Lengthening the daily period at 40°C to 12 or 18-hours delayed germination and increased T_{50} values.

Our research has identified two procedures for promoting high total germination of needle palm seeds rapidly and uniformly. Each procedure indicated a different probable cause for the poor germination of this seed. The scarification study indicated that needle palm seeds have a physical dormancy imposed by the thick-walled, tightly-packed sclereid cells of the sclerotesta. Removing the cap and sclerotesta covering the embryo cavity from seeds allowed the embryos to rapidly imbibe water and become fully hydrated. Embryo hydration promoted the emergence of the cotyledonary petiole from half the seeds (49%) within 1.3 weeks. The rapid germination of seeds without stratification at 5°C for 6 months indicated that at harvest seeds have mature embryos, and the embryos contain no chemical capable of inhibiting germination.

The results of our scarification study supported past reports that needle palm seeds have a physical dormancy permitting 7% to 14% total germination during 6-months to 2-years (Clancy and Sullivan, 1988; Popenoe, 1973; Shuey and Wunderlin, 1977). Constant warmth (30° to 35°C) after seed scarification was necessary to promote the emergence of the cotyledonary petiole. Carpenter (1988a) and Wagner (1982) have reported 30° to 35°C are required for germination and seedling growth of several palm species.

In our second study, seeds without scarification were soaked in DW for 7 days at 30°C; the water was changed daily to provide adequate aeration. After soaking, seeds were germinated in moist peatmoss at alternating 40°C for 6-hours and 25°C for 18-hours daily, and achieved 80% total germination. These results indicated that sufficient water penetrated the thick-walled, tightly-packed sclereid cells of the sclerotesta during 7 days of soaking at 30°C to fully hydrate the embryo. Although the cap covering the embryo cavity and the sclerotesta appear as physical barriers to embryo emergence, our results indicated that fully hydrated embryos emerge rather rapidly. The mean T_{50} was 1.3 weeks when seeds were scarified by removing the cap covering the embryo cavity and the sclerotesta above it, while hydrated non-scarified seeds germinated at alternating 40°C (6-hours) and 25°C (18-hours) had T_{50} of 2.4 weeks.

Our results cannot explain the rapid emergence of the cotyledonary petiole at constant 30°C after seed scarification, while 30°C failed to promote the germination of non-scarified seeds after hydration. Also, a few non-scarified seeds germinated at constant 35°C and none germinated at 40°C, but alternating 40°C for 6 or 12-hours daily with 25°C promoted high total germination. Possibly 40°C for short periods gives the promotive stimulus needed for the germination of needle palm seed. Carpenter (1988b) reported that imbibed *Butia capitata* (Mart.) Becc. palm seeds required constant 40°C for 3 weeks to terminate the dormancy of the seed, while 35°C under comparable conditions failed to promote germination.

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THE BLACK OLIVE (*BUCIDA BUCERAS* L.), A TROPICAL TIMBER TREE, HAS MANY FAULTS AS AN ORNAMENTAL

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Abstract. **The black olive (*Bucida buceras* L.) is native to the Yucatan peninsula and along the coast of Mexico, Central America and northern South America to the Guianas; the Bahamas, and the Greater and Lesser Antilles as far as Guadeloupe. Salt tolerant, the black olive grows in coastal swamps, wet inland woods, and on river banks, and tolerates dry limestone areas of South Florida. The tree is sturdily erect with tiered, whorled, often thorny branches, at first horizontal and later drooping. It is prone to producing suckers at the base. The elongated main branches bend downwards, making the tree top-heavy. Other drawbacks include the tree's need for regular pruning and its susceptibility to several pests and over two dozen diseases. *Philaphedra* scale causes the black olive to lose all its leaves; the mite *Eriophyes buceras* prevents normal fruit development, causing long, string beanlike galls. Both galls and leaves are high in tannin that stains sidewalks, vehicles, white roofs and cement decks. Black olives are best used for their excellent timber rather than as ornamentals.**

The black olive tree, *Bucida buceras* L. (syn. *Terminalia buceras* Wright) and the only other member of the genus, the Spiny Bucida, *B. spinosa* Jennings, belong to the family Combretaceae, which includes the familiar buttonwood (*Concocarpus erectus* L. and var. *sericea* Forst. ex D. C., Silver Buttonwood: also *Laguncularia racemosa* L., the white mangrove, and *Terminalia catappa* L., the tropical or Indian almond.

