

EFFECTS OF LIGHT WITH BANDING AND LAYERING TECHNIQUES ON  
ROOTING DIFFICULT-TO-ROOT WOODY SPECIES

A Report

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## ABSTRACT

The use of banding and layering techniques with different lighting treatments made it possible to successfully root several difficult-to-root woody plants. Stock plants were either grown in light or were etiolated under a shade cloth before they received the banding or layering treatment. *Lindera benzoin*, *Magnolia sieboldii*, and *Pterostyrax hispida* were each successfully rooted using the banding and layering technique. *Xanthoceras sorbifolium* was successfully rooted using the banding technique, only. Etiolation as a pretreatment helped increase rooting success for all of the plant species.

## BIOGRAPHICAL SKETCH

Brittany Lenze was born in the small-town Saint Marys, Pennsylvania. Growing up in rural Pennsylvania, Brittany has always had an affinity towards nature. This led her to study at Lycoming College and receive her B.S. in Biology (Ecology) with minors in Environmental Science and Painting in 2019. During her time at Lycoming College found her interest in plants and knew she wanted to study them further. This led her to pursue her M.P.S. degree in Horticulture at Cornell University. Her experience in this program has allowed her to gain the knowledge and skills needed to fulfil her goals of working with plants.

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## LIST OF ABBREVIATIONS

IBA	Indole-3-butyric acid
PAR	Photosynthetically active radiation

## **Introduction:**

Some plants are harder to asexually propagate than others, but different treatments and procedures have been discovered to help propagate these hard-to-root woody plants. Indole-3-butyric acid (IBA), etiolation, banding, and layering treatments have each been used to increase rooting. IBA is a synthetic auxin that is commonly used to root stem cuttings (Maynard and Bassuk 1991). When dissolved in acetone or ethanol, it has been shown to improve rooting (Amisshah and Bassuk 2004). Etiolation is the practice of growing a plant in the absence of light or in heavy shade with the goal of maintaining natural auxins in the plant tissue that would otherwise break down when exposed to light (Bassuk and Maynard 1987). The practice of purposeful etiolation of plants has shown to increase rooting percentages for a variety of different plants (Bassuk, Maynard, and Creedon 1986).

Banding is a technique used to propagate a variety of different plants. Banding is conducted by wrapping a portion of a plant stem in an opaque band, normally done after an etiolation treatment, in order to keep the wrapped part of the shoot in an etiolated condition (Bassuk and Maynard 1987). The use of Velcro™ as the banding material has been shown to help increase rooting due to its ability to blanch or prevent the production of chlorophyll in the stem, apply IBA to the blanched area, and wound the underlying stem tissue, which often causes the formation of advantageous root primordia on the banded shoot (Maynard and Bassuk 1987). The use of etiolation with banding has been shown to have increased rooting success with *Carpinus betulus* ‘Fastigiata’, *Castanea mollissima*, *Chionanthus virginicus*, *Fagus sylvatica*, *Quercus coccinea*, *Quercus palustris*, and *Quercus rubra* (Bassuk, Maynard, and Creedon 1986; Maynard and Bassuk 1985).

Severe pruning and layering techniques have proven helpful in propagating woody plants. This technique is performed by cutting the stock plant to a 4 cm stump in order to prompt the development of epicormic juvenile shoots (Amissah and Bassuk 2009). The shoots are then rooted while they are still attached to the parent plant (Amissah and Bassuk 2009). Amissah and Bassuk found when stock plants were cut back to a 4 cm stump, there was increased rooting success in the juvenile shoots compared to stock plants that were cut back to 100 cm stumps thereby showing that the rooting success of the shoot could be determined by the location of the shoot relative to the base of the plant, which follows the cone of juvenility (2009). The combined effects of etiolation, IBA and layering have been shown to increase rooting (Amissah and Bassuk 2009).

