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Effects of Indolebutyric Acid on Adventitious Root Formation from Semi-Hardwood Cuttings of 'Sarierik' Plum

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Abstract

The aim of the study was to assess the rooting ability of semi-hardwood cuttings of 'Sarierik' plum in order to develop an alternative propagation method for this important plum clone grown in the Nevsehir region of Turkey. The cuttings were treated with different levels (0, 500, 1000, 1500 and 2000 mg l^{-1}) of indole butyric acid (IBA) to test the hypothesis that differences in auxin concentrations could affect rooting ability of semi-hardwood cuttings of the 'Sarierik'. IBA application promoted a significant increase in rooting percentage over control cuttings. The best rooting percentage (87.5%) was achieved by 1500 mg l^{-1} of IBA application, whereas the rooting percentage of the untreated control cuttings was only 10.8%. Root formation was not dependent on callus formation. The propagation method developed here for 'Sarierik' is a very reliable, economical and convenient way of propagation as compared to its alternatives such as propagation by grafting, root suckers or *in vitro* multiplication.
Key words: Indole butyric acid (IBA), plum, rooting, propagation

INTRODUCTION

'Sarierik' is an important plum clone grown in the Nevsehir region of Turkey. This clone is traditionally propagated by root suckers or by grafting its scions to a rootstock. However, propagation by root suckers is not an efficient propagation method for commercial propagation due to the limited number of suckers produced by a tree. Grafting is a time consuming and expensive propagation method. Graft incompatibility may also arise. Grafting on a specific root stock may be necessary to solve problems such as soil born diseases. However, if the clone does well on its own roots and there is no obligation to use rootstocks, the use of grafting for propagation is a time consuming and expensive process. In such cases, plum trees can be produced by rooting of cuttings to provide uniform and efficient trees.

'Sarierik' plum grows and does well on its own roots in the Nevsehir region of Turkey. Therefore, it can potentially be produced by rooting of cuttings. Rooting of stem cuttings is one of the easiest and economical methods of propagation, however many woody plants are often difficult to root and this difficulty is still one of the major obstacles to economical propagation [1, 2]. There are several factors known to effect rooting in woody species such as substrate [3, 4, 5, 6], wounding of cuttings [7, 8], air environment [9], genotype and season [10] and plant growth regulators [11]. Among these factors, application of synthetic auxins to shoot cuttings may be very effective in promoting root formation in some genotypes [11]. Effect of indole butyric acid (IBA) on root formation from different types of cuttings were reported in several prunus species such as GF677 (peach x almond hybrid) peach rootstock [12], plum [13], [14] and Japanese plum [15].

In this study, the influence of various concentrations of external IBA applications on rooting of 'Sarierik' semi-hardwood cuttings was assessed to develop an alternative and efficient propagation system for 'Sarierik' plum.

MATERIALS and METHODS

Plant material and explant preparation

Current year semi-hardwood shoot cuttings were collected on the 1st of June in 2005 from 6 years old mature 'Sarierik' trees grown in a private farm in Nevsehir. Immediately after the collection, the cuttings were cut into 15 cm pieces and were cleaned from the leaves, leaving only three leaves at the top portion of the cuttings. Then, the cuttings were treated with a commercial fungicide, Captan, by being dipped in a liquid solution for 5 minutes. After surface drying, the cuttings were dipped for 15 s in one of four concentrations of IBA (0, 500, 1000, or 1500 mg l^{-1} IBA), which is dissolved in a solvent composed of 50% ethanol and 50% tap water. The control cuttings were being treated with the solvent (50% industrial alcohol) only.

Rooting medium and rooting conditions

The cuttings were then planted in mist beds (1x2 m in size and 20 cm in height) by inserting the bases of cuttings about 5 cm into rooting medium composed of pumice (1–5 mm) and placed in a glasshouse in a rooting room (covered with polyethylene sheet) maintained at 25±5 ^{o}C with a relative humidity of about 100% and an 16/8 h (light/dark) photoperiod. The mist beds were irrigated automatically by intermittent misting devices (one minute of misting every hour during the lighted period).

Accilimatization

After rooting, plants were planted in black polyethylene bags (15 cm x 20 cm) containing a potting mix composed of 50% pomice and 50% torf and transferred to a glasshouse maintained at 21±5 °C with a relative humidity of about 70% and 16/8 h (light/dark) photoperiod. The plants were covered with a transparent polyethylene sheet for the first two weeks to maintain the humidity. After one month of acclimatization, they were transferred to the open field.

Experimental design and statistical analysis

The experiment was conducted in a complete randomized design. Each treatment had 3 replications and each replication had 10 cuttings. Rooting response (as rooting percentage, root number, root length) and callus formation were measured after five weeks in the growth room under periodic mist. Data on percent rooting and percent callus formation were transformed by the arcsine square root transformation before performing the statistical analysis. Significant differences between treatments were tested by ANOVA and mean separation was done using Duncan's Multiple Range Test at $P = 0.05$.