Origin and Distribution

The natural range of this tree is from southern Mexico and Yucatan (Standley, 1924; 1930) through Guatemala (Aguilar, 1966), El Salvador (Guzman, 1947), Costa Rica (Standley, 1937), Honduras and Belize (Standley, 1931), and coasts of Colombia and Venezuela (including Margarita) and the Guianas (Little and Wadsworth, 1964), to Panama (Britton and Wilson, 1925-26; 1930). It is "doubtfully native" but cultivated in Barbados (Gooding et al., 1965), ranges northward from Guadeloupe (Francis, 1988), to Jamaica (Fawcett and Rendle, 1926), Cuba, Hispaniola, Puerto Rico and the Virgin Islands (Britton and Wilson, 1925-26; 1930), the Bahamas (New Providence, Andros, Inagua) and the Caicos Islands (Little and Wadsworth, 1964).

In Jamaica, the black olive grows in salt-marshes on the seacoast (Fawcett and Rendle, 1926), commonly along "lagoons, swamp and river margins" (Adams, 1972). It occurs in Puerto Rico and the Virgin Islands on "plains, hillsides, river banks and in coastal woods" (Britton and Wilson, 1925-26; 1930). It is usually associated with mangroves in the coastal swamps of Belize (Standley and Record, 1936). On the Atlantic coast of Guatemala, it flourishes along the beaches, (Standley, 1937). There are solid stands of the black olive in parts of southern Mexico on clay (originally calcareous) soils that are periodically inundated (Pennington and Sarukhan, 1968).

It was seen on Elliott's Key (Small, 1912) in early days and "the range was originally thought to have included the Florida Keys, but it is now believed that it did not occur on the Keys before colonization" (Francis, 1988).

Simpson wrote in 1926: "Several years ago, a Catholic priest brought it from Jamaica and two fine specimens grew at a church of this denomination in Miami. From these, seed has been distributed and now we are beginning to use it as a road tree" (Simpson, 1926). In 1933, J. K. Small reported that "Great numbers of these trees are raised as shade trees and ornamentals in Florida" (Small, 1933). In 1958, the City of Miami Springs wanted to plant black olives in its parkway. They sent bids to 104 nurserymen but only two had any black olives (at $87.50 per tree), so the plan was abandoned (Taylor, 1958). Professor J. V. Watkins (University of Florida, Gainesville) wrote in 1969 that "Some nurseries will have little black olive trees in cans" (Watson, 1969).

