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Effects of Different Culture Media on Rooting in Grafted Grapevine

Farklı kültür ortamlarının aşılı asma fidanı köklenmesi üzerine etkileri

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Anahtar Sözcükler:

Asma, hidroponik, omega aşılama, kök özellikleri, köklenme

ABSTRACT

This study was carried out to investigate effects of different culture media at the hydroponic system available at Ege University, Faculty of Agriculture, Department of Horticulture. As the plant material, Alfonso Lavallée grafted on Ruggeri 140 (140R) and Couderc 1616 (1616C) rootstocks with omega grafting was used. Three different aggregate media; such as pressed agricultural rock wool, oasis and perlite; as the control the mixture of soil, perlite and farm manure were used. As a result of the experiment the rooting ratio ranged from 53.33% in perlite to 73.33% in oasis for 140R. In the formation of sub and top callus, rockwool and perlite had higher value than the others. For the rooting capacity, the lowest and the highest values were obtained 8.33% (perlite) and 78.33% (rockwool) respectively. In this research, fresh and dry root weight values of 140R and 1616C rootstocks have shown the best result for each rootstock at agricultural rockwool. In rockwool, very high levels of rooting was observed, due to the high water-holding and aeration capacity.

ÖZET

Bu çalışma, Ege Üniversitesi, Ziraat Fakültesi, Bahçe Bitkileri Bölümünde mevcut hidroponik sistemde farklı kültür ortamının etkilerini araştırmak amacıyla gerçekleştirilmiştir. Bitki materyali olarak, Ruggeri 140 (140R) ve Couderc 1616 (1616C) anaçları üzerine omega aşı ile aşılanmış Alfonso Lavallée kullanılmıştır. Üç farklı agregat ortamı, tarımsal kaya yünü, oasis ve perlit ile kontrol olarak çiftlik gübresi, perlit ve toprak karışımı kullanılmıştır. Araştırma sonucunda oasisde %73.33, perlitte %53.33 oranında köklenme belirlenmiştir. Alt ve üst kallus oluşumu kaya yünü ve perlitte diğerlerinden daha yüksek değerde olmuştur. Köklenme kapasitesi için sırasıyla, en düşük ve en yüksek değerler % 8.33 (perlit) ve % 78.33 (kaya yünü) elde edilmiştir. Bu çalışmada, 140R ve 1616C anaçlarının yaş ve kuru kök ağırlıklarına ait değerleri tarımsal kaya yünü için en iyi sonucu göstermiştir. Tarımsal kaya yününde yüksek su tutma ve havalandırma kapasitesi nedeniyle çok yüksek köklenme oranı olduğu gözlenmiştir.

INTRODUCTION

From commercial viticulture perspective, grafting on a proper rootstock is a standard vineyard practice in most parts of the world. The European grape *Vitis vinifera* is highly susceptible to phylloxera, but many American native species are not. As a solution, the practice of grafting European scions onto phylloxera-resistant rootstocks was developed (Pongracz, 1983). This practice is still in used today, and these rootstocks are suited to a variation of conditions reflecting the

original environments of the parent plants (Granett et al., 2001). Nowadays, selected grape varieties were planted as grafted due to susceptibility of cultivated varieties to pests, i.e. mites, insects, nematodes and more importantly *Phylloxera*, leading to decline in the great majority of commercial plantations. Taking in to account this situation the use of suitable rootstocks is of great importance for successful commercial growing in terms of different vineyards cultivars (M. Alizadeh et al., 2010).

Most of the vineyards in our country are contaminated by phylloxera (*Viteus vitifolii*) and nematods. Thus, it was stated that American grapevine rootstocks should be used both to renew old plantation and to establish a new plantation (Kismali, 1978). On this matter, there are some problems in renewal of old vineyards and supplying grafted grapevine cuttings required at new vineyard facilities. Grapevine grafted cuttings requirement of our country has been determined to be 8-10 millions per year, however the production of grafted grapevine cutting can be only corresponded approximately 20-25% of this demand. In order to overcome this situation it is pointed out that new sapling facilities and new applications enhancing grafted cutting performances are required (Ilgın et al., 1990).

