Tuesday Afternoon, December 6, 1983

The afternoon session was convened at 2:00 p.m. with Dale Maronek serving as moderator.

Editor's Note: Dale Maronek moderated a group of short presentations on stripping of cuttings. The following paper by Dale Maronek, Ron St. Jean, Tom McCloud, Vernon Black and Dan Studebaker were part of that session.

STRIPPING VS. NONSTRIPPING ON ROOTING OF WOODY ORNAMENTAL CUTTINGS — GROWER RESULTS

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Abstract. The effect of two different wounding treatments on rooting of cuttings was determined for 19 species. Rooting of stripped (wounded) or nonstripped cuttings varied by species. Differences on root morphology were found among stripped and nonstripped cuttings of some species. The nonstripping treatment saved considerable time during the cutting preparation process. However, the probable money saved during cutting preparation was offset by increased time for collection of suitable wood, sticking of cuttings, and/or the area of space needed to propagate the nonstripped cuttings.

INTRODUCTION

Through the years, members of our Society have periodically presented information pertaining to the importance of wounding cutings in order to increase rooting and/or quality of the root system (2,3,4,5). Often, the discussion centered around the magnitude of the wound (2,3,4) rather than whether wounding is necessary at all. Since wounding is labor intensive, there is a need to determine the magnitude of wounding necessary to obtain acceptable rooting (2).

In recent years simply stripping the basal leaves off the cutting has been reported as an effective method of wounding (1). In speaking with individual propagators, many of them have experimented with rooting cuttings without wounding. Unfortunately, the results of many of these studies have not been published. Last year, Ralph Shugert of Zelenka Nursery, reported that unstripped *Taxus* cuttings exhibited comparable

rooting to stripped cuttings. He also pointed out the potential for savings in labor costs through the elimination of the stripping process.

Upon the suggestion of Leonard Stoltz, this year's program chairman, plans were made to expand upon Ralph Shugert's initial results and determine if some other plant species could be successfully propagated without wounding. Each of the authors of this paper were asked to propagate several different species with basal foliage stripped off the cuttings and a similar amount left intact or nonstripped. Everyone was to use their own commercial propagation practices with stripping and nonstripping being the only variables. Rather than individually discussing each of the author's materials and methods, the species used, along with other propagation information, is summarized in Table 1.

RESULTS AND DISCUSSION

The comparison of rooting percentages and the average of primary and secondary roots for cuttings of each stripped and unstripped species are summarized in Table 1. A discussion of each author's specific procedures and results follows below. In some instances, the roots on cuttings of a particular species were so profuse that no root counts were made.

Tom McCloud, Appalachian Nurseries. Shaded, summer softwood cuttings of *Euonymus alata* 'Compacta', *Lonicera pileata*, and late summer, semi-hardwood *Forsythia viridissima* 'Bronxensis' cuttings were stuck in raised greenhouse benches. At the time of lifting, root development on all species was sufficient for potting. The rooting percentages of stripped and nonstripped *Forsythia* and *Lonicera* cuttings were similar (Table 1.) However, the rooting percentage of nonstripped *Euonymus* cuttings was about 10 percent better than stripped cuttings.

In general, the root systems of *Euonymus*, *Forsythia*, and *Lonicera* nonstripped cuttings were better than stripped cuttings of the same species. Nonstripped *Lonicera* cuttings had more primary roots than stripped cuttings (Table 1). Roots on nonstripped *Forsythia* and *Euonymus* cuttings were 10 to 20% longer than those on stripped cuttings, suggesting that the nonstripped cuttings may have rooted earlier than stripped cuttings. These results concurred with results from a previous study in which nonstripped *E. fortunei* 'Colorata' cuttings rooted faster and had a better developed root system than stripped cuttings (McCloud, unpublished data).

Table 1. Cultural information and the effect of stripping or nonstripping on rooting of woody ornamental cuttings. Data listed by nursery and species.

