TECHNICAL SESSIONS

Tuesday Morning, December 10, 1985

The thirty-fifth annual meeting of the Eastern Region of the International Plant Propagators' Society convened at 8:00 a.m. in the Ballroom of the Biltmore Plaza Hotel, Providence, Rhode Island.

PRESIDENT SAVELLA: Good morning members of the Eastern Region of the International Plant Propagators' Society and guests. On behalf of the Eastern Region Board, I welcome you to our 35th Annual Meeting here in Providence. Your program chairman, Elton Smith, has put a very informative program together for you and I hope you all take a very active part in the meeting.

At this time I would like to turn the meeting over to your program chairman, Elton Smith.

ELTON SMITH: Thank you, Len and good morning. I think we have an excellent program and I hope you will take an active part in it and ask questions. The moderator for this morning's session is Dr. Paul Read.

ETIOLATION AS A TOOL FOR ROOTING CUTTINGS OF DIFFICULT-TO-ROOT WOODY PLANTS

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Abstract. The stockplant pretreatment techniques of etiolation and banding were used with success in the cutting propagation of 13 woody ornamental species. Each pretreatment alone was noted to have a significant effect on rooting while the combination of the two resulted in optimal rooting in most trials. An alternative banding method has been developed, using reusable adhesive bands of Velcro, which allows for the addition of root promoting chemicals as a part of the banding procedure. Substantial improvements in rooting response were obtained in a number of species previously considered difficult to root.

INTRODUCTION

The etiolation of stock plants as a pretreatment to cutting propagation involves growing shoots in the absence of light. The etiolated shoots which result from this treatment are typically chlorotic, possess smaller leaves, longer internodes, and are more succulent than their light-grown counterparts (5).

Banding of shoots as a stockplant pretreatment refers to wrapping an opaque material, usually black plastic tape

around that part of the shoot that will become the base of the cutting. Banding may be applied early in the growth of a light-grown shoot, and would properly constitute blanching, or may be used in conjunction with etiolation to maintain an etiolated zone at the base as the rest of the shoot is permitted to green-up. The goal of these stockplant pretreatments is to obtain stem cuttings with basal tissues that have developed in the absence of light. In this way these techniques are similar to the well known propagation techniques of air layering and stooling (12).

The techniques of etiolation and banding were first combined by Gardner (3), for use in apple propagation. Recently, much work has been done with these techniques at the East Malling Research Station, Kent, England. Their research with M.9 apple rootstocks and other woody species has shown that 80% shade or more produces shoots which root significantly better than light-grown controls (7,8,9). This permits the use of ventilated shading materials instead of black plastic, reducing temperature and humidity build-ups under the covers that can stress the etiolated shoots and promote disease (7,8,9). This also results in cuttings which are stronger and larger than those grown in complete darkness (4). The use of etiolation and banding at East Malling involves erecting shade enclosures as bud-break commences, and leaving the cover in place until shoots have elongated to a length sufficient for banding (8 to 10 cm) (11). Banding is applied at this time and left in place as the shoots green up (4).

Several decades of work, on a variety of plant materials, have soundly established the benefits which may be obtained using etiolation and banding as stock plant pretreatments to cutting propagation of apple (2,3,7,8,9), hibiscus (6), lilac (10), pistachio (1), and linden (7).

RESEARCH OBJECTIVES

In our earlier work with the banding of woody ornamentals we used black plastic tape as the banding material. During that process we became aware of a number of drawbacks to the use of this material. Plastic tape is difficult to use in that small pieces of the sticky tape must be cut and handled carefully in the process of banding. Furthermore the tape has been observed to unwind in a number of instances, allowing light to impinge upon the etiolated stem tissues. Finally, the degree to which the etiolated stems must be handled, both in putting on and removing plastic tape, can result in damage to the stems, which are by nature of being etiolated very delicate. In beginning our present research we sought a banding material which could be quickly and easily applied, necessitating as little

handling of the etiolated shoot as possible. Hence we have modified the banding technique to make use of a reusable adhesive banding material commonly known as Velcro. This opaque banding material excludes light in the same way as tape, but may be more easily applied and removed. Furthermore, the unique adhesive nature of the material permits the application of root promoting chemicals as a part of the banding process.

MATERIALS AND METHODS

In our present work, the techniques of etiolation and banding were used alone or in combination, as pretreatments to the cutting propagation of a number of woody ornamental species which are listed with their rooting responses in Table 1.

