

MACROPROPAGATION OF TROPICAL PLANTS AS PRACTICED IN FLORIDA

P.L. NEEL

*Southern Ornamental Nurseries
Boynton Beach, Florida 33437*

Propagation techniques employed with the more commonly grown tropical foliage and landscape ornamental plants in Florida are similar in most instances to those used for temperate zone plants. Nursery production of tropical plants in south Florida was summarized by Neel at the 1975 Eastern Regional IPPS meeting, and propagation of selected species was discussed in that paper (1). This paper summarizes the various methods of plant propagation (other than tissue culture) which are utilized in the Florida nursery industry. Commonly grown tropical foliage, landscape, and fruiting plants are presented separately. Examples of special considerations or treatments are presented for each category. For the purpose of discussion, in this paper foliage plants refers to those grown and adapted for use indoors in homes, offices, stores, malls, and similar locations.

FOLIAGE PLANTS

Because over 50 percent of the foliage plants produced in the U.S. are grown in Florida, mostly within 100 miles of Orlando, I shall begin with this category.

Most foliage plants are propagated either by cuttings and/or seed (Table 1). Vegetative propagation requires stock plants and a rooting facility, both of which increase costs. However, cutting-grown plants are usually ready for sale sooner than are seed-grown plants and do not exhibit the genetic diversity of the latter. Some juvenile foliage plants differ from adult plants in leaf morphology or other growth characteristics. *Hedera*, *Sygonium*, *Dizygotheca*, *Dieffenbachia* all have differences in their juvenile and adult forms. Cuttings from juvenile or adult plants may be used, depending on which characteristics are desired, or seed may be sown.

Seeding may be done in beds (*Chrysalidocarpus*), in trays (*Schefflera*), or in liner pots (*Asparagus*). Trays of seedlings may also be bought from commercial sources.

In the larger nurseries mechanized equipment is frequently used to fill containers, sow the seed or stick cuttings, and to place the containers in the propagation area. Artificial, sterile media are typically used. Smaller nurseries of less than 2 acres generally use more hand labor. Germination and rooting are usually done under intermittent mist in a covered house under

partial shade, often on raised benches. Bottom heat is used by some growers, especially in the central and northern part of Florida, and is especially desirable for palms (2). Florida-grown plants destined for sale in California must be grown on raised benches at least 18 inches (46 cm) off the ground in a certified nematode-free medium.

Seed of several species of foliage plants can be obtained from mature plants growing in south Florida. Examples of such plants are *Dizygotheca*, *Chrysalidocarpus*, *Brassaia*, *Philodendron selloum*, *Asparagus*, *Monstera*, *Spathiphyllum*, *Ardisia*, *Podocarpus*, *Chamaedorea*, *Beaucarnea*, and *Zamia*. Commercial seed brokers and companies fill deficits in local supplies and provide other types of seed.

Seeds should be removed from fleshy fruits before planting as the pulp often contains germination inhibitors. In addition, its decomposition increases the risk of disease and insect infestation. Depulped seeds of *Arecastrum* were shown to germinate significantly better than uncleaned seeds by Neel in an unpublished experiment. The seeds of *Caryota* and some other species of palm are embedded in flesh containing oxalic acid crystals. These will enter the skin and cause severe pain if one uses bare hands to clean the seeds.

Seed freshness is vital, as viability of many tropical plant seeds decrease rapidly following harvest. Special handling can prolong seed life, but it is best to plant as soon after the harvest or the opening of the sealed package as possible. *Monstera* seeds lose their viability in a few days after removal from the fruit, *Spathiphyllum* after a few weeks and *Chrysalidocarpus* after a few months.

Cuttings and seedlings are usually planted more than one per container to provide a full-appearing plant faster than would be the case were single plants pinched to induce branching. Many foliage plants exhibit strong apical dominance and develop few branches naturally. Many nurseries take tip cuttings to promote branching and to provide propagation materials. Cuttings and seedlings must be transplanted without delay. Tropical plants grow rapidly, and roots are damaged unless transplanting is done promptly.