Species	Cutting treatment	No. stuck	Date stuck	Date evaluated	Hormone treatment	Media	Duration of bottom heat and temperature Days C	Mist	Percent rooting	Ave. no. primary roots *	Ave. no. secondary roots *
					APPALACHIAN NURSERIES						
Euonymus alata 'Compacta'	Stripped	1,000	6-10-83	7-18-83	Wood's 1-20	60% perlite & 40% vermiculite	None	Int.**	86	NC***	NC
	Nonstripped	1,000	6-10-83	7-18-83	ibid.	ibid.	ibid.	95	NC	NC	
Lonicera pileata	Stripped	100	7-20-83	9-1-83	ibid.	60% perlite & 40% vermiculite	ibid.	ibid.	90	8	NC
	Nonstripped	100	7-20-83	9-1-83	ibid.	ibid.	ibid.	ibid.	90	12	NC
Juniperus horizontalis 'Wiltoni'	Stripped	1,000	8-24-83	11-7-83	ibid.	50% perlite & 50% peat	ibid.	ibid.	70	6.1	2.6
	Nonstripped	1,000	8-24-83	11-7-83	ibid.	ibid.	ibid.	ibid.	24	5	3
Forsythia viridissima 'Bronxensis'	Stripped	100	9-2-83	9-23-83	ibid.	ibid.	ibid.	ibid.	100	14	NC
	Nonstripped	100	9-2-83	9-23-83	ibid.	ibid.	ibid.	ibid.	100	15.3	NC

Table 1. Cultural information and the effect of stripping or nonstripping on rooting of woody ornamental cuttings. Data listed by nursery and species (continued).

Species	Cutting *treatment*	No. *stuck*	Date *stuck*	Date *evaluated*	Hormone *treatment*	Media	Duration of bottom heat and temperature Days C	Mist	Percent rooting	Ave. no. primary roots *	Ave. no. secondary roots *
					BAILEY NURSERIES, INC.						
Prunus virginiana 'Canada Red Select'	Stripped	78,000	6-13-83	10-10-83	750 ppm IBA	Sand	None	Int.	58	11	NC
	Nonstripped	100	6-13-83	ibid.	ibid.	ibid.	ibid.	Int.	60	10	NC
Lonicera xylosteum 'Compacta'	Stripped	47,500	7-6-83	ibid.	ibid.	ibid.	ibid.	ibid.	98	61	NC
	Nonstripped	100	7-6-83	ibid.	ibid.	ibid.	ibid.	ibid.	96	55	NC
Spiraea × *bumalda* 'Goldflame'	Stripped	100	6-16-83	10-10-83	None	Sand	None	Int.	94	13	NC
	Nonstripped	80,000	6-16-83	ibid.	ibid.	ibid.	ibid.	ibid.	90	17	NC
Syringa patula	Stripped	100	7-27-83	ibid.	750 ppm IBA	ibid.	ibid.	ibid.	97	51	NC
	Nonstripped	12,000	7-27-83	ibid.	ibid.	ibid.	ibid.	ibid.	96	36	NC
Prunus maackii	Stripped	44,000	7-27-83	ibid.	ibid.	ibid.	ibid.	ibid.	84	25	NC
	Nonstripped	100	7-27-83	ibid.	ibid.	ibid.	ibid.	ibid.	87	15	NC

Table 1. Cultural information and the effect of stripping or nonstripping on rooting of woody ornamental cuttings. Data listed by nursery and species (continued).

