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'Bradford' Pear Propagation by Softwood Cuttings[1]

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Abstract

Three experiments were conducted evaluating rooting of *Pyrus calleryana* 'Bradford'. Terminal cuttings rooted more easily than midsection or basal cuttings of recently matured wood. Use of 50% ethanol as a solvent for IBA resulted in reduced rooting of terminal cuttings. Superior ''quick dip'' treatments identified for propagation of 'Bradford' pear included: KOH + 10–20,000 ppm IBA, ETOH + KOH + 10–20,000 ppm IBA, and K-IBA at 20,000 ppm IBA.

Index words: indolebutyric acid, solvents, formulation, auxin, rooting

Introduction

'Bradford' pear is an outstanding seedling selection that has been a popular landscape tree in recent years in many parts of the United States (2). It is a vigorous, medium-sized, dense-headed tree that is pyramidal in youth, becoming a broad oval shape with age (2). Generally, 'Bradford' pears are produced commercially by shield budding on understocks of *Pyrus calleryana*. Asexual propagation by softwood cuttings would be advantageous in 2 areas: some graft incompatability has been reported from budding of 'Bradford' pear and cost of production would be reduced by successful softwood propagation. Reports indicate that 'Bradford' pear cuttings can be rooted, although considerable variation is reported in rooting success (1).

Materials and Methods

On May 14, 1981, recently matured shoots (about 2 months after full bloom) of current season growth, 45–54 cm (18–24 in) in length, were removed from 6 to 10 m (18 to 30 ft) 'Bradford' pear trees growing in full sun. Excised shoots were cut into 3 sections: terminal, mid and basal sections, 15–18 cm (6–7 in) in length. Five IBA treatments: 1,000, 5,000, 10,000, 20,000, and 40,000 ppm, and a water control were evaluated on each of the 3 shoot sections. A potassium salt-based IBA (K-IBA) was used and brought to volume with distilled water. Cuttings were wounded at the base, dipped for 10 sec in a given IBA treatment, stuck in a 1:1 peat:sand (v:v) medium, and misted once every 10 minutes for 12 seconds from 8AM to 4PM. The experiment was conducted in a glass greenhouse where maximum and minimum temperatures were 28° and 18°C (82 and 68°F), resp. Experimental units in a randomized block design consisted of 12 cuttings replicated 4 times.

Eleven weeks after the cuttings were stuck, data were collected on the number of cuttings rooted and the root systems were rated on a scale of 1 to 10 where 1 = 1–3 small unbranched roots and 10 = 6–10 long well branched roots.

The following year (1982) a second experiment was initiated on May 15 and handled similarly to Experiment 1.

In the third year (1983), apical and basal cuttings, 15–18 cm (6–7 in) in length, were taken from recently matured shoots of 'Bradford' pear on May 25. Four IBA formulations, each at 0, 10,000, and 20,000 ppm, were used to treat the 2 cutting types. Formulations of IBA used were: 1) potassium salt based IBA diluted with distilled water; 2) reagent grade IBA dissolved in 50% ethanol; 3) reagent grade IBA dissolved with KOH solution (1.4 KOH/100 ml H_2O); and 4) reagent grade IBA dissolved in 25% ethanol + KOH solution (.8 g KOH/100 ml H_2O). Four replications of 10 cuttings each were wounded at the base, dipped for 10 seconds in the appropriate IBA solution, stuck in a 1:1 peat:sand (v/v) rooting medium, and misted once every 10 minutes for 12 seconds. After 10 weeks, data were collected on percent rooted, number of roots, and root rating. Cuttings were rated on a 1 to 10 scale where 1 = no callus, 2 = callus, 3 = 1–3 small unbranched roots, 5 = 3 well branched roots, and 10 = 7–10 well branched roots.

Results and Discussion

In the first two years, terminal shoot sections had a higher rooting percentage and a better root rating than the other 2 shoot sections, with the exception of the shoot midsection in 1982 which had a root rating similar to that of terminal cuttings (Table 1). Terminal shoot rooting percentage was 63.5 and 90.4 in 1981 and 1982, resp. Shoot midsection had a greater rooting percentage and generally a higher root rating than basal shoot cuttings.

