SECTION 8
PROPAGATION

Dr. Ted Whitwell
Section Chairman and Moderator

Response of Tissue Cultured Red Maple Plantlets to High Pressure Sodium, Incandescent, and Ambient Light

John Day, Willard T. Witte, and Hermon Dickerson
Tennessee

Nature of Work: The general effects of photoperiod on growth of North American and other temperate region tree species are well known. Trees produce vegetative growth during long days greater than 14.5 hrs. and have reduced growth or are dormant during short days less than 8.5 hrs. (4). The use of artificial lighting to increase vegetative growth while reducing time of production of nursery crops during propagation/liner stages has been presented in several studies and has been successfully used by commercial nurseries. Cathy et al (1) reported the effectiveness of high and low-pressure sodium lighting (HPS, LPS) in increasing stem growth and dry weight for a wide variety of flowering and foliage plants. They concluded that light quality was less important than light intensity for growth and flowering of many early flowering and herbaceous plants. Cope (2) found that 24 hr. continuous photoperiod with supplemental florescent lighting at night increased stem height and/or fresh weight of seedings of some but not all the six woody ornamental tree species studied. In a preliminary study (3), we showed stem height of tissue cultured (TC) red maple and crabapple liners was greater after 10 weeks when subjected to 18 hr. photoperiod (12 hr. ambient [AMB] light + 6 hrs. 400 watt (HPS) lamps at 350 μmos•s^{-1}• m-^{2} to extend the photoperiod) compared with 18 hr. photoperiod (12 hrs. AMB light + 6 hrs. 100 watt incandescent [INC] lamps at 130 ,μmols^{-1}m^{-2} to extend the photoperiod) or ca. 12 hr. photoperiod (AMB light only). That experiment was inconclusive because plants in the HPS extended photoperiod treatment grew rapidly and became pot-bound before final growth data were recorded, thus suppressing stem growth late in the experiment and allowing other treatments to "catch up." The purpose of this study was to gain additional data from an improved experiment to more accurately determine and demonstrate the quantitative effects of 3 light sources and intensities on growth of TC red maple plants. Rooted microcuttings of *Acer rubrum* 'Autumn Flame'™ and *Acer xf reemanii* 'Autumn Fantasy'™ were planted and acclimated in the greenhouse beginning Jan 18, 1991 using 38-cell Tree Trays of Florida 2.5" x 5" deep pots, Fafard S-2 growing medium, 70° F bottom heat, 80% shading, plastic tents, intermittent mist, 100 ppm N Peters 20-10-20 soak 2X/week and other standard cultural procedures. After acclimation, three experimental light treatments (Table 1) were arranged along a 60 ft. span of expanded metal greenhouse bench. A randomized complete block design with 3 blocks and 20 subsamples/block/maple variety was employed. Burlap cloth was used to shield adjacent light treatments/ blocks. Light treatments were initiated February 18, 1991 when plantlets were well established and beginning to grow. Light intensity was recorded at plant level using a data logger system 21X and quantum sensor (Campbell Scientific/ Logan UT). Air and soil temperatures were recorded 2X/day; relative humidity 2X week (8 AM; 1 PM); soluble salts lX/week from Mar 4 to Apr 19, 1991. Stem height and diameter were measured Mar 20 and Apr 18, 1991 using a hand held ruler and digital micrometer. On Apr 20, 1991, all aerial plant parts (leaves and shoots) were removed and dried for 3 days at 144° F before weighing and recording dry weight.

Table 1. Three Experimental Light Treatments.

Treatment 1	Ambient (AMB)[1]	12 hr. natural photoperiod and light intensity; no artificial light.
Treatment 2	Incandescent (INC)[2]	18 hr. photoperiod; ambient daylength/light intensity + 100 watt INC lamps 8 AM 1 AM.
Treatment 3	H. Press Sodium (HPS)[3]	18 hr. photoperiod; ambient daylength/light intensity + 400 watt HPS lamps 8 AM 1 AM.

[1] Light intensity 0-350 $\mu mol \cdot s^{-1} \cdot m^{-2}$

[2] Two 100 watt General Electric incandescent lamps with white 12" reflectors/block, approximately 12" spacing between lamps and plant surface maintained throughout experiment; light intensity 130-220 $\mu mol \cdot s^{-}1 \cdot m^{-2}$ darkness to full sun; Note: reflectors reduced ambient light about 30%.

[3] One 400 watt Phillips Ceramlux HPS sodium lamps # C400S51 with Voight ballast/ fixture, 12" spacing between lamp/plant surface maintained throughout experiment; light intensity 350620 $\mu mol \cdot s^{-1} \cdot m^{-2}$ darkness to full sun respectively; Note: reflectors reduced ambient light intensity about 30%.