Species	Cutting treatment	No. stuck	Date stuck	Date evaluated	Hormone treatment	Media	Duration of bottom heat and temperature Days	C	Mist	Percent rooting	Ave. no. primary roots *	Ave. no. secondary roots *
					STUDEBAKER NURSERIES, INC.							
Juniperus chinensis 'Seagreen'	Stripped	1,045	1-20-83	5-23-83	Wood's 1-3	sand	98	18°	None	74.7	7.40	10.50
	Nonstripped	1,000	1-20-83	5-23-83	ibid.	ibid.	98	18°		39.6	6.16	7.30
Spiraea nipponica 'Snowmound'	Stripped	495	7-12-83	7-12-83	Wood's 1-10	ibid.	None		6 s./ 10 min.	72.1	NC	NC
	Nonstripped	495	7-12-83	ibid.	ibid.	ibid.	ibid.		ibid.	76.6	NC	NC
Forsythia × *intermedia* 'Lynwood'	Stripped	504	7-22-83	11-11-83	ibid.	ibid.	None		8 s./ 10 min.	91.3	34.4	50.3
	Nonstripped	504	7-22-83	11-11-83	ibid.	ibid.	ibid.		ibid.	90.3	27.7	58.1
Weigela florida 'Java Red'	Stripped	560	8-2-83	11-11-83	1000 ppm IBA	ibid.	None		8 s./ 10 min.	68.0	NC	NC
	Nonstripped	560	8-2-83	11-11-83	ibid.	ibid.	ibid.		ibid.	67.9	NC	NC
Berberis thunbergii 'Atropurpurea Nana'	Stripped	634	8- 4-83	11-11-83	Wood's 1-10	sand	None		high hmdty tent	46.7	6.8	12.0
	Nonstripped	634	8- 4-83	11-11-83	ibid.	ibid.	ibid.		ibid.	19.2	7.4	17.9

Table 1. Cultural information and the effect of stripping or nonstripping on rooting of woody ornamental cuttings. Data listed by nursery and species (continued).

Species	Cutting treatment	No. stuck	Date stuck	Date evaluated	Hormone treatment	Media	Duration of bottom heat and temperature Days	C	Mist	Percent rooting	Ave. no. primary roots *	Ave. no. secondary roots *
					VAN HOF NURSERIES							
Juniperus chinensis 'Hetzii'	Stripped	1,500	4-26-83	9-22-83	Wood's 1-5	sand	61	21°	8 s./ 6 min.	98	26	208
	Nonstripped	500	4-26-83	9-22-83	ibid.	ibid.	ibid.	ibid.	ibid.	72	11	215
J. conferta	Stripped	2,000	4-25-83	9-23-83	ibid.	ibid.	ibid.	ibid.	ibid.	84	17	152
	Nonstripped	500	4-25-83	9-23-83	ibid.	ibid.	ibid.	ibid.	ibid.	84	11	108
J. procumbens 'Nana'	Stripped	2,000	4-18-83	9-26-83	ibid.	ibid.	ibid.	ibid.	ibid.	49	8	118
	Nonstripped	500	4-18-83	9-26-83	ibid.	ibid.	ibid.	ibid.	ibid.	55	4	180
J. virginiana 'Grey Owl'	Stripped	2,000	4-14-83	9-28-83	ibid.	ibid.	ibid.	ibid.	ibid.	70	4	21
	Nonstripped	500	4-14-83	9-28-83	ibid.	ibid.	ibid.	ibid.	ibid.	48	7	52
J. horizontalis 'Abbey'	Stripped	600	4-13-83	9-29-83	ibid.	ibid.	ibid.	ibid.	ibid.	98	6	35
	Nonstripped	500	4-13-83	9-29-83	ibid.	ibid.	ibid.	ibid.	ibid.	46	19	86

* Average of 50 cuttings per treatment.
** Intermittent mist.
*** NC = Not Counted.

Late summer hardwood cuttings of *Juniperus horizontalis* 'Wiltoni' were stuck in flats and rooted under outside mist. Stripped cuttings rooted substantially better than nonstripped cuttings (Table 1). In addition, root systems of stripped cuttings were 10 to 20% longer.

Vern Black, Bailey Nurseries. Deciduous softwood cuttings were rooted in poly covered greenhouses. There were no significant differences in rooting percentages between stripped and nonstripped cuttings of all species propagated (Table 1). With the exception of *Spiraea* cuttings, nonstripped cuttings tended to have slightly fewer primary roots. However, regardless of the stripping treatment, root systems on all species were of acceptable size for planting.

There seems to be no real advantage to stripping softwood cuttings except for species with large leaves. Although stripping the lower leaves takes additional time, the increased time is offset by the increased efficiency in sticking stripped cuttings. Some plant species that we strip are *Cornus*, *Forsythia*, *Hydrangea*, *Lonicera*, *Syringa* (French cultivars), *Viburnum*, and most *Prunus* spp. Plant species we do not strip include *Euonymus*, *Physocarpus*, *Potentilla*, *Ribes*, *Spiraea*, and dwarf *Syringa* spp.

