light. In other materials such as glass, other films, and rigid plastics, the difference was 0–6%. Cravo-LS-7 allowed a 6% higher transmittance of blue light than PPFD, indicating that red light transmittance was reduced more than blue (Tables 1, 2). The blue light filtering characteristics of some materials could alter photosynthetic and photomorphogenic activity (8).

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Propagation of *Heptacodium jasminoides* Airy-Shaw by Softwood and Semi-hardwood Cuttings[1]

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Abstract

Softwood and semi-hardwood two node cuttings of *Heptacodium jasminoides* from basal and middle stem sections rooted better than terminal sections. Basal and middle softwood cuttings exhibited greater rooting (65 and 55% resp.) than terminal cuttings (42%). Basal softwood cuttings produced more roots (7.0) than terminal cuttings (3.8). Root length and rootball diameter were not different among the three cutting positions. Semi-hardwood basal cuttings produced an average of 53.5 roots, while middle and terminal cuttings produced 25.8 and 19.7, resp. Cuttings treated with the potassium salt formulation of indolebutyric acid (K-IBA) exhibited increased rooting, greater root number and length, and greater rootball diameter in softwood cuttings. Semi-hardwood cuttings treated with K-IBA rooted in higher percentages and produced more roots than untreated cuttings.

Index words: rooting, auxin, node position

Significance to the Nursery Industry

Nurserymen who want to propagate *Heptacodium*, a small deciduous flowering tree, would be most successful by using basal and mid-section cuttings. Cuttings treated with a 5000 ppm K-IBA 10 second quick dip should root readily within 12 weeks. Two node cuttings were used in this study to maximize plant material resources, however similar results would be expected with larger multi-node cuttings.

Introduction

Heptacodium jasminoides is a small deciduous flowering tree native to Western Hupeh, China (1). It is considered a rare plant even in its native habitat and was only available to the western world following the 1980 Sino-American Botanical Expedition to China (2). *Heptacodium jasminoides* has potential as a new nursery crop because of its exfoliating bark, vigorous growth and fragrant white late summer flowers. After flowering, the persistent calyces develop an attractive reddish color in the fall.

To introduce and promote a new plant to the nursery industry a defined propagation procedure for multiplication and distribution to nurserymen is required. Propagation of *Heptacodium jasminoides* by seed has not been studied extensively, however in preliminary studies, germination of seed has been slow and in low percentages (1). Propagation of dormant hardwood cuttings by the authors produced no rooted cuttings. Successful propagation by softwood cuttings using 10,000 ppm indolebutyric acid (IBA) in a mixture of ethyl alcohol and deionized water (1:1 by vol) has been reported (2). Preliminary studies in 1987 by the authors compared single node softwood cuttings taken from the terminal, middle and basal sections of stems. The basal portion of each cutting was immersed in a 50% ethanol solution containing one of three IBA treatments: 0, 2500, or 10,000 ppm indolebutyric acid (IBA). Results indicated basal sections rooted better than middle or terminal sections.

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Rooting for terminal, middle and basal sections was 33, 48 and 76% resp. However many of the severed portions of the cuttings were necrotic. This may have been caused by the alcohol solvent or use of softwood cuttings.

Therefore, two stuaies were initiated with the objective to evaluate the rooting response of softwood and semi-hardwood cuttings from terminal, middle and basal sections treated with selected concentrations of the potassium salt (K-salt) formulation of IBA (K-IBA).

Materials and Methods

Experiment 1: Softwood cuttings were prepared from 2-year-old container-grown *Heptacodium* plants maintained under natural day length greenhouse conditions on May 20, 1988. The excised shoots had leaves that were fully expanded and light green in color. The stems were light green, and firm, and the immature distal stems were quadrangular in shape. Each cutting consisted of 2 nodes and was 8–10 cm (3.1–4.0 in) in length. A light wound was administered to each cutting consisting of 2 equidistant vertical incisions on the basal stem to a depth reaching secondary xylem, each about 3.0 cm (1.2 in) long. The basal 3.0 cm were then dipped for 10 seconds into the following concentrations of K-IBA: 0, 2,500, 5,000, and 10,000 ppm. After preparation the basal end of 3.5 cm were inserted into a medium of perlite: peat (3:1 by vol). Each cutting was inserted into one of 24 individual cells in a plastic tray measuring 30 cm × 50 cm × 10 cm (11.8 × 19.7 × 3.9 in). The experiment was conducted in a glass-covered greenhouse maintained at day/night temperatures of 30 and 20°C (86 and 68°F). Intermittent mist operated 3 sec every 5 min from 8:00 a.m. to 6:00 p.m. daily. The experimental design was a randomized complete block design consisting of 12 trays and 24 replications. Each tray contained 2 completely randomized replications. Twelve weeks after the experiment was initiated, data were recorded. Data included percent rooting, number and length of roots and rootball diameter. Any cutting with one or more roots 1 mm (0.04 in) long was classified as rooted. Standard analysis of variance procedures were utilized for node position data analysis and regression for quantitative hormone concentration treatment analysis.

