Indian J. Hort. 68(2), June 2011: 255-258

Short communication

Submersion of grape rootstock 41B cuttings in water increase root formation

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Grape rootstocks originated from different *Vitis* sp. have become the part of grape growing all over the world due to their superior characteristics against biotic and a biotic stress factors. However, not all the rootstocks have all the desirable traits. Some are of varying degree of resistance to phylloxera, nematodes or grow poorly in lime or calcareous soils. Some even exerts its growth habit onto the scion, forcing it to mature early or late in the season. In plant propagation, the most common problem encountered is for some rootstocks to root poorly. Rootstocks such as 41 B, 99 R, 140 Ru, 420 A, Dog Ridge, and Ramsey have been known to root unsatisfactorily. Different ways to induce rooting in grape rootstocks have been tried with varying success. The factors studied include plant growth regulators, hot water treatment (Ophel *et al*., 12), Crocker *et al*. (2), and Waite and May (14), a combination of these treatments Keeley *et al*. (9).

Cuttings without root lack effective organs to replace transpired water loss, and cells must maintain adequate turgor for initiation and development of roots (Hartmann *et al*., 6). Soaking cuttings in water before grafting is commonly performed in the nurseries with varying durations to ease grafting and induce callus formation. This study was conducted to determine the duration for water soaking to induce adventitious root formation on 41B grape rootstock cuttings. Effect of auxin treatment after water soaking was also investigated.

One-year-old dormant 41B hardwood cuttings were collected from the commercial block of a vineyard located in Çanakkale, Turkey. Cuttings were collected from the middle section of the canes for grafting (6-8 mm in dia.). The bundles of the cuttings were kept in a black polyethylene bag in a cold storage under 1-2°C and 80% relative humidity until the experiment was set for approximately two months. The cuttings were separated in two sections. One section was used for only soaking and the other for soaking plus auxin treatment. The cuttings were placed in a big container filled with tap water in an order of 72, 48, 24, and 12 h duration. Cuttings which were left untreated in the polyethylene bag were taken as control. At the end of soakings, cuttings were taken out of the water and allowed to air dry.

Plastic pots (13 × 20 × 7 cm) were filled with perlite. Cuttings were cut into 2-bud segments prior to planting with lower bud disbudded using a pruning shear. As a hormone treatment, 500 mg/l IBA solution was prepared and lower 1 cm portion of the cuttings were dipped into this solution for 20 sec. Cuttings were planted in perlite containing boxes and placed in a climate chamber (24-26°C and 80% RH) with 16 h light and 8 h dark conditions. The experiment ended when plants no longer showed growth signs (approx. after 8 weeks).

Scoring on root development level on a scale of 0-4 (0 = no root formation, 1 = one sided weak root formation, 2 = two sided root formation, 3 = three sided root formation, and 4 = four sided root formation); root fresh weight (g), number of root developed, length of primary shoot (cm), node number on primary shoot, shooting (%), rooting (%), and intact viable plant ratio (%). The study was conducted in a randomized parcels trial design with four replicates and 15 cuttings per replicate. The data obtained was evaluated with Minitab (Release 13.1, Minitab Inc.) for one-way ANOVA for the treatments and the differences were tested with Duncan's multiple range test.

Data obtained showed that rooting and shoot growth of the 41B cuttings were influenced by the soaking treatment (Table 1). Root development was better in the water soaked and indole butyric acid (WS + IBA) treated cuttings since they produced roots along the three sides of the cuttings. Water soaking, except for 72 h WS, and control groups resulted in poorer root development and hardly induced two-sided roots. Root number differed according to the treatments. While 24 h WS + IBA gave the highest number of roots (12.75), control induced the least number of roots (5.60). Auxin dipping added more effect in more root initiation as opposed to the water soaking only treatment. Root fresh weight was also higher in most of the IBA treated cuttings after water soaking. Control along with 48 h WS + IBA gave intermediary root weight compared to other treatments. Node number on the primary shoot

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Table 1. Effect of water soaking (WS) and IBA application on growth features of 41 B rootstock cuttings.

