Effect of Root-Applied IBA on Root and Shoot Growth of Dwarf Peach Trees[1]

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Abstract

Roots of 1-year old dwarf (*Prunus persica* 'July Elberta' budded on *Prunus tomentosa*) peach trees were dipped in solutions of 100 ppm indole-3-butyric acid (IBA) with and without starch-polyacrylate gel in the treatment solution prior to planting in beds of 1:1 peat:perlite or in the field. Four weeks after treatment, plants treated with 100 ppm IBA with or without gel had 4 to 5 × the dry weight of new roots as did controls. Treatment with 100 ppm IBA plus gel increased the number of new roots by 62% over controls. During the first season in the field, plants treated with gel with or without IBA produced longer shoots than controls. During the second season, plants originally treated with 100 ppm IBA alone produced significantly longer shoots than any other treatment while those treated with IBA/gel were not different from controls. In a separate experiment, DMSO (dimethyl sulfoxide) and DMF (dimethyl formamide) at 0.4% in the treatment solution had no apparent influence on IBA-induced root initiation.

Index words: DMSO, gel, *Prunus persica*, root regeneration, transplanting

Introduction

Peach trees sold for residential landscape planting are commonly budded onto a dwarfing rootstock such as *Prunus tomentosa* or *P. besseyi*. One-year-old trees are harvested bare root and kept in cold storage until shipment to the retail nursery or directly to the homeowner.

The survival rate of bare root nursery stock is generally considered to be lower than that of container grown or B&B stock (2). Rapid root regeneration is considered essential for survival of bare root stock (4, 10, 12). Various treatments have been tested for their effects on root regeneration or transplanting survival of bare root plants. Among these are dipping roots in hygroscopic gel (1, 5), clay suspensions (11) and solutions of indolebutyric acid (IBA) (3, 4, 6, 7, 9).

Several problems presently limit the use of IBA to stimulate lateral root initiation by bare root nursery stock. Information is lacking on the short and long term effects of IBA on shoot growth of woody plants. Starbuck (8) reported that 500 ppm IBA stimulated root initiation of rose plants but reduced shoot growth and retarded flowering. Another problem limiting the routine use of IBA is that application techniques are inefficient and costly, involving either long term soaking of roots or large volumes of concentrated solutions. Materials reportedly enhancing the uptake of IBA include the organic solvents DMSO (dimethyl sulfoxide) (14) and DMF (dimethyl formamide) (15) and starch-polyacrylate gel (8). If the penetration of IBA into roots of woody plants can be enhanced, it may be possible to develop IBA treatments which are more efficient than those presently available.

The objectives of these experiments were to evaluate the effects of root-applied IBA on root and shoot growth of dwarf peach trees and, to determine if DMSO, DMF and starch-polyacrylate gel can enhance IBA-induced growth responses.

Materials and Methods

Experiment 1. On June 14, 1982, 200 1.5–1.8 m (5–6 ft) 'July Elberta' peach trees on *Prunus tomentosa* understocks were removed from the cold storage facility at Stark Brothers Nursery in Louisiana, Missouri. Roots of each plant were pruned by approximately 10% and dipped in one of four treatment solutions: water; 100 ppm IBA; 5 g/l gel ('Magic Water Gel,' Super Absorbent Co., Lumberton, NC) and 100 ppm IBA with 5 g/l gel. Fifty plants received each treatment. Forty were field planted in a randomized complete block design with 4 replications of 10 plants each. Planting holes were dug with a 46 cm (18 in) soil auger and backfilled by hand. Plants were then pruned back by 30%. A 61 cm (2 ft) strip was kept weed free with paraquat at 0.6 kg ai/ha (0.6 lb ai/A) and princep at 1.8 kg ai/ha (1.6 lb ai/A). Lengths of the 3 longest current season shoots of field planted trees were measured on August 19, 1982. Trees were pruned back by 30% in March 1983 and the length of the longest 3 shoots was again measured on August 21, 1983.

