ACER to ZELKOVA: propagation by cuttings avoids graft incompatibility

by Elwin R. Orton, Jr., Research Professor
Department of Horticulture and Forestry
Rutgers, the State University
New Brunswick, New Jersey 08903

ABSTRACT. --The use of single-node cuttings provides a practical method for the rapid increase of select clones of red maple (Acer rubrum L.) and avoids the problem of graft incompatibility encountered in propagating such plant material by budding. The general technique of propagation by stem cuttings is being extended to the commercial production of many other species of shade and ornamental trees where graft incompatibility has been a problem.

Graft incompatibility constitutes a serious problem in the use of scion cultivars of many different species of shade and ornamental trees. Acer rubrum and Quercus palustris Muenchh (pin oak) are species in which the graft incompatibility encountered with propagation by budding is of notable economic significance. Graft incompatibility may involve as high as 30 percent of the plants of A. rubrum 'October Glory' and other scion cultivars of this species. The incompatibility may be expressed as failure of the scion bud to unite with the seedling A. rubrum understock or it may be expressed as delayed-incompatibility after one or more years. Fortunately, most of the losses occur in the production nursery before the budded plants attain a height of 8 - 10 feet. However, instances of graft failure occurring after the plants have attained a caliper of 3 - 4 inches are not rare. The economic consequences of,graft incompatibility are more severe in cases where the incompatibility is not expressed (or detected) until after the plants are established in a landscape planting. At best, budding is an expensive form of propagation. When the additional cost associated with graft incompatibility is considered, the need for an alternative method of propagation is obvious.

There is a paucity of information relative to the nature of the graft incompatibilities encountered in the important genera and species of shade and ornamental trees. However, that need not preclude a practical solution to the problem(s). Based on the findings of five years of preliminary work, a demonstration study conducted in 1977 (Orton, 1978) proved the efficacy of utilizing single-node stem cuttings as a commercial means of propagating plants of select clones of A. rubrum. In addition to requiring less time and being more economical than budding, this method of propagation avoids any problem of graft incompatibility. The work with A. rubrum is reviewed herein.

LARGE CUTTINGS

In preliminary work with A. rubrum 'October Glory', it was found that large three-node cuttings eight to nine inches long and one-third to one-half inch in diameter taken during August and September rooted readily and grew vigorously. However, processing such large cuttings was unwieldly at all stages of the propagation procedure. Also, growth of more than one lateral bud often resulted, and pruning was required to obtain a plant with a single leader. More importantly, commercial production using cuttings of this size would not be feasible, due to the extremely large stock block of parental plant material that would be required. Tip cuttings from lateral shoots also were successfully rooted in preliminary trials, but use of such terminal cuttings also would require a large block of stock plants since each lateral shoot yields only one tip cutting. The use of single-node cuttings is advantageous because many cuttings can be obtained from each stock plant and the space requirements for handling such cuttings are minimal. Also, with the use of single-node cuttings, one can avoid the production of plants with multiple leaders merely by removing the vegetative buds in the axil of one leaf when sticking the cuttings.

SINGLE-NODE CUTTINGS

The principal work reported here was initiated August 7, 1977, for the purpose of demonstrating the efficacy of using single-node stem cuttings to propagate plants of A. rubrum. The plant material consisted of 48 lateral branches of current season's growth taken from four-year-old budded plants of 'October Glory' growing at Princeton Nurseries, Princeton, New Jersey.

One tip cutting and an average of 8.6 single-node cuttings were obtained from each lateral branch. Each single-node cutting was cut approximately three-eights inch above and one and one-half inches below the node. A total of 400 single-node cuttings was stuck in a propagation bench

containing'four parts sand and one part peat (compressed) by volume. All cuttings were treated with a mixture of Hormodin No. 3 and Benlate (19:l by volume). Intermittent mist was used. Frequency and duration of misting were six seconds every six minutes from 7 a.m. to 7:30 p.m. the first 11 days, from 8 a.m. to 6 p.m. the following six days and from 10 a.m. to 6 p.m. thereafter. Mist was not used during periods of rain or heavy cloud cover. Night lighting was employed from 10 p.m. to 2 a.m., utilizing 75 watt incandescent bulbs suspended three feet above the bench at a spacing of three and one-half feet. A minimum temperature of 24.5°C (76°F) was maintained in the propagation medium by the use of electric heating cables. Ambient air temperatures in the greenhouse ranged from 21° to 30°C (70° to 86°F) during daylight hours and from 13.3° to 20.6°C (56° to 69°F) at night.

Two levels of two variables (four treatments) were examined in this study: number of axillary buds per cutting (all buds intact vs buds removed from the axil of one leaf) and wounding (no wound vs a heavy wound made by removing a one inch slice from one side of the base of the cutting). A randomized complete block design with four replications of 25 cuttings per treatment was utilized for the 400 single-node cuttings. The cuttings were spaced two and one half inches apart in rows three inches apart. Cuttings in adjoining rows were positioned in an alternate alignment in order to reduce interference of the foliage in sticking the cuttings. The cuttings were inserted in the medium to a depth of approximately one and one-half inches in holes punched with a pointed dibble one-fourth inch in diameter.