Treatment	Root development level (scale 0-4)	Root No.	Root FW (g)	No. of nodes on primary shoot (n)	Rooting (%)	Primary shoot length (cm)	Shooting (%)	Intact viable plant (%)
12 WS	2.08 ± 0.19* bcd	9.38 ± 1.64 d	7.53 ± 0.34 c	4.70 ± 0.04 d	92.50 ± 2.85 ab	14.64 ± 0.31	93.3 ± 1.92	90.0 ± 2.73
24 WS	2.02 ± 0.08 cd	7.42 ± 0.35 f	7.03 ± 0.71 c	4.93 ± 0.17 c	96.66 ± 2.36 a	16.11 ± 1.35	97.5 ± 1.59	96.7 ± 2.36
48 WS	1.95 ± 0.08 cd	8.19 ± 0.16 e	8.05 ± 0.64 bc	4.72 ± 0.15 d	94.99 ± 0.96 a	15.64 ± 0.60	95.8 ± 1.60	93.3 ± 1.36
72 WS	2.40 ± 0.12 abc	9.18 ± 0.57 d	8.90 ± 0.78 bc	4.94 ± 0.94 c	99.16 ± 0.84 a	16.71 ± 0.84	95.8 ± 2.10	95.0 ± 2.15
12 WS/IBA	2.42 ± 0.14 abc	10.14 ± 1.07 c	14.19 ± 1.02 a	4.26 ± 0.24 e	93.34 ± 3.60 ab	15.28 ± 1.13	92.5 ± 1.59	89.2 ± 2.10
24 WS/IBA	2.84 ± 0.05 a	12.75 ± 0.98 a	12.61 ± 0.92 a	5.36 ± 0.18 a	100.0 ± 0.00 a	16.38 ± 0.69	95.0 ± 0.95	95.0 ± 0.95
48 WS/IBA	2.72 ± 0.14 a	11.48 ± 0.97b	11.31 ± 0.86 ab	4.77 ± 0.13 d	95.84 ± 1.59 a	18.16 ± 5.09	95.8 ± 1.60	94.2 ± 1.59
72 WS/IBA	2.59 ± 0.21 ab	10.67 ± 0.95 c	14.39 ± 0.88 a	5.11 ± 0.17 b	95.84 ± 2.50 a	16.38 ± 0.72	91.7 ± 5.53	91.7 ± 5.53
Control	1.76 ± 0.07 d	5.60 ± 0.48 g	12.24 ± 0.81 ab	4.66 ± 0.11 d	87.50 ± 3.69 b	14.22 ± 0.37	93.3 ± 2.73	86.7 ± 4.08

*Mean ± SE; WS = Water soaking

was highest in 24 h WS + IBA. Primary shoot length and shooting ratio along with intact viable plant ratio were not affected by the treatments. Rooting ratio was under the influence of the treatments to a lesser extent and control group resulted in less number of viable plants than most of the applications.

Data obtained clearly showed that water soaking increased rooting of the 41B cuttings. Auxin also has a positive effect on root induction. Keeping the cuttings submerged in water atleast 24 h and applying IBA afterwards resulted in the highest success. Water soaking and/ or IBA, however, did not improve the top growth of the cuttings. It is speculated that immersion of dehydrated vine wood stimulated root and callus formation might have been the result of leaching out of growth inhibitors. Kracke *et al*. (9) found that hard-to-root rootstock 140 Ru contained a low level of auxin and a very high amount of GA and ABA-like substances inhibiting root formation. They reported that soaking in water enhanced the rooting ability of 140 Ru and raised its IAA level. It is stated that dipping the cuttings of 140 Ru and 5 BB for 12 h reduced the quantity of GA-like substances and resulted in increased rooting ability. Subsequent analysis of the water revealed that the rootstocks that had maximum rooting capacity were associated with an increase in IAA-like and a decrease in GA-like substances. Bearing in mind that 41 B is also a hard-to-root genotype, soaking might have stimulated leaching out of growth inhibitors from the cuttings, leading to more rooting. Added IAA might have provided an extra advantage.

Although the water content of the cuttings used in this study was not established before the experiment was set, it is generally accepted that middle section cuttings have less water than apical section cuttings. However, Moretti (11) reported that a higher content of water did not always demonstrate the root growth, although he suggested using soaked cuttings. Hunter *et al*. (7) stated that water submersion of the rootstocks 99R, 140 Ru and 101-14 Mgt did not have any significant effects on the performance of the vines.

In our study, overall results showed that 24 h of soaking in water followed by 500 mg/l IBA treatment was the best treatment for grafting cuttings. These findings were in agreement with the reports of Chapman and Hussey (1), and Fabbri *et al*. (4) who found that water dipping improved the percentage of rooted cuttings. However, Roberto *et al.* (13) reported that 48 h of stratification in water provided the highest percentage of rooted cuttings for Jales and the highest number of roots in Kober 5 BB and Campinas rootstocks. The fresh and dry masses of roots and the percentage of cuttings with shoot growth were higher when the cuttings were submitted to the stratification treatment. Waite and May (14) soaked Chardonnay cuttings in 0, 4 and 15 h in water and found that only 15 h soaking produced roots..

Study suggest that hardwood cuttings taken from the basal or middle section of a 41B canes rooted better than those obtained from the section closer to apical region. Dipping of cuttings in auxin solution after water soaking for 24 h caused better rooting an increase in root characteristics.

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Received: January, 2010; Revised: December, 2010; Accepted : March, 2011