Ten additional plants from each treatment were planted in beds of 1:1 peat:perlite (by vol) in a polyethylene covered house on June 15, 1982. After 4 weeks number and weight of new roots and new shoots were determined.

Experiment 2. On May 20, 1983, 135 1.42 cm (0.56 in) 'July Elberta' trees on *P. tomentosa* understocks were removed from cold storage. One group of 15 plants was treated with 0, 100 or 500 ppm IBA with ethanol, DMSO or DMF added to the solution for a total of 9 treatments. In all treatments using IBA, crystalline IBA was dissolved in 20 ml of the appropriate solvent and brought to a final volume of 5 l with water, giving a final solvent concentration of 0.4%. Roots of each plant were dipped for 3 sec. The trees were planted in beds of 1:1 peat:perlite (by vol) in a polyethylene house in a randomized complete block design with 3, 5-plant replicates per treatment. Light transmission was reduced to 50% of ambient levels and the air temperature

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Table 1. **Effects of root applied IBA and starch-polyacrylate gel on root and shoot development of 'July Elberta' peach trees on *P. tomentosa* rootstock.**

Treatment		Greenhouse growth						Field growth	
IBA	Gel	No. new roots	Dry wt. new roots (g)	Dry wt. old roots (g)	No. shoots (g)	Dry wt. new shoots (g)	Dry wt. old shoots (g)	Shoot length[z] 1982 (cm)	Shoot length 1983 (cm)
0 ppm	−	130 b[y]	0.22 b	72.3 a	17 b	3.5 b	169.3 a	44 b	215 b
0 ppm	+	89 b	0.46 b	69.4 a	24 a	5.2 ab	142.2 b	59 a	202 b
100 ppm	−	132 b	1.03 a	74.8 a	24 a	5.1 ab	167.6 a	53 ab	263 a
100 ppm	+	211 a	0.94 a	85.2 a	19 ab	6.1 a	154.0 ab	59 a	216 b
ANOVA (Significance of F values)									
Source	*df*								
IBA	1	**[x]	**	NS	NS	NS	NS	NS	*
Gel	1	NS	NS	NS	NS	*	*	*	*
IBA × Gel	1	**	NS	NS	**	NS	NS	NS	NS

[z]length = total length of longest 3 shoots.

[y]means within a column followed by the same letter or letters are not significantly different at this 5% level according to the LSD test.

[x]NS, *, ** F value not significant (NS) or significant at the 5% (*) or 1% (**) level.

was maintained below 30°C (86°F) with ventilation. Trees were harvested between June 14 and 16. Dry weights of new roots, old roots, new shoots and old shoots were determined and new roots and shoots counted.

Results and Discussion

Experiment 1. Analysis of variance of data on root and shoot growth of trees planted in the polyethylene house indicate that IBA had significant effects at the 5% level during the first 4 weeks after treatment (Table 1). Plants treated with IBA alone at 100 ppm had nearly 5× the new root dry weight as controls. New shoot number was also higher on IBA-treated plants than on controls.

Significant IBA × gel interactions were detected for numbers of new roots and shoots on trees planted in the polyethylene house. Although analysis of variance indicated a significant effect of IBA on root number, the only treatment which increased root number was that combining IBA with gel. Thus it appears that gel may enhance the effect of IBA on root initiation. Although both IBA and gel independently increased the number of new shoots growing 4 weeks after treatment, the IBA/gel combination did not. This indicates that adding gel may alter the effect of IBA on shoot growth as well as on root growth; perhaps raising the tissue concentration of IBA to a level supraoptimal for shoot development (13).

After the first season, field planted trees treated with gel and IBA/gel had greater shoot lengths than controls (Table 1). Following the second season, however, plants originally treated with IBA alone had 22% more shoot growth than controls while those treated with gel and IBA/gel did not differ from controls.

Experiment 2. IBA had a pronounced effect on both number and dry weight of new roots produced by the trees in experiment 2 (Table 2). There is no indication that DMSO or DMF altered these effects. The number and dry weight of new shoots were not influenced by IBA in experiment 2.