Table 1. Influence of Different IBA Concentrations on Adventitious Root Formation from Semi-Hardwood Cuttings of *Prunus Domestica* cv. 'Sarierik' (n = 30)

Treatments (IBA mg l^{-1})	Rooting explant %	Root number	Root length (cm)
0 (Control)	10.8 c*	1.3 c	0.9 c
500	33.3 bc	3.4 bc	2.5 b
1000	66.7 ab	9.5 a	4.8 a
1500	87.5 a	7.6 ab	3.9 a
2000	75.0 a	7.4 ab	3.6 ab

*Means following the different letters in the same column differ significantly at P=0.05 probability by Duncan's Multiple Range Test.

RESULTS

Effects of IBA on rooting of 'Sarierik' plum cuttings

The shoot cuttings, placed in mist beds containing pumice, started to expand at the cut base in a week. Although some root formation was visible at the third week, most of the rooting occurred at the fourth and fifth week. Little or no rooting occurred in cuttings when they were treated with 0 mg l^{-1} IBA (Table 1). The percentages of root formations were greater in cuttings treated with any levels of IBA (up to 87.5%) than the control (10.3%) (Table 1). Although the lowest concentration of IBA (500 mg l^{-1} IBA) also resulted in increased rooting percentage, the difference was not statistically different from the control. The rooting percentages of all other IBA levels were significantly higher than that of the control (Table 1). The highest percentage of rooting (87.5%) was obtained from the cuttings that were treated with 1500 mg l^{-1} IBA (Table 1). Cuttings treated with intermediate and higher concentrations of IBA (1000, 1500 and 2000 mg l^{-1} IBA) consistently grew more roots per cutting than the cuttings that were treated with lower concentrations of IBA (500 mg l^{-1} IBA) and control treatment (Table 1). The shortest roots were observed in control treatment and in 500 mg l^{-1} IBA treatment. The root length was significantly increased when IBA concentration was increased from 500 mg l^{-1} to 1000, 1500 or 2000 mg l^{-1}. It was clear that the differences in rooting response were associated with differences in exogenously applied auxin concentrations. Successful root induction was effected by exogenously applied IBA levels and the best rooting percentages, the highest root numbers and the longest root formations were obtained at intermediate and high levels of IBA (1000, 1500 and 2000 mg l^{-1}) (Table 1). Among the treatments, 1500 mg l^{-1} IBA level appears as a optimum concentration since this level yielded the highest percentages of rooting in cuttings and also the root number and root length values were also satisfactory.

Effects of IBA on callus formation of 'Sarierik' plum cuttings

Although rooting percentages, root numbers and root lengths were higher in cuttings treated with intermediate or higher levels of IBA, the callus formation was highest under the control treatment. The lowest level of callus formation was obtained from 1000 mg l^{-1} IBA treatment (Figure 1).

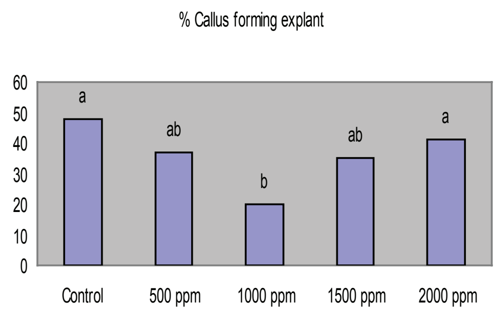

Figure 1. Callus formation from semi-hardwood cuttings of *Prunus domestica* cv. 'Sarierik' under different levels (0, 500, 1000, 1500 and 2000 mg l^{-1}) of exogenous IBA treatments.

Root formation was not necessarily depended on callus formation, because roots were able to form in most of the cuttings without any intermediate callus phase. There were no significant statistical associations (r=0.37) between callus formation and percentage of rooting (Figure 2); in fact, the 1000 mg l^{-1} IBA treatments that had much higher rooting percentages than the control treatment, but did not have as much callus as the control treatment.

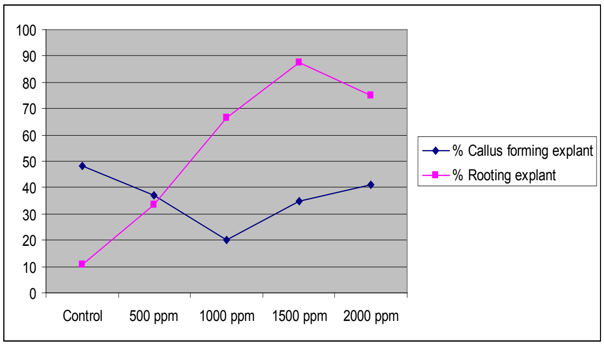

Figure 2. The comparison % callus formation and % rooting under different IBA treatments. There were no statistically significant associations between these two independent variables (r=0.37) at *P*=0.05 level.

Acclimatization

Rooted plantlets were transferred from mist beds to black polyethylene bags and acclimatized with % 95 successes in a month in a greenhouse. Upon transferring to the open field, the plants grew healthy and showed no morphological abnormalities.