Dale Maronek and Daniel Studebaker, Studebaker Nurseries. Rooting percentages of stripped and nonstripped *Spiraea*, *Forsythia*, and *Weigela* cuttings were similar (Table 1). Only the rooting percentages of *Berberis* and *Juniperus* cuttings were affected by stripping treatment. Stripped cuttings of both of these species rooted nearly 50% better than nonstripped cuttings.

With the exception of *Forsythia* cuttings, stripping did not affect the overall size of the root systems on any deciduous species. The root systems of stripped *Forsythia* cuttings were visually larger than those on corresponding nonstripped cuttings. This was attributed to the larger number of primary roots formed on stripped cuttings (Table 1). However, the smaller root systems on nonstripped *Forsythia* cuttings were still of acceptable size for planting.

Stripping did affect the development of basal shoots on *Spiraea* cuttings. On 15 to 20% of all nonstripped cuttings, one to two shoots developed at the base of the cuttings. In contrast, none of the stripped cuttings had any basal shoot development. It would be of importance to determine if basal shoot formation on nonstripped cuttings had an effect on plant salability, especially as a liner.

Stripping treatments also had an effect on the pattern of root development and on root morphology of *Juniperus* cut-

tings. Roots of stripped cuttings were much finer and had more secondary roots than roots on nonstripped cuttings. The primary roots from nonstripped cuttings were thicker and quite brittle compared to those formed on stripped cuttings. A substantial number of these brittle roots broke off when the cuttings were potted. In addition, roots only formed from the basal end of the nonstripped cutting while root formation was fairly consistent up and down the stem of stripped *Juniperus* cuttings. Although not investigated in this study, root formation at only the base of the cutting could ultimately affect how the cuttings are potted and subsequent survival.

Ronald St. Jean, Van Hof Nurseries. All *Juniperus* cuttings were stuck in outside sand frame units and bottom heat was applied with electric cables set at 21°C for the first 61 days of propagation. Stripped cuttings of *Juniperus chinensis* 'Hetzii', *J. virginiana* 'Grey Owl', and *J. horizontalis* 'Abbey' rooted substantially better than corresponding nonstripped cuttings.

In contrast, nonstripped *J. conferta* and *J. procumbens* 'Nana' rooted substantially better than corresponding stripped cuttings. In general, all rooted cuttings had well developed root systems. The number of primary and secondary roots on stripped and nonstripped cuttings varied by species. However, regardless of the stripping treatment, fewer primary roots were often offset by an increase in the number of secondary roots.

We will continue to use nonstripped *J. conferta* and *J. procumbens* 'Nana' for both winter and summer production. Using nonstripped cuttings actually took more time since selection of cutting wood was restricted to thinly branched cuttings. Also, the smaller cuttings required more time to stick.

SUMMARY AND CONCLUSIONS

The results of this study indicate that the advantages of nonstripping versus stripping of cuttings should be determined on a species by species basis. In this study, root systems of most nonstripped cuttings were comparable to those of stripped cuttings. Consequently, the advantages of not stripping cuttings appear to be increased rooting and/or savings in labor. However, any labor savings as the result of not stripping cuttings may be partially or completely offset by a combination of factors. First, some propagators found it required more time to select cuttings of smaller size that didn't need to be stripped. Second, although man-hours were saved in the actual preparation of the cuttings, this was somewhat offset by the additional time reported by each propagator to stick the cuttings. Finally, nonstripped cuttings of some species required more bench space than stripped cuttings.

In addition, the results of this study also identified several areas which need to be examined more closely. The effects of decaying vegetative material in the propagation medium should be determined. Although none of the propagators experienced any difficulties in this study, decaying plant material could increase the spread of disease. In addition, decaying plant material could release plant toxins which may affect the rooting of cuttings. Finally, changes in root morphology should be closely monitored, since these may affect how the cuttings are handled during other subsequent nursery operations, e.g. lifting and/or potting of cuttings.

LITERATURE CITED

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CHARLIE PARKERSON: I have a question for all the panel members. Did you all stick your cuttings to the same depth for each treatment?

PANEL MEMBERS: Yes.