Local names for the black olive are not numerous, despite the tree's wide distribution in Latin America, probably because it is not commonly domesticated. Names recorded in the literature are: amarillo (Panama) (Record and Hess, 1947); Antigua whitewood (Barbados) (Gooding et al., 1965); black olive (Bahamas) (Britton and Millspaugh, 1920), (Jamaica) (Fawcett and Rendle, 1926; Adams, 1972), (Puerto Rico) (Britton and Wilson, 1925-26; 1930), (Florida) (Simpson, 1926; Small, 1933); bucaro (Puerto Rico) (Standley, 1924; Britton and Wilson, 1925-26; 1930; Standley, 1928; Perez-Arbelaez, 1956); bullet tree (Belize) (Standley, 1928; Standley, 1931; Standley and Record, 1936; Perez-Arbelaez, 1956), (Yucatan) (Standley, 1930); bully tree (Yucatan, Belize) (Standley, 1930; Standley and Record, 1936); bullywood (Belize) (Standley, 1924; Little and Wadsworth, 1964); cacho de toro (Yucatan) (Pennington and Sarukhan, 1968), (Guatemala) (Standley and Williams, 1962); caracoli de Puerto Rico (Dominican Republic) (Record and Hess, 1947); gli-gli (Guadeloupe) (Little and Wadsworth, 1964); gregre (Puerto Rico) (Little and Wadsworth, 1964); Gregory wood (Puerto Rico) (Britton and Wilson, 1925-26; 1930); Grignon (French Guiana) (Little and Wadsworth, 1964); gri-gri (Dominican Republic) (Little and Wadsworth, 1964); gris-gris (Guadeloupe) (Little and Wadsworth, 1964); guaraguao (Dominican Republic) (Little and Wadsworth, 1964); gue-gue (Haiti) (Little and Wadsworth, 1964); hucar blanco (wood white); hucar prieto (wood dark) (Puerto Rico) (Cook and Collins, 1903); jicaro (Cuba) (Perez-Albelaez, 1956); jucare (Puerto Rico) (Cook and Collins, 1903); jucarillo (Cuba) (Little and Wadsworth, 1964); júcaro (Hawaii) (Neal, 1965), (Cuba) (Standley, 1928); Jucaro bravo (Cuba) (Record and Hess, 1947); jucaro común (Cuba) (Roig y Mesa, 1945); jucaro de costa (Cuba) (Record and Hess, 1947); jucaro de playa (Cuba) (Standley, 1924); jucaro negro (Cuba) (Little and Wadsworth, 1964); leertouwarsboom (Surinam) (Record and Hess, 1947); marión (Panama) (Record and Hess, 1947); olive bark tree (Jamaica) (Fawcett and Rendle, 1926); olivero (El Salvador) (Guzman, 1947); oxhorn bucida (Puerto Rico) (Harrar and Harrar, 1946; Francis, 1988), (Florida) (West and Arnold, 1946; Little and Wadsworth, 1964); paete (Guatemala) (Aguilar, 1966); pocte (Guatemala) (Standley and Williams, 1962); pucte or puc-te (Mexico) (Standley, 1924; Standley, 1930; Standley and Record, 1936), (Guatemala) (Standley and Williams, 1962); pueté (Mayan name) (Standley, 1928); pukte or pukjte (Mexico) (Standley, 1924; Pennington and Sarukhan, 1968); ucar (Puerto Rico) (Cook and Collins, 1903; Standley, 1924; Standley, 1928; Perez-Arbelaez, 1956; Little and Wadsworth, 1964; Francis, 1989); water gregre (Puerto Rico) (Britton and Wilson, 1925-26; 1930).

Description

The black olive is an erect tree, 24 to 80 ft. tall, with trunk attaining up to 3 ft. in diameter. Of variable growth habit (Sturrock and Menninger, 1946) its tiered branches are more or less horizontal, drooping at the ends. Twigs are forked (zigzag) and bare to the tips where the close-set, alternate, spatulate to elliptic leaves are whorled. The leaves are leathery; to 3-1/2 in. long. Some trees are spineless but others often bear sharp spines 1/4 to 3/4 in. long,

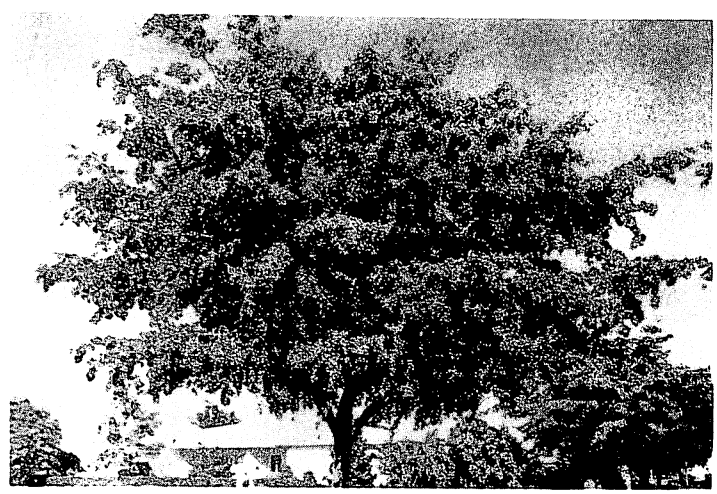


Figure 1. The black olive (*Bucida buceras* L.) has wide-spreading branches, drooping at the tips. Photo by Julia F. Morton.

on the young, lower branchlets (Standley, 1924; Standley, 1928; Standley, 1931; Standley and Record, 1936; Standley, 1937; Little and Wadsworth, 1964; Pennington and Sarukhan, 1968).