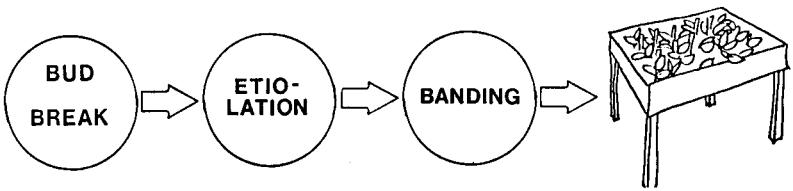
The procedure of etiolation involves erecting a black cloth covered structure over the shoots to be etiolated at the time of bud break and prior to the appearance of leaves. The structure is left in place, excluding light from the developing shoots, until the shoots have elongated enough for bands to be applied (2 to 5 in.). The progress of shoot elongation may be determined by visual inspections made briefly every couple of days. This does not appear to compromise the benefits of etiolation (11). At the time that etiolation is completed the banding material is applied to the base of the etiolated growth. Caution must be exercised at this point because etiolated shoots, lacking protective pigmentation, are susceptible to sun scorching. It is our practice to apply the banding material and then replace the shading cover partway. This allows the entry of a small amount of light. Over the course of one week the cover is gradually rolled back or lifted, allowing shoots to green up. After one week or so the shoots will tolerate exposure to full sunlight; however, the speed with which shoots adjust to higher light levels varies among species. The technique outlined above is presented graphically in Figure 1.

Hormone may be applied with the Velcro band at the time that the shoot is banded. In the present work we used Hormodin 3, a talc preparation containing 8000 ppm IBA. The hormone is applied to the band by pressing an opened band into a layer of the hormone. Excess hormone may be tapped from the band before application to the stem. The hormone laden band is then pressed firmly onto the stem, forcing the hooks of the band into the succulent stem tissues. Wounding of the stem occurs at this time.

After 4 weeks the cutting is made by severing the shoot from the stock plant, just below the band. The band is removed, and the cutting is then placed in the propagation mist

bench for rooting. Before sticking, the cuttings were treated with a talc preparation of 4000 ppm IBA and 25% Captan fungicide. In our research we used a rooting medium of perlite, peat, and white sand (2:1:1 v:v:v). The cuttings received bottom heat of 25°C and incandescent lighting was used to maintain a 16 hour photoperiod.

Figure 1. Etiolation and Banding as Stock Plant Pretreatments



1) Shade placed over shoots before leaves appear, and left in place until shoots reach 2″ to 5″.

2) Shade removed gradually over 1 week.

3) Banding applied when shade is first removed, and bands left on for 4 weeks as shoots green up.

4) Cuttings made just below band. Band removed before cuttings are placed in the propagation bench.

RESULTS

The rooting results for each trial presented here represent 4 treatments which were applied to the stock plants before the cuttings were made. The four shoot treatments were:

(1) light grown and not banded (control);

(2) light grown and banded with Velcro plus hormone;

(3) etiolated and not banded; or

(4) etiolated and subsequently banded with Velcro plus hormone.

The rooting responses of 22 trials, representing 13 species, are presented in Table 1. Information on stock plant age and disposition, and the time allowed for rooting in the propagation bench have been included.

The results show that in 16 of the 23 trials the combination of etiolation and banding resulted in the greatest increase in rooting response. The rooting responses may be grouped into those which responded primarily to etiolation, and those which responded primarily to banding. In the former category we have the shoots taken from a 10-year-old hedge of *Carpinus betulus*, young plants of *Castanea mollissima*, seedlings of *Quercus palustris*, and a 30-year-old hedge of *Q. robur*. Responding more to banding were shoots taken from either seedlings or a 30-year-old hedge of *Carpinus betulus*, a 30-

year-old hedge of *Corylus americana* 'Rush', 6 cultivars of *Syringa vulgaris*, and 3-year-old seedlings of *Pinus strobus*. Shoots from stock plants of *Q. coccinea*, on the other hand, required both pretreatments for a rooting response.

