Lee Klinger: Yes, I am. It's actually through the nutritional value of the lime wash. I need to point out that I'm treating more than 70 varieties of trees now and having good success.

Greg McPhee: What is your nutritional program for your pumpkins? Are you using growth promoters?

Paul Rys: I only add organic matter from horse manure and shavings, and the reason why I'm doing that is other growers add all kinds of chemicals to get them to grow really big. I'm trying to grow them in a controlled environment. If I see a pumpkin plant that is vigorous with no additives, then I know it's going to have the potential for being bigger later.

Notes on Propagation of Various Tropical Woody Ornamentals©

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Auxin series, ranging from 0 to 7500 ppm, were evaluated on eight tropical woody ornamental materials as laboratory exercises for a class in plant propagation. The auxins were either indole-3-butyric acid (IBA) used alone or the commercial preparation Dip 'N Grow® (1% IBA and 0.5% NAA). Terminal cuttings were taken in late fall, rooted under intermittent mist during low light winter conditions, and evaluated 6 to 8 weeks later in most cases. Rooting percentages and a rooting index based on root mass were determined. Optimum auxin concentrations were: 1000 ppm for *Acalypha wilkesiana* (dwarf copper-leaf), 6250 ppm for *Aglaia odorata*, 500 ppm for *Duranta erecta* 'Alba', 6000 ppm for *Galphimia gracilis*, 1500 ppm for *Ilex vomitoria* 'Stoke's Dwarf', 6000 ppm for a *Rhododendron aurigeranum* × *R. herzogii* hybrid, 2500 ppm for *Thunbergia erecta*, and 1200 to 2250 for *Gardenia brighamii.*

INTRODUCTION

"Propagated by cuttings" is the usual notation for propagation information in many of the books that describe tropical ornamental plants (Chin, 2003; Rauch and Weissich, 2000; Sparrow and Hanly, 2002; Staples and Herbst, 2005; Whistler, 2000). Such information is not specific enough, especially for plants that are difficult to propagate by cuttings. The information provided in this paper was extracted from a series of plant propagation experiments set up for a plant propagation class at the University of Hawaii over several years. The objective was to inform students about how to take data and determine the best concentration in an auxin series for the propagation of a particular plant. Students had to prepare a write-up of the exercise as practice for future laboratory experiments.

MATERIALS AND METHODS

The plant materials were: *Acalypha wilkesiana* (dwarf copper-leaf), *Aglaia odorata* (Chinese rice flower), *Duranta erecta* 'Alba' (golden dewdrop), *Galphimia gracilis* (thryallis), *Gardenia brighamii* (nanu, a native Hawaiian gardenia), *Ilex vomitoria*

Table 1. Plant materials, treatments, and conditions used for selected tropical ornamental cuttings.

Plant materials	Medium[1]	Date cuttings taken	Duration of rooting	Auxin[2] concentrations (ppm a.i.)
Acalypha wilkesiana (dwarf copper-leaf)	V:P	12/8/2004	6 weeks	DNG: 0, 500, 1000, 2000, 3000, 4000
Aglaia odorata	V:P	11/29/2001	11 weeks	DNG: 0, 1250, 2500, 3750, 5000, 6250, 7500
Duranta erecta 'Alba'	V:P	12/2/2000	6.5 weeks	IBA: 0, 500, 1000, 1500, 2000, 2500
Galphimia gracilis	V:P	11/25/2002	7 weeks	DNG: 0, 1000, 2000, 3000, 4000, 5000, 6000
Ilex vomitoria 'Stoke's Dwarf'	P:P	11/28/2000	7 weeks	IBA: 0, 500, 1000, 1500, 2000, 2500
Rhododendron hybrid	P:P	No record	8 weeks	DNG: 0,500, 1000, 2000, 4000, 5000, 6000
Thunbergia erecta	P:V	12/2/2003	7 weeks	DNG: 0, 150, 450, 1000, 1500, 2000, 2500
Gardenia brighamii	V	2/12/97	10.3 weeks	DNG: 0, 1200, 2250

[1] V:P = 1:1 (v/v) vermiculite-perlite, P:P = 1:1 (v/v) peat : perlite, P:V =1:1 (v/v) peat : vermiculite, V = coarse vermiculite.