Rooted or unrooted cuttings of foliage plants are also sold by specialized commercial nurseries. Some of these firms are located in Florida but most are located in Puerto Rico or Central America. Bareroot plants entering the U.S. are inspected for diseases and insects before shipment to the purchaser. Inspections are made at the USDA plant quarantine facility located at the International Airport in Miami. State inspectors also check plants in nurseries for pests and diseases.

Most foliage plant cuttings initiate roots without the aid of rooting hormones. However, these can significantly increase the number of roots while decreasing the time necessary for rooting. Fungicidal and bactericidal treatments, both pre- and post-planting, are widely used to control diseases in seeds and cuttings.

Protection from temperatures below 10°C (50°F) is necessary in the production of quality foliage. *Aglaonema*, *Dieffenbachia*, *Polyscias*, gesneriads, and some *Dracaena* species are among the more cold sensitive plants. In south Florida saran houses are usually covered with plastic; fuel oil burners are used to supply heat on cold nights. Steam heat is used in many fiberglass houses in central Florida, where temperatures may remain below 10°C (50°F) for several days and drop well below freezing at night. Stock fields of more cold-tolerant plants in south Florida are protected from rare episodes of freezing temperatures with overhead sprinklers.

LANDSCAPE PLANTS

Central and South Florida woody plant nurseries produce subtropical and tropical species primarily for use within the state. North Florida nurseries sell throughout the southeastern U.S. Demand for landscape material is subject to fluctuations in the economy which, in turn, affect construction. However, the continued influx of people seeking the sun makes the outlook good for continued high demand for woody plants in Florida in the 1980's. Many nurseries either stopped or drastically curtailed production of landscape plants in the early 1979's as foliage plant production became more profitable. This, combined with a great increase in population, has resulted in shortages of many kinds of landscaping plants, especially larger-sized trees. The increased demand has driven prices up and resulted in more nurseries returning to landscape plant production.

About 90 percent of the production is in containers, 10% in the ground. Almost all of the production is in full sun. Field-grown plants are started from container plants. As with foliage plants, landscape plants are nearly all started from seeds, cuttings or both (Table 2). A few species may be best propagated by air layering. Tissue culture techniques have not been developed as widely on woody plants as they have with foliage plants, and few tissue-cultured plants are presently being supplied to the landscape nursery trade. This will probably change in the next decade as tissue culture research continues.

Seeds of many kinds of tropical and subtropical landscape plants can be collected locally. These are usually sown soon

after harvest, as is the case with seeds of foliage plants. Seeds of some leguminous tropical trees have very hard seedcoats and require scarification or a hot water treatment, as do those of some temperate zone trees. Seeds are usually sown in flats or beds in a sheltered location. Intermittent mist may be used during germination. Tree seedlings are planted one per pot while shrubs are planted from two to five per pot. Soil-containing media are typically used in most landscape nurseries for starting seedlings and for subsequent transplanting. Frequently this is a mixture of sand, peat, muck and coarse sawdust. Coconuts can be laid on the ground outside and simply covered with sawdust. They can also be planted in containers, pointed end down. During germination the cavity in the coconut becomes filled with the cottony mass that is formed as the milk breaks down and nourishes the developing embryo.

Softwood and semi-hardwood cuttings are stuck 3 to 5 per pot under intermittent mist. This is usually under partial shade but may also be done under full sun if a windbreak encloses the misting area. Cell packs or peat pots may also be used for rooting. Smaller sized rooting containers are usually filled with a more porous medium than normal potting soil to compensate for their decreased drainage.

Growth of most tropical plants is at a minimum during the cool, dry winter months, November through February, and the availability of suitable cutting material from local plantings decreases drastically. Rooting and subsequent cutting growth are also decreased as days shorten and temperatures fall so that liner production of tropicals is least in winter. Under spring through autumn conditions cuttings root in 2 to 4 weeks, although up to 12 weeks may be required for some species. Rooting hormones are widely used on cuttings of landscape plants.

Calcium carbonate deposits and iron discoloration on foliage are two problems faced by a number of nurseries in the southeastern part of Florida. Chemical treatment of the water to lower the pH and to change the oxidation state of the iron has been beneficial in severe cases. The use of surface waters eliminates iron staining but does not solve the lime problem.

