Effect of Cutting Size on Rooting and Subsequent Growth of Acer rubrum 'Red Sunset' Cuttings[1]

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Abstract

Rooting and subsequent overwinter survival and growth of single-node (5 cm; 2 in), triple-node (15 cm; 6 in), and tip cuttings (15 cm; 6in) of *Acer rubrum* L. 'Red Sunset' were compared. Triple-node cuttings had significantly more roots and total length of roots than single-node and tip cuttings, but no difference in percent rooting or percent survival existed among the cutting types. The triple-node and tip cuttings had significantly greater caliper after the first year of growth than the single-node cuttings, but the difference was minor (1 to 2 mm; 0.04 to 0.08 in). No difference in first year height existed among the cutting types. The single-node cuttings were straighter and had significantly fewer lateral budbreaks than the triple-node and tip cuttings.

Index words: propagation, liners

Introduction

Orton (7) first reported satisfactory rooting percentages of *A. rubrum* single-node, 5 cm (2 in) long cuttings. The use of single-node cuttings decreases the space requirement for handling and increases the number of cuttings obtained from a stock block (7). English (5) advocated the use of single-node cuttings for *A. rubrum* trees. However, many producers of *A. rubrum* liners still use longer (15 to 20 cm; 6 to 8 in) multi-node cuttings (6).

Longer multi-node cuttings would be preferred over single-node cuttings if they rooted more readily or grew more vigorously after planting. No definitive work has been conducted comparing the rooting results of different length cuttings. Donnelly and Yawney (3) reported that rooting percentages of *A. saccharum* Marsh. increased substantially with increasing shoot length. Forty-eight % of the 15 cm (6 in) cuttings rooted and 28% of the 5 cm (2 in) cuttings rooted. Dixon (2) observed that larger cuttings (15 to 25 cm long, 6 to 8 in) of *A. japonicum* Thunb. 'Aconitifolium' rooted better than smaller ones. Suszka (12) determined that rooting percentages and mean root length increased when the length of *Populus* × *euromericana* cuttings was increased from 5 to 20 cm (2 to 8 in).

Shugert (9) believed that it would not be economical to use single-node *A. rubrum* cuttings to produce liners, as the length of time to produce liners of a saleable size with single-node cuttings would be longer than for larger cuttings. Clay (1) reported that English obtained a 0.6 to 1.0 m (2 to 3 ft) *A. rubrum* plant in 1 year in British Columbia which was comparable to growth of a 1-year-old seedling. Single-node *A. rubrum* cuttings planted in #2 nursery containers made as much as 1.83 m (6 ft) of new growth in the first year in New Jersey (7).

Acer rubrum 'Red Sunset' has been one of the highest rated trees in the Ohio Shade Tree Evaluations and is considered one of the best shade trees by many nurserymen and landscape designers because of its clean foliage, strong wood, rapid growth rate, brilliant red fall color, and wide regional adaptability (4). Large numbers of *A. rubrum* 'Red Sunset' are produced; consequently, great savings could be achieved through any increase in efficiency of the production process.

The purpose of this study was to compare the percent rooting and subsequent season's growth of single-node and triple-node (no terminal bud present) cuttings of *A. rubrum* 'Red Sunset.' Additionally, the effect of tip cuttings (terminal bud present) on rooting and subsequent growth was assessed.

Methods and Materials

Plant material. On July 31, 1985, cutting material was taken from 5-year-old, 5–6 m (16.4–19.7 ft) tall *A. rubrum* 'Red Sunset' field-grown trees in Piedmont, South Carolina. The terminal buds had not formed, and the tips of the shoots consisted of soft, green, unhardened wood.

Cuttings. Three types of cuttings were made from the cutting material: 1) Single-node cuttings: cut 10 mm (0.4 in) above the node and 40 mm (1.6 in) below the node (total length 5 cm; 2 in); 2) Triple-node cuttings: the first cut made 10 mm (0.4 in) above the distal node and the second cut made below the proximal node so that the cutting's total length was 15 cm (6 in); and 3) Tip cuttings: cut 15 cm (6 in) long, contained 3–5 nodes, and included the terminal bud. Each cutting was dipped for 5 sec in 5,000 ppm indolebutyric acid (IBA) dissolved in 50% ethanol. The cuttings were stuck in 5 inch standard Kord plastic pots (12 cm wide × 10 cm deep) containing a perlite:peat (2:1/v:v) media and placed on a greenhouse bench under mist (2 ½ seconds every 5 minutes). The cuttings were shaded by 55 percent black saran shade cloth.

The experimental design was a randomized complete block design with 8 cuttings × 3 treatments × 5 blocks. After 6 weeks the mist was turned off and cuttings were sampled to determine percent rooting, number of roots, and average root length.