Clearly, root-applied IBA can strongly influence root and shoot growth of peach trees for up to 2 years following treatment. In experiment 1, 100 ppm IBA without gel caused an increase in the dry weight of new roots produced during the first 4 weeks but had no effect on root number. This may mean that 100 ppm IBA was sufficient to cause a more rapid initiation of new lateral roots, therefore allowing a longer period for root growth relative to the non-IBA treated plants.

In the field, at the end of the first season, plants treated with gel and IBA/gel had longer shoots than did controls. After the second season, however, neither of these treatments differed from controls in shoot growth, while plants originally treated with 100 ppm IBA without gel had significantly longer shoots. One logical explanation for this

Table 2. **Effects of IBA and 3 organic solvents on root and shoot growth of 'July Elberta' peach trees on *P. tomentosa* rootstock.**

Solvent[z]	IBA (ppm)	Number new roots	Dry wt. new roots (mg)	Number new shoots	Dry wt. new shoots (g)
DMF	0	74 bc[y]	205 b	9.0 a	2.13 a
DMF	100	82 bc	265 ab	9.6 a	2.60 a
DMF	500	145 a	423 ab	9.7 a	2.16 a
DMSO	0	88 b	212 b	11.5 a	2.32 a
DMSO	100	89 b	194 b	10.2 a	2.01 a
DMSO	500	98 ab	302 ab	8.7 a	2.31 a
ETOH	0	65 c	216 b	11.2 a	2.15 a
ETOH	100	114 ab	226 ab	8.7 a	2.57 a
ETOH	500	106 ab	527 a	9.1 a	2.07 a
ANOVA (Significance of F values)					
Source	*df*				
Solvent	2	NS[x]	NS	NS	NS
IBA	2	**	**	NS	NS
Solvent × IBA	4	NS	NS	NS	NS

[z]DMF, DMSO, ETOH denote dimethyl formamide, dimethyl sulfoxide and ethanol, respectively.

[y]means within a column followed by the same letter or letters are not significantly different at the 5% level according to the LSD test.

[x]NS, ** F value nonsignificant (NS) or significant at the 1% (**) level.

change is that the IBA/gel treatment stimulated ''excessive'' root initiation; creating a sink competing with shoot growth during the first season and weakening the trees.

These results show that treatments which stimulate the formation of the maximum number of new roots are not necessarily the best for establishment and subsequent shoot growth of woody plants. IBA has long been known to stimulate lateral root initiation by roots of woody plants. This research shows, however, that if IBA is to be used as a transplanting aid, research will be required to determine the optimum dosage for promoting root growth of the species to be treated without inhibiting shoot growth.

Starch-polyacrylate gel particles apparently serve effectively as reservoirs of IBA solution on the root surface. Further research will be required, however, to quantify the actual dose of growth regulator entering the root as a result of root treatment with suspensions of IBA-impregnated gel particles.

DMSO and DMF have been shown effective in enhancing the effect of IBA on rooting of stem cutting (15). Their lack of effect in experiment 2 may have been due to the use of a suboptimum concentration (0.4%) of solvent. The possibility also exists that uptake of IBA by root tissues is relatively efficient and it is not enhanced by organic solvents to the same extent as is stem uptake.

Significance to the Nursery Industry

Establishment of bare root nursery stock in the field or landscape requires the rapid initiation of lateral roots. This research shows that IBA is effective in stimulating lateral root initiation by dwarf peach trees. Starch-polyacrylate gel increased the effect of 100 ppm IBA on number of new roots. If further research substantiates this effect, the use of gel could significantly reduce treatment cost, especially if IBA-impregnated gel particles could be accurately sprayed onto the roots (6). These results indicate, however, that IBA treatments stimulating a large increase in lateral root initiation may have no positive effect on shoot growth in the field during the first season. The optimum dosage for each species should be determined before such an IBA root dip treatment is used on that species on a large scale.

(*Ed. note:* This paper reports the results of research only, and does not imply registration of a chemical under amended FIFRA. Before using any of the products mentioned in this research paper, be certain of their registration by appropriate state and/or federal authorities.)

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