The black olive appears to be evergreen but there is a steady fall of leaves all year round. Tiny flowers, pale-yellow or greenish-white, appear in dense, stalked spikes, rising from the leaf bases. The small, somewhat hairy, fruits are black, 5-angled, 1-seeded. Seeds are minute, brown. In Florida, the fruits are usually attacked by the eriophid mite (*Eriophyes buceras*) which transforms the ovary of each flower into long, slender, brown, stringbean-like galls that are shed in great numbers and litter the streets and sidewalks (Small, 1912; Britton and Millspaugh, 1920; Standley, 1924; Britton and Wilson, 1925-26; 1930; Fawcett and Rendle, 1926; Standley, 1928; Standley, 1931; Small, 1933; Standley and Record, 1936; Standley, 1937; Harrar and Harrar, 1946; Standley and Williams, 1962; Little and Wadsworth, 1964; Gooding et al., 1965; Denmark, 1966; Pennington and Sarukhan, 1968; Lakela, 1971; Adams, 1972; Liberty Hyde Bailey Hortorium, 1976; Correll and Correll, 1982; Long and Morton, 1990).

Propagation and Culture

The black olive is difficult to propagate (Bush, 1972). Growth may be fast or slow (Guzman, 1947; Francis, 1988). It has been calculated that there are 38,000 seeds per 2.2 lbs. (Francis, 1988). The seeds germinate 12 to 17 days after planting in a nursery but many are damaged by insects (Smiley, 1962). Only 2500 of the seeds in the 2.2 lbs. may actually grow. Many seedlings do not survive transplanting. In rich soil, some may reach 30 ft. in height in 10 years.

Terminal softwood cuttings succeed well in a mist-bed. Air-layering is also a practical means of propagation (Smiley, 1962).

Pests and Diseases

In addition to the eriophyid mite mentioned earlier, black olive trees are often subject to attack by large flights of the Keys whitefly (*Aleurodicus dispersus*), which exude honeydew and induce sooty mold (Chellman, 1978). Alfieri et al. (1984), in their Index of Plant Diseases in Florida list 18 organisms as attacking the black olive.

The black olive's trunk and large branches are usually heavily pecked by woodpeckers and it should be realized that decay fungi can attack the wood through these holes (Chellman, 1978).

Other Problems

Nixon Smiley, garden editor of *The Miaml Herald*, warned in 1962 that young black olive trees should be carefully pruned to train them properly, otherwise they become bushy trees impossible to walk under. Nurserymen grow the trees close together and supported by stakes until they are strong enough to stand straight (Smiley, 1962). Mature trees should be topped every few years to keep them compact and protect them from storm damage. Trees that are not trimmed and are allowed to develop long, drooping branches suffer severe damage in hurricanes and become irregular, badly misshapen and increasingly subject to

Figure 2. A sad sight is this decapitated black olive, riddled with woodpecker holes oozing gum. Photo by Julia F. Morton.

Figure 3. An abundance of drooping branches and suckers at the base is typical of young black olives receiving no horticultural attention. Note the car deep in the shade. Photo by Julia F. Morton.

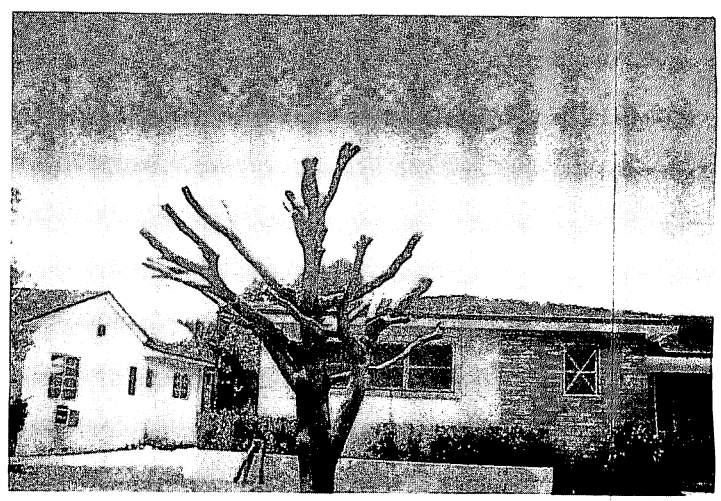


Figure 4. Topping the black olive severely every few years is the best way to maintain it as a conventional street or dooryard ornamental. Photo by Julia F. Morton.

breaking of branches when the next storm arrives, though the strong trunk of the trees usually remains erect. In the 1992 tornado a 20-ft. black olive was blown out of the ground, roots and all, and flung 70 ft. (William Graves, personal communication).