Overwinter survival and growth. Five cuttings × 3 treatments × 5 blocks (75 total cuttings) were overwintered in an air-inflated double-layered polyethylene structure. On May 1, 1986, overwinter survival percentages were deter-

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mined, and 4 cuttings of each treatment in each block were planted in #3 nursery containers using a pinebark:sand (4:1/v:v) medium. The containers were randomly placed on 45 cm (18 in) centers. In early June, 14 g of 18.0 N-12.5 P-10.0 K Osmocote was topically applied to each container. The plants were not pruned or staked, and were hand-watered as needed.

On December 17, 1986, the height and caliper (15 cm; 6 in above the medium surface) of the liners were measured. At the same time, the liners were examined to determine the occurrence of lateral or terminal budbreaks from the original cutting wood. Only significant lateral budbreaks which would require pruning during the first year were counted. The growth habits of the liners were rated according to the scale: 2) saleable, as straight central leader present; 1) saleable, afterstaking to straighten central leader; and 0) unsaleable, as liner would have to be cut back to a few buds above ground level, and a new central leader would be developed from the subsequent growth.

Results and Discussion

Rooting study. Many rooting studies have shown that large cuttings give better rooting results than small cuttings (2, 3, 12). The rooting results of this study (Table 1) indicate that multi-node, 15 cm (6 in) *A. rubrum* 'Red Sunset' cuttings do give better rooting results than smaller 5 cm (2 in) single-node cuttings. The number of roots and the total length of the roots of the triple-node cuttings were significantly greater than those of the single-node cuttings.

The triple-node cuttings had significantly more roots and greater total length of roots than similarly-sized tip cuttings. The authors and English (5) have observed that *A. rubrum* cuttings, which are still soft and green, rapidly necrotize in the misting bed and this would deleteriously affect rooting results. The terminal portions of the tip cuttings were green and soft when the cuttings were stuck, and the cuttings did lose leaves during the rooting process. Many propagators routinely remove soft, succulent tissue when cuttings are stuck.

No study has been conducted to examine why larger cuttings give better rooting results than smaller cuttings. In this study, no statistical difference in rooting percentages existed between the 3 cutting treatments, but larger cuttings exhibited more root growth (Table 1) than the smaller single-node cuttings. The greater leaf area of the larger cuttings with 6 or more leaves would provide more carbohydrates to support root development than the 2 leaves of the single-node cuttings. In addition, the greater carbohydrate reserve capacity of the larger 15 cm (6 in) cuttings could provide additional support for root development.

Survival. Cuttings of *A. rubrum* have a significant overwintering problem. Cuttings which do not resume growth after rooting, do not overwinter as successfully as those that break bud and produce a flush of shoot growth. In this study, no significant differences in overwinter survival existed among the 3 cuttings types. Ninety-two % or greater of the cuttings survived the winter (Table 1). None of the cuttings broke bud before overwintering. No fertilizer was added to the cuttings in this study before this type of overwintering period. Smalley and Dirr (10) reported the deleterious effect of fertilizer on the overwinter survival of *A. rubrum* 'October Glory' cuttings which do not break bud. The high overwinter survival rates of these cuttings provide further support for the concept of Stimart et al. (11) that fertilizer should not be applied after rooting to taxa which exhibit the overwinter survival problem.

Table 1. Effect of cutting size on rooting and overwinter survival of *Acer rubrum* 'Red Sunset.'

Cutting type	Rooting (%)	Total number of roots	Total length of roots (cm)	Survival (%)
Single-node	88a[z]	12b	77b	92a
Triple-node	95a	47a	197a	96a
Tip	85a	16b	116b	96a

[z]Means within columns followed by the same letter or letters are not significant at the 5% level using the Duncan's Multiple Range Test.

Subsequent growth study. The greater root growth of the triple-node cuttings compared to single-node cuttings would be valuable to nurserymen, if this extra root growth translated into greater top growth during the subsequent growing season. Hypothetically, the greater root growth would provide more root surface area which would facilitate the uptake of water and nutrients. Also, the roots are the major storage organ for a small plant (8, 13), and the greater root mass would provide more carbohydrate reserves to support early spring budbreak and growth. In this study, little difference existed among the caliper or height results of the single-node, triple-node, and tip cuttings in the year following rooting (Table 2). A statistical difference (0.2 cm; 0.08 in) was found between the caliper results, but this difference would be inconsequential, economically, as deciduous liners are graded by height when they are this small.