2-5% of production stage losses in grafted grapevine cutting production occurs during grafting and 2-30% of it occurs during callusing. Furthermore, 20-72% of losses occurs during rooting at the nursery (Kocamaz, 1991). The structure of nursery soil and soil and climate conditions during 2-3 weeks period following grafted cuttings greatly affect the success of grafted grapevine cutting performance to be achieved. The losses at pulling out of cuttings are significant besides losses occurring during the vegetation period. In recent years, hydroponic systems are used at open fields and greenhouses in order to minimize nursery losses, to meet the increasing grafted grapevine cutting demand, to produce more cuttings per unit area, to increase quality, to reduce cost and labor (Şengel, 2005).

Rooting media is also one of the most important factor for grafted cutting production in greenhouse where the temperature, relative humidity and air ventilation can be kept under control, as they directly effecting the cutting growth. Previous studies have shown that mixture and pure rooting media directly effects the cutting quality and efficiency, at the same time, rooting media efficiency depend on the size of pot and combination of varieties/rootstocks.

In this study, some materials that can removed during planting for increasing the efficiency of rooting and rooting quality were used. Thus, it is targeted to minimize losses which may occur during removal of the tube or nylon material of the cutting. In the current study, it was aimed both to decrease labor costs and to obtain more cutting per unit area. Plant materials were evaluated in terms of the rooting ratio, root lengths, fresh and dry weight of the roots, the diameter of sub-callus and top callus, fresh and dry

weight of shoots were investigated. Thereby it is considered that this study would be provided benefits in our country that increasing the cutting loss and respond to increasing cutting demand.

MATERIALS AND METHODS

This study was carried out at the Grapevine Production facility of Ege University, Faculty of Agriculture, Department of Horticulture during 2004-2005.

Alfonse Lavallée grafted on Ruggeri 140 (140R) and Couderc 1616 (1616C) rootstocks with omega grafting was used (May, 1997; Çelik et al., 2002). These two rootstocks were selected because 140R is very resistant *Phylloxera* and active lime 20%. This rootstock successfully grows in limy and dry soils so it will develop very strong and will delay maturation. Controversely, 140R possess low rooting ratio. On the other hand 1616C is a vigorous rootstock. Fruit set is improved by this rootstock. It has a long vegetative cycle and delays ripening period. It has a shallow, well-branched root system. It is sensitive to drought and best adapted to fertile, humid, poorly drained soils. It grows poorly in infertile and sandy soils (Kracke et al., 1981).

Three different aggregate medium; such as pressed agricultural rock wool, oasis and perlite; as the control the mixture of soil, perlite and farm manure were used. Control treatment was prepared as size 15 cm x 25 cm black plastic bags including soil, perlite and farm manure.

Alfonse Lavallée cultivar was grafted on two different rootstocks. Rootless grafted cuttings which have completed their callus development were planted in three different medium.

The hydroponic system used for the research have consisted of long flume type pots made of polystyrene where nutrition solution is passed through and fed to the plants. Dimensions of each polystyrene flume type pots available in this hydroponic system consisting of circulation pumps and materials facilitating the circulation of the nutrition solution are 12 cm x 113 cm with a depth of 20 cm. Each of the pots has a capacity of 20 saplings and the experiment was set up as three replications for each threatment. The drainage system consist of pipes which collect the nutrition solution drained from pots via flumes and carry it back to the tank and pipes transferring the fresh nutrition solution to cuttings.