There has been considerable controversy over the density of the typical irregular canopy of the black olive trees along commercial thoroughfares in Miami, as they hide merchant's signs and many have been removed for that reason (Martin, 1990).

Among other undesirable qualities, the black olive should not be adjacent to parked automobiles, sidewalks, terraces, cement decks, or be so close as to overhang white tile roofs, because the fruits exude tannin and cause long-lasting stains (Stresau, 1986), as do the galls already mentioned.

The 1966 hurricane (which was a "dry" hurricane—strong winds and little rain) defoliated most of the trees in its path. It blew the leaves of the black olives against houses, and their walls were stained yellow. This unfortunate event gave rise to many complaints about black olives (Calvin Leonard, personal communication).

Seriously, the black olive is out-of-place as a street and ornamental tree and should be more commonly recognized as a valuable, salt-tolerant source of lumber.

Uses of the Wood

This tree is particularly valued as a source of lumber in Yucatan. The sapwood is thick, pale-yellow or light-brown (Fawcett and Rendle, 1926; Little and Wadsworth, 1964), not as durable as the heartwood (Sturrock, 1968). The heartwood is light yellow-brown or dark-brown (Cook and Collins, 1903; Little and Wadsworth, 1964), sometimes streaked with orange (Fawcett and Rendle, 1926). It is very hard and heavy (Gifford, 1945; Francis, 1989); moderately fine-grained; takes a fine polish; is resistant to decay (Standley and Record, 1936). However, it is difficult to work (Little and Wadsworth, 1964); is not popular for furniture (Francis, 1989). In Central America it is often used for construction (Standley, 1928; 1931; 1937). In Puerto Rico it is employed for carts, gates, fences, heavy-duty flooring, platforms, work-benches (Little and Wadsworth, 1964), shelves, boat-knees and mallets (Cook and Collins, 1903). Elsewhere it is used for non-marine piling (Francis, 1988) or in waters free of *Teredo* spp. (Francis, 1989); also for crossties, posts, bridges (Standley and Williams, 1962; Little and Wadsworth, 1964); axles and wheel hubs (Standley, 1924), though it has a tendency to crack (Cook and Collins, 1903).

