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

NINA BASSUK, DIANE MISKE, AND BRIAN MAYNARD

Department of Floriculture and Ornamental Horticulture
Cornell University
Ithaca, New York 14853

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.

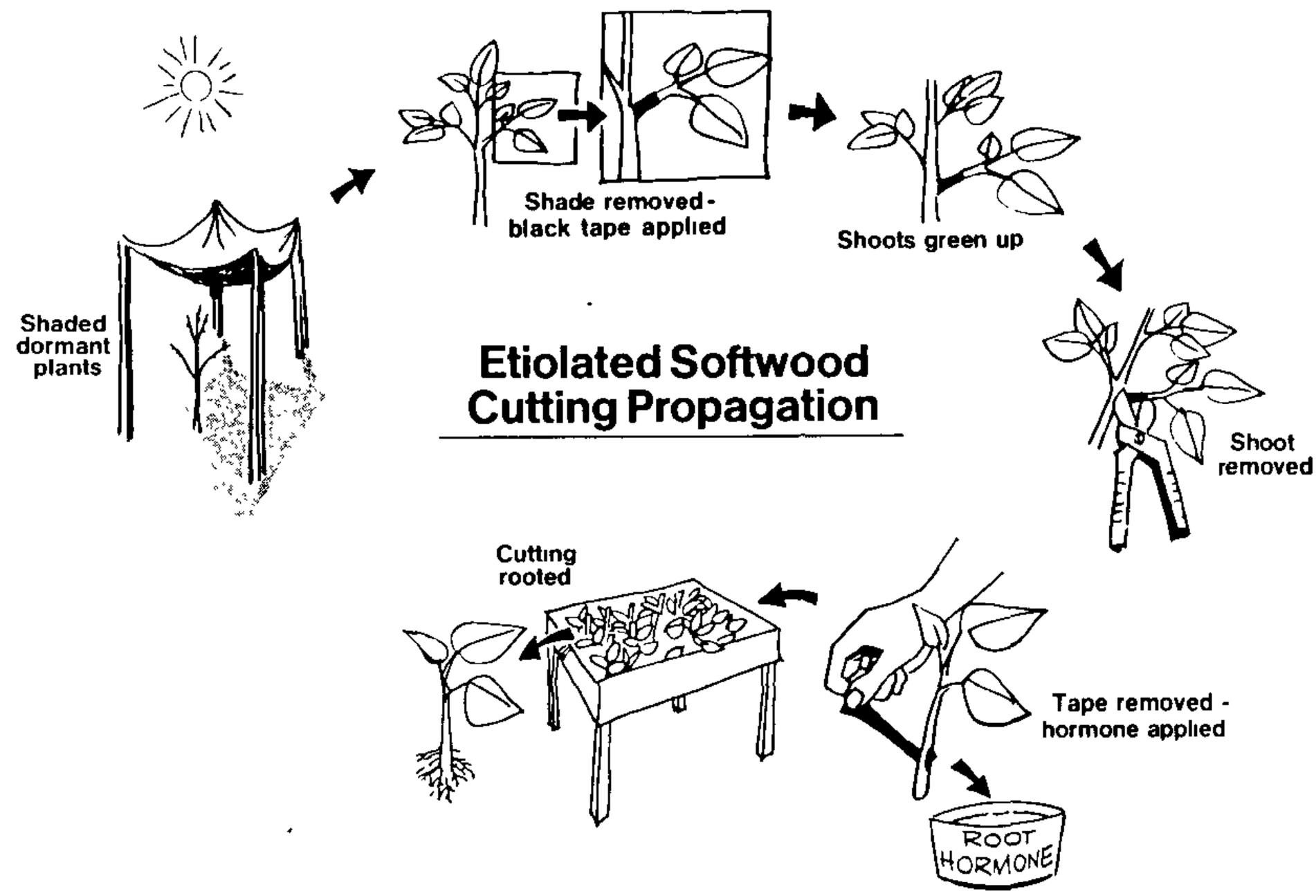

Figure 1. A graphic representation of the stock plant etiolation method

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.

