

Windows of Opportunity for Rooting Woody Stem Cuttings

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Summary

To share newly developed woody ornamental plants with the public, it is absolutely essential to be able to regenerate them. In the past 10 years, we have propagated more than 60,000 plants in our woody ornamental plant breeding programs. Our successes and failures indicated that our first consideration should be optimal seasonal timing in taking stem cuttings. Timing and types of

woody stem cuttings significantly impacted the rooting ability of different species. Depending on the taxa, the higher rooting percentages were largely from semi-hardwood cuttings, collected during late spring and summer. In addition to timing, stock plant source, hormone application, plant materials, hormone cofactors, and other environmental factors should also be considered.

INTRODUCTION

The most crucial step to market newly developed woody ornamental plants is developing realistic regeneration strategies for commercial production. We have collected

specimens from the wild, conducted controlled crosses, and germinated seeds from open pollination. In the process, we developed many new clones, with cultivars of

great market potential. Unfortunately, recalcitrant propagation of these plants can be a difficult challenge that significantly delays or prevents the commercial introduction of promising new cultivars.

The challenges associated with propagation increase when plants are collected from wild populations. After multiple collection trips to various Asian countries - thousands of plant taxa were brought back to the University of Georgia (UGA) after USDA inspection. Each year, approximately 6,000 potential new woody plants are propagated and evaluated at the UGA Woody Plant Research Lab. This paper presents data from the Lab, including a review of the window of opportunity for rooting woody stem cuttings.

MATERIALS AND METHODS

Sources of New Ornamental Plants. For the past 10 years, we have explored and collected ornamental plants from local, state, national, and international locations. Before the pandemic, many plant collection trips were completed (at least twice a year) to Asian countries, especially China, Japan, Korea, Nepal, and Vietnam. With USDA import permission and immense help from local hosts, around 150-250 accessions of potential ornamental plants were brought back to the United States each year. To trial and make available sufficient new plant materials, regeneration of these species is a primary concern.

Controlled crosses yielded many new clones, and open pollinated seedlings were a great resource to select elite ornamental plants. Again, some of these newly developed plants are exceedingly difficult to propagate, limiting further evaluation.

General Propagation Approaches. To be able to regenerate new plants and share

them with gardeners and the Green Industry, it is important that we approach plant propagation using appropriate technologies (Davies et al., 2018). Since our collection areas had similar climates and other natural environmental conditions, we managed to germinate seeds either with a one to four-month cold stratification, or directly sowing outdoors with protection of wired mesh (to prevent animal damage) during late fall or winter. For other propagules, such as bulbs or rhizomes, we placed them in a cooler with moist peat moss.

For clonal propagation of new woody plants, attempting to root stem cuttings has provided the best results. The ability to successfully root woody stem cuttings typically guarantees the feasibility of commercial nursery production. When taking woody stem cuttings, a primary consideration is the seasonal collection time and cutting types. Semi-hardwood stem cuttings during late spring and summer months are preferred. For certain woody plants, softwood stem cuttings root more vigorously. A lot of hardwood cuttings (both evergreen and deciduous plants) were also collected; it took a significantly longer period to root the cuttings but sometimes proved a better approach for regenerating new plants. Rooting hormone composition and concentration along with rooting co-factors should also be considered for the propagation of new woody plants.

RESULTS AND DISCUSSION

Helwingia chinensis. This new potential woody ornamental shrub [0.9-1.2 m (3-4 ft) tall] is from north China with unique flowers and red berry-like drupes on the middle of upper leaves (Fig. 1). The plant is performing well in partly shade areas in piedmont Georgia. To propagate this plant, the

most vigorously rooting cuttings are from the softwood stem, which rooted in 3-4 weeks with or without rooting hormones.



Figure 1. *Helwingia chinensis* (red pearl on palm) has unique ornamental traits, including red berry-like drupe on the middle of leaves.

***Nandina* ‘Coolglow Peach’.** A patented new cultivar with outstanding foliage color and compact habit (Fig. 2). Only a few seeds have been observed. The plant can be rooted year-round via stem cuttings with or without a rooting hormone of 1,000 ppm indole-3-butyric acid (IBA). Unfortunately, very few stem cuttings are available per plant; hence, tissue culture may be a feasible method for commercial production.



Figure 2. Foliage color and habit of *Nandina* ‘Coolglow’.

***Zelkova schneideriana* ‘Gold Goblin’.** A dwarf and compact seedling mutation was selected from thousands of seedling populations (Zhang et al., 2022). The grafted plant is about 1.8 m (6 ft) tall and 1.8 m (6 ft) wide after 10 years (Fig. 3). To control the height, this plant should be grafted on the regular *Zelkova* seedlings at the height you desire. We conducted softwood, semi-hardwood, and hardwood cuttings, and the rooting percentages were respectively, 100%, 93%, and 62%. The rooted liners grew as ground-cover plants if no stake is provided.