[2] DNG = Dip 'N Grow (1% IBA, 0.5% NAA), IBA = indole-3-butyric acid.

'Stoke's Dwarf' (yaupon holly), *Rhododendron aurigeranum* × *R. herzogii* (an unnamed hybrid), and *Thunbergia erecta* (bush thunbergia). In most cases, the materials used for propagation were terminal cuttings about 4 to 5 inches in length. The lower one-third of foliage was removed prior to auxin treatment for ease of insertion into the medium. Cuttings were taken in late November or early December with the intention of reading results in mid- to late January in a plant propagation laboratory.

The auxin preparation was usually the commercial formulation Dip 'N Grow® (1.0% indole-3-butyric acid and 0.5% naphthalene acetic acid as active ingredients; Dip 'N Grow, Inc., Clackamas, Oregon), but indole-3-butyric acid dissolved in ethanol and diluted to desired concentrations with water was used for some plant materials (Table 1). Dilution series were prepared, but these were different from year to year (Table 1).

The basal $^1/_2$ to $^3/_4$ inches of stem was immersed in the auxin solution for 5 min for concentrations below 5000 ppm and 1 min for concentrations of 5000 ppm or higher. Cuttings were inserted into a medium of moist 1 vermiculite : 1 perlite (v/v) to a depth of about 1.5 inches. A medium of 1 peat : 1 perlite (v/v) was used for the *Ilex* and the *Rhododendron,* vermiculite only for the *Gardenia*, and peat-vermiculite for the *Thunbergia.* Three replicates of 10 cuttings per replicate were used for each treatment. Flats were placed under intermittent mist (8 sec on with 8 min between mist bursts during daylight hours). Ambient air temperatures ranged from 74–84 °F (day) to 65–72 °F (night). Light levels under saran shade were 70% of full sun (15–30 $mol \cdot m^{-2} \cdot day^{-1}$ during December).

At the time of evaluation, usually about 6–8 weeks, cuttings were removed from the medium and rooted cuttings were counted and the rooting response

was assessed on the basis of ranks (Angelo, 1938). Rooting indices were calculated for each replication of each treatment using the methods of Mahlstede and Lana (1958) and O'Rourke and Maxon (1948). Each cutting was assigned a value according to 5 = heavy rooting, 4 = medium rooting, 3 = light rooting, 2 = alive but no roots, 1 = dead. The rooting index was determined by summing the weighted values for each replicate of 10 cuttings and dividing by 10. The three replicate rooting index values were averaged for each treatment. The percent rooting was determined for each replicate, and the three replicate values were averaged for each treatment. The classes did not conduct further statistical treatment such as analysis of variance and mean separations.

RESULTS

Table 2 summarizes all rooting results.

Acalypha wilkesiana rooted well without auxins, but rooting percentage and root quality declined at 2000 ppm auxin and higher.

Aglaia odorata is considered difficult to root. The few cuttings that did root had medium to heavy root systems 11 weeks after sticking, and most of these were in the auxin concentrations of 2500 and 6250 ppm. The winter months may not be the optimum time of year for propagating this species.

***Duranta erecta* 'Alba'** rooted readily, even without auxin, with many cuttings producing medium to heavy root systems in 6.5 weeks. Somewhat higher rooting indices were attained with the auxin treatments. With another few weeks in the propagation flat, all would have been heavily rooted.

Galphima gracilis was difficult to root and lost many leaves under the intermittent mist regime. The best percentages of rooting and rooting index values were attained with the 2000 and 6000 ppm concentrations of auxin. The winter months may not be the best time for propagating this species.

