

THE OCEAN-GOING NONI, OR INDIAN MULBERRY (*MORINDA CITRIFOLIA*, RUBIACEAE) AND SOME OF ITS "COLORFUL" RELATIVES¹

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Morton, Julia (*Morton Collectanea, University of Miami, P. O. Box 8204, Coral Gables, Florida 33124*). THE OCEAN-GOING NONI, OR INDIAN MULBERRY (*MORINDA CITRIFOLIA*, RUBIACEAE) AND SOME OF ITS "COLORFUL" RELATIVES. *Economic Botany* 46(3):241–256. 1992. The genus *Morinda* embraces about 80 species, mostly of Old World origin. *M. citrifolia* L. (southern Asia-Australia), noted as a source of dye and edible leaves, has buoyant seeds that float for many months and commonly appears in the Pacific and also in tropical America where *M. royoc* L., *piña de ratón*, is indigenous, inhabits inland hammocks and pinelands as well as seacoasts, and is also one of the floating-seed morindas. There are brief references to its use for dyeing in the Cayman Islands and Yucatan. Both *M. citrifolia* and *M. royoc* have sundry folk-remedy uses. *M. parvifolia* Bartl. has antitumor/antileukemic activity. High intake of selenium by *M. reticulata* Benth. has poisoned horses in Australia. In the Philippines, there is new interest in the wood of *M. citrifolia*. It is hard and of beautiful grain.

El marinero, noni, o mora de India (*Morinda citrifolia*, Rubiaceae) y unos de sus parientes pintorescos. El género *Morinda* abarca alrededor de 80 especies. La mayoría se origina en el Viejo Mundo. *M. citrifolia* (sur de Asia hasta Australia) conocida como fuente de tinte y hojas comestibles. Tiene semillas boyantes que flotan por muchos meses y comúnmente aparecen en el Pacífico como también en América tropical donde *M. royoc* L., *piña de ratón*, es indígena; habita en hamacas y bosques de pino poco adentro del país, como también en ciertas costas del mar. Es una de las morindas de semillas-flotantes. Hay notas breves en la literatura sobre su uso en tintorería en las Cayman Islands y Yucatan. La *M. citrifolia* y la *M. royoc* ambos poseen algunos usos en medicina folklórica. La *M. parvifolia* posee actividad antitumor/antileukemico. La alta absorción de selenio en la *M. reticulata* ha causado envenenamiento en caballos en Australia. En las Filipinas hay nuevo interés en madera de la *M. citrifolia*. Es dura y de fibra bonita.

Key Words: dye; folk remedy; food; Indian mulberry; *Morinda* spp.; noni.

The genus *Morinda*, of the family Rubiaceae, is believed to include about 80 species, mostly of Old World origin. At the time of H. B. Guppy, there were 50 known species, and he estimated that 60% were "confined to islands, large and small, in Malaya and in the Indian and Pacific oceans," and "not more than 15% of the species being restricted to America" (Guppy 1917).

Today, it seems that less than 20 species have been recorded as of economic value or otherwise noteworthy. One species stands forth as the "queen" of the genus, for its conspicuous features, its multiple uses, and its supreme ability to distribute itself on seacoasts far and wide,

without needing human aid. This wandering plant is *M. citrifolia* L. (syns. *M. bracteata* Roxb., *M. citrifolia* var. *bracteata* (Roxb.) Hook f.; *M. indica* L.), native to Malaysia, Australia and Polynesia (Brown 1946). It was formerly cultivated nearly throughout India (Watt 1908). It is common in thickets and second growth forests (Brown 1946), in valleys and on low hills in all the Philippine Islands (Monsalud et al. 1966); has been cultivated in villages throughout Southeast Asia or "at least encouraged to grow" (Burkill 1935). In Java, it grows wild from the sea up to 500 m elevation and once was cultivated everywhere (Ochse and Bakhuizen van den Brink, Jr. 1931).

It was long ago introduced by Polynesians to Hawaii where it became very popular and acquired the common name of noni. As the older

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generations faded out, the noni became less visible. By 1905 it was mostly found around "abandoned native dwellings" (Degener 1945).