Figure 3. Fall foliage color and habit of *Zelkova schneideriana* ‘Gold Goblin’.

***Ilex rotunda* ‘Peace Time’.** A new, yellow fruited cultivar of evergreen Lord’s holly (Fig. 4). The plant was selected from wild seedling populations and evaluated for 9 years. The optimum window for rooting this plant is via hardwood stem cuttings, collected during winter. With aid of 3,000 ppm IBA, rooting percentage of 40-70% can be reached after about 6 weeks (Zou et al., 2022).



Figure 4. Fruit branches of *Ilex rotunda* 'Peace Time'.

Myrica (Morella) rubra clones. Yummy berry, or yang berry, is a small evergreen landscape tree originated from China (**Fig. 5**). The plant is dioecious, so we can select male plants or female plants for landscapes and edible fruit production. For the past nine years, we have evaluated 75 seedling plants (35 females, 21 males so far). Spring's new growth is gorgeous, and the fruits are delicious. In an attempt to propagate this plant, both Atlanta Botanical Garden and UGA Woody Plant Research Lab took stem cuttings from 2016 to 2018 - without success.



Figure 5. Fruits, new foliage color, and habit of *Myrica rubra*.

To find the best time to root stem cuttings, we took woody stem cuttings monthly from May 2019 to February 2020 and treated them with 8,000 ppm-IBA. The results indicated that the semi-hardwood stem cuttings from the first flush of the year could be rooted at 33% (**Fig. 6**). Obviously, the window of rooting this newly introduced plant should be May to July, when

the foliage of the first sprouted branches of the year was fully extended. During 2021, we collected stem cuttings of *M. rubra* in May, June, and July with the additional step of soaking them in Superthrive® solution (one teaspoon per gallon) for 30 minutes (<https://superthrive.com/>). We then applied rooting hormones at 8,000 ppm-IBA with a rooting percentage of 78%.

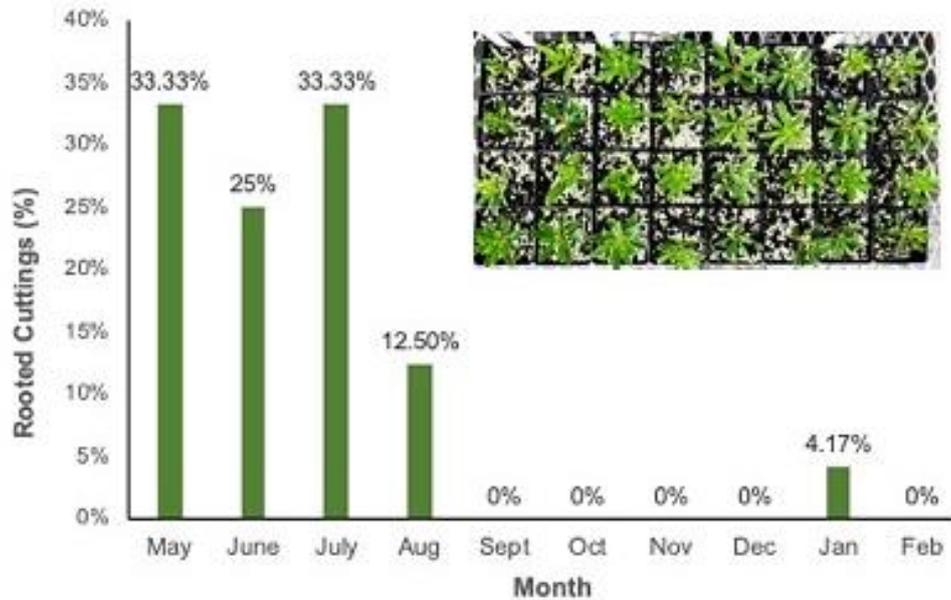


Figure 6. Effect of timing on the rooting of *Myrica rubra* stem cuttings under the treatment Hormodin 3 during 2019-2020.

We approach the propagation of new woody ornamentals systematically by investigating the best timing for taking stem cuttings, rooting hormone type, formulation, and concentration, co-factors - and finally sources of plant materials (roots, juvenility, etc.) and other factors (Ruchala et al., 2002). For *Myrica rubra*, we recommend taking stem cuttings in May, June, or July, soaking them in a Superthrive® solution (as a co-factor source), and applying rooting hormones at 8,000 ppm-IBA or higher.

***Loropetalum chinense* var. *rubrum* ‘Ever Red’.** The stem cuttings should easily root, however the stock plants for stem cutting collection should be replenished every 5 years. If stem cuttings continue to be collected after 5 years, the rooting percentage could be 33% or lower.

