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Effect of Rootstocks on Different Physiological Parameters in Some Grape Cultivars

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Abstract

Rootstocks affect the vigor, yield and fruit quality besides the physiology and alter the resistance of the scion to abiotic and biotic stress factors. In viticulture, different rootstocks affect the same scion also in different ways. This study was conducted in five years old vineyard in Manisa conditions. Leaf samples of Cabarnet Souvignon, Merlot and Syrah cultivars grafted on 110 R (*Vitis berlandieri x Vitis rupestris*) and 1103 P (*Vitis berlandieri* x *Vitis rupestris*) were taken during veraison. Proline, carbohydrate, color (CIE *L*, a*, b**) and chlorophyll (SPAD) contends of the samples were analyzed. The effects of the rootstocks on scion were compared. The obtained data were interpreted according to statistical analysis and Duncan Multiple Comparison Test was used to state the differences. Statistical differences in all parameters were noted when all rootstocks and scion combinations evaluated together. When rootstocks effects on scion analyzed, 1103 P were found statistically significant in all parameters except carbohydrate values where 110 R were found insignificant in proline, a* and L* values. As a result rootstocks were found effective on evaluated physiological parameters and scions have different response on the same rootstock.

Key words: Vine, rootstock, proline, carbohydrate, SPAD, color.

Özet

Anaçlar üzerine aşılı çeşidin büyüme, verim ve meyve kalitesinin yanı sıra fizyolojisini de etkileyerek, abiyotik ve biyotik stres faktörlerine karşı dayanımını değiştirir. Bağcılıkta da farklı anaçlar aynı çeşidi farklı şekillerde etkileyebilmektedir. Bu çalışma Manisa koşullarında, beş yaşındaki bağda gerçekleştirilmiştir. Ben düşme döneminde, 110R(Vitis berlandieri x Vitis rupestris) ve 1103P (Vitis berlandieri x Vitis rupestris) anaçlarına aşılı Cabarnet Sauvignon, Merlot ve Syrah çeşitlerinden yaprak örnekleri alınmıştır. Bu örneklerde proline, karbonhidrat, renk (CIE *L*, a*, b**) ve klorofil (SPAD) analizleri yapılmıştır. Anaçların çeşitler üzerindeki etkileri karşılaştırılmış, veriler Duncan çoklu karşılaştırma testi kullanılarak yorumlanmıştır. Anaç ve çeşit kombinasyonları birlikte değerlendirildiğinde incelenen tüm parametreler istatistiksel olarak önemli bulunmuştur. Anaçların çeşide olan etkileri karşılaştırıldığında 1103P anacı, karbonhidrat değerleri hariç tüm parametrelerde önemli çıkarken 110R anacı, prolin, *a** ve *L** değerleri bakımından önemsiz bulunmuştur. Sonuç olarak anaçlar incelenen fizyolojik parametreler açısından etkili bulunurken çeşitler, aynı anaç üzerinde farklı tepkiler vermiştir.

Anahtar kelimeler: Asma, anaç, prolin, karbonhidrat, SPAD, renk.

Introduction

Grapevine rootstocks have been using for a long time for different reasons. The major reason to use rootstocks is their resistance to some biotic (phylloxera and nematodes) and abiotic (high pH soils, saline soils, low pH soils, wet or poorly drained soils and drought) stress factors (Reynolds and Wardle, 2001). There are many researches on effects of rootstocks on scion physiological and biological properties like photosynthesis, dry matter (Wlliams and Smith, 1991), mineral constituens (Grant and Mathews, 1996, Ibacache and Sierra 2009) and hormonal status (Satisha *et al*. 2007). Rootstocks also affect the resistance of the scion by regulating some physiological (stomatal regulations, photosynthesis rate, metabolite accumulation) and morphological properties (vegetative growth, leaf shape). During (1994) studied rootstock effects on scion photosynthesis and found that the rootstock effect on gas exchange is scion specific; Bica *et al*. (2000) found that the effect of rootstocks was significant on leaf area, chlorophyll content, stomatal conductance and quantum yield. 'Chardonnay' vines grafted on 'SO4' showed lower photosynthesis, quantum yield, stomatal conductance and chlorophyll content than on '1103P'. Baveresco (2000) reported that the

chlorophyll concentration of the leaves was strongly affected by the graft combination.

Each rootstock has different effect and this is related to scion also. It is important to choose appropriate rootstock variety combination in viticulture unless it is directly related to yield and quality of grape and wine. (Fisarakis *et al.* 2001; Grant and Matthews, 1996; Gregory *et al*., 2013).

The aim of this study is determine the some metabolic constituents of three different wine grape varieties grafted on two different rootstocks and compare the effects of the rootstocks.

