dieffenbachia hybrids have been fertile. Data from aglaonema hybrids will be available in the spring of 1982. This information combined with the great deal of natural variation within these genera lead to a great deal of optimism concerning the development of new and better cultivars for the future

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INFLUENCE OF EXTENDED PHOTOPERIOD AND FERTILIZATION ON ROOTING *ACER RUBRUM* L. 'RED SUNSET' CUTTINGS

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Abstract. Terminal unbranched *Acer rubrum* L 'Red Sunset' cuttings were propagated in June, July and August, 1980 Cuttings were stuck in an Osmocote 18-6-12, 5 4 kg/m^3 amended medium, a 20-20-20 (200 ppm N) liquid fertilizer applied to the medium, or a control medium containing no fertilizer, and placed under a 4 hour extended or natural photoperiod The cuttings had higher rooting percentages when they were propagated in June and July under an extended photoperiod, regardless of fertility Cuttings propagated in August had significantly lower rooting percentages for all treatments There were no differences observed in rooting percentages, or root dry weights, due to fertilizer in the rooting medium for cuttings propagated in a natural photoperiod Cuttings had greatest root dry weights when they were rooted in an Osmocote-amended medium, and under an extended photoperiod

Acer rubrum L cultivars are most commonly propagated by budding onto seedling understcok of the same species. However, this practice has recently come under review because of graft incompatibility problems. Schwab (14) reported Acer rubrum graft incompatibility losses of 50% the first year after budding, and an additional 10 to 20% during the second growing season. The graft incompatibility losses necessitate that an alternative vegetative propagation method be developed.

Softwood *Acer rubrum* cuttings have been successfully rooted (1,5,13,14,15,20) However the actual propagation procedure varies greatly. May through September cutting dates have been tried (1,13,14,15). It is important to determine the best cutting date for specific *Acer rubrum* cultivars in order to produce a quality plant.

Supplemental lighting (9,11,13,19) applied to softwood cuttings, and nutrients applied to the propagation medium (4,6,8,10,16,22,23) are two possible methods for increasing rooting of *Acer rubrum* cuttings Nutrient mist has reduced nutrient loss from the plants and increased rooting percentage and root quality (3,21,22,23). However, nutrient mist encourages surface algae growth which may reduce aeration and drainage (2). To overcome possible algae problems and still obtain increased root growth from added nutrients, additions of Osmocote or other slow release fertilizers have been researched (3,4,6,8,10,17,18). Since there is little research on the effects of Osmocote on deciduous shade tree cuttings, it is important to determine the Osmocote response on cuttings of red maple

Photoperiod is another factor that may influence red maple propagation by cuttings. Extended photoperiods have promoted rooting of many woody plants (7,9,11,12,13,19,20). In these studies long days during rooting decreased time to root initiation and/or increased the root system development It is important to determine whether cultivars of *Acer rubrum* will respond to an increased photoperiod during propagation.

This study used *Acer rubrum* 'Red Sunset' cuttings to determine the optimum time to take cuttings, the effect(s) of fertilizers applied to the medium during rooting, and the effect of supplemental lighting on rooting of cuttings

The first terminal cuttings were taken from 6 cm caliper nursery grown trees on June 16, 1980. The terminal bud and first node of each cutting were removed, bases wounded on two sides below each axillary bud, and the basal 4 cm was dipped in a 6000 ppm indolebutyric acid (IBA) (50% water/ 50% ethyl alcohol) solution for 5 sec. Each cutting was stuck in a separate .3 liter container filled with 3.1 (by vol) perlite/ peat rooting medium Overhead mist was set to give 6 sec. mist every 3 minutes from 8.00 AM to 7·30 PM. One half of the cuttings received natural light and the remaining plants received 4 hours (10.00 PM to 2·00 AM) of 75 watt supplementary incandescent light. Incandescent bulbs were placed 1 m apart and 1 m above the propagation bench The light intensity recorded at cutting height was approximately 20 foot candles (215 lux)

Within a photoperiod treatment, cuttings were rooted in one of the following amended media. (1) Osmocote 18-6-12 (9 month formulation) *incorporated in the rooting medium* at a rate of 5.4 kg/m^3 one week before cuttings were stuck, (2) a

Peter's brand 20-20-20 liquid solution (200 ppm N) applied to the rooting medium after rooting began, and then applied at 3 day intervals; (3) no fertilizer (control medium). A random complete block design was used, with 7, 5 plant reps. Similarly, cuttings were collected and treated on July 23 and August 28 After a 5 week rooting period, cuttings were harvested and percent rooting, root dry weights, percent bud break, and shoot length of the longest broken bud were recorded.