Table 1. Effect of etiolation and banding stock plant pretreatments on the percent rooting of 14 woody ornamental plant species

	Percent rooted[1]				
	Light grown		Etiolated		
Plant	No band	Velcro + hormone	No band	Velcro + hormone	Rooting time (weeks)
Species:					
Acer griseum 1 yr old seedlings	7	12	14	34	4
A. griseum 30 yr old trees	0	0	0	5	4
A. saccharum 1 yr old seedlings	47	64	65	86	2
Betula papyrifera 1 yr old seedlings	51	65	71	100	2
Carpinus betulus 1 yr old seedlings	0	63	5	94	2
C. betulus 10 yr old hedge	19	65	96	92	2
C. betulus 30 yr old hedge	14	52	37	72	2
Castanea mollissima 4 yr old seedlings	0	0	44	100	
Corylus americana cv. Rush 20 yr old hedge	4	83	0	87	4
Pinus mugo 3 yr old seedlings	41	64	–	–	12
P. strobus 3 yr old seedlings	29	79	58	83	12
Quercus coccinea 1 yr old seedlings	0	0	0	46	4
Q. palustris 1 yr old seedlings	31	24	50	44	4
Q. robur 1 yr old seedlings	36	70	53	58	4
Q. robur 30 yr old hedge	0	9	27	36	4
Q. rubra 2 yr old seedlings	37	50	29	35	4
Syringa vulgaris 4 yr old potted shrubs					
'Belle de Nancy'	28	65	21	38	5
'Charles Joly'	0	51	26	63	5
'Charles X'	20	70	45	79	5
'Michel Buchner'	21	79	43	83	5
'Mme. Lemoine'	10	10	21	83	5
'Pres. Grevy'	17	48	35	42	5

[1] Twelve or more cuttings used per treatment. Replicated 3 times when the availability of shoot material permitted.

We observed in nearly every case in which stems were banded with Velcro plus hormone, that the area under the band was swollen by the time the bands were removed after 4 weeks. Moreover, in two of the species, *Betula papyrifera* and *Carpinus betulus*, visible root primordia formed under the band on the stock plant. Cuttings made from these pre-rooted shoots rapidly developed root systems in the propagation bench. This response was noted previously in etiolated and banded apple shoots by Gardner (3) and Howard (8).

DISCUSSION

In the present research the stock plant pretreatments of etiolation and banding yielded very favorable increases in rooting response of a wide range of difficult-to-root woody ornamental plant species. Considering that these trials were the first attempts using etiolation and banding with the majority of these species, the results are especially encouraging. It is anticipated that continued work using these techniques on the same species will result in impressive increases in rooting response. The results obtained with several of these species represent, to the best of our knowledge, the best rooting responses yet achieved. Notably: *Carpinus betulus* (96%), *Castanea mollissima* (100%), *Q. coccinea* (46%), *Q. palustris* (50%), and *Q. rubra* (50%).

It may be recommended, based on this work and the works of previous researchers, that the use of etiolation and banding as stock plant pretreatments to cutting propagation will result in substantial increases in rooting response. In a number of species it appears that the response to one of the treatments alone, i.e. etiolation or banding, may be sufficient to warrant the use of only that stock plant retreatment. For example, the work of a number of researchers on the cutting propagation of apple has indicated that for that species etiolation is about twice as effective as banding in promoting rooting, though the combination of the two pretreatments always resulted in the optimal response (2,3,7,8,9).

The technique of etiolation and banding is especially useful for the propagation of particularly difficult-to-root species, where the value of the propagules warrants the moderate cost of the material needed to etiolate and band the stock plants. It also represents a viable alternative, we believe, to other, more expensive and labor intensive propagation techniques, such as grafting. Etiolation and banding may be applied on any one of a number of scales, from single branches to entire hedges, and even small potted trees. Furthermore, the components involved: the shade enclosure and reusable adhesive bands, are

easily obtained, and may be recycled indefinitely, with a minimum of preparation.

Reusable Velcro adhesive bands represent an improvement over plastic tape in that (1) they are easier to apply and remove, (2) they are reusable, (3) and they serve an added advantage in permitting the application of root promoting chemicals while simultaneously wounding the area of the stem in which we hope adventitious roots will form.

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PETER VERMEULEN: Do you have a list of plants that were not responsive to your technique?

BRIAN MAYNARD: *Acer rubrum* was not, but all treatments gave easy rooting. *Tilia cordata* also did not respond but work at East Malling showed positive results with that plant.

JOHN SMUGULA: Is the length of etiolation important?

BRIAN MAYNARD: We like the shoots to be long enough so that the shoot tips are not damaged during banding. Probably 2 to 5 in.; however, we have let them go longer.