Results and Discussion. See figures 1-3. This experiment showed significant effects of three discrete light treatments on the growth of two TC red maple varieties after 12 weeks. Both maple varieties responded similarly. Plants grown under HPS extended days were significantly taller (Fig. 1) and greater in dry weight (Fig. 2) than INC or AMB treatments. However, HPS was no better than INC for stem diameter as HPS and INC were significantly greater than ambient for all parameters tested (Fig 3). These data agree with results observed in our preliminary study (2). Different results may have been realized in this experiment had light intensities of treatments been equalized. However, our primary objective was to determine and report growth differences under practical and readily available lighting equipment.

Significance to Industry: This study demonstrates the excellent performance of plants in the HPS treatment but more importantly the good results obtained from inexpensive INC lighting. When coupled with good cultural practices, both light treatments resulted in rapid production of high quality plants. This production method involved the use of greenhouse space during the winter, high quality TC plants, and an early production system starting time. It resulted in high quality potted maple liners that when planted outside in May or June of the first growing season and grown in containers one additional growing season yielded well-branched, landscape-sized trees 7-8' tall with 1.75-2.0 inch caliper.

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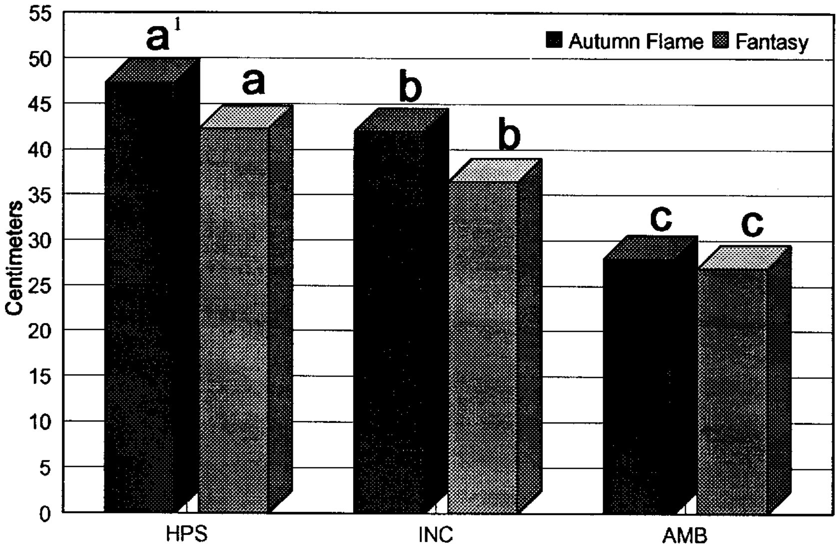
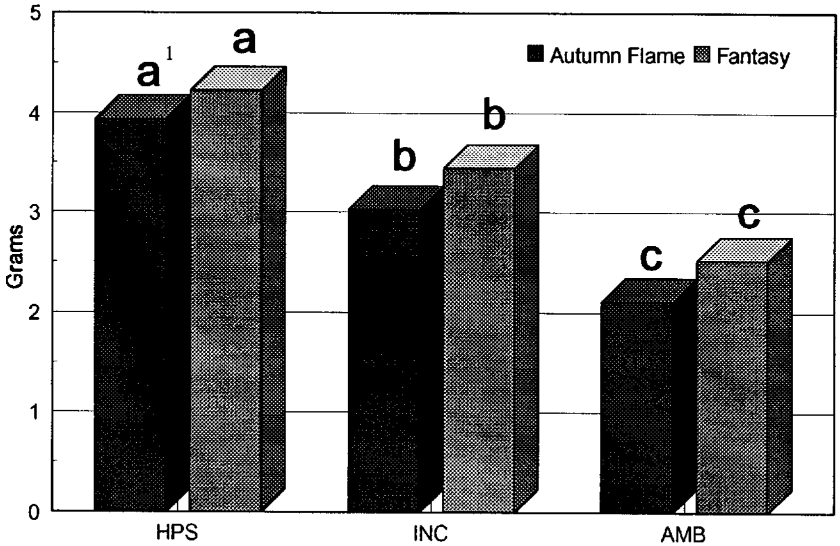
Figure 1. Effect of two months of light treatments on height (cm) of 'Autumn Flame' and 'Fantasy' red maple tissue cultured plantlets.