The growth resulting from the single-node cuttings was statistically more desirable, in the context of a production scheme, than the growth from the other 2 types of cuttings. A higher rating indicated that the growth was straighter; thus, the use of single-node cuttings could reduce pruning and staking efforts resulting in lower production costs. Typically, *A. rubrum* liners are grown for 1 year in the field, and the growth is then cut back to a few buds above the ground in the second spring. Vigorous growth follows this severe cutback, and 1 shoot is trained into a central leader. Potentially, the use of single-node cuttings could reduce the production schedule by 1 year. The straight growth from

Table 2. Effect of cutting size on first year growth of *Acer rubrum* 'Red Sunset.'

Cutting type	Caliper (cm)	Height (m)	Straightness rating	Percent lateral budbreak[z]
Single-node	1.4a[y]	1.68a	1.55a	53a
Triple-node	1.6b	1.79a	1.00b	90b
Tip	1.5b	1.78a	1.00b	70a

[z]Only significant lateral budbreaks which would require pruning during the first year were counted. The growth habit of the liners was rated according to the scale: 2) saleable, as straight central leader present; 1) saleable, after staking to straighten central leader; and 0) unsaleable, as liner would have to be cut back to a few buds above ground level, and a new central leader would be developed from the subsequent growth.

[y]Means within columns followed by the same letter or letters are not significant at the 5% level using the Duncan's Multiple Range Test.

the single-node cutting would make the cutting back process to promote straight growth unnecessary.

The triple-node cuttings also had a greater percentage of lateral budbreaks (Table 2) during the spring from buds present on the original cutting material. These lateral bud breaks developed into larger branches that should have been pruned during the first season of growth. This indicates that single-node cuttings would require less pruning than triple-node cuttings.

Tip cuttings, which contain a terminal bud, could produce straighter growth during the first year than cuttings which do not contain a terminal bud. The results of this experiment demonstrated that the existence of a terminal bud in a tip cutting does not promote the development of a straight liner, as single-node cuttings had a significantly greater straightness rating than tip cuttings.

Significance to the Nursery Industry

Single-node cuttings of *A. rubrum* 'Red Sunset' could be used to lower propagation costs by reducing the amount of stock block cutting material and cutting handling space required. No difference in amount of first-year growth was found between single-node and multi-node cuttings. Single-node cuttings had higher quality growth in terms of straightness which could result in reduced pruning and staking costs. Thus, the use of single-node cuttings for propagation of *A. rubrum* 'Red Sunset' could lower production costs with no resulting loss in amount of growth and with a potential increase in quality of the finished liner.

Literature Cited

1. Clay, L. 1980. Question box. Proc. Intern. Plant Prop. Soc. 30:53.

2. Dixon, E.A., Jr. 1980. Propagation of certain *Chamaecyparis* cultivars and *Acer japonicum* 'Aconitifolium.' Proc. Intern. Plant Prop. Soc. 30:336–337.

3. Donnelly, J.R. and H.W. Yawney. 1972. Some factors associated with vegetatively propagating sugar maple by stem cuttings. Proc. Intern. Plant Prop. Soc. 22:413–430.

4. Dirr, M.A. 1983. Manual of woody landscape plants. Stipes Publishing Co., Champaign, IL.

5. English, J.A. 1981. Rooting *Acer rubrum* cultivars using single node cuttings. Proc. Intern. Plant Prop. Soc. 31:147–150.

6. Moller, G.A. 1985. How one Oregon grower produces trees from softwood cuttings. Amer. Nurseryman 162(5):68–69.

7. Orton, E.R., Jr. 1977. Single-node cuttings: A simple method for the rapid propagation of plants of selected clones of *Acer rubrum* L. The Plant Propagator 24(3):12–15.

8. Robinson, J.C. and W. Schwabe. 1977. Studies on the regeneration of apple cultivars from root cuttings. II. Carbohydrate and auxin relations. J. Hort. Sci. 52:221–233.

9. Shugert, R. 1980. Question Box. Proc. Intern. Plant Prop. Soc. 30:513.

10. Smalley, T.J. and M.A. Dirr. 1986. The overwinter survival problems of rooted cuttings. The Plant Propagator 32(3):10–14.

11. Stimart, E.P., M.A. Goodman and E.N. Ashworth. 1985. The relationship of shoot growth and nitrogen fertilization to cold hardiness of newly rooted *Acer palmatum* Thunb. 'Bloodgood' stem cuttings. Scientia Hortic. 27:341–347.

12. Suszka, B. 1963. Survival and dimensions of one-year poplar plants in relation to the length of cuttings and their location on the shoot. Arboretum Kornickie, Posan 8:221–246.

13. Stassen, P.J.C. 1984. Seisoensveranderinge in die Koolhidraatinhoud van jong applebome. S.-Afr. Tydskr. Plant Grond. 1(3):92–95.