CHARLIE PARKERSON: A question for Ron St. Jean. Why did you select a smaller cutting for the nonstripped?

RON ST. JEAN: Because I was interested in equal bench density for the stripped and nonstripped.

CHARLIE PARKERSON: I do not think that yours was a fair test. We can not expect different sized cuttings to throw off the same number of roots.

PETER VERMEULEN: What method did each of you use to strip?

PANEL MEMBERS: Leaves were pulled off.

ED MEZITT: I am interested in the juniper cuttings. Were they all tip cuttings? We usually trim off the tips and make thicker cuttings because they give us more wood to root.

RON ST. JEAN: Yes, they were tip cuttings.

TOM MCCLOUD: Some of the *Juniperus horizontalis* 'Wiltonii' may have been mid-stem cuttings. Thick cuttings would provide more wood for rooting.

NORMAN TESSIER: Did you get a lot of debris in the sand from the nonstripped juniper cuttings? Did you use a fungicide?

RON ST. JEAN: It did not cause a problem and we did not use a fungicide.

PETER VERMEULEN: Ron, just for the record, there are two forms of *J. procumbens* 'Nana'. One came from D. Hill Nursery and the other from Europe. Many of the eastern nurseries use the European form. Is the one that you are using similar to *J. squamata* 'Prostrata'? It is important that we know this.

RON ST JEAN: Yes.

GERALD VERKADE: I am confused about the size of the *J. procumbens* 'Nana' cuttings. How long were they?

RON ST. JEAN: About 4 in long.

DAN STUDEBAKER: Ron, how did you introduce the *J. procumbens* 'Nana' into the medium?

RON ST. JEAN: We used a knife to draw a line and then stuck them.

DAN STUDEBAKER: What I am driving at is the following: I think we need to be sure to get good medium contact with nonstripped cuttings which can be difficult.

RALPH SHUGERT: I have two comments. First, just because we mention sticking the genus *Taxus* is not enough. You need to watch those cultivars and don't do your whole crop nonstripped; experiment with each cultivar. Second, in my opinion, we do not stick unstripped cuttings as deep in the bench. I think the shallower we can stick the cutting the better we are.

JAMES WILL: We have been sticking in July all our magnolia cuttings (*M.* × *soulangiana, M. stellata, M. salicifolia*) for the last 8 years without stripping. Many of the cultivars root 95 to 98% in outdoor sand beds. By not stripping, the cuttings are anchored better in the bed.

MARK RICHEY: I find that certain nonstripped cultivars require only ½ as much hormone, especially in the summer, or basal burn will result.

VOICE: I had the same problem with 'Crimson Pygmy' barberry cuttings, sticking them the same time you did. I took them early in July with ½ in. of last year's growth and found I could root a very high percentage with varying concentrations of hormone.

DALE MARONEK: Where did your roots form?

VOICE: Generally on the older .wood or the union of the two wood types.

JOERG LEISS: We also use old wood with excellent results in July.

SOMATIC MEIOSIS

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In order to obtain new genetic variability plant breeders have turned to wide hybridization. Wide hybridization is the process of obtaining progeny from crosses between distantly related species or genera. Wide hybridization could involve more classical approaches such as embryo culture (9) or some of the newer techniques of genetic engineering like electrically-induced cell fusion (13). In either case, a hybrid is produced which is likely to be intermediate in morphology between the two parents. Further breeding is generally required before a commercially valuable plant type is created.

In most instances wide-hybrids are sterile because of a lack of chromosome pairing during meiosis. This sterility can sometimes be corrected through chromosome doubling to create a type of polyploid called an amphidiploid. Amphidiploids, even though polyploid, behave like diploids in that only two of the potential four chromosomes in a set pair during meiosis (1).

Not all amphidiploids, however, are fertile. In the case of the interspecific hybrid *Lilium* 'Black Beauty' (*L. speciosum* × *L. henryi*), viable pollen was not produced until after the chromosomes were doubled. Five hundred and fifty pollinations with a very fertile amphidiploid *Lilium* 'White Henryi' (*L. henryi* × *L. leucanthum* var. *centifolium*) resulted in the pro-