Cuttings taken on June 16 had similar rooting percentages when rooted under the same photoperiod treatment (Table 1). However, within the extended photoperiod regime cuttings rooted in the Osmocote amended medium or control medium had significantly higher rooting percentages than cuttings that received the same fertility treatment, but rooted under natural light. Extended photoperiod alone had a positive effect on rooting percentage for cuttings taken in mid-June These results agree with Lanphear and Meahl (9), who reported increased rooting percentages of *Juniperus horizontalis* 'Plumosa' cuttings when rooted under 18 hour photoperiods Fertility in the rooting medium had no effect on rooting percentages when cuttings were placed under the same photoperiod treatment.

Table 1. Effects of fertility-photoperiod treatments on mean rooting percent, root dry weight, percent bud break, and shoot length of *Acer rubrum* 'Red Sunset' cuttings propagated June 16, July 23, and August 28, 1980

	June 16				July 23[y]		August 28[y]	
Treatment	Rooting percentage	Root Wt (g)	Percent Bud Break	Shoot Length (mm)	Rooting Percentage	Root Wt (g)	Rooting Percentage	Root Wt (g)
Extended photoperiod 4 hrs light (10 PM-2 AM)								
Osmocote	[z]91 4a	2 93a	51 4a	20 57a	91 4a	1 82a	54 2a	46a
Liq Fert	82 8ab	1 84bc	20 0b	3 57b	88 4a	1 23bc	60 0a	38a
Control	94 3a	1 90b	11 4b	5 40b	82 8ab	0 89bcd	48 4a	31ab
Natural Photoperiod								
Osmocote	60 0c	1 49bc	20 0b	5 20b	57 2c	1 32b	25 7b	27ab
Liq Fert	74 3bc	1 13bc	8 6b	1 30b	74 2abc	0 80cd	20 0b	13b
Control	57 1c	0 93c	5 7b	1 14b	65 6bc	0 62d	25 7b	11b

[z] Mean separation in columns by Duncan's multiple range test 5% level Values with the same letters are not significantly different

[y] No bud break or shoot growth was observed for cuttings taken on July 23, or August 28

Cuttings rooted in the Osmocote amended medium and under an extended photoperiod had a significantly greater mean root dry weight than cuttings rooted in the same amended medium but under natural light (Table 1) The mean dry weight was more than twice the dry weight of cuttings rooted in the Osmocote amended medium and under natural light (Table 1 and Fig. 1). Cuttings rooted under an extended photoperiod and without any fertilizer (control medium) also had a significantly greater mean root dry weight than cuttings rooted in the same medium but under natural light (Table 1). This result agrees with others (7,9,13,19). The increased root volume might be due to earlier rooting (9). Cuttings receiving Osmocote in addition to a long photoperiod would have longer periods of time for growth with a continuous supply of nutrients available as well. Within the extended photoperiod regime, cutting rooted in an Osmocote treated medium had a significantly greater mean root dry weight than cuttings receiving different fertility treatments (Table 1). However, within the natural light regime, there were no significant differences due to fertility treatment. Osmocote incorporation significantly increased root weight only when supplemental light was employed. This result disagrees with Johnson and Hamilton (8) who reported increased root volume of various cuttings that were rooted in an Osmocote amended medium alone. These researchers measured the extent of rooting after a 10 to 12 week period in the propagation bench. The cuttings of *Acer rubrum* 'Red Sunset' were analyzed after 5 weeks in the propagation bench, which might explain why there were not any significant effects within the natural lighting regime.