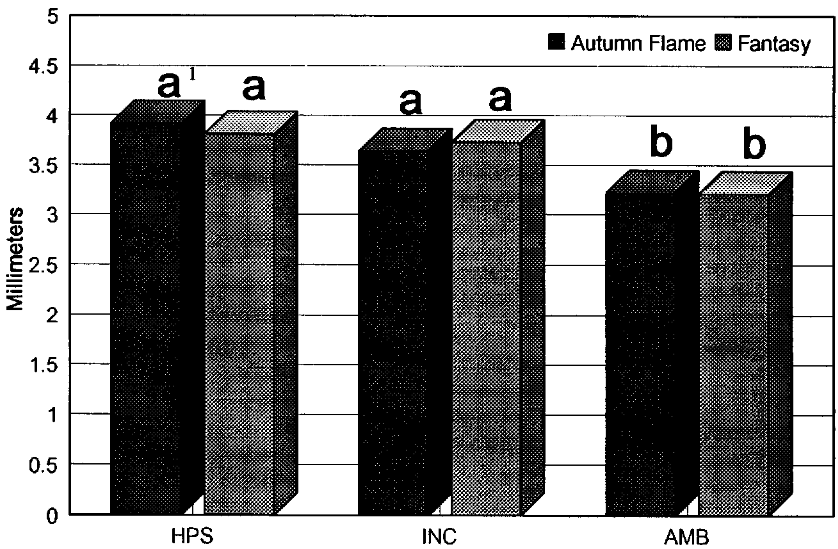
[1] Means followed by the same letter are not significantly different at the 5% level of probability according to Duncan's New Multiple Range Test.

Figure 2. Effect of two months of light treatments on dry weight (grams) of 'Autumn Flame' and 'Fantasy' red maple stem and leaf tissue.



[1] Means followed by the same letter are not significantly different at the 5% level of probability according to Duncan's New Multiple Range Test.

Figure 3. Effect of two months of light treatments on stem diameter (mm) of 'Autumn Flame'and 'Fantasy'red maple tissue cultured plantlets.



[1] Means followed by the same letter are not significantly different at the 5% level of probability according to Duncan's New Multiple Range Test.

Propagating Bottlebrush Buckeye from Stem Cuttings

Richard E. Bir, H. W. Barnes, J. L. Conner and T. E. Bilderback
North Carolina & Pennsylvania

Nature of Work: Bottlebrush buckeye, Aesculus parviflora, is a large (up to 12 feet wide by 15 feet tall) native shrub hardy in much of the Eastern United States. Panicles of white flowers with prominent stamens are borne in profusion above the foliage in mid summer. The fact that bottlebrush buckeye performs well in both the full sun and full shade make it a valuable landscape plant (Dirr 1990). However, bottlebrush buckeye is frequently in short supply within the nursery industry.

One reason plants are in short supply is that most are propagated from seed. Seed propagation requires viable seed which are collected before they can dry out and planted shortly after collection since seed loses viability quickly and no dormancy requirements (Fordham 1987). Root cuttings are the preferred method of propagation in England but are prone to rotting and percentages are often low.

Research (Dirr and Burd 1977) indicated that rooting of softwood stem cuttings has great potential. In 1976, 80% rooting was obtained using 1000 ppm IBA in alcohol as a quick-dip. In 1977, a 5000 ppm IBA quick dip produced 60% rooting while the 1000 ppm treatment produced 0% rooting. Concentrations of 10,000 ppm IBA and higher appeared to be toxic. These differences were attributed to the rapid maturity of cutting wood in bottlebrush buckeye. It was suggested that since the 1977 cuttings were taken from more mature tissue, they required treatment with a higher concentration of IBA in order to root.

In 1993, two studies were initiated to help determine guidelines for commercial propagators concerning timing of cuttings and rates of hormone use. The timing study was conducted at Lorax Farms, Warrington, PA. The stock plant from which cuttings were taken in this study was a mature specimen located at Winterthur Museum and Gardens in Delaware. The hormone study was conducted at the Mountain Horticultural Crops Research Station, Fletcher, NC. The stock plants were mature specimens located at Biltmore House and Gardens, Asheville, NC.

Timing Study: Cuttings were taken 3, 6 or 9 weeks after vegetative growth began in the spring. Terminal stem cuttings 8 inches long were taken in early morning. Immediately, they were placed in an ice chest which was then kept in the shade while being transported to Lorax Farms. Stems were recut, reducing length to approximately 6 inches with flower buds removed, then dipped for one second into a rooting solution consisting of 5000 ppm IBA and 2500 ppm NAA in propylene glycol (RV anti-freeze). Cuttings were stuck in a 1:1 (v/v) peat:perlite rooting media under intermittent mist.

Percentage rooting and number of roots per cutting rooted were determined one month after treatment. There were 50 cuttings per treatment per replicate. Ratings were taken on 5 randomly selected cuttings per treatment in each of four replicates.

Hormone Study: Cuttings were taken in early morning, placed in a plastic bag then into a cooler for transport to Fletcher where a new cut was made on each cutting, reducing length to approximately 6 inches. Flower buds were removed and leaf length was reduced by approximately one-third. Rooting media was 1:1 peat:perlite (v/v) under intermittent mist. Five cuttings were treated in each of four replicates with treatments randomized within replicates. Cuttings were untreated (control) or treated with either 2500, 5000 or 10,000 ppm IBA as a quick dip. IBA was dissolved in either isopropyl alcohol or propylene glycol. The potassium salt of IBA was dissolved in water. Percentage rooting, length and number of roots per cutting rooted were determined five weeks following treatment.