Experiment 2: On August 12, 1988, semi-hardwood cuttings were taken from the same stock plants utilized in Expt 1. and divided into terminal, middle and basal sections. The leaves were larger and darker green in color than the softwood cuttings and the stems were rounded with a reddish green color. The semi-hardwood cuttings snapped with a distinct sound when broken. Two-nodal cuttings from each of the 3 sections were taken. Each cutting was 8–10 cm (3.1–4.0 in) long. All cuttings were wounded as described in Expt 1 and treated by dipping the basal 3.5 cm (1.4 in) for 10 sec in one of the following concentrations of K-IBA: 0, 2,500, 5,000, 7,500 and 10,000 ppm. After air drying for approximately 8 min cuttings were inserted to a depth of 3.5 cm (1.4 in) into individual cells in a rooting tray measuring 30 cm × 50 cm × 10 cm (11.8 × 19.7 × 3.9 in). Intermittent mist operated 3 sec every 5 min from 8:00 a.m. to 6:00 p.m. daily. The experimental design was a randomized complete block using 4 cuttings per treatment with 6 replications. Each replication consisted of 2.5 trays for a total of 360 cuttings. The cuttings were evaluated after 12 weeks. Data included percent rooted, number, length of roots and rootball diameter.

Results and Discussion

Node position influenced percent rooting and root number in both experiments, however, there was no interaction between node position and rooting hormone concentrations, therefore data presented are averaged across nodal positions.

Experiment 1. Softwood cuttings from the basal and mid-sections rooted better than terminal cuttings (Table 1). The rooting percentage obtained was 64.6, 55.2, and 41.7%, resp. Basal softwood cuttings had more primary roots than terminal cuttings (7.0 to 3.8 resp.). Primary root length and root ball diameter were not different among the three nodal positions.

K-IBA application significantly increased rooting percentage, primary root number and root ball diameter in softwood cuttings (Table 2). The highest primary root number was obtained by treating cuttings with 5,000 ppm K-IBA. Root length was reduced when treated with 10,000 ppm K-IBA.

Experiment 2. Basal cuttings from semi-hardwood cuttings yielded higher percent rooting, root number and rootball diameter than mid-section and terminal cuttings (Table 1). Basal cuttings produced more than twice as many primary roots as terminal cuttings (53.5 and 19.7 resp.). Node position did not influence root length.

Rooting percentage and primary root number were sig-

Table 1. Node position effect on rooting of softwood and semi-hardwood cuttings of *Heptacodium jasminoides*.

Type of cutting	Rooting (%)	Root no.	Root length (mm)	Rootball diam. (mm)
Experiment 1		**Softwood**		
Basal	64.6 a	7.0 a	65.3 a	47.2 a
Mid-Section	55.2 a	5.6 ab	60.7 a	41.1 a
Terminal	41.7 b	3.8 b	61.0 a	45.9 a
Experiment 2		**Semi-hardwood**		
Basal	85.0 a	53.5 a	87.6 a	61.8 a
Mid-Section	60.8 b	25.8 b	78.2 a	41.9 b
Terminal	37.5 c	19.7 b	84.2 a	51.6 ab

[z]Means of 24 cuttings. Mean separation within columns followed by the some letter or letters are not significant at the 5% level using LSD.

Table 2. Effect of K-IBA concentrations on rooting of softwood and semi-hardwood cuttings of *Heptacodium jasminoides*.

K-IBA concn.	Rooting (%)	Root no.	Root length (mm)	Rootball diam. (mm)
Experiment 1		**Softwood**		
Nontreated	30.6	0.6	61.7	21.1
2,500 ppm	58.3	5.2	69.8	50.2
5,000 ppm	68.1	8.7	67.1	49.1
10,000 ppm	58.3	7.3	50.6	46.7
Significance				
R^2	0.11	0.14	0.05	0.12
Linear	***	***	NS	***
Quadratic	***	**	*	***
Experiment 2		**Semi-hardwood**		
Nontreated	30.6	14.7	95.4	45.3
2,500 ppm	65.3	34.6	86.4	50.9
5,000 ppm	76.4	42.1	84.3	55.5
7,500 ppm	70.8	40.8	76.7	53.3
10,000 ppm	62.5	32.8	77.6	52.8
Significance				
R^2	0.26	0.27	0.03	0.01
Linear	***	*	NS	NS
Quadratic	***	NS	NS	NS

NS, *, **, ***Nonsignificant or significant at the 5%, 1%, or 0.1% levels, respectively.

nificantly increased with application of K-IBA in semi-hardwood cuttings ($P<0.1$ and 0.05 resp.). A higher rooting percentage and a greater number of roots were produced with cuttings treated with K-IBA compared to nontreated cuttings of semi-hardwood materials. There were no K-IBA treatment effects on root length or for rootball diameter.

Data on growth after propagation is unavailable. *Heptacodium* in the North Carolina State Arboretum has reached a height of 3.6 m (12 ft) and approximately 1/2 this width, but has been pruned extensively for propagation. Koller (2) reported that after 5 growing seasons seedling trees ranged from 1.8 to 3.0 m (6 to 10 ft). From lateral cuttings, shoots appear to exhibit plagiotrophic growth, however, they grow vigorously, and verticle shoots usually are initiated from the base of the plant.

(**Ed. note:** This paper reports the results of research only, and does not imply registration of a pesticide 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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