DISCUSSION

'Sarierik' plum is traditioanly propagated by root suckers or grafting. However, the use of root suckers is not suitable for mass propagation since trees gave limited numbers of suckers. Propagation by grafting requires about two growing seasons and is an expensive propagation method. Alternatively, the use of cuttings allows propagation in mass numbers and is an inexpensive and quick way of propagation. To develop an alternative and efficient propagation system for 'Sarierik' plum, the effects of different levels of exogenous IBA applications on adventitious root regeneration from cuttings of plum clone 'Sarierik' were assayed *ex vitro*.

The results confirmed the importance of exogenous IBA applications, and choosing the right concentrations of IBA for rooting has critical importance. There were striking differences between treatments. The intermediate and higher concentrations of IBA (1000, 1500 and 2000 mg l^{-1} IBA) had a significantly higher rooting percentage than the 500 mg l^{-1} IBA. The control treatment resulted in the lowest percentage of rooting. Our results on promotion of adventitious root formation by synthetic auxin applications are in agreement with the findings of other researchers in other *Prunus* species [10, 13, 14, 15]. The best rooting percentages, as reported for cuttings of other *Prunus* species [14, 10, 16], was achieved from intermediate and higher concentrations of IBA (1000, 1500 and 2000 mg l^{-1} IBA). The exogenously applied IBA and its levels were both very critical in present experiments to increase the level of rooting. This suggests that the inability of root formation is due to the inability to synthesize auxin. It was proposed that the main function of IBA is to support the conjugation between endogenous IAA and amino-acids which result in the synthesis of the specific proteins essential for formation of root initials [17]. The results show that only a low level of rooting occurs in the absence of external auxin treatment, whereas auxin treatments resulted in up 87.5% root formation in cuttings.

The traditional way, propagation by root suckers, can not comply with the demand since the trees suckers in very limited numbers (from one to a few suckers per tree). Propagation by grafting is expensive and time consuming, requiring about two years. On the other hand, rooting of cuttings takes only about five weeks and new plants can be offered to market after one month of acclimatization. Thus, the entire process of production takes only about 12 weeks.

The alternative propagation method developed here for 'Sarierik' is a very efficient and reliable method of propagation. When this method is compared to other methods of propagation such as, in vitro propagation and grafting, it saves time and it is a more economical way of propagation than these alternatives.

REFERENCES

[1] Damiano C, Monticelli S. 1998. In vitro fruit trees rooting by agrobacterium rhizogenes wild type infection. Electronic Journal of Biotechnology. 1: 15.

[2] Webster AD. 1995. Temperate fruit tree rootstock propagation. New Zealand Journal of Crop and Horticultural Science. 23: 355-372.

[3] Denny C, Arnold A. 2001. Interactions among rooting substrate, phenological stage of cuttings and auxin concentration on the rooting of cotinus obovatus. Journal of Applied Horticulture Lucknow. 1: 13-16.

[4] Tofanelli M, Rodrigues J, Ono E. 2003. Rooting of peach cv. Okinawa hardwood cuttings at different stem diameters, substrates, and pots. Ciencia Rural. 33: 437-442.

[5] Pocorny F, Austin M. 1982. Propagation of blueberry by softwood terminal cuttings in pine bark and peat media. Hortscience. 16: 181-182.

[6] Verdonck O, Penninck R, De Boodt M. 1983. The physical properties of different horticultural substrates. Acta horticulturae. 150: 155-160.

[7] Howard B. 1984. Plant propagation. Report of East Malling Research Station, *1983*. P. 131-132.

[8] Edwards R, Thomas M. 1979. Influence of wounding and IBA treatments on the rooting of cuttings of several woody perennial species. The Plant Propagator. 24: 9-12.

[9] Heide O. 1965. Photoperiodic effects on the regeneration ability of begonia leaf cuttings. Physiologia Plantarum. 18: 185-193.

[10] Tsipouridis C, Thomidis T, Isaakidis A. 2003. Rooting of peach hardwood and semi-hardwood cuttings. Australian Journal of Experimental Agriculture. 43: 1363-1368.

[11] Howard BH. 1967. Rootstock propagation by hardwood cuttings: A progress report for nurserymen. Report of The East Mailing Research Station For *1966*, P. 202.

[12] Tsipouridis C, Thomidis T, Michailides Z. 2005. Factors influencing the rooting of peach gf677 (peach & almond hybrid) hardwood cuttings in a growth chamber. New Zealand Journal of Crop and Horticultural Science. 33: 93-98.

[13] Nicotra A, Damiano C. 1975. Rooting trial of several peach and plum varieties by hardwood cuttings. Acta Horticulture. 54: 63-70.

[14] De Souza FX, De Lima RN. 2005. Rooting of cuttings of different hog plum stock plants treated with IBA. Revista Ciência Agronômica. 36: 189-194.

[15] Bal JS, Sandhawalia SS. 2000. Studies on propagation of subtropical plum. Acta Horticulturae. 517: 151-158.

[16] Tworkoski T, Takeda F. 2007. Rooting response of shoot cuttings from three peach growth habits. Scientia

Horticultureae. 115: 98-100.
[17] Ryugo K, Breen PJ. 1974. Indoleacetic acid metaholism in cuttings of plum (prunus cerasifera x p. Munsoniana cv. Mariana 2624). Proceedings of the American Society of Horticultural Science. 99: 247.