Results and Discussion: Timing Study - Differences in number of roots per cutting rooted or length of roots on those cuttings which rooted were not significant. Differences in percentage rooting were significant (Figure 1). Conclusions are twofold: 1. Timing is very important. Cuttings should be taken within the first six weeks after vegetative bud break in spring. 2. Rooting hormones are not essential to accomplish rooting but significantly enhance percentage rooting.

Hormone Study - Differences in root length were not significantly different. Differences in percent rooting and the number of roots per cutting rooted were significant. Conclusions were: 1. The highest percentage rooting occurred in 5 treatments: all solvent treatments at 5000 ppm IBA, with 2500 ppm IBA in alcohol or 10,000 ppm IBA in propylene glycol. 2. The greatest number of roots per cutting rooted occurred in all of the 10,000 IBA in propylene glycol as well as in the 5000 ppm IBA in alcohol treatment.

Table 1. Percent rooting and number of roots per cutting as affected by IBA concentration and solvent.

ppm IBA	Solvent	Percent Rooting*	#Roots/Cuttina*
0	none	20. d	3.0 c
2500	Water	47. c	3.5 c
	Alcohol	73.ab	7.1 bc
	Glycol	67. b	4.6 bc
5000	Water	73.ab	7.7 bc
	Alcohol	80.a	10.8ab
	Glycol	87.a	5.7 bc
10000	Water	60. b	9.8abc
	Alcohol	67. b	9.0abc
	Glycol	87.a	14.6a

*Rp05 Duncan's New Multiple Range Test

Significance to the Industry: 1. Bottlebrush buckeye cuttings should be taken from three to six weeks after vegetative bud break in the spring. 2. The combination of the greatest percentage rooting and cuttings with the greatest number of roots in hormone formulations readily available to nurseries is 5000 ppm IBA in alcohol.

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Seed Germination of Annual Vinca as Influenced by Light and Temperature

Frank A. Blazich, Paul H. Henry, and Farrell C. Wise
North Carolina

Nature of Work: Annual vinca *[Catharanthus roseus* (L.) G. Don] is a popular bedding plant notable for continuous flower production from spring to frost. The species is tolerant of heat, drought, wind, and poor soils, making it a mainstay of gardens in southern states and coastal regions. It would be helpful to growers of annual vinca if the time required to produce a salable plant (10 to 14 weeks) could be shortened through more efficient propagation techniques. The species is propagated by seed and recommendations found in the literature regarding germination are contradictory.

Propagation guidelines for the species typically recommend germinating seeds at 21° to 27°C (70° to 81°F) in darkness (3, 5, 7, 8). However, the Association of Official Seed Analysts (2) recommends germination at an 8/16 hr thermoperiod of 30°/20°C (86°/68°F) with 8 hr of light daily during the high temperature portion of the cycle. Carpenter and Boucher (4), in the most thorough study to date, reported that germination was optimized at temperatures of 25° to 30°C (77° to 86°F) and that constant light inhibited germination. However, their study did not investigate the effect of alternating thermoperiods or photoperiods < 24 hr.

Several years ago, we conducted two experiments to investigate the influence of light and temperature upon germination of annual vinca. Results of these studies, which complement the latter work of Carpenter and Boucher (4), are presented herein.

In the first experiment, seeds of 'Dawn Carpet' and 'Little Bright Eye' annual vinca were exposed to one of four temperatures (15°, 20°, 25°, and 30°C) (59°, 68°, 77°, and 86°F) during both the 8 hr (day) and 16 hr (night) portions of an alternating thermoperiod. Within each temperature regime, half the seeds of each cultivar received 1 hr of light daily during the 8 hr portion of the thermoperiod; the other half remained in constant darkness. Germination counts were recorded every 2 days for 10 days. The second experiment consisted of placing seeds at 25°C (77°F) with daily exposure to photoperiods of 0, 1, 2, 4, 8, 12, or 24 hr. Germination counts were recorded daily for 5 days.

Results and Discussion: The first experiment showed that cumulative germination of both cultivars was suppressed at day or night temperatures of 15°C (59°F). Heat input computed as daily degree hours (8 x short cycle temperature + 16 x long cycle temperature) (1, 6) was a controlling factor in germination; different thermoperiods having equivalent numbers of daily degree hours had similar effects upon germination response. There was a strong interaction between temperature and light for both cultivars. For seeds maintained in darkness, final germination percentages ['Dawn Carpet' (86%); 'Little Bright Eye' (97%)] were similar at any daily heat input within the range of 360 to 720 daily degree hours. When seeds received 1 hr of light daily, heat inputs ≥ 440 daily degree hours were required to ensure similar germination percentages.

In the second experiment, photoperiods of 24 hr suppressed germination response compared to all other light treatments. Photoperiods ≤ 12 hr did not adversely affect response compared to seeds germinated in darkness.