Table 2. Plants propagated in the spring by hardwood cuttings and special treatments required. (Treatments given prior to sticking)

Cornus — dipped in Fermate powder
Cornus alba 'Elegantissima' — Rootone 10 + Fermate
Forsythia — 2500 ppm IBA + 1000 ppm Ethrel, quick-dip
Ligustrum — Rootone 10
Philadelphus — 2500 ppm IBA + 1000 ppm Ethrel, quick-dip
Potentilla cultivars — Rootone F
Sambucus
Spiraea
Symphoricarpus
Weigela — 2500 ppm IBA + 1000 ppm Ethrel, quick-dip

The rooted cuttings are dug in the fall with a modified potato digger and put in a cooler where they will be graded, counted, and trimmed for planting in the field the following spring.

MIKE DODGE: Have you had any success with lilacs from hardwood cuttings?

BERNARD FOURRIER: Yes with *Syringa* × *chinensis*

STOCK PLANT ETIOLATION FOR IMPROVED ROOTING OF CUTTINGS

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Abstract. The practice of stock plant etiolation, whereby dormant plants are grown under severely restricted light levels and then allowed to green up while shoot bases remain etiolated, using a covering of black adhesive tape, produced significantly better rooting of cuttings. Rooting was improved from 5% to 68.5% for *Fagus sylvatica*, from 15% to 42.5% for *Carpinus betulus*, and from 53.3% to 83.3% for *Pinus strobus*. Cuttings from 6 hybrid lilac cultivars also showed improved rooting with prior etiolation and, moreover, the period over which lilac cuttings could be propagated successfully was lengthened considerably.

INTRODUCTION

Using etiolation or, the exclusion of light, in the stimulation of adventitious root growth is a well established practice. As early as 1537 there is mention of light reduction having a favorable effect on the rooting of apple cuttings (3). The practices of stooling and other types of layering routinely use this

principle when mounding soil around the portion of stem to be rooted. Even when we insert the base of a cutting into an opaque rooting medium we are achieving this same effect.

Technically, etiolation refers to plants grown in total darkness; however, as this term has sometimes been used in propagation, it may refer to plants grown in a heavily shaded condition with some low level of light present. It is important, however, that the distinction be made between etiolation and the practice of blanching where stock plants are grown initially in the light and then shaded either entirely or in a localized area, usually the base of the stem (6).

Within the last ten years, the practices of etiolation and/or blanching have been investigated with renewed interest, primarily due to the work reported by Howard and co-workers at the East Malling Research Station in England (6,7,9). Their first success with this technique was with the difficult-to-root apple rootstock, M9, where prior etiolation of the stock plant increased rooting of softwood cuttings from 11% to 78%, on the average (6). Other researchers have also had success with the following difficult subjects for cutting propagation: *Tilia* spp. (9), *Acer platanoides* 'Crimson King' (9), *Pinus sylvestris* (5), *Syringa vulgaris* cvs. (8), *Mangifera indica* (1), and *Persea americana* (3), among others.

The purpose of this work was to etiolate such poorly rooting species as *Fagus sylvatica*, *Carpinus betulus*, and *Pinus strobus*, as well as 6 cultivars of *Syringa vulgaris* for the purpose of increasing their rooting percentages and, in the case of the lilacs, to lengthen the period of time over which cuttings could be successfully propagated. Hybrid French lilac cuttings are quite variable in their rooting response and propagators who have been successful attribute their success largely to choosing the correct timing for cutting collection, usually a brief period during initial shoot growth (2). Due to differences among the growth rates of lilac cultivars, variations in seasonal weather patterns from year to year, and stock plant growing conditions, choosing the optimal time for cutting collection can be a tricky endeavor.

METHODS

The method used to etiolate these plants was first developed by Gardner (4), modified by Howard (7), and further expanded for this report (Figure 1). Just prior to bud break, dormant stock plants, either in-ground hedges or container-grown plants, were covered by black plastic stapled over a frame which allowed for adequate new shoot growth. Light readings under the black plastic showed an average of 99%

light reduction, as slits were cut in the plastic for ventilation. The white pine plants, however, were grown in a 70°F day/ 62°F night greenhouse under 92% shade saran cloth.