*Aesculus glabra* Willd., Ohio buckeye, is a 6 to 12 meter tree. *A. glabra* occur naturally from Pennsylvania, west to Nebraska and Kansas, and as far south as Alabama. *A. glabra* is commonly found along riverbanks and creeks and makes a good native tree for wild and natural settings. Their light brown dehiscent fruits are commonly used for propagation after being cold stratified for 3 to 4 months (Dirr and Heuser 1987, Dirr 2009). There has also been success by grafting cultivars onto *A. hippocastanum*, *A. glabra*, or *A. flava* using both side or cleft grafts and whip and tongue or splice grafts (Dirr 2009, Brotzman 2012). While there has not been any research conducted that investigates the propagation of *A. glabra* using banding or layering, there has been success rooting cuttings of *A. indica* using a 4000 ppm IBA treatment (Majeed and Mughal 2009).

*Lindera benzoin* L., spicebush, is typically 1.8 to 3.7 meters tall at maturity and is considered to have a slow to medium growth rate. It is endemic to a region spanning from Maine to Ontario spreading west to Kansas and south into southern Florida and Texas. *L. benzoin*

produces bright scarlet, oval drupes which are commonly used to propagate this taxon. There has been little success with propagating this species using greenwood cuttings, but the rooting percentage is low (Dirr 2009). No studies demonstrate the use of banding or layering as a possible propagation technique for this species.

*Xanthoceras sorbifolium* Bunge., yellowhorn, is a 5.5 to 7.3 meter tall tree or shrub native to Northern China. *X. sorbifolium* is known for its attractive white flowers and its ability to adapt to a variety of different soils. They produce rounded capsules with several large pea sized seeds that can be used for propagation (Dirr 2009). There has been some success using root cuttings with moderate bottom heat as a means of propagation (Dirr and Heuser 1987), but there have been no studies on the use of banding or layering as a propagation technique for this species.

*Gymnocladus dioicus* (L.) K. Koch, Kentucky coffeetree, is a slow growing 18.2 to 22.9 meter tree native from New York to Pennsylvania to Minnesota, Nebraska, Oklahoma, and Tennessee. *G. dioicus* is known for its ability to adapt to variable growing conditions, including: growing in limestone based soils to tolerating drought and common urban conditions. It produces reddish brown to brownish black leathery legume fruits containing seeds that are commonly used for propagation (Dirr 2009). There has also been some success in propagating this species with the use of chip budding, micropropagation, and root cuttings (Dirr and Heuser 1987). Micropropagation has been successful in propagating a male form. (Smith and Obeidy 1991). There has been no research done on the use of banding or layering as a propagation technique for this species.

*Pterostyrax hispida* Sieb. and Zucc., fragrant epaulettetree, is a 6 to 9 meter medium growth tree that is native to Japan and China. *P. hispida* produces long, cylindrical, densely

bristled drupes that produce seeds which can be used for propagation (Dirr 2009). Soft wood cuttings taken in June and July have been known to root easily, and there have been successful attempts at rooting August cuttings with the use of 3000 to 5000 ppm IBA-quick dip (Dirr and Heuser 1987). There has been no research done on the use of banding or layering as a propagation technique for this species.

*Magnolia sieboldii* K.Koch, Oyama Magnolia, is a 3 to 4.6 meter shrub or small tree with cup-shaped flowers native to Japan and Korea. (Dirr 2009). There has been some success propagating this plant from cuttings with the use of 8000 ppm IBA in a talc form (Dirr and Heuser 1987). In general, deciduous magnolias best root when cuttings are taken from the softwood in the spring (Ranney and Gillooly 2014). The use of CO<sub>2</sub> mist has been shown to increase rooting in *M. sieboldii* cuttings (Lin and Molnar 1981). There has been no research done on the use of banding or layering as a propagation technique for this species.

For all of the plants listed above, there has been minimal to no research done to determine if clonal propagation via a banding or layering technique is a viable method of propagation. The goal of this study is to determine if banding or layering with different lighting treatments are viable methods of propagation for the plant species listed above. The results of this study could help commercial growers to propagate these difficult-to-root woody plants.