Significance to Industry: Data indicate that if seeds of annual vinca are maintained in darkness, cumulative germination percentages will be similar at any heat input within the range of 360 to 720 daily degree hours. If seeds receive light during germination, photoperiods should be ≤ 12 hr and daily heat input should be ≥ 440 degree hours to ensure maximum response.

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Stock Plant Effects on Foster Holly Cutting Development

Cecil Pounders and Stephen Garton
Alabama

Nature of Work: Young plants of Foster holly **(Ilex X attenuata** Ashe 'Foster #2') generally have variable branching structures and plagiotropic growth regardless of climatic or cultural conditions. Some plants grow vertically but most shoots have undesirable growth angles. It was suggested that part of this variation may be due to the phenomenon whereby propagules maintain the habit they had as shoots on the stock plant (cyclophysis)(1). The objectives of this experiment were to: 1) test for differences in propagule growth and form due to variation among stock plants growing in "uniform" nursery conditions and 2) determine if position where cuttings originated on the plant affected early propagule development. Understanding sources of variation among and within stock plants may lead to a better understanding of stock plant factors that affect plant development.

Eight Foster holly stock plants were randomly selected from a group of ten-year-old plants at a Decatur, Alabama nursery. Plants were 10 ft. tall uniform in color and branching structure. Plants were not being heavily sheared but were being pruned annually during cutting collection with additional corrective pruning to maintain dense uniform plants. On September 6, 1989 cuttings of current season growth were collected from contiguous 2 ft horizontal bands around each plant crown, beginning at the band from ground level to 2 ft and continuing up the entire crown, which produced five bands per plant. Fifteen shoots of sufficient length to produce three cuttings were randomly taken around the crown from each band. Shoots were subsequently divided into first (terminal), second (middle), and third (basal) position cuttings which were 2.5 inches in length. Propagation procedures and growth regimens were those previously outlined for Foster holly (3).

Plants remained in propagation trays until April 1, 1990. Plants with the media in their rooting cell were shifted to 4 in. square pots and grown until August 10, 1990 when the angle of dominate shoot (ANG) measured with a protractor to nearest 10°, (0° horizontal to 90° vertical) and number of shoots per cutting (SHN) were collected. Data were analyzed to detect the effects of individual stock plants as well as location (band and stem position) within the plant crown on subsequent cutting development. After data were collected, all shoots were pruned back to two nodes above the original cuttings and allowed to regrow. By December 19, 1990 plants appeared to be approximately the same size as when previous data were collected so phase 2 data were recorded. Phase 1 evaluated differences in unpruned propagules while phase 2 tested for differences in the same plants after regrowth from pruning.

Results and Discussion: Angle of the dominant shoot (ANG) was not affected by the stock plant but was affected by band in phase 1. The best mean ANG occurred in the lowest band within the crown with a weak trend of ANG deterioration (more horizontal) as band moved up the tree. The trend was erased by pruning and not detected in phase

2. Cutting position along stems within bands had a much larger effect on ANG than band. Position affected ANG most in phase 1 with differences reduced by pruning (phase 2). Angle of dominant stem was most vertical in terminal cuttings while second and third position cuttings tended to have similar less vertical angles. Differences detected between cutting position were due in part to the presence of an apical bud on terminal cuttings. Dominant shoots, however, grew randomly from any upper bud on the terminal cutting so the bud may be more important chemically than morphologically (2). Morphological, hormonal, and nutritional differences in individual cuttings controlled much more of the observed variation in ANG than position where cuttings originated on the stock plant (band).

Number of shoots (SHN) was also not affected by the stock plant where the cutting originated. In phase 1, SHN showed a mean increase as band moved from the base of trees (band 1) to the top (band 5). Cuttings position along shoots proved to have the greatest effect on SHN, however. Terminal cuttings produced more new shoots than cuttings from the middle and basal position. Differences between the three positions were greatest in phase 1. After pruning (phase 2), differences were reduced, but terminal cuttings consistently produced the most shoots.

Significance to industry: Neither stock plant or position in the plant crown account for much of the variation in stem angle and number of new shoots observed in Foster holly propagules. Use of terminal cuttings has a positive impact on both vertical orientation of the dominant shoot and number of shoots produced by cuttings.

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Cupric hydroxide affects root length and flowering of *Lantana* during propagation and following transplanting into hanging baskets

Sven E. Svenson and Diane L. Johnston
Florida

Nature of Work: Container-induced root deformation can adversely affect the growth of bedding plants (1, 4) and woody species (5) following transplanting. Cuttings of perennials rooted in small pots are subject to the same root deformation as container grown bedding plants or woody species. The benefits of growing woody plants in copper-treated containers have recently been summarized (5). Treatment of interior container surfaces with cupric hydroxide [$Cu(OH_2)$] eliminated or reduced root deformation in *Coreopsis lanceolata* L. and *Chrysanthemum* X *superbum* Bergmans ex J. Ingram, respectively (1). In this study, the influence of $Cu(OH)_2$-treated containers on shoot and root growth of *Lantana* during liner propagation, and on growth and flowering following transplanting into hanging baskets was evaluated.