At least one widely used landscape plant in Florida is not propagated commercially at present. This is *Sabal palmetto*, the cabbage palm, which is the Florida state tree. Mature specimens are all dug from the wild and planted directly on the job. Several kinds of cycads formerly were also dug from the wilds of Florida and Mexico, but this practice has been stopped due to the implementation of the endangered species act. Cycads are included in the list of plants covered. Large specimens of ponytail palm (*Beaucarnea*) are also dug in Mexico and sold in

Florida nurseries, but these are also easily propagated from seed.

Grafting. Gardenias in Florida are commonly cleft grafted onto *G. thunbergia* for nematode resistance. The rootstocks are grown from seed obtained from locally grown plants or from a commercial source. The stock is allowed to attain a stem diameter of $\frac{1}{8}$ to $\frac{1}{4}$ inch (3 to 6 mm) before grafting.

Jacaranda scions from especially attractive trees are sometimes grafted onto seedlings. This is done not only to increase a desirable plant, but because the seedlings, due to juvenility, take many years to bloom, whereas a grafted tree blooms the second year following grafting.

Casuarina cunninghamiana, Australian pine, is sometimes grafted onto *C. equisetifolia* because the latter does not develop root suckers, while *C. cunninghamiana* does not produce the objectional seed cones of *C. equisetifolia*.

TROPICAL FRUITS

There is much interest in south Florida in the culture of tropical fruits, both by amateurs and industry. South Florida produces most of the nation's limes and mangos as well as avocados, lemons and papayas. The University of Florida has a Research Center at Homestead, which dedicates much effort to bettering tropical fruit crop production. The USDA maintains a plant introduction facility in Miami where all types of plant materials are evaluated as to their suitability for introduction into this country. The Rare Fruit Council International and the Broward County Rare Fruit and Vegetable Council both promote the use of and research on tropical fruits by local residents.

Grafting of selected superior seedlings is frequently done because cuttings from mature fruiting plants often will not root (Table 3). Also, many hobbyists do not have mist facilities. Most nurseries grow only mango, citrus, and avocado. The approach, side veneer, and cleft grafts are most frequently used, while budding is used on citrus. Most tropical fruit plants make attractive additions to the landscape and should be more widely used in the areas where they will grow.

Citrus is budded mainly onto sour orange (*C. aurantium*), trifoliolate orange (*Poncirus trifoliata*), or Cleopatra mandarin (*C. reshni*). The various rootstocks impart certain qualities to the fruit itself. In addition, they allow the trees to grow in poorly drained soils. The grafting process also maintains the adult nature of the scion, which results in thornless growth and early fruiting, sometimes as early as a year from budding. Dormant buds are taken from wood below the second or third growth flushes from round (in cross section) stems. Budding can be done whenever the bark "slips", typically from April through October.

Persea (avocado) does not root from cuttings. Superior cultivars are cleft, side veneer or side grafted onto seedlings. Seeds are planted in pots or plastic sleeves as they become available in the fall and winter months. Germination is hastened and improved by cutting from $\frac{1}{4}$ to $\frac{1}{2}$ inch (6-13 mm) off the tip of the seed. Within a few weeks the shoot emerges from the seed. Commercial grafting of avocados is done during the winter months. Some early-planted seed is ready to graft later that same season. The scion buds must not be in active growth at the time of grafting. Partial shading of grafted plants is beneficial.

Mangifera (mango) cuttings will not root. Approach and side veneer grafting are both used. Chances for a good take are greatest during the rainy season of May through September. Seeds are planted during the fruiting season, which is also from

May through September. Some seedlings may be large enough for grafting in the same season, while the others are grafted a year later.

Averrhoa carambola is a fruit gaining in popularity as better cultivars are found among seedlings or are introduced from abroad. It is side veneer or approach grafted onto seedlings or is air-layered. Seedlings will fruit in 2 to 3 years from seed but most produce inferior quality, sour fruit. However, the trees are quite ornamental with pink blossoms and bright yellow, ribbed fruit.

In the side veneer graft method, as used by tropical fruit hobbists, the scion can be up to about 12 inches (30 cm) long. The stock and scion should ideally be of about the same diameter. They are cut longitudinally in half and the scion cambium mated to the stock cambium before wrapping in plastic tape. For more difficult-to-graft species, the base of the scion can be left free of the stock and inserted into a small plastic bag containing water. The bag is tied to the stock and can be refilled as often as necessary to keep the scion alive while the graft union forms (Figure 1).