Table 1. Nutrition solution content fed to tube grapevine cuttings

Nutrition element	Dosage (mg/L)	Chemical source	Required amounts for 1 ton of water
N	90	Nitric Acid (55%)	200 ml HNO ₃
P	45	MAP (61 P ₂ O ₅ %, 12 N%)	169 gr
K	110	KNO ₃ (13 N%, 46 K ₂ O%, 38 K%)	288 gr
Ca	-	-	-
Mg	45	MgSO ₄ .7H ₂ O (10Mg%)	450 gr
Fe	2	Sequestrene (6 Fe%)	33,3 gr
Mn	1	MnSO ₄ .H ₂ O	3,073 gr
Zn	0,75	ZnSO ₄ .7H ₂ O	3,312 gr
Cu	0,25	CuSO ₄ .5H ₂ O	0,982 gr
B	0,3	H ₃ BO ₃	1,691 gr
Mo	0,02	(NH ₄) ₆ Mo ₇ O ₂₄ .4 H ₂ O	0,037 gr

- Stock solutions were prepared by using pure water in final volume of 10 L.

- Solution was applied to the saplings by adding 1 L of solution mixture to 100 L of tap water.

The formulation of nutrition solution is given in Table 1. (Adamova, 1978; Bondarenko et al., 1979).

According to the randomized simple factorial design experiment for each of two different rootstocks in the rooting medium and the control plots, three replications and each replication consist of 20 cuttings to be were founded.

The fresh root weight (g), fresh shoot weight (g), dry root weight (g), dry shoot weight (g), root length (cm), Rooting ratio (%), sub callus formation ratio (%) and top callus formation ratio (%) which determine cutting quality of grafted American grapevine rootstocks were measured on each cutting and the mean values were used for statistical analysis.

- Average fresh root weight (g): Roots grown on the grafted grapevine cutting in each replication was cut, weighted and then average value was found.
- Average fresh shoot weight (g): Fresh shoot grown on grafted grapevine rootstocks in each repetition were cut, weighted and then average value was found.
- Average dry root weight (g): Roots were dried at 65°C in incubator and then weighted and then average value was found.
- Average dry shoot weight (g): Shoots were dried at 65°C in incubator and then weighted and then average value was found.
- Average root lengths (cm): The longest 3 roots were measured and their average is given for each treatment.

f. Average sub-callus formation ratio (%): The callus formed by rootstocks/rootstocks circumference was stated as %.

g. Average top callus formation ratio (%): The callus formed by cultivar/cultivar circumference were stated as %.

h. Rooting ratio: The number of rooted cuttings was determined and the value was given as %.

A completely randomized simple factorial design with three replications was used in the experiment. The data were subjected to analysis of variance by SPSS (SPSS Inc. 10.0, USA) software, and differences between means were determined by Fischer's Least Significant Difference test.

RESULTS AND DISCUSSION

The effect of rooting media x rootstock was not statistically significant for any of the assessed parameters. A statistically significant difference between rooting media in terms of fresh shoot weight (g) and dry shoot weight (g) was not assessed for 140R rootstock cuttings. Values of 140R rootstock fresh root weight were found as 1.15 g with perlite, 1.57 g with rockwool, 1.91 g with oasis and 1.83 g with control. Additionally, dry root weigh value was determined as 0.46 g with perlite, 0.67 g with rockwool, 0.73 g with oasis and 0.70 g with control (Fig. 1).

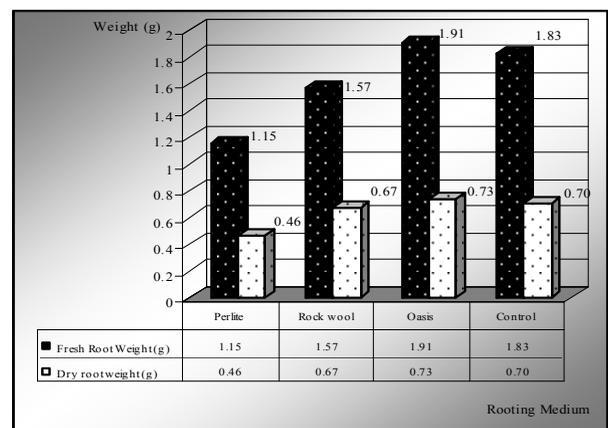


Fig.1. The effect of different rooting media on the fresh and dry root weights of 140R rootstock. Different letters indicate significance at the *n.s.*: non-significant. Mean values of 3 replicates.