DESCRIPTION

It is a shrub, or small or medium-sized tree, 3–10 m high (or more), with quadrangular or somewhat rounded branches and evergreen, opposite (or spuriously alternate), dark, glossy, wavy, prominently-veined leaves (with 7–9 veins on each side of the midrib); broadly elliptic to oblong, pointed at both ends, 10–30 cm in length, 5–15 cm wide. Variety *potteri* has smaller, green-and-white leaves (Neal 1965). Small, white, 5-lobed, tubular, fragrant flowers, about 1.25 cm long, are borne in globose heads 2.5 cm across. The heads develop into compound fruits composed of many small drupes fused into an ovoid, ellipsoid or roundish, lumpy body, 5–10 cm long, 5–7 cm thick, with waxy, white or greenish-white or yellowish, semi-translucent skin, the surface faintly patterned with 4- to 6-sided outlines, each with a central "eye" giving rise to the common, naive description as being like a potato (Degener 1945). The flesh is juicy, bitter, dull-yellow or yellowish-white, and contains numerous red-brown, hard, oblong-triangular, winged, 2-celled stones to 1 cm wide, each containing 4 seeds about 3.5 mm long (Backer and Bakhuizen van den Brink, Jr. 1965; Brown 1946; Fawcett and Rendle 1936; Gooding et al. 1965; Monsalud et al. 1966; Ochse and Bakhuizen van den Brink, Jr. 1931; Pulle 1934; Safford 1905; Seaforth et al. 1983). When fully ripe, the fruit has a pronounced "rancid cheese" odor (Cribb and Cribb 1975).

NATURAL DISPERSAL

Guppy (1917) said that the fruit soon decays when it falls into the sea but the seeds are extraordinarily buoyant because each has a large, bladder-like cavity. He put several into sea-water and found them "all afloat and sound after 5 weeks and gave promise of floating unharmed for many months." Once on shore, the plant grows rapidly and fruits virtually the year around (Benthall 1946; Little and Wadsworth 1964).

When he saw the plant a mile or two inland from Jamaica's coast, and even at altitudes of 183 and 215 m above the sea, Guppy surmised that secondary dispersal is probably by fruit-eating birds (Guppy 1917). Hayden and Dwyer (1969) found a further aid to buoyancy—minute

pits in the cells of the seed testa. Inland species of *Morinda* in the Old World do not have fully developed adaptations for floating (Guppy 1917).

The noni has become naturalized on open shores of the New World from Mexico to Panama, Colombia, Venezuela, and Surinam, and on many of the islands of the West Indies, the Bahamas, Bermuda, and the Florida Keys (Britton and Wilson 1925-6, 1930; Correll and Correll 1982; Pulle 1934; Long and Lakela 1971). Therefore, it has acquired an assortment of local names (see Table 1).

VIRTUES OF THE TREE AND ITS WOOD

The noni is a remarkable tree that deserves recognition for its ability to survive in harsh environments. It is extremely salt-resistant and can tolerate drought for several months (Terra 1966). It is not particular as to soil, flourishing wild on sandy shores or rocky, lava-strewn coasts in Hawaii (Merlin 1977) and on limestone and volcanic terrain of Guam (Stone 1970). In Surinam, it is cultivated as a windbreak (Ostendorf 1962). It is planted as a support for pepper vines in India (Anonymous 1962).

Its wood has received little attention, perhaps because it is very difficult to ignite (Maiden 1889), and is therefore not a source of fuel. The sapwood is soft (Little and Wadsworth 1964) and splits on drying (Burkill 1935).

The heartwood is yellow when fresh, darkens to yellow-brown or dull-olive (Burkill 1935); has a musk-like odor; is very close-grained, sometimes wavy, more attractive than Australia's satinwood (*Zanthoxylum brachyacanthum* F. & M.) (Audas 1952?). Though sometimes described as soft because it is easy to work, that of some trees is fairly hard (Benthall 1946), is used for turning, takes a good polish (Maiden 1889), and has been made into plates and dishes (Benthall 1946). In India, it was chosen for making native slippers (Drury 1873). In Australia, the trees are cut when leafless in winter and the logs kept submerged to protect them from termites (Maiden 1889). The weight varies from 18 to 20 kg per cu. ft. (Benthall 1946; Maiden 1889). Indian-grown timbers have measured 15–21 m in length and 50–75 mm in diameter (Maiden 1889).

In the Philippines, the heartwood of an old noni tree felled by a typhoon was found to be of beautiful texture and grain. Believing that the wood could be a source of high revenue, foresters quickly collected seeds to establish a plantation



Fig. 1. The noni's willowy, low-hanging branches protect some of the tree's lush foliage from strong coastal winds. Note the flowering heads which will soon develop into compound fruits.

in a coastal location and wood samples were taken to the Forest Products Research Laboratory for physical and chemical testing (Binua and Bugaring 1982).