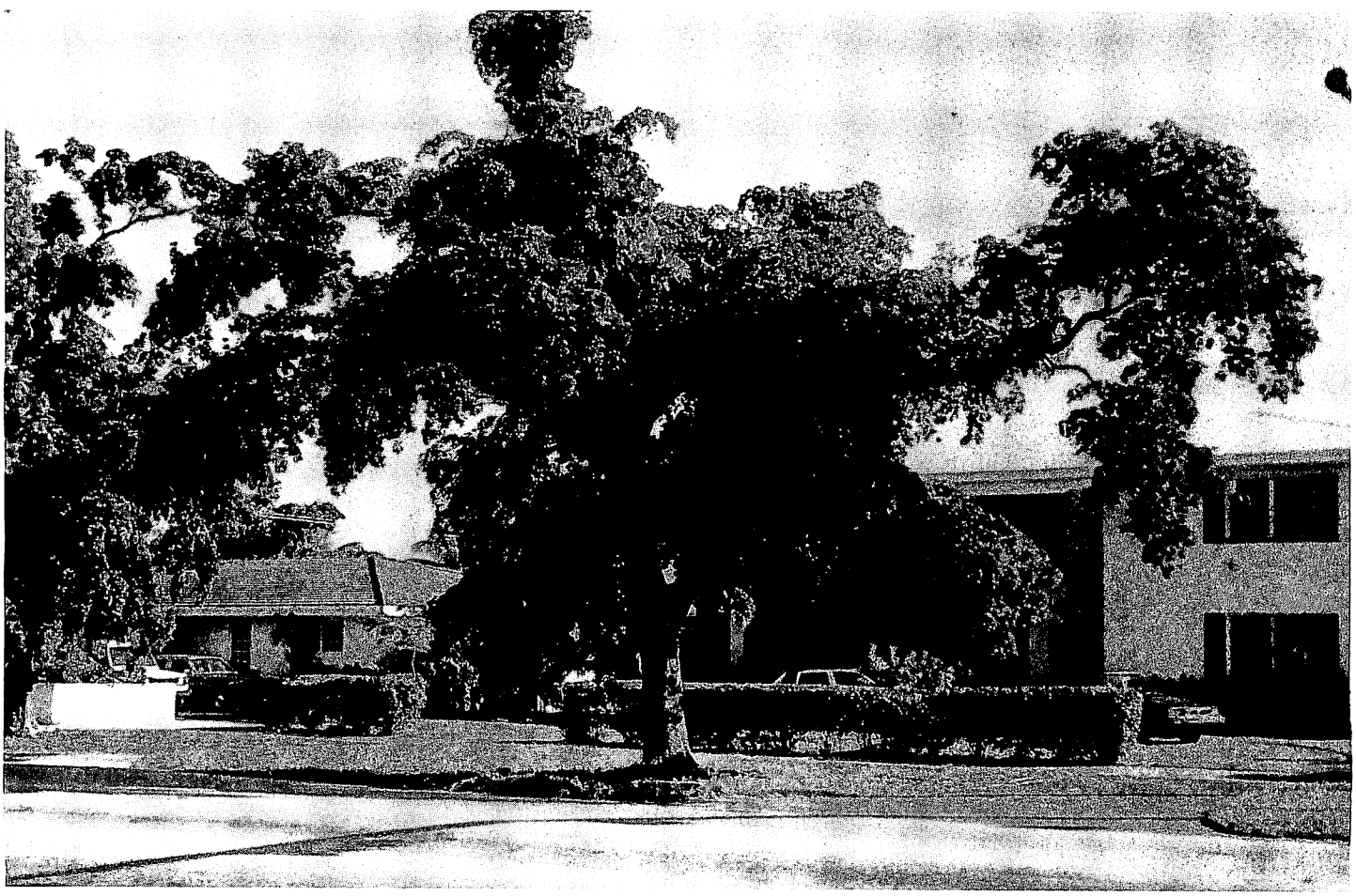
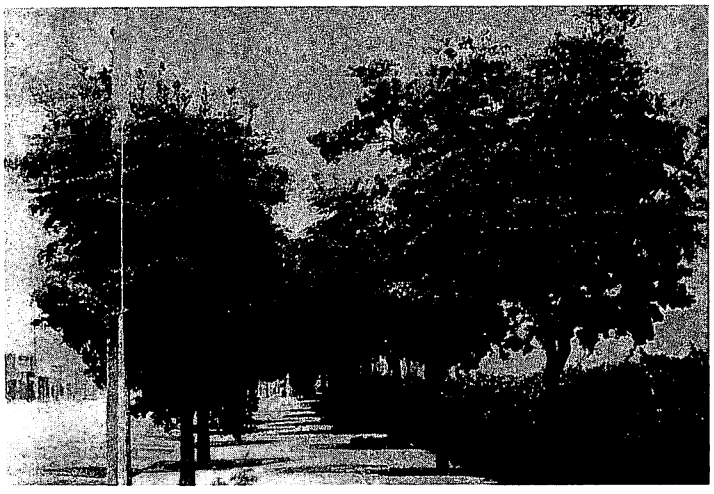


Figure 5. This storm-disrupted black olive seems unable to regain a sense of direction even one year after tornado "Andrew" (Aug. 23, 1992) and a second lashing—"Andrew Jr."—(Feb. 13, 1993). Photo by Larry Gilstad.

a



b

Figure 6. An obvious misuse of black olive trees: 6a. Double row of young trees along a sidewalk. 6b. In just a few years, the sidewalk has turned into a dark tunnel, heavily stained. Photo by Julia F. Morton.

In 1970, Joe Robles, then University of Miami Maintenance Foreman, told me that his great-grandfather's boat was 150 years old and still sound. It was made of black olive on the island of Culebra, off the eastern shore of Puerto Rico; was soaked for 2 months or so in the mangrove mud and, as a result, became entirely rot- and termite-resistant. Boats made thus in Culebra always sell for double the price of boats made otherwise in Puerto Rico (Joe Robles, personal communication).