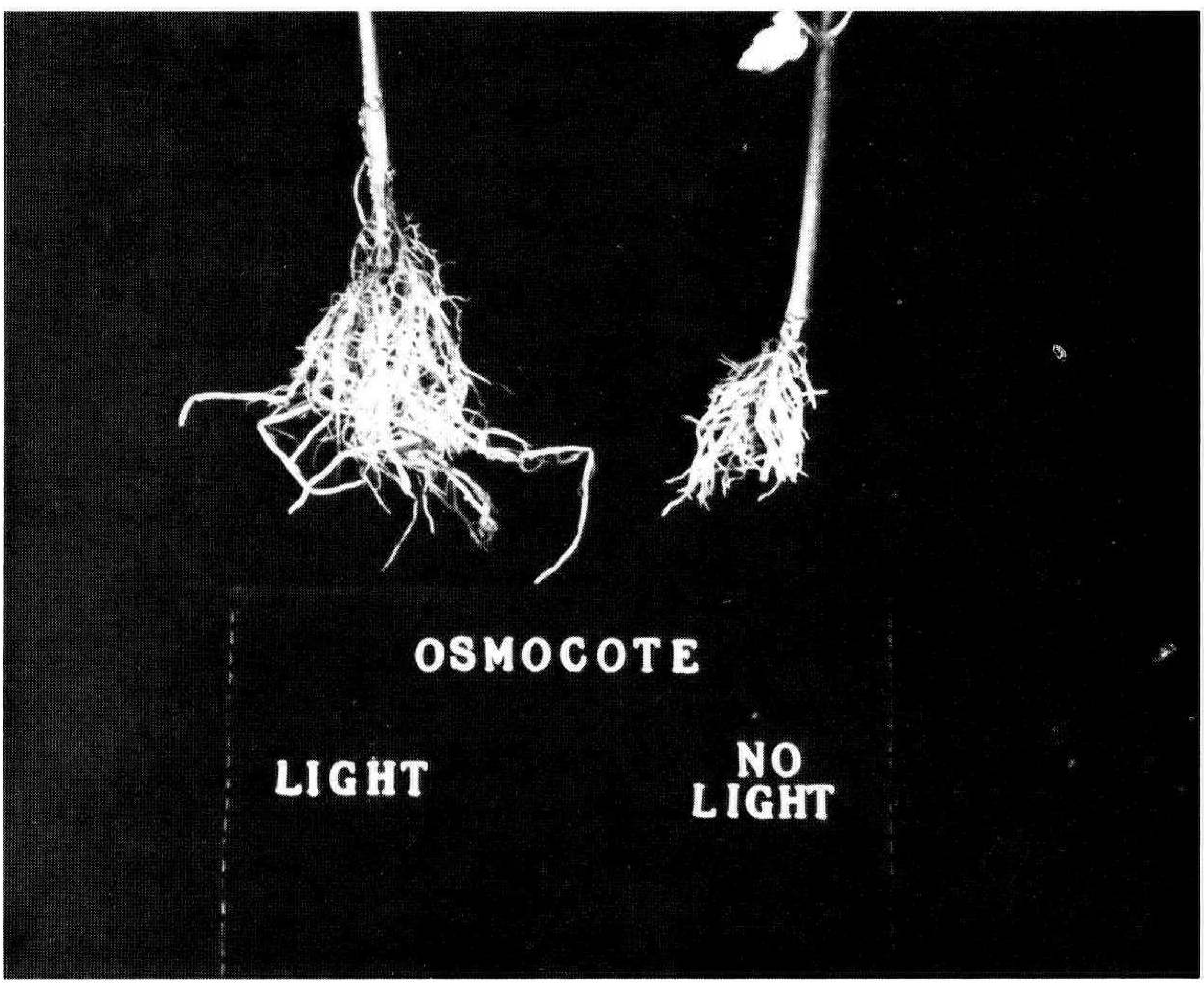

Figure 1. June-rooted *Acer rubrum* 'Red Sunset' cuttings in an Osmocote amended medium, under (*left*) an extended photoperiod (light), or under (*right*) a natural photoperiod (no artificial light).

Many of the cuttings taken on June 16 had broken bud before they were removed from the propagation area The cuttings that were rooted in an Osmocote amended medium and under the extended photoperiod treatments had a significantly greater mean percent bud break than any of the other fertility-photoperiod treatments (Table 1) These cuttings had more than a two fold increase in bud break than cuttings propagated in the same fertility treatment under natural light. Within the natural light regime, fertility had no effect on percent bud break. The combination of Osmocote and supplemental light appears to be important in order to achieve optimal bud break for June cuttings.

Average shoot length of broken buds in the cutting bench followed the same trends as percent bud break. Cuttings receiving a treatment combination of Osmocote and supplemental lighting had the longest average shoot growth. There is an interaction between Osmocote and photoperiod that yields increased bud break and shoot growth Osmocote used without lighting caused no significant differences and vice versa.

Cuttings taken on July 23 had similar rooting percentages when rooted in the same photoperiod treatment (Table 1) For this date, the cuttings rooted in Osmocote and under the extended photoperiod treatment had a significantly greater rooting percentage than cuttings rooted in the same fertility but under natural light. Unlike the first experiment, photoperiod didn't affect rooting. Root dry weights were significantly higher in the first experiment for the following treatments. (1) Osmocote and supplemental light; (2) Control and supplemental light (Table 2). The remaining 4 treatments had similar weights for both cutting dates. In general, rooting percentage was not affected by either cutting date, but root weight was higher for cuttings taken in June when they were treated with an extended photoperiod or an extended photoperiod plus Osmocote incorporation. An extended photoperiod apparently has a more marked affect on rooting when natural day lengths are long also.