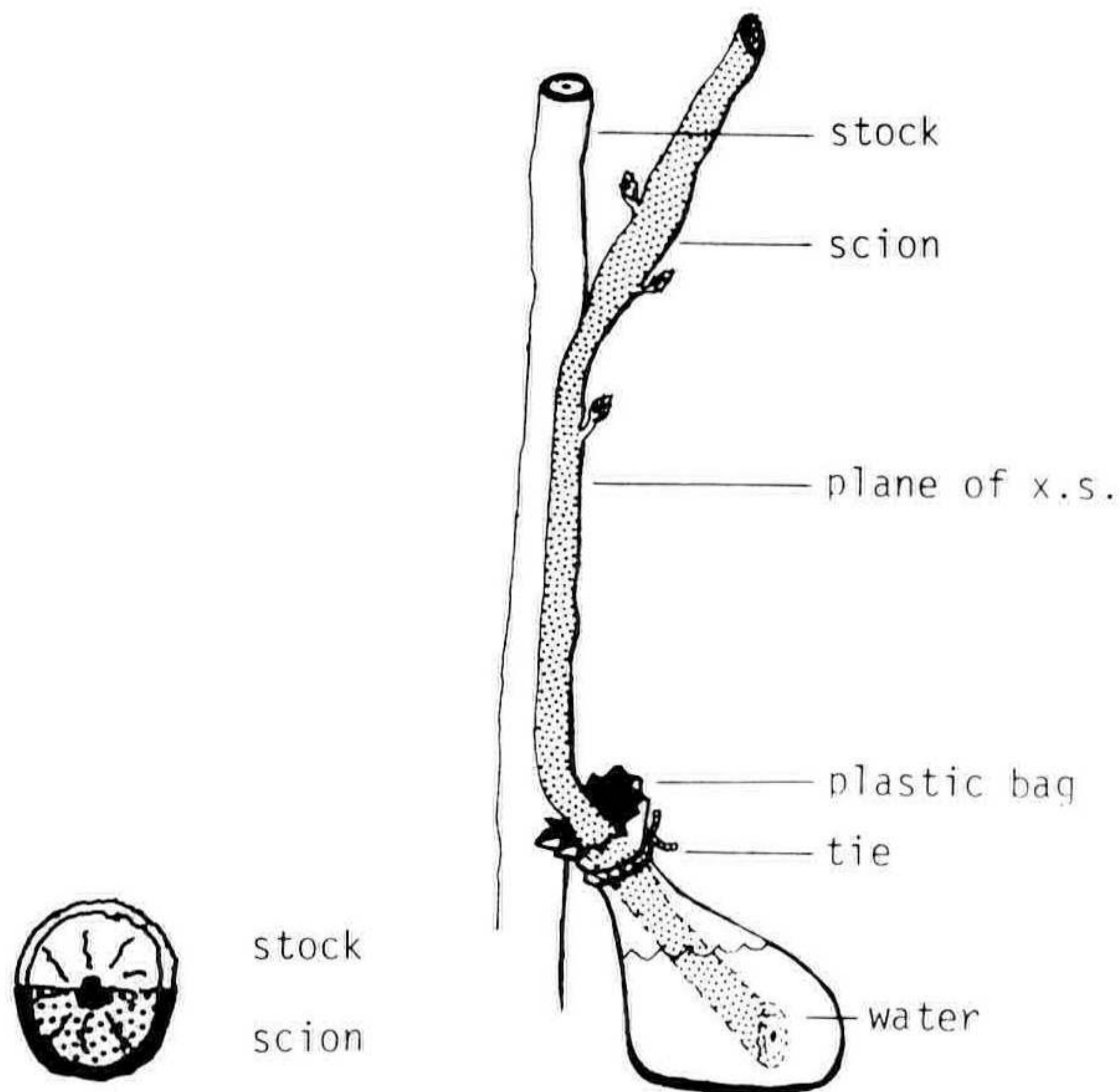


Figure 1. Left: Cross section through center of side veneer graft. Stock and scion are of similar size to provide a better match of their cambium layers. Graft is held with plastic tape or rubber bands. Right: Side view of graft. If scion has leaves the upper part may also be covered with a plastic bag to reduce drying. Water may be added as needed. After the union takes, the lower part should be cut off.