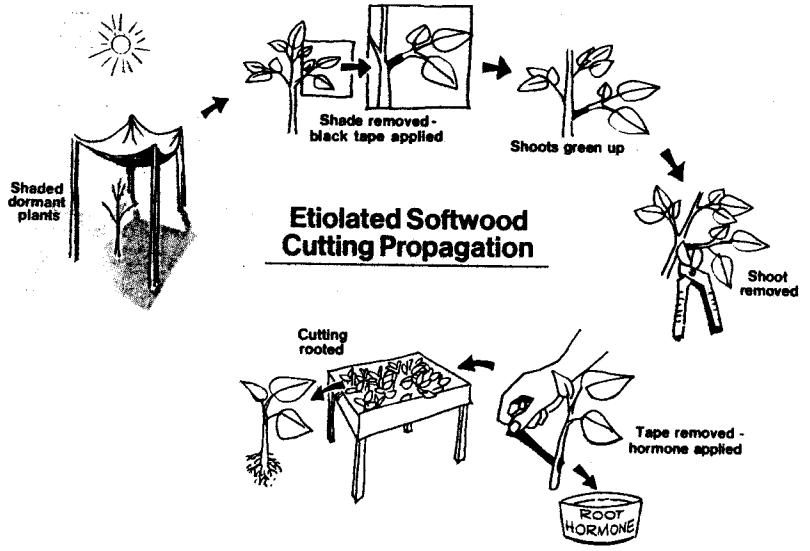

Figure 1. A graphic representation of the stock plant etiolation method.

After new growth reached approximately 6 to 8 cm in length, the north side of the enclosure was removed to begin weaning the greenish-yellow, soft shoots to the sun. Also, at this time, some shoots were banded at their bases with black adhesive tape to keep the future rooting zone of the shoot in an etiolated condition while allowing the shoot tips to green up. All black plastic shading was removed within one week and, after another week of greening-up, cuttings began to be collected. Collection continued at set intervals up to 12 weeks after shade removal in some cases. After shoots were collected, banded shoots had their tapes removed and then all cuttings were treated as normal softwood or greenwood cuttings, i.e. IBA was applied and the cuttings were rooted under mist in the greenhouse.

RESULTS

Cuttings from etiolated hedges of *C. betulus* and *F. sylvatica* showed a striking improvement in rooting over their respective controls (Table 1). Cuttings were collected at 2 and 8 weeks after banding, treated with 3000 ppm IBA in talc, and rooting assessed after 5 weeks in the mist bench.

Table 1. Effect of etiolation and banding on rooting of *Fagus sylvatica* and *Carpinus betulus* cuttings.[1]

	Percent rooting		
	+Shade+Band	+Shade−Band	−Shade−Band
Fagus sylvatica	69	42	5
Carpinus betulus	43	0	15

[1] 20 cuttings per treatment

Greenhouse grown *Pinus strobus* cuttings were collected at 4-, 8-, and 12-week intervals after shading was removed and/or banding applied, and given a quick dip with 4,000 ppm IBA and 25% Captan in 50% ethanol. Rooting percentages were averaged for all collection dates after cuttings were in the mist bench for 3 months. Etiolation or banding without prior shading improved rooting significantly (Table 2).

Table 2. Effect of etiolation and banding on rooting of *Pinus strobus* cuttings.[1]

	Percent rooting	
	+ Banding	− Banding
Etiolated	83	84
Light grown	79	53

[1] 36 cuttings per treatment

Cuttings from 6 hybrid lilac cultivars were collected 2-, 5-, 8-, and 12-weeks after shade was removed and/or banding applied. All cuttings were treated with 1,000 ppm IBA in talc and rooting assessed after 5 weeks in the mist bench (Figure 2). For 'Charles X', rooting of the control (−shade −band) was fairly high, 60%, at 2 weeks but dropped to 10% by 5 weeks, and remained low thereafter. The full etiolation treatment (+shade +band) began as did the control at 2 weeks, but improved to 80% at 5 weeks, before dropping to a steady 30% at the 8 and 12 week dates. With intermediate treatments, blanching (−shade +band) showed a small improvement over the control although not up to the levels of the full treatment. Initial shade minus banding gave no improvement over the control. A similar pattern of treatment responses is seen for 'Michel Buchner.' Control plants (−shade −band) rooted poorly at 2 weeks, gradually rising to 60% by 12 weeks. The full etiolation treatment began similarly to the control at 2 weeks but by 5 weeks was rooting at 80%, rising to 100% at the 8 and 12 weeks collection dates. With the 2 intermediate treatments, blanching (−shade +band) again showed a favorable, if more variable response, than the full treatment, and initial shading alone without banding showed little improvement over the controls.

