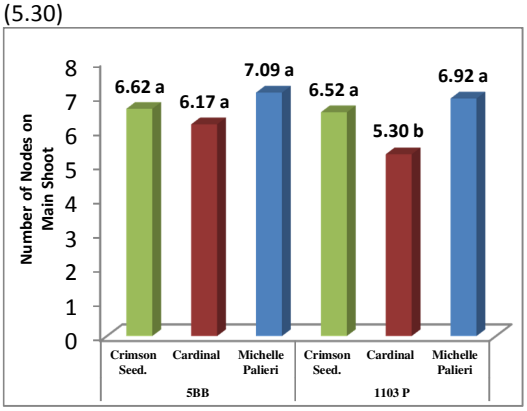


**Figure 8.** Number of nodes on main shoot

**Root growth data**

The highest value of root development level (0-4) was obtained from Cardinal/1103 P (2.50) and the lowest one from in Cardinal/5 BB (2.06) combinations. There were no significant differences among combinations related to root development level of potted vine grafts (Figure 9).

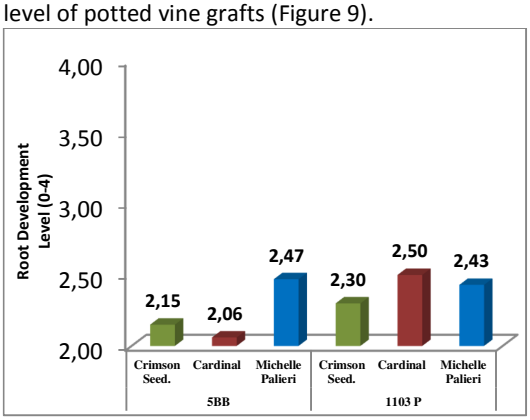


**Figure 9.** Root development level (0-4)

The average root number per potted vine was shown in Figure 10. 1103 P rootstock had higher rooting percentage in this experiment. According to the results, there was no significant difference between combinations nevertheless average root number was the highest in Michele Palieri/1103 P (11.90) and Cardinal/1103 P (11.23) and Crimson Seedless/5 BB (8.15) gave the lowest one.

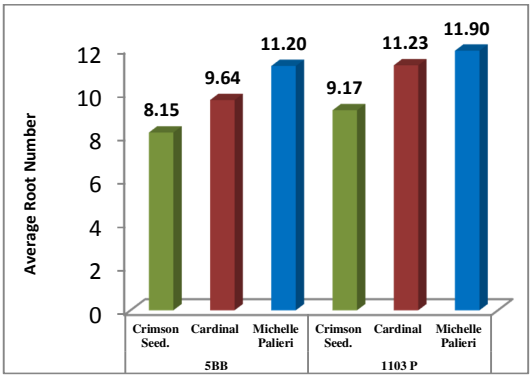


**Figure 10.** Average root number

As can be seen in Figure 11, the longest average root length was observed in Cardinal/1103 P (9.66cm) and Cardinal/5 BB (8.50cm) while the shortest average root length was Michele Palieri/1103 P. There were no significant differences between combinations.

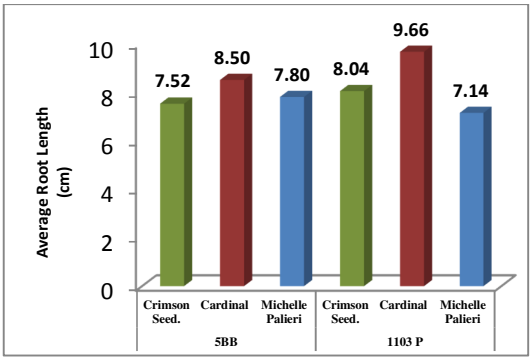


**Figure 11.** Average root length (cm)

**Chlorophyll content**

In our study there is a statistically significant difference between the chlorophyll content of varieties grafted on 5 BB and 1103 P rootstocks. It is determined that 5 BB rootstock was more effective in respect of photosynthesis efficiency and chlorophyll amount of scion. Among the varities Crimson Seedless had the lowest chlorophyll content on both rootstocks. While the Cardinal had the hightest.