## **Methods:**

One-year-old stock plants of *A. glabra*, *G. dioicus*, *L. benzoin*, *M. sieboldii*, *P. hispida*, and *X. sorbifolium*, were potted in soilless mix (Cornell Mix) in standard #1 containers. In October 2019, all plants were chilled in a cooler at 2.2°C (36°F). After four months, plants were moved to a greenhouse with 15.7 to 30.7°C temperatures, 15.7 to 94.9% relative humidity, and 0

to 1624.8  $\mu$ moles PAR. The shoot apical meristems were immediately removed from all of the plants. Varying numbers of *A. glabra*, *L. benzoin*, *M. sieboldii*, and *P. hispida* were randomly assigned one of six treatments (light + banding, light - banding, etiolation + banding, etiolation - banding, layering + light, and layering + etiolation). *G. dioicus* and *X. sorbifolium* were randomly assigned to one of four groups (light + banding, light - banding, etiolation + banding, and etiolation - banding).

### Banding:

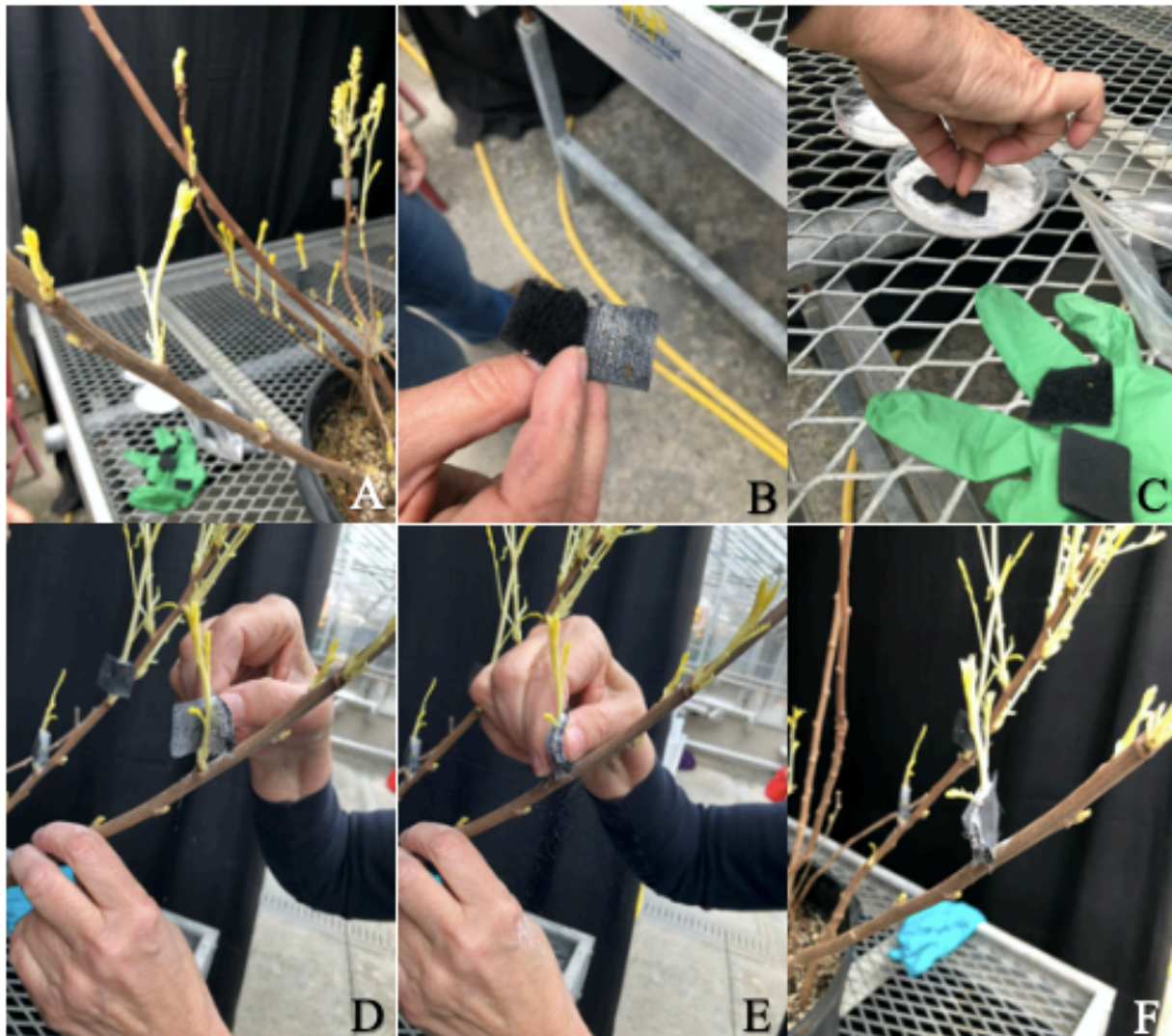
Once the buds began to swell, the plants were either etiolated (98% light exclusion) or grown under natural light. The plants to be etiolated were placed under a black-cloth tent which excluded all photosynthetically active radiation (PAR). Once the shoots were around 5-7.6 cm long, the light-grown shoots had 2.5 cm Velcro™ dipped in talc-based 8000 ppm IBA (Hormodin® 3) placed firmly around their bases (Figure 1). An equal number of shoots either etiolated or light grown had no Velcro™ band applied. Once etiolated shoots were approximately 5-7.6 cm long, Velcro™, which have been previously coated in 8,000 ppm IBA via Hormodin® 3, were applied to the shoot bases. After banding, plants were moved under a shade cloth that excluded 60% PAR to ease adjustment to full-light conditions. After a week under shade cloth, the plants were moved to full light. All plants were grown in full light through the duration of the experiment. If at any point the shoots began to grow longer than 10 cm, the apical meristem was pinched off. After three weeks from the initial shoot banding, shoots were removed from the plant. The cuttings were dipped in 8000 ppm IBA (Hormodin® 3), placed in a tray filled with soilless potting soil, and placed on a mist bench with a shade cloth overhead.