The effect of different rooting media on fresh shoot weight value of 140R rootstock was determined as significant ($p=0.05$) (Fig. 2).

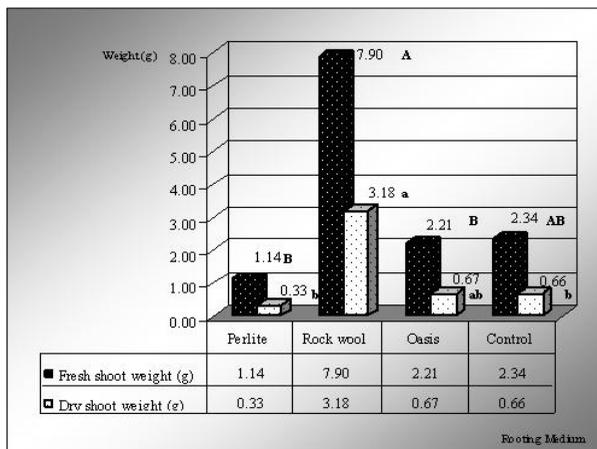


Fig.2. The effect of different rooting media on fresh and dry shoot weight of 140R rootstock. Shoot weights marked by different letters indicate significance at the $p=0.05$ level; capital letters indicate differences among fresh shoot weight, small letters among dry shoot weights. Mean values of 3 replicates.

According to this result, rockwool (7.90 g) ranked the first row. It was followed by control (2.34 g), oasis (2.21 g) and perlite (1.14 g) (Fig. 2).

Similarly, dry shoot weight differed significantly ($p=0.05$) according to rooting (Fig. 2). The variation range of this parameter found out 0.33 g (perlite) and 3.18 g (rockwool) as limiting value (Fig. 2).

The effect of the different rooting medium on the average of the longest 3 roots of 140R rootstock was determined non-significant. Root mean values varied between 17.63 cm and 22.47 cm for 140R rootstock (Fig. 3).

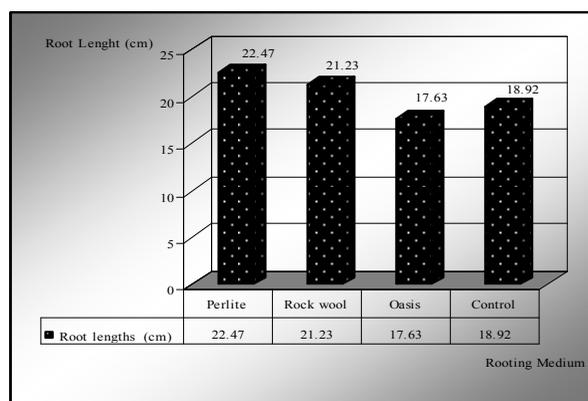


Fig.3. The effect of different rooting media on the average of 3 longest roots of 140R rootstock. Different letters indicate significance at the *n.s.*: non-significant. Mean values of 3 replicates.

It was not observed significant differences in relation to the formation of sub and top callus among the media.

However, in the formation of sub and top callus, rockwool and perlite had higher value than the others (Fig. 4).

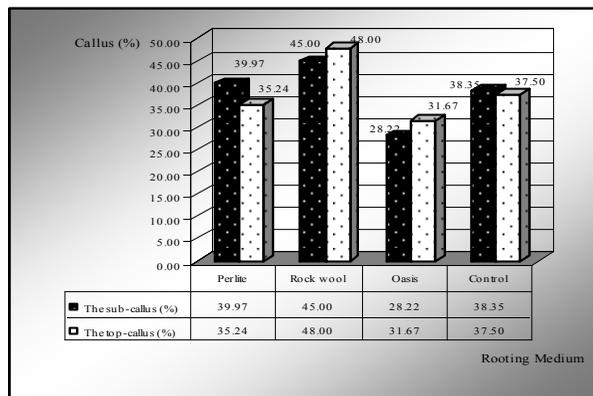


Fig.4. The effect of different rooting media on the sub-callus and top-callus formation of 140R rootstock. Different letters indicate significance at the *n.s.*: non-significant. Mean values of 3 replicates.