Table 1. Propagation methods used for fifty commonly grown tropical foliage plants in Florida.

Scientific Name Common Name	Seeds	Cuttings ¹	Air Layers	Divisions	Runners	Used in Landscape
<i>Aglaonema</i> sp. Aglaonema		1		3		
<i>Aphelandra squarrosa</i> Zebra plant		1				
<i>Araucaria heterophylla</i> Norfolk Island pine	1	3				x
<i>Asparagus densiflorus</i> 'Sprengeri' Sprengeri asparagus	1	3				x
<i>A. densiflorus</i> 'Myers' Foxtail asparagus	1	3				x
<i>A. setaceus</i> Plumosa fern	1	3				x
<i>Beaucarnea recurvata</i> Ponytail palm	1					x
<i>Begonia</i> sp. Various begonias	1	2				x
<i>Brassaia actinophylla</i> Schefflera	1					x
Bromeliads	1	2				x
Cacti	2	1				x
<i>Chamaedora</i> sp. Bamboo, Parlor Palm	1					x
<i>Chlorophytum comosum</i> Spider plant				3	1	
<i>Chrysalidocarpus lutescens</i> Areca palm	1					x
<i>Cissus rhombifolia</i> Grape ivy		1				
<i>Codiaeum variegatum</i> Croton		1	2			x
<i>Cordyline terminalis</i> Ti plant		1		3		x
<i>Crassula</i> sp. Succulents, jade, etc.		1				x
Cycads Cycads	1			3		
<i>Dieffenbachia</i> sp. Dieffenbachia cvs.		1				
<i>Dizygotheca elegantissima</i> False aralia	1	3				x
<i>Dracaena deremensis</i> 'Janet Craig', 'Warneckii'		1				x
<i>D. fragrans</i> 'Massangeana' Corn plant		1				x
<i>D. marginata</i> Red-edged dracaena		1				x
<i>Epipremnum aureum</i> Golden pothos		1				x
<i>Ficus benjamina</i> var. <i>benjamina</i> Benjamin fig		1	3			x
<i>F. elastica</i> Rubber tree		2	1			x
<i>F. lyrata</i> Fiddle-leaved fig		3	1			x
Gesneriads African violets, episcia	2	1	2	2		
<i>Howea fosteriana</i> Kentia palm	1					x
<i>Hoya carnosa</i> Wax plant		1				
<i>Maranta</i> sp. Prayer plant		1	2			
<i>Monstera delicosa</i> Pertussum						
Split-leaved philodendron	2	1				x
<i>Nephrolepis exaltata</i> Boston fern	3 spores				1	x

1 = a common method; 2 = an alternate method; 3 = a rarely used method

Table 1. (continued)

Scientific Name Common Name	Seeds	Cuttings ¹	Air Layers	Divisions	Runners	Used in Landscape
<i>Peperomia</i> sp. Peperomias		1				
<i>Pilea</i> sp. Pilea		1				
<i>Philodendron seluom</i> Self-heading philodendron		1				x
<i>P. scandens</i> subsp. <i>oxycardium</i> Heartleaved philodendron		1				
<i>Platyserium bifucatum</i> Staghorn fern	2 spores			1		
<i>Pleomele</i> sp. Pleomele		1				x
<i>Podocarpus macrophylla</i> Buddhist pine	1	3				x
<i>Polyscias fruticosa</i> Ming & parsley aralias		1				x
<i>Rhaphis excelsa</i> Lady palm	1					x
<i>Sansevieria trifasciata</i> Snake plant		1		1		x
<i>Schefflera arboricola</i> Dwarf schefflera	1	2				x
<i>Schlumbergera truncata</i> Christmas cactus		1				
<i>Spathiphyllum</i> × 'Mauna Loa' Peace lily	1					
<i>Syngonium podophyllum</i> Nepthytis	1	1				
<i>Yucca elephantipes</i> Spineless yucca		1				x

1 = a common method; 2 = an alternate method; 3 = a rarely used method

Table 2. Propagation methods used for fifty commonly grown landscape ornamental plants in Florida.