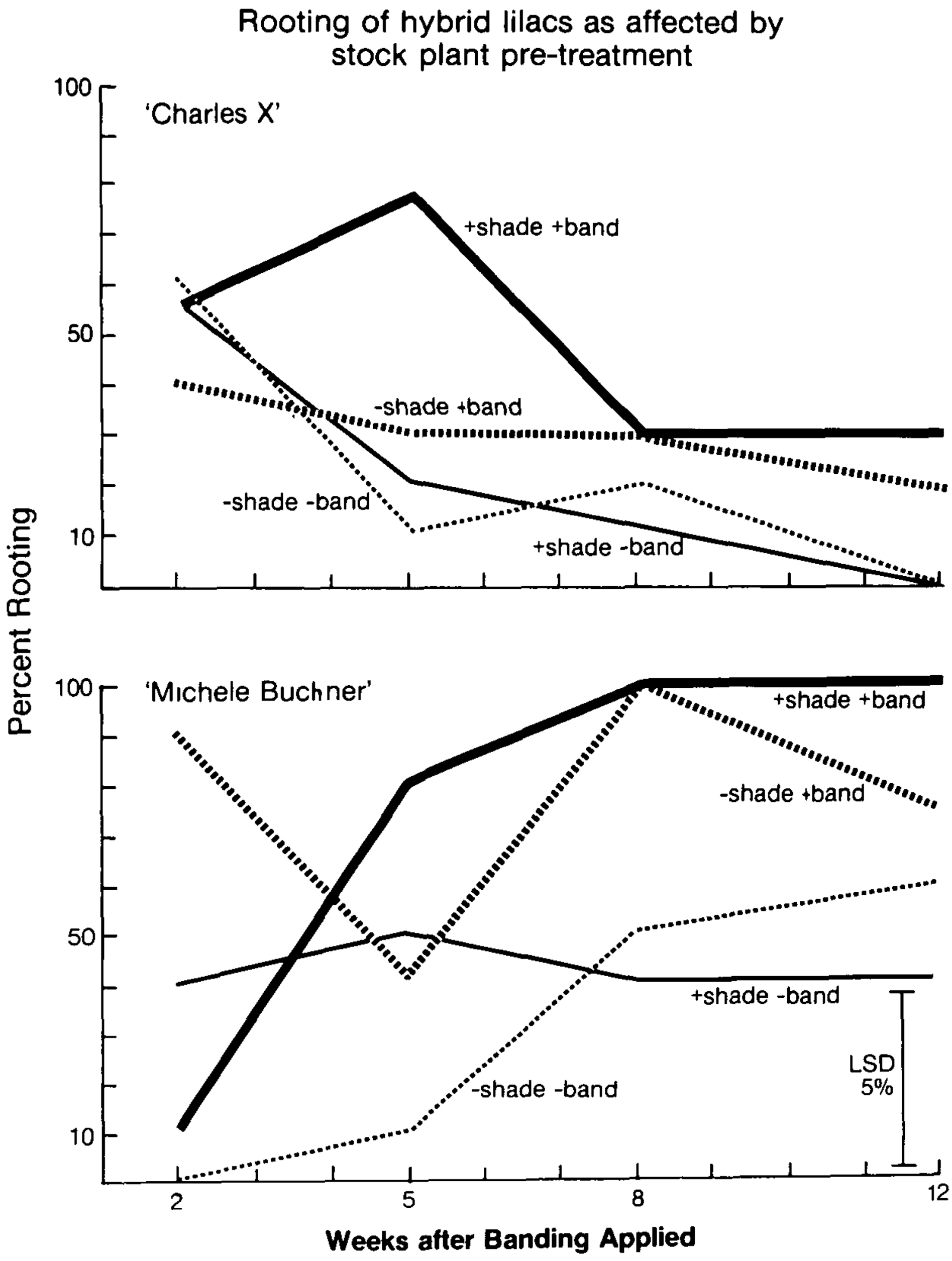

Figure 2. Rooting of hybrid lilac cultivars as affected by etiolation, banding, and date of collection

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.