The rooted cuttings in replicates 1 and 2 were lifted at 21 days and potted into Zarntainer No.200 containers, utilizing a mixture of two parts peat (compressed), two parts sand and one part soil (by volume). Rooted cuttings in replicates 3 and 4 were harvested at 35 days and potted in one-gallon plastic containers, using medium from the same 2:2:1 mixture. The potted cuttings were examined October 7, 1977 (60 days after sticking the cuttings), to obtain survival data and to record the number of cuttings that exhibited a flush of new growth. Rooting response and plant survival data are presented in Table 1.

Of the 400 single-node cuttings, 392 (98 percent) were rooted heavily at the time of removal from the propagation bench. All four treatments yielded commercially acceptable results regarding both the number of cuttings that rooted and the number of plants surviving on October 7. The numerical differences between treatments shown on Table 1 are not statistically significant. However, the cuttings potted at 21 days subsequently performed better than those potted at 35 days. (Table 2).

Of the 194 cuttings surviving from the 21-day harvest, 139 (72 percent) exhibited new vegetative growth when examined on October 7. Of the cuttings potted after 35 days in the propagation bench, 190 were alive on October 7, but only 63 (33 percent) exhibited new growth on that date. This differential growth response is believed to be a result of the transplant shock received by the cuttings potted at 35 days. The roots of these cuttings were five to eight inches long and were interlocked with the roots of adjacent cuttings such that a stripping action occurred when the cuttings were lifted from the bench. As a result, they came out bareroot and required frequent hand misting for several days following potting. In contrast, the cutting potted at 21 days were removed from the bench with an intact ball of medium adhering to the roots. Cuttings that produce a flush of vegetative growth prior to the winter dormant season constitute stronger plants, which can be overwintered more successfully and will yield more vigorous growth the following year. In preliminary work, plants transplanted to two-gallon containers following overwintering in a plastic greenhouse heated to a minimum temperature of 1°C (34°F) grew as much as six feet the following season when maintained in a greenhouse.

BUD REMOVAL AND WOUNDING

The effects of the different levels of the two variables (number of buds and level of wounding) employed are indicated by the data in Table 3.

Table 1. Effect of number of buds and wounding on rooting and survival of 400 single-node cuttings of A. rubrum 'October Glory'.

Treatment	No. of cutts. rooted in 24 days (Reps. 1 & 2)	No. of cutts. rooted in 35 days (Reps. 3 & 4)	Total Number (and percent) of cuttings rooted 21 and 35 days	No. of Plants Alive 10-7-77
1 Buds intact, no wound	46	48	94	92
2 One bud, no wound	50	50	100	96
3 Buds intact, heavy wound	50	50	100	98
4 One bud, heavy wound	50	48	98	98
Total	196	196	392	384

Table 2. Survival and growth response of rooted cuttings.

Treatment	Number of days in propagation bench	Condition of rooted cuttings on 10-7-77		
		Number alive	New Growth Number	Percent
1 Buds intact, no wound	21	45	32	71
	35	47	18	38
2 One bud, no wound	21	49	33	67
	35	47	10	21
3 Buds intact, heavy wound	21	50	41	82
	35	48	15	31
4 One bud, heavy wound	21	50	33	66
	35	48	20	42
Total	21	194	139	72
	35	190	63	33

Table 3. Effect of number of buds and wounding on rooting and on growth response of the rooted cuttings.

Experimental variable	Average of treatments	Number of cuttings rooted	Condition of rooted cuttings on 10-7-77		
			Number alive	New Growth	
				Number	Percent
Buds intact	1 & 3	194	190	106	56
One bud	2 & 4	198	194	96	49
No wound	1 & 2	194	188	93	49
Heavy wound	3 & 4	198	196	109	56

Neither removal of buds in the axil of one leaf at the time the cuttings were stuck nor heavy wounding of the cuttings had a demonstrable effect on rooting and survival of the plant material or on the early growth response of the rooted cuttings. Thus, it would appear that removal of buds at the time unrooted cuttings of A. rubrum are processed can be substituted for later pruning to achieve plants with a single leader.

Wounding the cuttings might have been expected to result in increased absorption of the synthetic root-promoting growth regulator (IBA) utilized, but no inhibitory effect on budbreak was evident. Fifty-Six percent of the wounded cuttings exhibited a new flush of vegetative growth at 60 days, compared with 49 percent for the unwounded cuttings. However, wounding did influence the position on the cutting at which roots formed. Root initiation occurred at the basal portion of unwounded cuttings, whereas, on wounded cuttings, roots emerged directly above the wound as well as at the base of the cuttings.