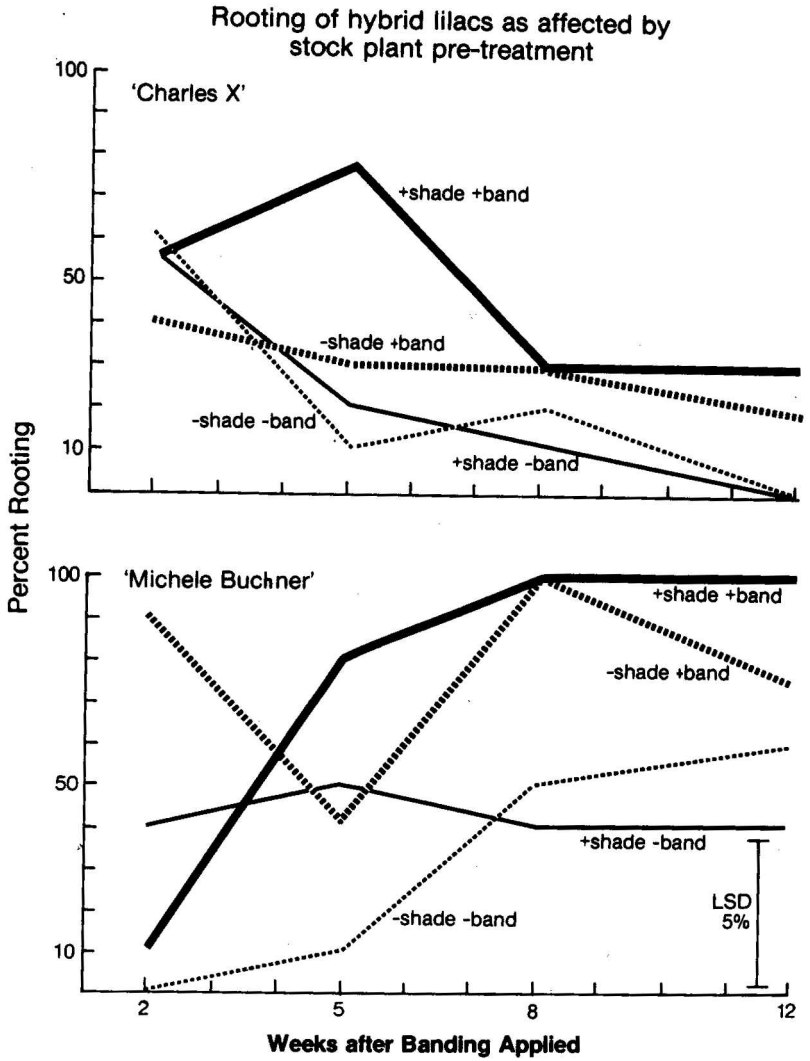

Figure 2. Rooting of hybrid lilac cultivars as affected by etiolation, banding, and date of collection.

Stock plants of 4 other lilac cultivars were also given the full etiolation pre-treatment (Figure 3). With these cultivars, etiolation also improved rooting; however, the results were less consistent. 'Madame Lemoine' is noted to be a particularly shy rooter, at best rooting only at 30 to 40% (2), yet etiolated cuttings collected 12 weeks after the shade was removed and banding applied, rooted at 80%. Unfortunately, there were not

enough shoots on control plants to make a true comparison. 'President Grevy', also a shy rooter, showed only slight improvement with prior etiolation, while etiolated 'Belle de Nancy' and 'Charles Joly' showed significant improvement over their respective controls.