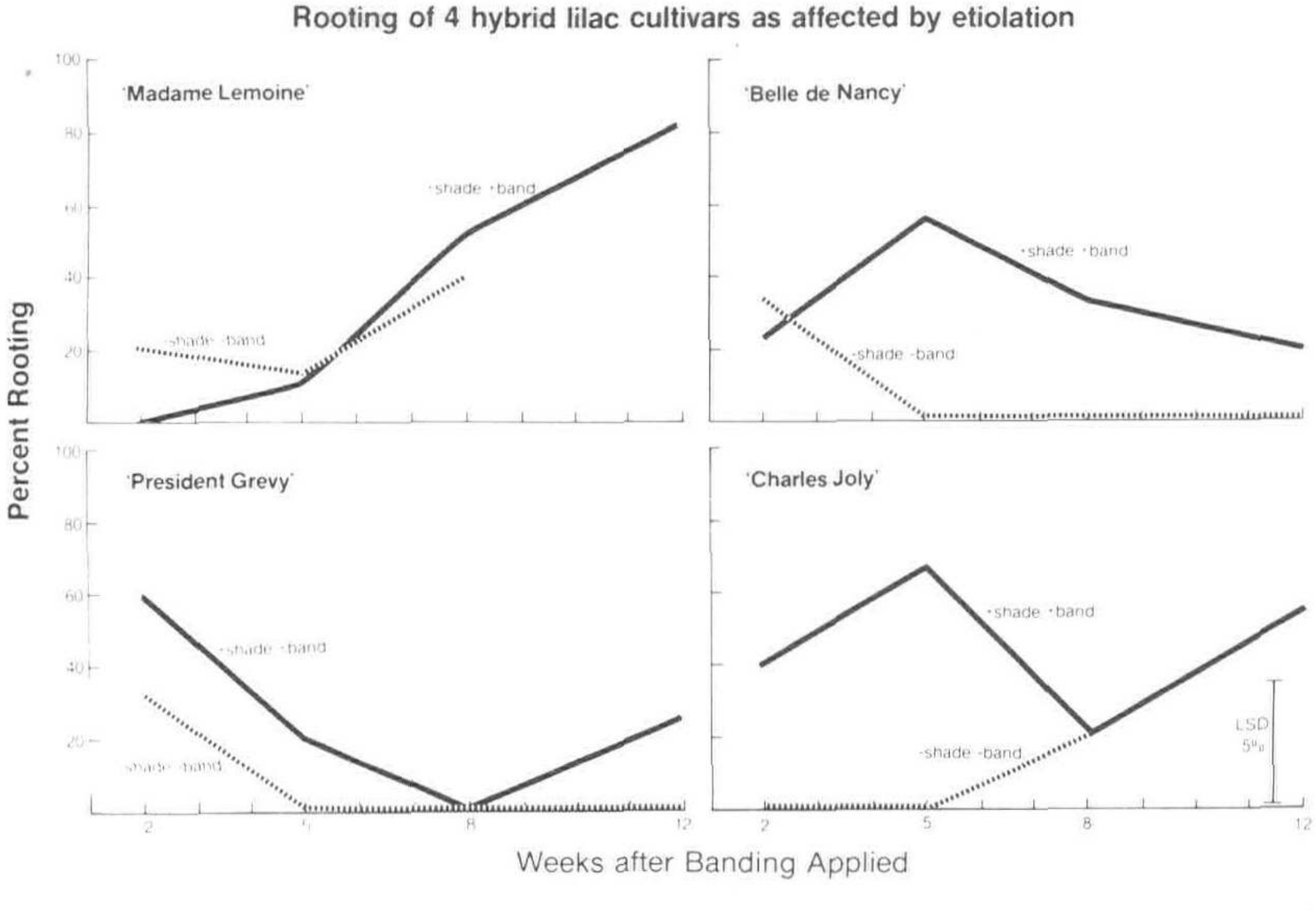

Figure 3. Rooting of 4 hybrid lilac cultivars as affected by etiolation and date of collection.

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.

LITERATURE CITED

1 Bid, N N and S K Mukherjee, 1972 Studies into the effects of forced shoot etiolation and different media on the rootage of *Mangifera indica* L. cuttings *Acta Horticulturae* 24 77-81.

2 Coggeshull, R.G. 1962 Hybrid lilac from softwood cuttings. *Amer Nurseryman* 115 (12)7-8

3 Frolich, E F 1961 Etiolation and the rooting of cuttings *Proc Inter Plant Prop Soc.* 11 277-283

4 Gardner, F E 1937 Etiolation as a method of rooting apple variety stem cuttings *Proc Amer. Soc Hort Sci* 34 323-329

5 Hansen, J , L.H Stromquist, A Ericsson 1978 Influence of the irradiance on carbohydrate content and rooting of cuttings of pine seedlings (*Pinus sylvestris* L) *Plant Physiol.* 61 975-979.

6 Harrison-Murray, R S 1981 Etiolation of stock plants for the improved rooting of cuttings 1 Opportunities suggested by work with apple *Proc Inter Plant Prop Soc* 31 386-392

7 Howard, B H 1979 Etiolation of leafy summer cuttings Rep E Malling *Res Stn* for 1979(1980) pp 70-71

8 Rowell, D.J 1981 Etiolation of stock plants for the improved rooting of cuttings II Initial experiences with hardy ornamental nursery stock. *Proc. Inter Plant Prop Soc* 31. 392-397

9 Shepherd, H.R , B H , Howard and R S Harrison-Murray 1980 Pre-etiolation of *Tilia* spp and other ornamental trees and shrubs *Rep E. Malling Res. Stn.* for 1980(1981) pp 69-72

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.