Stimulation of rooting above the wound could prove to be beneficial in commercial production of such plant material in the event of a temporary period of overwatering. It was observed in preliminary work with cuttings of A. rubrum that newly formed roots die and turn black quiEkly when overwatered either while in the propagation bench or immediately following potting. However, root regeneration was rapid once the medium became drier. Thus roots formed high on the cuttings (above the wound) might be less subject to dieback in the event of a short period during the propagation process when excess water is present in either the propagating or the growing medium.

TIP CUTTINGS

The 48 bud sticks utilized as a source of the 400 single-node cuttings discussed above provided 48 tip cuttings. These cuttings possessed three to five nodes each, were five to seven inches long and were handled under the same conditions as the single-node cuttings, except that the more succulent nature of the plant material necessitated more frequent misting.

Of the 48 tip cuttings, 46 (96 percent) were heavily rooted and possessed roots five to eight inches long when potted (53 days). The shearing effect of the interlocked roots bare-rooted the cuttings at lifting and caused considerable transplant shock. Thus, it was nec-

essary to provide shade and frequent misting in order to establish the plants following potting. Undoubtedly, the need for this special treatment would have been avoided had the cuttings been lifted from the propagation bench at 35 days.

MATURE CUTTINGS

In addition to the main study discussed above, which involved cuttings from juvenile plants, cuttings from a mature specimen of 'October Glory' were utilized in an attempt to demonstrate further the relative ease with which plants of A. rubrum 'October Glory' can be propagated from stem cuttings.

July 20, 1977, 60 single-node cuttings and 33 tip cuttings were taken from lateral shoots of a mature specimen (22 years from budding) growing at the Rutgers University research and display garden, New Brunswick, N. J. The tree was growing under drought conditions such that none of the lateral shoots provided more than two single-node cuttings plus a three to four-inch terminal cutting. Handled in the same manner as the single-node and tip cuttings, respectively, of the main study, 53 (88 percent) of the 60 single-node cuttings and five (33 percent) of the terminal cuttings were heavily rooted at the time of potting (10 weeks). A few of these cuttings produced new growth and flowered during this period.

A small number of cuttings of A. rubrum 'Red Sunset' was stuck August 8, 1977, in an attempt to demonstrate that the ease with which stem cuttings of this species can be rooted is not limited to cuttings of the cultivar 'October Glory'. Thirteen cuttings from one bud stick of 'Red Sunset' were stuck in the same propagation bench as the single-node cuttings of 'October Glory'. All 13 cuttings were rooted when lifted from the bench 16 days later.

In addition, 40 cuttings (including wounded and non-wounded single-node and two-node cuttings) were obtained from five lateral shoots of four-year-old budded plants of 'Red Sunset'. These cuttings were stuck in a medium of two parts peat (compressed), seven parts sand and one part soil (by volume) in Jiffy pots No. 335 ($3\frac{1}{2}$ inch). The pots were placed in two wooden flats, which were set on top of the medium in the propagation bench. After 14 days, the flats were removed from the mist bench and placed on a standard greenhouse bench under lights (10 p.m. to 2 a.m.) as used over the propagation bench. At 28 days after sticking the cuttings, many roots had penetrated the peat pots. In each flat, 19 of the 20 cuttings rooted.

Handling the cuttings in individual pots eliminated the transplanting operation; furthermore, in commercial practice, a flat containing 20 plants would constitute an economical unit to transport to the field.

These studies with 'October Glory' and 'Red Sunset' showed that the use of single-node stem cuttings is a simple method for the rapid increase of plants of select clones of A. rubrum. This work was conducted in cooperation with Princeton Nurseries, and, as preliminary results were obtained, the information was shared with personnel at Moller's Nursery, a major producer of ornamental and shade trees in Oregon. As reported by Schwab (1979), Moller's nursery has now extended the list of trees propagated by cuttings to include plants of flowering crab apples (Malus), flowering plums (Prunus),flowering cherries (Prunus), Amelanchier canadensis, Katsura-tree (Cercidiphyllum), cultivars of silver maple (Acer saccharinurn and the Lindens (Tilia).

At present, graft incompatibility remains a major problem in the production of the 'Sovereign' pin oak and select clones of other members of the black oak group. However, preliminary attempts at Rutgers University to propagate plants of the black oak group by means of stem cuttings have yielded encouraging results. Thus, the addition of these plant materials to the list of plants propagated by stem cuttings may not be far in the future. Once the demand for specific cultivars of these species provides the economic incentive, commercially acceptable techniques for propagating such plant materials from stem cuttings most likely will be achieved rather quickly.

LITERATURE CITED

Orton, Elwin R.
1978. SINGLE NODE CUTTINGS: A SIMPLE METHOD FOR THE RAPID PROPAGATION OF SELECT CLONES OF ACER RUBRUM L. The Plant Propagator 24(3)4-6.

Schwab, Bert W.
1979. NEW TECHNIQUES FOR GROWING WEST COAST TREES. The American Nurseryman 149(g): 70-72.