Ilex vomitoria is considered moderately difficult to root (Berry, 1994; Duck, 1985; Gwaltney, 1992; Whitcomb, 1983), although 'Stoke's Dwarf' may be somewhat easier. In this experiment, auxin concentrations of 1500 and 2000 ppm yielded the best rooting percentage and root qualities.

***Rhododendron aurigeranum* × *R. herzogii* hybrid** in the section Vireya was an unnamed cross created by Lyon Arboretum horticulturist Robert Hirano. Rhododendrons in this section are often easier to root than in species hailing from more temperate climates (Kenyon and Walker, 1997). The use of an auxin improved both the percentage rooting and root quality over nontreated cuttings, with the best results at the 5000 and 6000 ppm concentrations.

Thunbergia erecta rooted better when auxin was used, with the best result at the highest auxin concentration used in this experiment, 2500 ppm.

Gardenia brighamii is a rare species native to the Hawaiian Islands that is finding wider use as a landscape ornamental. Considered somewhat difficult to propagate, about two-thirds of the cuttings rooted at auxin concentrations of 1200 to 2250 ppm but required more than 10 weeks to do so. It is likely that a higher auxin concentration would provide better and faster rooting because Lilleeng-Rosenberg (2005) recommends a No. 16 rooting powder (presumably 1.6% IBA) for this plant.

Table 2. Rooting percentages (%) and rooting indices (RI) for selected tropical ornamentals in response to auxin concentration series. Rooting index values: 5 = heavy rooting, 4 = medium rooting, 3 = light rooting, 2 = alive, no roots, 1 = dead. Auxin sources: (1) Dip 'N Grow, (2) indole-3-butyric acid.

Auxin Concn	*Acalypha wilkesiana* (1)		*Aglaia odorata* (1)		*Duranta erecta* (2)		*Galphimia gracilis* (1)		*Ilex vomitoria* (2)		*Rhododendron* hybrid (1)		*Thunbergia erecta* (1)		*Gardenia brighamii* (1)	
(ppm)	%	RI	%	RI	%	RI	%	RI	%	RI	%	RI	%	RI	%	RI
0	96.7	4.2	30.0	2.0	94.4	3.3	16.7	1.7	3.3	2.0	77	2.9	43.3	2.6	40.0	2.0
150													70.0	3.1		
450													60.0	3.1		
500	90.0	4.1			100	3.9			60.0	2.8	90.0	3.3				
1000	96.7	4.4			100	3.5	23.7	1.8	80.0	3.0	100	3.3	66.7	3.4		
1200															64.0	3.2
1250			26.7	2.1												
1500					100	3.8			93.3	3.4			80.0	3.2		
2000	73.3	3.5			94.4	3.7	26.7	2.0	90.0	3.3	97.0	3.4	87.0	3.5		
2250															62.3	3.1
2500			36.7	2.1	100	3.7			78.5	3.2			93.0	3.8		
3000	60.0	2.8					10.0	1.5								
3750			30.0	1.7												
4000	40.0	2.4					20.0	1.9			90.0	3.4				
5000			30.0	1.9			10.0	1.3			97.0	3.6				
6000							33.3	2.1			97.0	3.8				
6250			46.7	2.2												
7500			20.0	1.7												

DISCUSSION

An auxin series ranging from 0–7500 ppm was an effective way to determine optimum concentrations for some tropical woody ornamental shrubs. Plant materials thought easy-to-root required less auxin to stimulate rooting than more difficult-to-root species. Care in selecting the type of cutting is necessary because uneven maturities of wood sometimes biased treatments, although replications were set up to balance numbers of cuttings with different maturities. These experiments were conducted during winter months in preparation for a plant propagation class to evaluate early in the spring semester, and results might have been better if propagation was done on newly matured summer or fall growth. These results, however, give an indication of auxin concentrations to try (where needed) for the species used in these experiments.

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