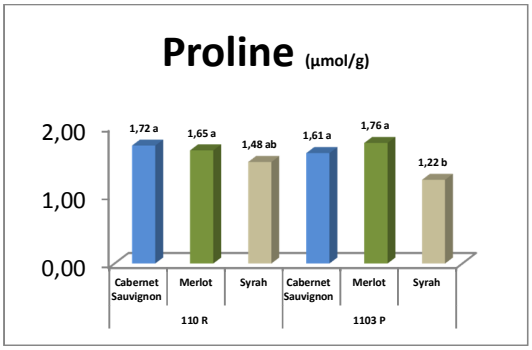

Figure 1: Proline contents of the varieties on two rootstocks

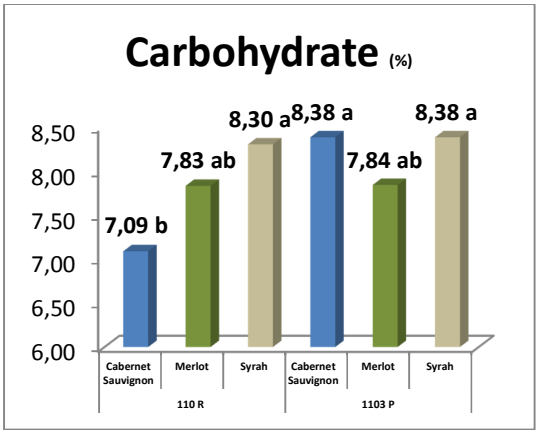

Figure 2: Carbohydrate contents of the varieties on two rootstocks

Material and Method

This study was conducted in Manisa Viticultural Research Station vineyards on five years old Cabarnet Sauvignon, Merlot and Syrah grape varieties grafted on 110R(*Vitis berlandieri x Vitis rupestris*) and 1103P (*Vitis berlandieri x Vitis rupestris*) rootstocks. Planting distance between the rows was 2,5m and on the rows was 1,5m. Soil was sandy-loam

No irrigation was applied until the veraison at 9th of July when the samples were collected. Fully-expanded mature leaves from the mid-shoot area were collected and all of them mix and grind together. The appropriate amount for the chemical analyses was taken from this bulk.

Proline analyses were done according to Bates et al. (1973). Carbohydrate analyses were done by using anthrone method. Chlorophyll contends of the leaves were measured by using Minolta 502 chlorophyllmeter and the values indicated as SPAD. *L*, a*, b** values were measured by using colorimeter.

Statistical analyses were done by using SPSS program and Duncan's multiple range tests were used to compare means.

Results

All evaluated parameters were found statistically important ($p \leq 0.05$). Proline content was the highest in Merlot/1103P (1.76 µmol-ml^{-1}) combination. The second one was the Cabarnet Sauvignon /110R (1.72 µmol-ml^{-1}) combination. Syrah on the other hand had the lowest proline content one both rootstocks (1.48 and 1.22 µmol-ml^{-1}). When compared to rootstocks the varieties except Merlot on 110R had more proline content than the varieties on 1103P (Figure1). As we compared the total carbohydrate contents of the varieties Syrah had the highest values (8.30, 8.38) on both rootstocks. On the other hand, Cabarnet Sauvignon /110R combination had the lowest carbohydrate content 7.09%. But on the 1103P rootstock carbohydrate content of Cabarnet Sauvignon increased to 8.38% where the other varieties seemed to not effect (Figure 2). The highest SPAD value (44.08) obtained from Merlot/1103P combination where the lowest one (37.80) obtained from Cabarnet Sauvignon /1103P combination (Figure 3). On the contrary L^* value of the Merlot/1103P combination was the lowest (40.06) while Cabarnet Sauvignon /1103P combination had the highest one (41.68). L^* values showed a parallel alteration with the carbohydrate contents (Figure 4). Highest b^* value (12.98) was obtained from Cabarnet Sauvignon /1103P combination and the lowest one (8.79) from Merlot/110R combination. Merlot gave the lowest values on both rootstocks (Figure 5). On the other hand the lowest a^* value was obtained from Cabarnet Sauvignon /1103P combination. Syrah/110R combination has the highest a^* value (-8.45) (Figure 6).