Quick dip treatments of IBA were generally most effective when in the 10,000–40,000 ppm range (Table 2). The highest rooting percentage in 1981 occurred when 20,000 or 40,000 ppm IBA was used, while in 1982 the rooting percentage was similar between IBA treatments of 5,000–40,000 ppm. In 1982, both the terminal and midsection cuttings had a rooting percentage greater than 70, while basal cuttings rooted less than 50 percent. We would speculate that environmental differences resulted in greater rooting in 1982 compared to 1981. During the early spring of 1982, an early warm period resulted in early flowering of the 'Bradford' pear; this was shortly followed by freezing weather. These conditions may have resulted in the accumlation of endogenous rooting hormones as compared to 1981. Even with the enhanced rooting in 1982, the higher IBA treatments still resulted in increased rooting percentages compared to the other IBA treatments within a shoot section.

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Table 1. Effects of cutting type on rooting of 'Bradford' pear[z].

	1981				1982			
	Terminal	Mid-section	Basal	LSD (.05)	Terminal	Mid-section	Basal	LSD (.05)
Rooting (%)	63.5	45.4	25.5	11.1	90.4	84.8	70.4	8.5
Root no.	3.2	3.0	2.1	0.8	5.3	5.2	3.6	0.8
Root rating[x]	2.8	2.6	1.9	0.7	6.1	5.3	4.4	0.8

[z]Recently matured growth 45–54 cm (18–24 in) in length was subdivided into 3 sections: terminal, mid-section, and basal. Each was about 15–18 cm (6–7 in) in length.

[y]Cuttings taken: 1981 = May 14, 1982 = May 15.

[x]Root rating scale: 1 = 1–3 small unbranched roots, 10 = 6–10 long well branched roots.

Table 2. Effects of IBA rate and cutting type on rooting of 'Bradford' pear.

IBA ppm (thousands)	Terminal[z] 1981	Terminal[z] 1982	Mid-section 1981	Mid-section 1982	Basal 1981	Basal 1982
	Rooting %					
1	48.5	75.8	20.8	70.0	12.9	49.4
5	43.8	92.5	25.0	93.3	18.8	60.0
10	60.7	100.0	47.9	90.0	23.3	80.0
20	91.7	92.2	52.1	81.4	30.6	78.6
40	72.9	91.7	81.2	89.4	41.7	84.2
Rate linear	.05	.04	.005	NS	.005	.002
Rate quad	NS	.009	NS	NS	NS	.005
	Root No.					
1	1.8	3.2	2.4	3.2	1.4	2.5
5	3.1	4.6	1.8	4.8	1.4	2.7
10	3.3	5.2	3.3	4.6	2.4	3.6
20	3.7	4.8	3.8	6.4	2.5	4.4
40	4.1	8.8	3.9	7.0	2.7	4.9
Rate linear	.05	.0001	.01	.003	NS	.008
Rate quad	NS	NS	NS	NS	NS	NS
	Root rating[x]					
1	1.8	4.3	1.5	4.3	1.7	3.8
5	2.5	6.0	1.3	4.7	1.0	3.5
10	2.5	7.3	3.3	4.5	1.8	4.8
20	3.0	6.0	3.3	6.8	2.3	5.0
40	4.0	7.0	3.8	6.0	2.5	4.8
Rate linear	.02	.02	.01	.02	NS	NS
Rate quad	NS	NS	NS	NS	NS	NS

[z]Recently matured growth 45–54 cm (18–24 in) in length was subdivided into 3 sections: terminal, mid-section, and basal. Each was about 15–18 cm (6–7 in) in length.

[y]Cuttings taken: Year 1 = May 15, Year 2 = May 15.

[x]Root rating scale: 1 = 1–3 small unbranched roots, 10 = 6–10 long well branched roots.

In 1981, the 40,000 ppm IBA treatment resulted in a greater root system rating than the lower IBA rates (1,000–10,000), while in 1982 all IBA treatments ranging from 5,000 to 40,000 ppm resulted in a better root system rating than the 1,000 ppm IBA rate.

Terminal shoot and midsection cuttings generally had better root system ratings compared to basal shoot cuttings. As with the rooting percentage, the root system rating appeared to be higher (better) in 1982.

In 1983, terminal cuttings rooted better (60.3%) than basal cuttings (37.5%) (Table 3) and had greater root numbers (3.4 vs 2.3) and higher root ratings (6.3 vs 5.5) (Table 4). With IBA rates, rooting percentage responded linearly and quadratically with 3 formulations, but only linearly with the K-salt. Increasing the IBA rate beyond 10,000 ppm resulted in numerically lower rooting percentage for terminal cuttings except with the K-salt formulation. Due to a significant rate × solvent interaction, an averaged regression over rate × solvent was not feasible. However, with root number and root rating, there was not a significant interaction and both variables responded linearly and quadratically to IBA rates.