Scientific Name Common Name	Seeds	Cuttings	Air Layers	Divisions	Used as Foliage Plant
<i>Acacia auriculiformis</i> Ear acacia	1 ^a				
<i>Acalypha wilkesiana</i> Copperleaf		1			
<i>Acer rubrum</i> Red maple	1				
<i>Allamanda cathartica</i> Yellow allamanda		1			
<i>Arecastrum romanzoffianum</i> Queen palm	1				x
<i>Bauhinia blakeana</i> Hong Kong orchid tree	1		2		
<i>Bischofia javanica</i> Bishopwood tree	1	2			
<i>Bougainvillea glabra</i> Bougainvillea		1			
<i>Bucida buceras</i> Black olive	1	2			
<i>Butia capitata</i> Jelly palm	1				
<i>Callistemon viminalis</i> Bottlebrush	2	1			

a. 1 = a common method; 2 = an alternate method; 3 = a rarely used method

Table 2. (continued)

Scientific Name Common Name	Seeds	Cuttings	Air Layers	Divisions	Used as Foliage Plant
<i>Carissa macrocarpa</i> Natal palm		1			x
<i>Casuarina</i> sp. Australian pines	1	1			
<i>Chrysobalanus icaco</i> Cocoplum	2	1			
<i>Cinnamomum camphora</i> Camphor tree	1				
<i>Coccoloba uvifera</i> Sea grape	1	3			
<i>Cocos nucifera</i> Coconut	1				
<i>Crinum americanum</i> Crinum lily	3			1	
<i>Cycas</i> sp. Cycads	1				x
<i>Delonix regia</i> Royal poinciana	1				
<i>Eucalyptus</i> sp. Eucalyptus	1				
<i>Eugenia uniflora</i> Surinam cherry	1				
<i>Euphorbia milii</i> Crown of thorns		1			
<i>Ficus microcarpa</i> (Syn.: <i>F. retusa</i> 'Nitida')		1			
<i>Gardenia augusta</i> (Syn.: <i>G. jasminoides</i>)		1			
<i>Grevillea robusta</i> Silk oak	1				
<i>Hibiscus rosa-sinensis</i> Red Chinese hibiscus		1			
<i>Ilex vomitoria</i> Vomitoria holly		1			
<i>Ixora coccinea</i> Red ixora		1			
<i>Jacaranda acutifolia</i> Jacaranda	1				
<i>Jasminum volubile</i> Wax jasmine		1			
<i>Juniperus chinensis</i> 'Kaizuka' Hollywood juniper		1			
<i>J. virginiana</i> Eastern red cedar	1				
<i>Lagerstroemia speciosa</i> Queen's crape myrtle		1			
<i>Lantana montevidensis</i> Trailing lantana		1			
<i>Ligustrum japonicum</i> Japanese wax-leaf privet		1			
<i>Livistona chinensis</i> Chinese fan palm	1				
<i>Murraya paniculata</i> Orange jessamine	1	2			

a. 1 = a common method; 2 = an alternate method; 3 = a rarely used method

Table 2. (continued)

Scientific Name Common Name	Seeds	Cuttings	Air Layers	Divisions	Used as Foliage Plant
<i>Nerium oleander</i> Oleander		1			
<i>Phoenix roebelenii</i> Pygmy date palm	1				x
<i>Pittosporum tobira</i> Japanese pittosporum		1			x
<i>Plumbago capensis</i> Leadwort		1			
<i>Quercus virginiana</i> Live oak	1				
<i>Rhododendron</i> sp. Azalea		1			
<i>Roystonea elata</i> Florida royal palm	1				
<i>Strelitzia reginae</i> Bird-of-paradise	1				x
<i>Swietenia mahagoni</i> West Indian mahogany	1				
<i>Tabebuia caraiba</i> Silver trumpet tree	1				
<i>Trachelospermum jasminoides</i> Confederate jasmine		1			
<i>Virburnum suspensum</i> Sandangua viburnum		1			

a. 1 = a common method; 2 = an alternate method; 3 = a rarely used method

Table 3. Propagation methods used for fifty tropical fruit plants in Florida.