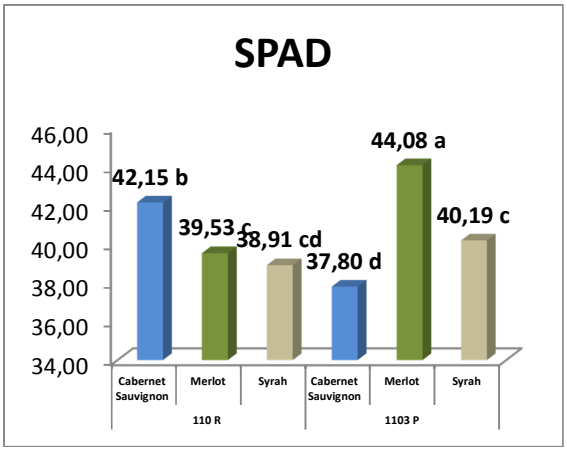

Figure 3. Chlorophyll contents (SPAD values) of the varieties on two rootstocks

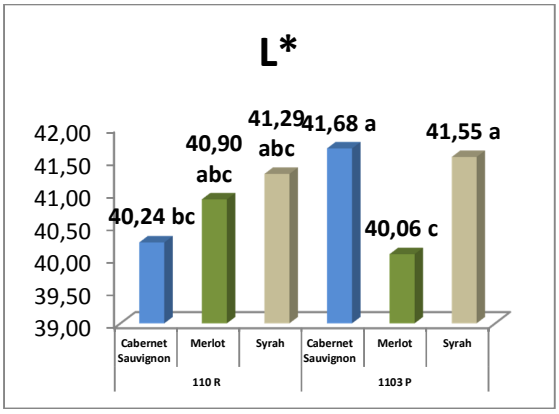

Figure 4. *L** values of the varieties on two rootstocks

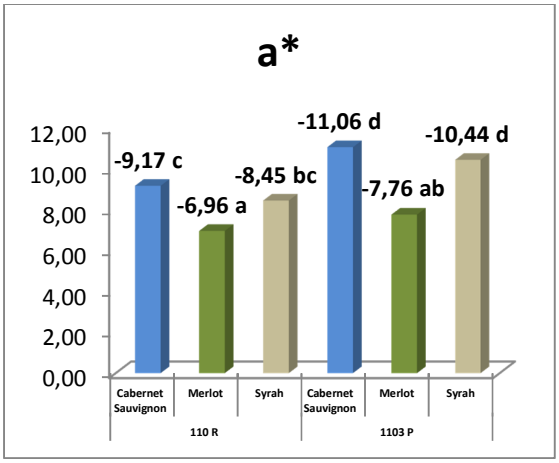

Figure 5. *a** values of the varieties on two rootstocks

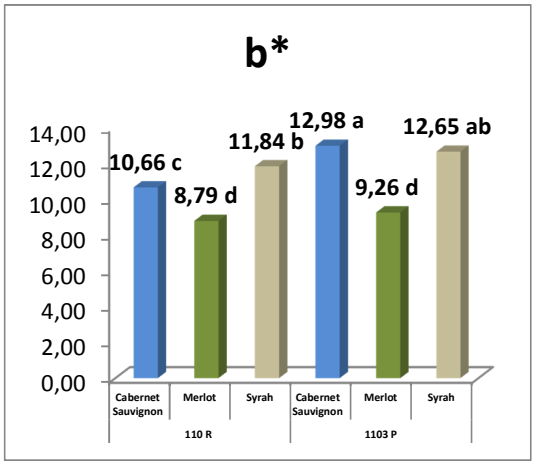

Figure 6. *b** values of the varieties on two rootstocks

Discussion and Conclusion

There are many researches on the alteration of investigated parameters by application of stress factors and the effects of rootstocks on the reaction of the varieties. This study is a preliminary experiment of more comprehensive study on stress to determine the current situation of some stress metabolites in vineyard conditions. The rootstocks used in this study were *Vitis berlandieri x Vitis rupestris* hybrids and both have a good tolerance to drought.

In our conditions, Merlot variety accumulates more proline, carbohydrate and chlorophyll on 1103P rootstock. But statistically the effects of rootstock on proline accumulation were found insignificant. On the other hand the proline content of Syrah variety was higher on 110R rootstock and these finding was statistically important.

In respect of carbohydrate amounts of the varieties, the effect of 1103P rootstock on Cabarnet Sauvignon was significant. Carbohydrate accumulation was higher on 1103P rootstock.

Chlorophyll content of the Merlot variety was found the highest and 1103P rootstock had a positive effect on this variety but Cabarnet Sauvignon had the highest chlorophyll content on 110R rootstock. Gargın (2011) compared the chlorophyll contents of some vine rootstocks and reported that the highest chlorophyll content (30.19) was in 420A while 5BB had the lowest one (20.62). In our results these varied between 37.8 and 44.08. Because the chlorophyll content of the leaves varied by genotype, age of the plant, leaf structure and environmental factors (Çelik, 1998) these results accepted as reasonable. Color parameters (*L*, a*, b**) gave parallel results which Cabarnet Sauvignon had the highest values on 1103P rootstock. The color properties of some

grape varieties were 28.84-35.99 (*L**) -1.44 and -2.69 (*a**) 16.23 and 21.7 (*b**) as reported previously (Gülcü and Demirci, 2011). In our study *a** values were between -6.96 and -11.06; *b** values were between 8.79-12.98 and the *L** values were 40.06-41.68. *L** values also showed an opposite alteration with SPAD values.

According to these findings we may conclude that, investigated rootstocks in this study have effect on the varieties some metabolite and chlorophyll contents. These effects may be due to genetic or environmental factors. This study could be used as a preliminary step for the future stress studies.

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