IBA formulation affected rooting of terminal 'Bradford' pear cuttings. With terminal cuttings treated with either 10,000 or 20,000 ppm IBA, ETOH (70%) reduced rooting percentage compared to ETOH + KOH (92.5%); KOH at 10,000 ppm IBA and K-salt at 20,000 ppm had greater rooting than ETOH within respective IBA rates (Table 3). With basal cuttings, rooting percentages generally increased with increasing IBA rates when the K-salt and KOH formulations were used. Both ETOH and ETOH + KOH resulted in suppressed rooting percentages at 20,000 ppm IBA. Reduced rooting at 20,000 ppm IBA with ETOH-containing formulations probably occurred as a result of burning observed on the cutting base (0.5–1.0 cm). Root

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Table 3. Effects of IBA rates and formulations on rooting of 'Bradford' pear.

IBA rate (ppm)	Formulations									
	Terminal cuttings					Basal cuttings				
	K-Salt	ETOH	ETOH + KOH	KOH	Mean	K-Salt	ETOH	ETOH + KOH	KOH	Mean
	Rooting %									
0	30.6a	20.6a	15.0a	15.0a	—	2.5a	0.0a	2.5a	0.0a	—
10,000	67.5b	70.0b	92.5a	95.0a	—	45.8a	57.5a	61.4a	57.5a	—
20,000	87.5a	60.0b	87.5a	82.5ab	—	67.5a	50.0b	35.0b	70.0a	—
Mean	—	—	—	—	60.3	—	—	—	—	37.5
Rate × solvent (P > F) = .04 terminal, .02 basal										
Rate linear	.0001	.0001	.0001	.0001		.0001	.001	.001	.0001	
Rate quad	NS	.0001	.0023	.0001		NS	.003	.001	.0003	
LSD .05 = 4.91, cutting type (terminal vs basal)										
	Root No.									
0	2.2	2.4	2.5	1.1	2.0	0.5	0.0	0.3	0.0	0.2
10,000	3.4	3.9	4.6	4.6	4.1	3.2	3.5	3.7	4.0	3.6
20,000	4.1	3.4	4.2	4.9	4.2	3.7	2.6	2.9	3.2	3.1
Mean	3.2a	3.2a	3.7a	3.5a	3.4	2.5a	2.1a	2.3a	2.4a	2.3
Rate × solvent (P > F) = .10 terminal, .51 basal										
Rate linear					.0001					.0001
Rate quad					.0015					.0001

Mean separation within rows by Duncan's multiple range test, .05 level.

Table 4. Effects of IBA rate and formulation on root rating of 'Bradford' pear.

IBA rate (ppm)	Formulations									
	Terminal cuttings					Basal cuttings				
	K-Salt	ETOH	ETOH + KOH	KOH	Mean	K-Salt	ETOH	ETOH + KOH	KOH	Mean
0	3.7	4.6	4.9	3.5	4.2	3.0	1.0	3.0	1.0	3.0
10,000	6.5	7.1	7.6	8.1	7.3	5.3	6.1	6.1	5.8	5.8
20,000	7.0	6.3	6.9	8.1	7.9	6.0	5.3	5.3	5.7	5.5
Mean	5.7c	6.0bc	6.6ab	7.1a	6.3	5.4a	5.7a	5.7a	5.7a	5.5
Rate × solvent (P > F) = .21 terminal, .80 basal										
Rate linear					.0001					.0001
Rate quad					.0001					.001
LSD .05 = 4.91, cutting type (terminal vs basal)										

number was not affected by IBA formulation. Rooting rating from best to the poorest of terminal cuttings were KOH, ETOH + KOH, ETOH, and K-salt. Root rating of basal cuttings were not affected by IBA formulation.

Significance to the Nursery Industry

These data show that terminal cuttings of 'Bradford' pear root more easily than midsection or basal section or recently matured growth taken in mid-May. IBA rates ranging from 10,000 to 40,000 ppm generally resulted in superior rooting. Use of 50% ETOH as a solvent for IBA dissolution, a standard procedure, results in less rooting than other formulations tested. The K-IBA was not as effective as a rooting treatment as IBA dissolved with KOH. Consequently, the higher rate range should be used with K-IBA. Suggested treatments from propagation of 'Bradford' pear would include: KOH + 10,000–20,000 ppm IBA; ETOH + KOH + 10,000–20,000 ppm IBA; K-IBA at 20,000 ppm IBA.

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