Other Uses

Black olive wood has been employed for making charcoal (Standley and Record, 1936; Little and Wadsworth, 1964) and the bark has been often mentioned as having been a source of tannin (Cook and Collins, 1903; Fawcett and Rendle, 1926; Standley, 1931; Standley and Record, 1936; Harrar and Harrar, 1946; Perez-Arbelaez, 1956; Standley and Williams, 1962; Little and Wadsworth, 1964).

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NEPHTHYTIS CULTIVARS TO KNOW AND GROW

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Additional index words. aroid, arrowhead vine, foliage plant, *Syngonium*, variety trial.

Abstract. **Twenty-eight nephthytis (*Syngonium*) species and cultivars from tissue culture in 72-cell trays were potted in 12-cm pots and grown during the winter of 1992 and spring of 1993 in a shaded greenhouse. After 16 weeks, plants were measured for top growth, leaf dimensions and assigned leaf color codes. Plant height ranged from 13-29 cm. The number of plants with specific growth habits were: few shoots (8), intermediate (12), and clump-like (8). Leaf texture designations, based on leaf surface area, were as follows: fine (6), intermediate (15), and coarse (7). The leaf colors and primary vein colors of the 28 cultivars evaluated were recorded.**

Nephthytis is the common name used by most people in the foliage plant industry for aroids belonging to the genus - *Syngonium* Schott. The botanical name formerly used for *Syngonium* was *Nephthytis*, hence the common name used today. Many popular plant books refer to nephthytis as arrowhead vines, a name derived from the leaf blade shape.

There are approximately 20 *Syngonium* species which are indigenous to tropical America (Liberty Hyde Bailey Hortorum, 1976). Of the species listed in Hortus Third, only *S. wendlandii* is propagated through tissue culture for the Florida foliage plant industry in its original state. The remaining plants are either hybrids or mutants (sports) of hybrids or species. The literature suggests that many of the currently popular cultivars are selections from *S. podophyllum* or hybrids of the species (Liberty Hyde Bailey Hortorum, 1976).

It was estimated in 1992 that nephthytis composed 2% of the Florida-grown foliage plant mix (Sheehan, 1993). This represents essentially no change in proportion of nephthytis to the total foliage plant product mix on a statewide basis since 1975 (Smith and Strain 1976). In 1976 nephthytis was estimated to be 4%, 1%, and 2% of the total foliage plant mix for central Florida, south Florida, and statewide, respectively.

Nephthytis produced by tissue culture laboratories are in a juvenile phase when sold as microcuttings or plugs. Plants in the juvenile phase produce arrowhead-shaped leaves. As most of these plants grow in size, and particularly as they develop long vines under bright light, the new leaves become lobed in a palmate pattern. This leaf shape transition indicates that the plant is mature, or nearly so. Considering the low light levels in most interiorscapes and the restriction of plant size through pruning, nephthytis plants usually remain in the juvenile state when grown indoors.

Nephthytis are sold to retail consumers as specimen plants in small containers up to approximately 20 cm (8-inch) diameter. Very small plants in cell trays or individual containers up to 7.5 cm (3-inch) are frequently used in combination planters, such as dish gardens. One of the most popular uses of the plant is in 15-30 cm (6-12-inch) hanging planters. A few nephthytis are grown in pots fitted with a vertical stake, pole or trellis which supports the vines; those finished on a supporting pole are called totems.

Commercial interiorscapers have extended nephthytis utilization to include large specimens [containers exceeding 20 cm (8-inch)], large hanging planters [containers exceeding 30 cm (12-inch)], and mass planting for ground cover effect by placing plants on 45-75 cm (18-30-inch) centers, depending upon the cultivar. Nephthytis are excellent for plantings which cascade over cabinets, walls and similar construction features.

The purpose of this report is to characterize the growth habits and appearance of the major nephthytis cultivars grown in Florida.

Materials and Methods

Twenty-eight cultivars of *Syngonium* were obtained from four commercial plant tissue culture laboratories as established plants ("plugs") in 72-cell cavity trays filled with a peatlite medium. Since the growth habit of a tissue-cul-

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