Stem tip cuttings (15 cm or 6 in long) were removed from stock plants of *Lantana camara* L. 'Dallas Red' and *Lantana montevidensis* Briq. 'Alba.' Leaves were removed from the basal 5 cm (2 in) of the stem, and then the basal ends of the cuttings were inserted into ProMix BX media (Premier Brands, Inc., Stamford, CT) in 5.7 cm (2.25 in) top diameter square pots. No rooting compounds were used. Prior to being filled with medium, interior surfaces of pots were sprayed with a liquid latex-$Cu(OH)_2$ compound [100 g $Cu(OH)_2$/liter (3.34 oz/qt)], formulated as Spin Out™ (Griffin Corp., Valdosta, GA), or left untreated. Cuttings were rooted under intermittent mist (5 sec every 10 minutes) in a fiberglass greenhouse providing 420 μmol m^{-2} s^{-1} maximum PPF (about 2200 ft-c), 85% relative humidity, and 30/26 C (86/78 F; max/min). Natural day lengths (Lat. 26.1 N. Long. 80.2 W; Fort Lauderdale, FL) were used throughout the study. Six weeks after sticking, seven rooted liners from treated and untreated pots were harvested to determine shoot length, and shoot (stems and leaves) and root dry weights. Before drying roots, length of the longest root and total root length were estimated using a line-intersect technique (6).

Unharvested liners were potted 2 per pot into ProMix BX media in 15 cm (6 in) top diameter hanging baskets (Lerio Corp., Kissimmee, FL). Pots were top-dressed with 13 9 (about 0.5 oz) of Osmocote 13N-5.2P-10K (Grace/Sierra, Milpitas, CA). Plants were grown in a screenhouse covered with black saran-type shade cloth providing 780 μmol m^{-2} S^{-1} maximum PPF (about 4100 ft-c). Temperatures averaged 35/27 C (95/80 F; max/min), and plants received daily overhead irrigation supplemented with natural rainfall. After six weeks in hanging baskets, post-propagation growth was evaluated using shoot length, narrowest and widest plant width perpendicular to its vertical axis, and number of nonsenescent flowers. All data were analyzed using analysis of variance in a completely randomized design (n=7).

Results and Discussion: Elongation of adventitious roots stopped when root tips came in contact with the $Cu(OH_{)2}$-treated container sidewall or bottom surface, preventing the development of a deformed root system. Root tips in contact with the $Cu(OH)_2$-treated surface were blackened and swollen, with lateral root branching starting 1.2 cm (about 0.5 in) behind the inhibited root tip. No foliar symptoms of copper toxicity were observed. These observations are consistent with previous reports of mild copper toxicity being localized to the area around the root tips (2). Roots growing within untreated liners continued to grow along the exterior of the liner's rootball, forming a mat of roots at the rootball surface conforming to the shape of the pot. Roots elongating along the exterior or the rootball were susceptible to damage during transplanting.

After rooting for six weeks in liner pots, $Cu(OH)_2$-treatment did not influence shoot, root or total plant weights of *Lantana.* Reported dry weight responses to $Cu(OH)_2$-treatment have varied among species (1, 3, 5). Roots of the two *Lantana* species had similar weights. Although $Cu(OH)_2$treatment did not influence root dry weight, total root length and the length of the longest root were reduced in $Cu(OH)_2$-treated pots (Table 1). The longest root of L. *camara* was longer than that of L. *montevidensis* in untreated liners, but shorter in $Cu(OH)_2$-treated liners.

Six weeks after transplanting into hanging baskets, $Cu(OH)_2$ did not influence stem length or shoot size. However, transplanting from $Cu(OH)_2$-treated liners increased the number of flowers. For example, L. *montevidensis* had over 150% more flowers when transplanted from $Cu(OH)_2$-treated liners than from untreated pots.

Significance to Industry: Improved flowering after transplanting from $Cu(OH)_2$-treated pots was reported for *Impatiens wallerana* Hook f., but not for C. X *superbum, Pelargonium* X *domesticum L,* or *Tagetes patula* L. *(1).* By increasing the number of flowers on shoots of similar size, transplanting from $Cu(OH)_2$-treated liner-pots was found to improved the overall appearance of *Lantana* in hanging baskets. Application of $Cu(OH)_2$ to pots used during propagation prevented root deformation, reducing the length of roots growing on the exterior of the rootball. By reducing root growth on the exterior of the rootball, less damage to roots may occur during transplanting.

Transplanting from $Cu(OH)_2$-treated liners into hanging baskets enhanced flowering of *Lantana camara* and *Lantana montevidensis.* The potential of $Cu(OH)_2$-treatment applied to pots during propagation to improve flowering after transplanting should be tested on a wider range of species.