After four weeks, the plants were removed from the trays and the rooting success of the cuttings was recorded as a percentage.

### Layering:

Stock plants similar to the plans used for cuttings were taken from the cooler after four months and immediately cut back to a 10 cm stump. Once the buds began to swell, the plants were either etiolated (98% light exclusion) or grown under natural light. The plants to be etiolated were placed under a black cloth tent allowing them to grow in darkness. Once the shoots were 7.6 cm long, the shoot bases were painted with a 4000 ppm IBA solution, (50% water, 50% ethanol). A bottomless pot (a pot with the bottom cut off of it) was placed over the stump and filled with enough potting substrate to cover the bases of the shoots. The etiolated plants were moved under a shade cloth after they were layered to help them adjust to full light conditions. After a week under the shade cloth, the plants were moved to full sun. After three months, the bottomless pot was removed and successful rooting of the layered shoots was recorded as percentage rooted.

Figure 1:



Images of banding technique. A: etiolated *X. sorbifolium* shoot. B: 2.5 cm piece of Velcro™. C: Velcro™ being dipped in Hormodin® 3. D. Velcro™ being placed around base of etiolated shoot. E. Velcro™ being pressed firmly around shoot. F. banded etiolated *X. sorbifolium* shoot.

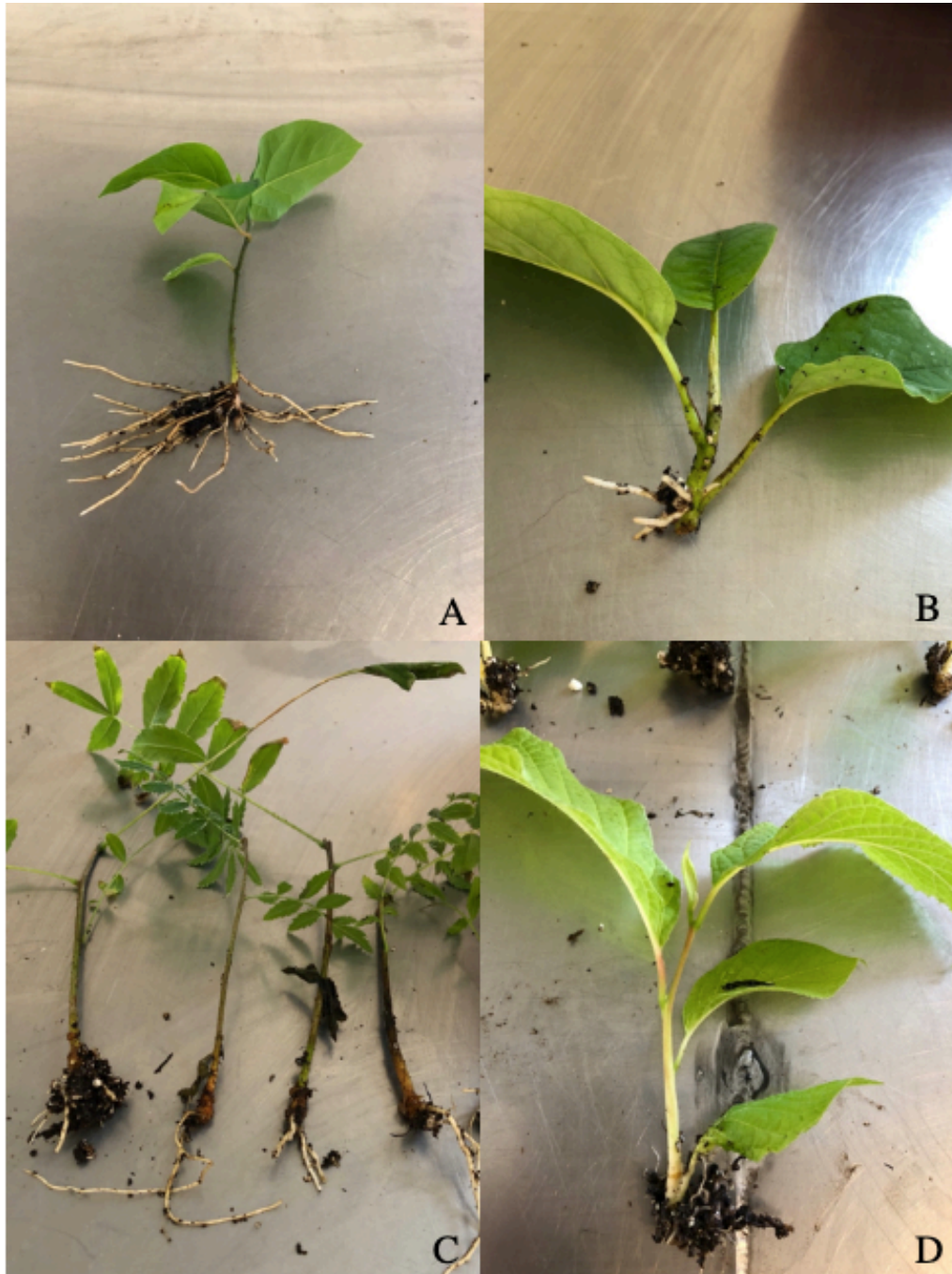
### Results:

*L. benzoin*, *M. sieboldii*, *P. hispida*, and *X. sorbifolium*, were all rooted successfully from cuttings (Figure 2 and Table 1). The use of banding (localized light exclusion) in both the etiolation and light treatments for *L. benzoin* gave the best results, 82% and 66%, respectively. The use of banding in both the etiolation and light treatments for *M. sieboldii* had similar results,