NONI AS A SOURCE OF FOOD AND FODDER

Early Hawaiians ate the fruit of the noni tree only in times of famine (Degener 1945), as did the people of the Marquesas who only fed the fruit to hogs (Brown 1935). This is a common practice in Puerto Rico (Little and Wadsworth 1964). Nevertheless, the fruit was important for subsistence in most of Polynesia (Brown 1935) but by 1956 the plant was resorted to mainly for

dyeing (Massai and Barrau 1956). In Raratonga, Samoa and Fiji the fruit was common fare, raw or cooked (Brown 1935). Australian aborigines were very fond of the fruit (Maiden 1889). In Burma, the unripe fruits are cooked in curries; the ripe fruits are consumed raw with salt. Even the seeds are roasted and eaten (Benthall 1946; Sturtevant 1919).

The slightly bitter, very young leaves are relished raw or cooked as vegetables and eaten with rice in Java and Thailand (Ochse and Bakhuizen van den Brink, Jr. 1931; Pongpangan and Poo-brasert 1972). Mature leaves are wrapped around fish before cooking and are eaten with the fish (Brown 1935; Ochse and Bakhuizen van den



Fig. 2. The noni bears continuously and heavily. Immature fruits are pale-green and hard; full-grown fruits, on the same branch, are waxy and yellowish. The wind-battered upper leaves of this small tree were being attacked as well by a large lubber grasshopper.

Brink, Jr. 1931). In India, the leaves are lopped as fodder for livestock and as feed for silkworms (Anonymous 1962).

CHEMICAL COMPOSITION

Noni fruits contain 52.3% moisture; on a dry-weight basis, 24–158 mg ascorbic acid per 100

g. Tests have shown strong evidence of terpenes (Peerzada et al. 1990). The leaves contain 2.6–3.9% protein (Terra 1966).

MORINDA DYE

The noni has been most widely known for its dye which was first used experimentally in Eu-



Fig. 3. Ripe noni fruits, cut in half, reveal a multitude of the famous buoyant seeds that float from shore to shore.

rope in 1790 (Burkill 1935). Perkin and Everest (1918) wrote that both *M. citrifolia* and *M. tinctoria* Roxb. (now *M. coreia* Buch. Ham.) were extensively employed for dyeing, the plants being found in nearly all the provinces of India, either wild, as in the jungles of Bengal, or cultivated "in small patches in betel nut plantations or near the homesteads of the dyers." In Bengal, the plants were grown from slips or cuttings, but elsewhere raised from either cuttings or seed.

When 3 yrs old, the plants were taken up and the roots, 1 m or more in length and not over 1.25 cm thick, were cut off and processed (Perkin and Everest 1918). Larger roots were discarded, or could be used if necessary after removal of the bark. If too old, the roots are useless, as the coloring principle gradually disappears (Benthall 1946). It is present mainly in the bark (red) and less in the peeled root (yellow).

The upper parts of the plant are reduced to cuttings for the next planting (Perkin and Everest 1918), which was usually preceded by a crop of cotton (Watt 1908). The dried, powdered roots were fermented, or were digested with boiling dilute acid with added 1% of chalk. The colors produced (red, pink, lilac, chocolate, orange-red, scarlet, dull-purple or black) depended on the

mordant (chromium, iron, tin, etc.) and the amount used. Rich yellows were obtained by adding acetic acid (Perkin and Everest 1918). With a different mordant, even green was achieved (Smith 1882). Simmonds (1854) declared that the red dye was generally very brilliant and far more permanent than other red dyes.

Morinda dye was little used in the Philippines because it doesn't directly dye cotton (Perkin and Everest 1918). Both cotton and wool have been dyed with it in Queensland (Audas 1952?). In India, it used to be prized for dyeing carpets and yarn in general (Benthall 1946). It was formerly favored for coloring batik cloth in Java (Cribb and Cribb 1975), for handkerchiefs and turbans in India (Drury 1873) and in Madras, particularly, for red turbans. Polynesians used it for dyeing dresses, fixing the color with alum (Maiden 1889). In the Marquesas, the grated root was combined with grated wood of the kou tree (*Cordia subcordata* Lam.), together with turmeric and coconut oil. After straining, the tapa cloth was dipped in the mixture and then wrung out and dried (Brown 1935).