Bud breaks did not occur in cuttings during the July 23 cutting date Bud break and shoot growth in the propagation bench was only stimulated by the early cutting date. The cuttings taken in mid-July might have been in a different physiological state than cuttings taken in June These cuttings might not have been as sensitive to the specific treatments that stimulated bud break.

On the August 28 cutting date, within a photoperiod treatment, there were no significant differences in percent rooting (Table 2). As with the other cutting dates, there was no fertilizer effect. However, the cuttings that received an extended photoperiod had significantly greater mean rooting percentages than cuttings rooted under natural light at corresponding fertility levels (Table 1). These results are similar to the other cutting dates. The use of an extended photoperiod treatment in late August significantly increased rooting percent but the use of fertility in the rooting medium at this time was not beneficial In general, the rooting percentages recorded for all 6 treatments were significantly less than percentages observed for the first two cutting dates (Table 2). The low rooting percentages observed can be explained by the late cutting date. The shoots of the stock plants in the nursery were growing very slowly or had stopped growing when the cuttings were taken The shoots had hardened substantially and terminal buds were forming. These conditions will often lower the rooting percentage.

Table 2. Effect of cutting date on mean rooting percentage, and root dry weight for fertility-photoperiod treatments on cuttings of *Acer rubrum* 'Red Sunset'

	Extended photoperiod			Natural photoperiod		
Cutting Date	*Osmocote*	*Liq Fert*	*Control*	*Osmocote*	*Liq Fert*	*Control*
June 16						
Rooting percentage	[a]91 4a	82 8a	94 2a	60 0a	74 0a	57 0a
Root Dry Wt (g)	2 92a	1 84a	1 90a	1 49a	1 13a	0 93a
July 23						
Rooting percentage	91 4a	88 6a	82 8a	57 0a	74 0a	65 6a
Root Dry Wt	1 82b	1 24a	0 89b	1 32a	0 80a	0 62ab
August 28						
Rooting percentage	54 0b	60 0b	48 6b	25 8b	20 0a	25 6a
Root Dry Wt (g)	0 46c	0 38b	0 31b	0 27b	0 13b	0 11b

[a] Mean Separation in columns by Duncan's multiple range test, 5% level

There were no significant differences in mean root dry weight among any of the fertility treatments within each photoperiod regime for the August cutting date. However, cuttings treated with liquid fertilizer under an extended photoperiod had a significantly higher mean root dry weight than cuttings treated with the same fertility level and rooted under natural light. Extending the photoperiod only increased root dry weight when fertility was added to the rooting medium. The root weights taken from the third cutting date were significantly less than the first two experiments for the following treatments. (1) Osmocote and supplemental light; (2) liquid fertilizer and supplemental light; (3) Osmocote and natural light, (4) liquid fertilizer and natural light (Table 2) There were no bud breaks recorded for cuttings taken on August 28.

In general, cuttings of *Acer rubrum* 'Red Sunset' had the highest rooting percentages and root dry weights when they were propagated in June and July. Only those cuttings propagated in June broke bud and began to grow while still under mist. The use of an extended photoperiod in the propagation area significantly increased rooting percentages for all cutting dates. However, the actual percentages were significantly less on the third date. Cuttings that were rooted in an Osmocote amended medium and under an extended photoperiod had a significantly greater root dry weight than cuttings of all other treatments for the first two experiments. In the first experiment, percent bud break and shoot length were highest when cuttings were treated with Osmocote and an extended photoperiod. This study indicates that to maximize rooting percentage and stimulate the most root and shoot growth while plants are still under mist it is important to propagate *Acer rubrum* 'Red Sunset' cuttings in June under an extended photoperiod and in a rooting medium amended with Osmocote.

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MICHAEL DIRR Why select 6,000 ppm IBA for your auxin treatment?

BRYCE LANE. My advisor recommended that concentration on the basis of his experience.

ELWIN ORTON: Is there any interest from Ohio growers in using the single node cutting for propagation? When I first reported this in 1977 all treatments rooted 98% in 21 days. Commercial growers appear to be using tip cuttings.

BRYCE LANE· After having followed up on this research with ideas on production, I would recommend single node cuttings because we had to pinch out one of the two nodes that broke. This caused the production of a "dog leg" in the stem at the 6 to 8 in level

ELWIN ORTON: Yes, we established that fact in 1977