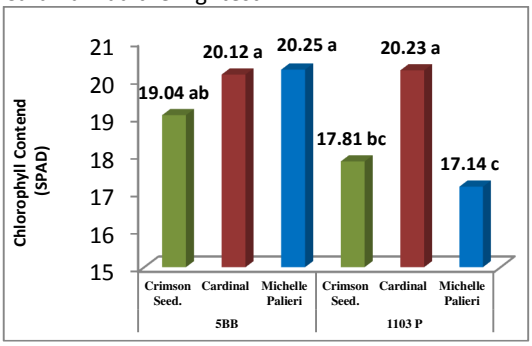


**Figure 12.** Chlorophyll content (SPAD)

**Dısscussıon**

Significant differences were observed between the combinations in respect to studied parameters. The difference between the varieties grafted on to 1103 P and 5 BB was statistically important. In respect to callusing levels the highest value among the cultivars was Michele Palieri. The values of Cardinal and Crimson Seedless were 3.63 and 3.51 respectively. Among the rootstocks the highest value was in 5BB (3.73) but 1103P has moderately lower values (2.96). Çelik and Akgül (1992) determined the affinity levels between 3.96-3.49. In another study callusing level in the combinations of 5BB and Müşküle grape variety was obtained 2.88 (Sivritepe and Türkben, 2001). Cangi et al. (2000) obtained the affinity values 3.79 and 3.59 from the varieties Erciş and Hafızali which grafted on to 5 BB rootstock and they also reported that the callusing on rootstock was more than callusing on scion. In this study the best result was obtained from the Michele Palieri combination in respect to sprouting ratio. Sivritepe and Türkben (2001) reported that the sprouting ratio in Müşküle and 5BB combination was 47.78%. In this study the rooting ratio of 5BB combinations was low. Other studies also supported these findings Sivritepe and Türkben (2001). Besides, when compared the rooting ratio of the rootstocks, it was reported that 5BB was lower than 1103P (Sağlam et al. 2005).

The highest graft ratio was obtained in Cardinal/5BB (80.00%)and Michelle Palieri/1103 P (78.33%)combinations. Crimson Seedless/1103P (46.66%) combination gave the lowest graft ratio. Baydar and Ece (2005) obtained remarkably low graft ratios 42,67%, 42.82% and 43.89% from Razakı, Alphonse Lavallée and Italia cultivars grafted on 5BB also 22,49%, 39.85% and 18.95% on 1103P rootstocks respectively in vineyard conditions. Despite the graft ratio in our study was high, this also showed that different results could be obtained depending on the variety and the growth conditions. The differences between the shoot growths of the potted grafts were statistically important. The most vigorous shoots were in Crimson Seedless/1103 P (3.40) combination while the weakest shoots were in Cardinal/1103 P (2.85) combination. Çelik (1998) found that the shoot growth levels of Amasya Beyazı and Alphonse Lavallée grafted on 5BB in nursery were 2.20 and 2.30 respectively. In the same study the shoot diameters were 8.90 – 8.98 mm. In our study the potted grafts were in greenhouse conditions. The shoot diameters of Michele Palieri/1103P (2.27mm) and Michele Palieri/5 BB (2,21mm) were quite close to each other as the other combinations. Generally it might be concluded that shoot vigor is depends on scion more than rootstock. The findings on root

growth levels, average root numbers and average root length of the grafts showed that the best results were in 1103 P rootstock. Despite there was no statistically difference, 1103 P gave better results than 5 BB in respect to root growth of potted grafts. It has been known that 5 BB has a weak root system and is difficult to root. These findings were compatible with the previous studies.

In our study there is a statistically significant difference between the chlorophyll content of varieties grafted on 5BB and 1103P rootstocks. We determined that 5BB rootstock was more effective in respect of photosynthetis efficiency and chlorophyll amount of scion. Same results also reported by other researchers (Candolfi-Vasconcelos et al. 1997, During 1994, Koblet et al. 1996, Keller et al. 2001, Bica et al. 2000). On the other hand 5BB rootstock has the lowest chlorophyll amount among the other rootstocks as reported by Gargın (2011).

**Conclusıon**

This study was evaluated in two stages. Before planting 5 BB rootstock gave the best results in callusing level and graft ratio. 1103 P gave the best results in respect to rooting. Among the varieties the highest callusing level was in Michele Palieri and the highest sprouting and rooting rate were in Cardinal. Michele Palieri gave the best graft ratio in two combinations. In second stage, after planting, average shoot growth parameters of the combinations were high in 5 BB. But the average root growth parameters were higher in 1103 P combinations. The average chlorophyll contends were generally high in 5 BB combinations. Among cultivars Cardinal has the highest chlorophyll content. And the Crimson Seedless has the lowest one. Among cultivars the best results obtained from Michele Palieri in respect to shoot growth parameters while Cardinal gave the worst in two combinations. In rooting parameters the root development level and average root number were high in Michele Palieri. But Cardinal was best in average root length. We concluded that 5BB rootstock positively affects chlorophyll content of the scion than 1103 P. Among the grape varieties that we used in this study, Cardinal has the highest SPAD values while the Crimson has the lowest on both rootstocks.

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