Scientific Name Common Name	Seeds	Cuttings	Air Layers	Grafting
<i>Ananas comosus</i> Pineapple		1 ^a		
<i>Annona reticulata</i> Custard apple	1			3
<i>Annona squamosa</i> Sugar apple	1			3
<i>Antidesma bunius</i> Bignay	1	2		3
<i>Artocarpus heterophyllus</i> Jackfruit	1			3
<i>Averrhoa carambola</i> Carambola	2			1
<i>Blighia sapida</i> Akee	1			
<i>Calocarpum sapota</i> see <i>Pouteria sapota</i>				
<i>Carica papaya</i> Papaya	1			
<i>Carissa carandas</i> Karanda	2	1		
<i>Casiminoa edulis</i> White sapote	2			1

a. 1 = a common method; 2 = an alternate method; 3 = a rarely used method

Table 3. (continued).

Scientific Name Common Name	Seeds	Cuttings	Air Layers	Grafting
<i>Chrysophyllum cainito</i> Star apple	1			3
<i>Citrus</i> sp. Lime, Lemon, Orange, etc.	3			1
<i>Clausena lansium</i> Wampi	1			3
<i>Diospyros discolor</i> Velvet apple	1			
<i>D. digyna</i> Black sapote	1			3
<i>Dovyalis caffra</i> Kei apple	1			
<i>D. hebecarpa</i> × <i>D. abyssinca</i> Tropical apricot		1		
<i>Eriobotrya japonica</i> Loquat	1			2
<i>Eugenia aggregata</i> Cherry of the Rio Grande	1			
<i>E. grasilensis</i> Grumichama	1	3		
<i>E. luschnathiana</i> Pitomba	1			
<i>Euphoria longan</i> Longan	3		1	
<i>Feijoa sellowiana</i> Pineapple guava	3	1		
<i>Flacourtia indica</i> Governor's plum		1		3
<i>Garcinia livingstonei</i> Imbe	1			
<i>Harpephyllum caffrum</i> Kafir plum	1			
<i>Litchi chinensis</i> Lychee	3		1	
<i>Macadamia integrifolia</i> Macadamia nut	2		1	
<i>Malpigha glabra</i> Barbados cherry	1			
<i>Mammea americana</i> Mamee sapote	1			
<i>Mangifera indica</i> Mango	3			1
<i>Manilkara zapota</i> Sapote	1			3
<i>Melicococusi sapodilla bijugatus</i> Spanish lime	1			
<i>Muntigia calabura</i> Strawberry-tree	1	1		
<i>Musa</i> × <i>paradisiaca</i> Banana		1		

a. 1 = a common method; 2 = an alternate method; 3 = a rarely used method

Table 3. (continued).

Scientific Name Common Name	Seeds	Cuttings	Air Layers	Grafting
<i>Myrciaria cauliflora</i> Jaboticaba	1			
<i>M. glomerata</i> Yellow jaboticaba	1			
<i>Passiflora edulis</i> Passion vine	1	1		
<i>Persea americana</i> Avocado	2			
<i>Pouteria campechiana</i> Egg fruit	1			
<i>P. sapota</i> Mamay	2			1
<i>Psidium lottorale</i> var <i>longipes</i> Strawberry guava	1	1		
<i>Rubus niveus</i> Mysore raspberry		1		
<i>Spondias mombin</i> Yellow mombin		1		
<i>Synsepalum dulcificum</i> Miracel fruit	1	2		
<i>Syzygium cumini</i> Jambolan plum	1			
<i>S. jambos</i> Rose apple	1			
<i>Tamarindus indica</i> Tamarind	1			
<i>Vitis rotundifolia</i> Muscadine grape		1		
<i>Ziziphus mauritiana</i> Indian jujube	1			

a. 1 = a common method; 2 = an alternate method; 3 = a rarely used method

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GEORGIA PEAT: 100,000,000 YD³ OF MEDIUM

WILLIAM H. CRIBBS and ROBERT LITTLE

Valdosta State College
Valdosta, Georgia 31601

Abstract. The formation of peat bogs in southern Georgia and northern Florida is unique in many respects when compared to peat bogs elsewhere in this country. The bogs are characterized by steep drainage slopes, deep peat deposits, and rapid past development. Analysis of peats from such bogs