The rooting ratio ranged from 53.33% in perlite to 73.33% in oasis (Fig. 5).

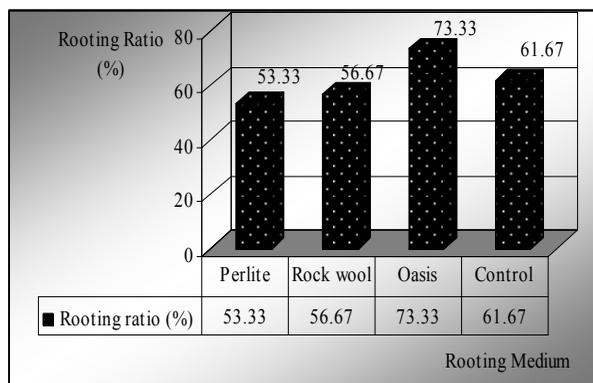


Fig. 5. Rooting ratio efficiencies of 140R rootstocks in different rooting media. Different letters indicate significance at the *n.s.*: non-significant.

As fort to 1616C rootstock, it was not occur significant differences with regard to fresh root weight. The lowest and the highest values were obtained 0.79 g (oasis) and 3.24g (rockwool), in respectively (Fig. 6).

By contrast statistical difference was stated at level 5% for dry root weight (Fig. 6).

For dry root weight of 1616C rootstocks rockwool (1.08 g) and control (0.91 g) taken place in the first statistical group and the others were location in the second group (Fig. 6).

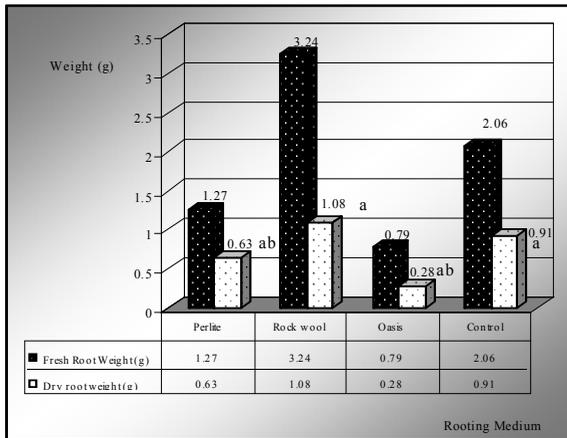


Fig. 6. The effect of different rooting media on the fresh and dry root weights of 1616C rootstock. *n.s.*: non-significant. Dry root weights marked by different letters indicate significance at the $p=0.05$ level; small letters among dry shoot weights. Mean values of 3 replicates.

The effect of different rooting media was shown as non-significant for fresh shoot weight and for dry shoot as well (Fig. 7).

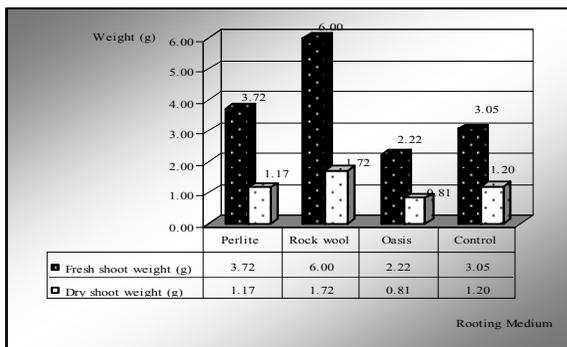


Fig.7. The effect of different rooting media on fresh and dry shoot weight of 1616C *n.s.*: non-significant. Mean values of 3 replicates.