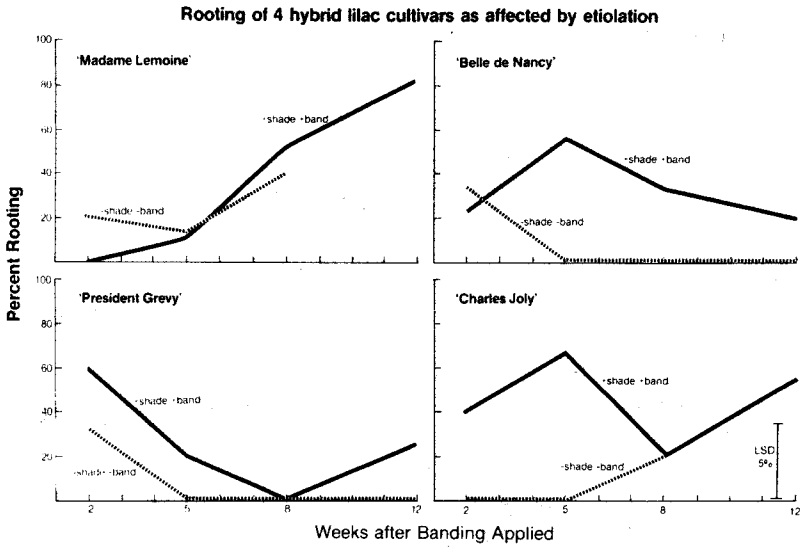

Figure 3. Rooting of 4 hybrid lilac cultivars as affected by etiolation and date of collection.

DISCUSSION

It is apparent that prior etiolation of cutting material and the related treatment of blanching are capable of improving rooting in a diverse group of plants. *Pinus strobus* cuttings responded positively to both shading or banding, either treatment achieving a 25 to 30% increase over the control cuttings. With this plant, localized banding was not necessary to keep the base of the etiolated shoot in a shaded condition while the shoot was greening-up as long as the shoot was initially grown under shaded conditions.

Etiolated *F. sylvatica* and *C. betulus* shoots showed a dramatic increase in rooting ability over their respective controls. Additionally, with *Fagus*, but not *Carpinus*, shading without subsequent banding also gave a noticeable improvement over the control.

Although all lilac cultivars showed a positive rooting response to etiolation plus banding, the magnitude of their respective improvements was cultivar dependent. Previous re-

ports stating that 'Madame Lemoine' and 'President Grevy' were poor rooters (2) were borne out by this study; however, for 'Me Lemoine' there was potentially a 4 week period (between the 8 and 12 week collection dates) where the etiolated cuttings rooted over 60%. 'President Grevy', the poorest in this trial, also reached 60% rooting success with prior etiolation at the two week collection date. Neither of these two cultivars' controls ever reached acceptable rooting levels. If we continue to arbitrarily use a 60% rooting level as being acceptable to commercial propagators, then 'Belle de Nancy' and 'Charles Joly' also reached that level for one and two collection dates, respectively, compared to none for their controls. With the case of 'Charles Joly', which has been reported to be an easy rooter with 75% or more rooting (2), the fact that we did not see this may be due to an inadequate level of IBA (1,000 ppm) used in this study, and a troubling frequency of decay in the bench as no fungicide was used. IBA concentrations of 3000 to 8000 ppm have been used by others on lilacs (2).

With the better rooting cultivars, 'Charles X' and Michel Buchner', not only was rooting significantly improved by stock plant etiolation, but the period over which cuttings could be successfully collected was lengthened considerably. Other propagators reporting variable success using etiolation with lilacs may not have witnessed its effectiveness due to having had only one collection time (8).

Again using the 60% rooting criteria as acceptable, etiolated 'Charles X' could potentially be rooted successfully at the 2 week collection date through to the fifth week or longer, while the control only rooted successfully at the first collection date. Etiolated 'Michel Buchner' cuttings could potentially be rooted at better than 60% for even longer — from the fifth week collection date, through to the twelfth week date, while its control rooted acceptably only at the last collection date.

It appeared to be essential that lilac shoots be grown in an etiolated state and then banded to exclude light from the future rooting zone of the cutting to achieve large improvements in rooting. Overall levels of lilac rooting may be further improved by the use of higher IBA levels and a fungicide in the mist bench.

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BILL FLEMER: The name of the second lilac clone is incorrectly spelled. It is 'Michel Buchner'.

PETER VERMEULEN: With *Carpinus* you had 0% with the intermediate treatment. Do you have a reason for that?

NINA BASSUK: It appears that it required both etiolation and localized banding to get the 40%.

RALPH SHUGERT: Did you use 1000 ppm IBA on all your cuttings?

NINA BASSUK: No, we used 4000 ppm plus 25% Captan in talc on *Pinus strobus* and *Carpinus*, and 3000 ppm on *Fagus*.

RALPH SHUGERT: For lilacs, 1000 ppm seems light. How did you determine this?

NINA BASSUK: The 1000 ppm was based on results from greenhouse-grown plants. In retrospect they appear to have been more sensitive than outdoor grown plants. If I did it over again, I would use a higher concentration of IBA.