82% and 85% respectively, but the number of cuttings taken was relatively low. Without the use of banding for *M. sieboldii*, the rooting success was 0%. Overall *P. hispida* was fairly easy to root. The etiolation treatment had slightly greater rooting numbers and mass. *P. hispida* had a rooting success of 100% with the etiolation and banding treatment, 90% with the etiolation and no banding treatment, 79% with the light and banding treatment, and 61% with the light and no banding treatment. For *X. sorbifolium*, the use of banding for both the etiolated and light treatments gave the best rooting results, 86% and 83% respectively. There was also some success rooting *X. sorbifolium* without banding in both the etiolation and light treatments (72% and 16% respectively), but the number of cutting used was relatively small. No cuttings were taken from *A. glabra* due to the fact that plants did not form shoots to take cuttings from. *G. dioicus* rooting percentage was 0% because the cutting rotted under the overhead mist.

The layering treatment was successful at rooting *L. benzoin*, *M. sieboldii*, and *P. hispida* (Table 2). For *L. benzoin*, there was a 100% rooting success with the use of etiolation along with the layering technique, while without etiolation the rooting success was only 38%. *M. sieboldii* had similar results. The etiolated plants had a rooting success of 100%, while the light grown plants had a rooting success of 0%. *P. hispida* had a 100% rooting success using the layering technique with and without etiolation. There were no results for *A. glabra* due to the plants not producing shoots.

Figure 2:



Images of successfully rooted cuttings. A: rooted *L. benzoin*. B: rooted *M. sieboldii*. C: rooted *X. sorbifolium*. D: rooted *P. hispida*.

Table 1: The effects of light and banding treatments on rooting.

	Total no. of cuttings	Percent rooted (%)
<i>L. benzoin</i>		
Light only	13	30
Light+banding	24	66
Etiolation only	12	33
Etiolation+banding	11	82
<i>M. sieboldii</i>		
Light only	10	0
Light+banding	11	82
Etiolation only	15	0
Etiolation+banding	20	85
<i>P. hispida</i>		
Light only	47	61
Light+banding	31	79
Etiolation only	30	90
Etiolation+banding	32	100
<i>X. sorbifolium</i>		
Light only	12	16
Light+banding	18	83
Etiolation only	11	72
Etiolation+banding	21	86

Table 2: The effects of light and layering treatments on rooting.

	Total no. of shoots	Percent rooted (%)
<i>L. benzoin</i>		
Light	8	38
Etiolation	13	100
<i>M. sieboldii</i>		
Light	5	0
Etiolation	5	100
<i>P. hispida</i>		
Light	18	100
Etiolation	18	100

**Discussion:**

This research was an excellent ‘proof of concept’ work even though the numbers of plants used were low. Before these trials, there was little to no research on the use of banding or layering treatments as potential techniques to propagate the plants used in this experiment. *L. benzoin*, *M. sieboldii*, *P. hispida*, and *X. sorbifolium* were all successfully rooted using the banding treatment both with and without etiolation as a pretreatment, but the use of etiolation as a pretreatment seems to increase the percent rooting in all of the species. *L. benzoin*, *M. sieboldii*, and *P. hispida* were also successfully rooted using the layering technique, and the use of etiolation as a pretreatment was vital for *L. benzoin* and *M. sieboldii*. Etiolation seemed to play a vital role in increasing the rooting success for these species in both banding and layering treatments. Multiple studies have shown that etiolation has increased rooting in a variety of different species (Bassuk, Maynard, and Creedon 1986, Maynard and Bassuk 1985).

The results of this experiment are important for the propagation of these plants. All of the plants used in this experiment are traditionally propagated through the use of seeds, but now

there is an opportunity to use banding or layering as possible techniques. The ability to asexually propagate these taxa allows for greater opportunity to make clonal selections with superior ornamental traits. Future research should consider replicating these propagation studies with larger sample sizes.

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