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Table 1. Influence of $Cu(OH)^2$-treated liners on root growth of *Lantana* after propagation, and on flowering after transplanting into hanging baskets.

Species	Container treatment during propagation	Total root length (in)	Length of longest root (in)	Number of flowers[Z]
Lantana camara	+ $Cu(OH)_2$	12.2 d[Y]	1.4 d	18 b
	- $Cu(OH)_2$	13.0 c	5.0 a	12 c
Lantana montevidensis	+ $Cu(OH)_2$	20.0 b	2.2 c	25 a
	- $Cu(OH)_{)2}$	23.6 a	4.0 b	9 c

[Z]Number of flowers per pot one month after transplanting.

[Y]Means followed by the same letter in the same column are not significantly different at the 5% level (Fisher's LSD).

The Effects of Timing and Growth Regulator Treatment on the Rooting of Cephalotaxus *harringtonia*

Andrea Southworth and Michael A. Dirr
Georgia

Nature of Work: *Cephalotaxus harringtonia,* Japanese plum yew, and its varieties and cultivars offer unlimited landscape potential for zones (5)6 through 8 (Dirr, 1990). Plants are heat and drought tolerant, sun and shade adaptable and resist deer browsing. Demand for this species has increased steadily in the past three years. In 1994, the low growing forms (var. *drupacea* and 'Prostrata') were named Georgia Gold Medal Award recipients, which resulted in depletion of nursery inventory. Janick et al. (1994) reported limited success with tissue culture propagation of C. *harringtonia,* however, cutting propagation has not been well defined. This study determined the effects of timing and growth regulators on the rooting of a prostrate clone of *Cephalotaxus harringtonia.*

Materials and Methods: Six-inch-long terminal cuttings of *Cephalotaxus harringtonia* (Forbes) K. Koch were taken on September 15, 1993, from a prostrate clone at the University of Georgia. Cuttings were pruned to 4-inches and the basal half of the needles removed. Half (40) of the cuttings were dipped to a depth of 2.5 cm (I in.) for 5-seconds in 10,000 ppm of the potassium salt of indole-3-butyric acid (KIBA) in water, while the remaining cuttings were left untreated. The cuttings treated with KIBA were air dried, and all cuttings were inserted into a 3 perlite: I peat (v:v) medium. Each treatment (KIBA and control) was completely randomized and consisted of five repetitions with eight cuttings per replicate. The intermittent mist cycle consisted of 1, 2 1/2 second burst per 5-minutes from 8:30 a.m. until 6:00 p.m. in greenhouse conditions (approximately 30/21° C day/night). Bottom heat (70°F) was provided during December through March for all cuttings. Rooting percentages, number of roots, and root lengths were determined after 16-weeks. Standard statistical analysis was performed. This procedure was repeated monthly and will continue through August, 1994. Data presented in this paper reflect cuttings taken through March, 1994.

Results and Discussion: Timing and growth regulator treatments affected the rooting of *Cephalotaxus* (Table 1). Although earlier studies report no benefit from IBA treatment (Janick et al., 1994; Dirr and Heuser, 1987), it is clear that using a growth regulator had a significant effect in this study. The application of 10,000 ppm KIBA was based on *Cephalotaxus* and *Taxes* propagation literature (Dirr and Heuser, 1987). In all months except September, rooting percentages were higher in treated versus untreated cuttings. The untreated October, November and December cuttings had the lowest rooting percentages, numbers and lengths.

Optimum rooting occurred in treated cuttings from December through March with 88, 90, 78, and 70 percent rooting, respectively. Root number and root lengths were also highest during these months. Some basal necrosis was observed on treated cuttings from September through November, but no cuttings died.

Mr. John Alden, County Line Nursery, Byron, GA, takes cuttings in July and treats them with 8,000 ppm KIBA. He reports that rooting takes about one-year. The authors observed that the December through February cuttings rooted more quickly (by 12-weeks) than the September through November cuttings. From a commercial standpoint, the collection and rooting of cuttings during winter would permit subsequent transplanting and nursery production. This might shorten production time in a one-gallon to less than 12-months. Dudley Nursery, Thomson, GA, reports that it takes two full growing seasons to produce a finished 3-gallon plant. In addition, the cuttings are rooted a year prior to up-canning. This approach results in a 3-year cycle. Utilizing the results from this study, it is possible to produce a 3-gallon in two years from the time the cuttings are stuck.

Significance to the Industry: The time required for current nursery production of *Cephalotaxus* is considered long by commercial standards. This study suggests that cuttings collected during December, January, February and March and treated with KIBA root in high percentages and produce quality root systems. As a result, production time of *Cephalotaxus* could be shortened.