***Magnolia* ‘Kevin1609’.** This plant is a controlled cross seedling from *Magnolia sieboldii* ‘Colossus’ x *M. insignis* ‘Anita Figlar’ with beautiful red flowers (**Fig. 7**). As soon as new branches are long enough

[more than 13 cm (5-in) long] - stem cuttings should be taken and treated with 3,000 or 8,000 ppm-IBA. Rooting percentages were between 27% - 60% after 2-4 months. The rooted cuttings should be placed on extended light and warm conditions to push their bud break and grow new shoots before the winter months. Rooted cuttings without new flush growth had 100% mortality next spring!



Figure 7. Habit and flowers of *Magnolia* ‘Kevin1609’.

***Camellia sinensis* (tea).** Tea ranks as the most consumed beverage in the world excluding water. Although we have grown tea in the U.S. for more than 200 years, there was only one commercial tea farm in the continental U.S. before 2010. To increase the popularity of tea and select better adapted cultivars for the southeastern U.S., we collected 147 clones and propagated them for further evaluation (**Fig. 8**).

The rooting percentages were 25% - 100% and highly variable among the clones (Hao et al., 2020). ‘Rosea’ is a named cultivar with red new growth and pink flowers. The leaves are small and the mother plant was 40 years old. ‘McArthur’ was brought back from Asia and planted in the late 1800s. The age of the mother plants played a significant role in the rooting percentage of stem cuttings. The lowest rooting percentages were from older, mature stock plants (**Table 1**).

Table 1: Rooting percentage of *Camellia sinensis* clones. Significant different at $p < 0.05$ level with different letters.

Clone	Rooting %	Clone	Rooting %	Clone	Rooting %	Clone	Rooting %
SZ28	100.0a	SZ21	93.0ab	SH26	87.5abc	SZ11	68.8cdef
SH29	100.0a	SH41	92.2abc	SZ07	84.4abc	‘Assamic’	63.3def
CC17	99.2a	‘Kunming’	91.4abc	SH47	81.3abcd	SH33	59.4rfg
SH36	97.7a	CC15	90.6abc	SH08	78.1bcde	‘McArthur’	39.8fg
CC06	96.9a	SZ16	89.9abc	SZ09	75.0bcde	SZ03	37.5fg
SZ27	95.3ab	SH51	88.3abc	CC04	75.0bcde	‘Carswell’	33.6fg
CC11	93.8ab	SZ22	87.5abc	SH13	71.9cdef	‘Rosea’	25.0g

When cuttings were taken, the number of nodes per cutting (length) had significant effects on rooting percentage and root quality. For tea plants, 2-3 nodes per cutting



Figure 8. Propagation of *Camellia sinensis* using stem cuttings by Dr. Ming Cai, Dr. Junhuo Cai, Dr. Junjun Fan, Dr. Xiaohong Zhou, Dr. He Li, Ms. Qian Song, Ms. Jinying Dong, Dr. Zhilong Hao, Dr. Donglin Zhang, and Dr. Jieming Wang. More than 10,000 rooted cutting were transplanted into one-gallon pots.

yielded significantly higher rooting percentage at 90% or higher. Both one-node or 5-nodes reduced the rooting percentage to 75% or lower. Rooting quality was signifi-

cantly better as the number of nodes increased. Generally, rooted cuttings rated 3 or higher were acceptable root quality for transplanting (Table 2). Plant growth increased as the number of nodes increased (data not presented; Zhou et al., 2020). We

recommend that tea stem cuttings should be taken from October to November, rooted in warm greenhouses and transplanted the next April or May. In July or August, tea liners could be sold in one-gallon containers at 41-51 cm (16-20 in.) tall.

Table 2. Effect of cutting length/nodes on rooting of *Camellia sinensis* ‘Kunming’. Root rating was from 1 (no roots) to 5 (excellent rooting). Rooted cuttings rated 3 or higher were acceptable root quality for transplanting.

Node	Rooting %	Root Quality
1	75.0c	1.8c
2	96.9a	2.5b
3	90.6ab	3.2ab
4	84.4bc	3.6a
5	75.0c	3.9a

Some plants, such as *Anneslea fragrans*, *Cercis chuniana*, *Ilex buxoides*, *Kalmia latifolia*, and *Osmanthus fragrans*, have not been rooted yet or have an extremely low rooting percentage from stem cuttings. However, not all newly introduced plants are difficult to propagate by stem cuttings. We had higher than 75% rooting success for *Camellia rosthorniana* ‘Xulin166’ (prolific flowering during winter), *Chimonanthus* ‘ZackK07-23’ (evergreen and very compact), *Ilex decidua* ‘GuihongC04-36’ (persistent bright red berry-like drupes to July), *Lagerstroemia* cultivars, *Populus deltoides* ‘Hongye1501’, *Viburnum* ‘YujieK02-33’ (very compact), ‘Pinkie51’ (pink flowers), ‘Jinying1572’ (evergreen and cold hardy), ‘LongqingC04-31’ (prolific flowering with rounded habit).

It is our immense pleasure to share the newly bred woody ornamental plants and our experiences of propagating them. Together, we are seeking your help to better propagate these plants and quickly bring them to the ornamental market.

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