The average values of the longest 3 roots was not statistically different related with the investigated media (Fig. 8).

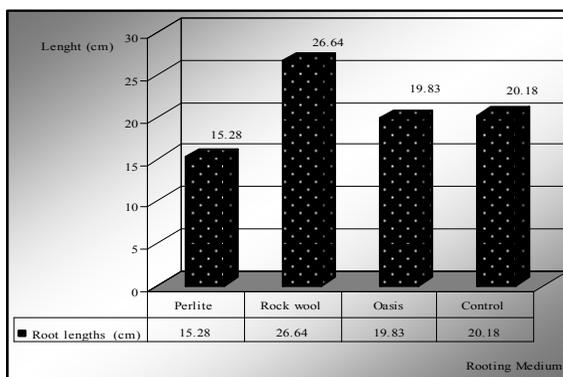


Fig. 8. The effect of different rooting media on the average of 3 longest roots of 1616C. *n.s.*: non-significant. Mean values of 3 replicates.

The data in relation to sub and top callus formation are given in Figure 9. Results point out the insignificant interactions.

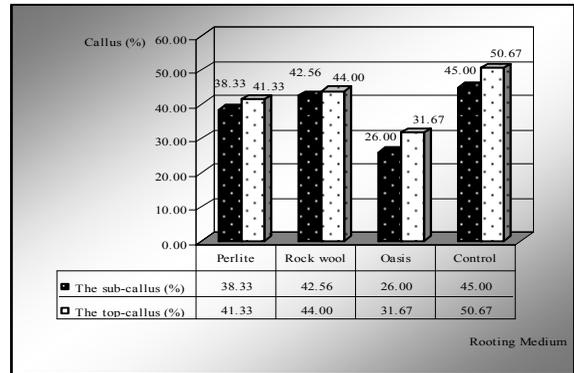


Fig. 9. The effect of different rooting media on the sub-callus and top-callus formation of 1616C rootstock. *n.s.*: non-significant. Mean values of 3 replicates.

As for rooting ratio, the lowest and the highest values were obtained 8.33% (perlite) and 78.33% (rockwool) respectively (Fig. 10).

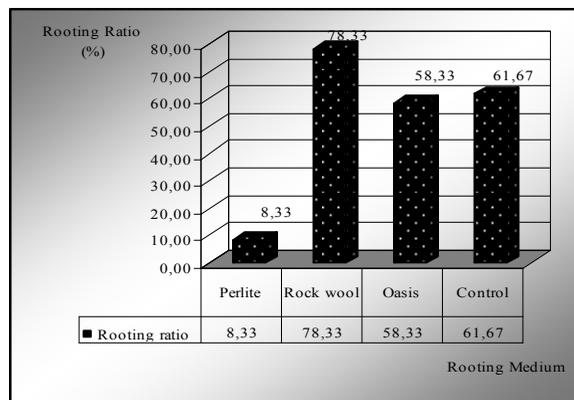


Fig. 10. Rooting ratio efficiencies of 1616C rootstocks at different rooting media.. Different letters indicate significance at the *n.s.*: non-significant.

In this research, fresh and dry root weight values of 140R and 1616C rootstocks have shown the best result for each rootstock in agricultural rockwool. In rockwool, as a result of high water-holding capacity and aeration capacity high levels of rooting occurred.

It was concluded that perlite was not a suitable rooting medium owing to the low water holding capacity for two rootstocks.

No negative effect of oasis blocks on root growth was recorded. Moreover, the ease of obtainment and

cheapness together with high success rate in rooting of cuttings, makes this substrate a good alternative for propagators.

In general in respect to media, the cuttings grown in rockwool and oasis could be planted with these blocks for the establishment of the vineyard. Therefore this situation is of great importance for viticulture.

The rockwool had positive effect on the cutting quality in terms of shoot weights and development rootstocks.

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