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Table 1. The effects of timing and KIBA on the rooting percentage, root number, and root length of *Cephalotaxus harringtonia.*

	Control			KIBA		
Month	**Percent rooted**	**Mean number of roots**	**Mean total root length (cm)**	**Percent rooted**	**Mean number of roots**	**Mean total root length (cm)**
Sept.	68	3	6.4	15	5	8.8
Oct.	18	1	1.1	43	3	5.8
Nov.	5	1	1	45	3	3.3
Dec.	5	1	1	88	11	38.1
Jan.	33	2	8.5	90	11	49.2
Feb.	28	5	8.7	78	9	17.7
March	58	5	13.9	70	7	14.4

Means are per rooted cutting.

Propagation of Alstroemeria Hybrids: a Potential New Herbaceous Perennial for the Southeast

Stephen Garton and Cecil Pounders
Alabama

Nature of Work: Alstroemerias are rhizomatous, perennial, herbaceous, monocotyledonous plants which are indigenous to the South American continent where more than 60 species exploit a diverse range of habitats (5). Rhizomes produce shoots which may be vegetative or generative and fibrous roots, some of which may become tuberous. Since plants are heterozygous and do not breed true from seed, two methods of vegetative reproduction are applied in commercial production, the first method is crown division, and the second method is tissue culture propagation from rhizome tips. Vegetative propagules must possess viable rhizome buds to perpetuate this totipotent organ (4). All commercial cut-flower varieties are clones of single elite plants and are interspecific hybrids developed from at least two species (2). This work was carried out to investigate the potential of Alstroemeria as a flowering plant for spring sale in North Alabama.

Seeds were collected from plants obtained from commercial brokers. Seeds were treated by exposure to dry air in an oven at 90 F for at least 4 weeks. Weekly, during the latter half of August and through September 1992, seeds were broadcast over a commercial peat/vermiculite medium and covered with an additional 0.25" layer of medium. Flats were placed in a polyethylene covered, quonset greenhouse with minimum night temperature set at 55F. Seedling emergence was observed after 3 weeks and continued for 6 weeks. Plants were obtained from approximately 70t of the seeds sown. When 2 or 3 stalks were visible, seedlings were moved up to 4" plastic square pots using a similar medium. After transplanting, the minimum night temperature was set at 47F. Plants were fertilized with a 20:20:20 soluble fertilizer which was proportioned at 300 ppm N at alternate waterings. During flowering, fertilizer was applied as a dilute solution of potassium nitrate (150 ppm N) at alternate waterings. In early summer, samples of flowering plants were transplanted to either 1 gallon pots containing a pine bark/sand potting mix or directly to outdoor beds in a clay loam soil. The gallon pots were placed on ground covered with woven landscape fabric. Both sets of plants were watered by sprinkler irrigation when necessary. Plants were observed periodically to assess flowering and were allowed to overwinter. Observations on winter survival were recorded the following spring.

Results and Discussion: Plants began flowering in late February and continued to flower through spring and early summer. Approximately 50% of the original seedling population was judged to be commercially acceptable, producing plants which attained a height between 8 and 20 inches, with at least two flowering stalks. The most desirable were retained as stock plants for further breeding and for multiplication through vegetative propagation. Samples of flowering plants were offered for sale to the public at Alabama A&M University and through cooperation with a local bedding plant producer (Rainbow Nursery, Decatur, Alabama). The public acceptance of the flowering Alstroemeria plants was very strong in both locations.

Observation of plants in the landscape indicated that plants which were adequately supplied with water and nutrients produced flowers through summer, but flowering in some plants was inhibited by summer heat. The conditions in which plants were grown strongly influenced winter survival since those grown in containers survived and resumed vigorous growth in April 1994 compared to those grown in ground beds which did not survive. The demise of plants in the ground appeared to be associated with cold, wet conditions rather than with cold hardiness. Consumers reported that summer flowering was enhanced by afternoon shade and that good winter survival was obtained in situations where plants were grown in well drained beds. It is hypothesized that the extensive subterranean storage organs of Alstroemeria are intolerant to prolonged cold, wet conditions which are typical of north Alabama soils in winter.

These observations were taken from a population of seedlings which were variable in several traits including flower color, floriferousness, and plant vigor. Seedling emergence occurred over a long period and a high proportion of culls was produced. Vegetative propagation of the best selections via tissue culture or division will provide a uniform, quality product which will translate to increased customers acceptance. Vegetative propagation and continued testing is proceeding.

Significance to Industry: Plants from uniform seedling populations or vegetatively propagated hybrids have great potential as herbaceous plants for the southeastern states. Plants flowered during spring and remained in bloom throughout the major spring retail period when customer traffic was most intense. Since, plants produced an attractive long-lasting inflorescence, in a variety of colors, the customer acceptance was strong. The low heat requirement during the winter minimized fuel bills when compared to other greenhouse grown products. In landscape situations, good drainage appeared to be essential for winter survival of subterranean organs.

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