The root bark contains a number of anthraquinone derivatives, mostly morindone, derived by hydrolysis from the glucose morindin, which

TABLE 1. VERNACULAR NAMES OF *MORINDA CITRIFOLIA*.

ach	India	Anonymous 1962; Benthall 1946; Chopra et al. 1958
awl tree	Australia	Audas 1952?
	India	Simmonds 1854
	Java	Ochse and Bakhuizen van den Brink, Jr. 1931
	Malaya and Polynesia	Sturtevant 1919
baga	Dominican Republic	Pierre-Noel 1971
bangkoro	Philippines	Brown 1946
bankoro	Philippines	Quisumbing 1951
bankudo	"Pacific world"	Merrill 1945
bilimbi	French West Indies	Honychurch 1986
boi douleur	Haiti	Pierre-Noel 1971
bumbo	Africa	Altschul 1973
bungbo	Africa	Altschul 1973
buñuela	Dominican Republic	Pierre-Noel 1971
canary wood	Australia	Audas 1952?; Maiden 1889
cheesefruit	Australia	Peerzada et al. 1990
coca	Dominican Republic	Pierre-Noel 1971
doleur	Haiti	Little and Wadsworth 1964; Pierre-Noel 1971
feuille douleur	Haiti	Pierre-Noel 1971
feuille froide	Dominica	Nicolson 1991
forbidden fruit	Barbados	Gooding et al. 1965
fromagier	Haiti	Pierre-Noel 1971
gardenia hedionda	Puerto Rico	Little and Wadsworth 1964; Pierre-Noel 1971
grand morinda	Vietnam	Petelot 1954
great morinda	Australia	Cribb and Cribb 1975
	Malaya	Corner 1952
headache tree	St. Croix	Millspaugh 1902
hog apple	Cayman Islands	Proctor 1984
	Jamaica	Adams 1972
huevo de reuma	Dominican Republic	Pierre-Noel 1971
Indian mulberry	Australia	Maiden 1889
	Florida	Morton 1981a
	Guam	Safford 1905
	Hawaii	Merlin 1977
	India	Benthall 1946; Drury 1873
	Java	Ochse and Bakhuizen van den Brink, Jr. 1931
	Puerto Rico	Little and Wadsworth 1964
	Fiji	Parham 1943; Safford 1905
	Guam	Safford 1905; Stone 1970
	Guam	Safford 1905
Leichhardt's tree	Australia	Maiden 1889
limburger tree	Florida	Morton 1981b
mengkoedoe	Surinam	Ostendorf 1962; Stahel 1942
mengkudu	Malaya	Burkill 1935
menkudi besar	Malaya	Corner 1952
menkudu besar	Malaya	Corner 1952
mirier de Java	Seychelles	Baker 1877
mona	Tahiti	Smith 1882
monii	Tahiti	Smith 1882
mora de la India	Cuba	Roig y Mesa 1945
morinda	Australia	Webb 1948
	Puerto Rico	Little and Wadsworth 1964
	Surinam	May 1982
mulberry	Cayman Islands	Proctor 1984
	India	Watt 1908

TABLE 1. CONTINUED.

nhau	Vietnam	Petelot 1953
nhau lon	Vietnam	Petelot 1954
nhau nui	Vietnam	Petelot 1953
nho	Laos	Petelot 1953
nhor prey	Cambodia	Petelot 1953
nhor thom	Cambodia	Petelot 1953
nigua	Dominican Republic	Little and Wadsworth 1964
nino	Philippines	Binua and Bugaring 1982; Brown 1946; Safford 1905
nona	Malaysia	Safford 1905
noni	Hawaii	Degener 1945
	Polynesia	Massai and Barrau 1956; Merlin 1977
	Puerto Rico	Pierre-Noel 1971
nono	Tahiti, Raratonga	Brown 1935
nonu	Samoa	Safford 1905
	Tonga Islands	Altschul 1973
nuna	southern India	Safford 1905
pain bush	Trinidad and Tobago	Seaforth et al. 1983
pain killer	Dominica	Altschul 1973
	Puerto Rico	Little and Wadsworth 1964
	St. Croix, St. Thomas and other Virgin Islands	Eggers 1879; Millspaugh 1902
piña de puerco	Dominican Republic	Barker and Dardeau 1930; Pierre-Noel 1971
piñuela	Dominican Republic	Pierre-Noel 1971
pomme macaque	French West Indies	Honychurch 1986
rubarbe caraibe	French West Indies	Honychurch 1986
	Guadeloupe	Pierre-Noel 1971
ruibarbo caribe	El Salvador	Guzman 1947
	Guadeloupe	Little and Wadsworth 1964
togari wood	India	Watt 1908
urati	Solomon Islands	Safford 1905
wild pine	Barbados	Gooding et al. 1965
yor ban	Thailand	Pongpangan and Poobrasert 1972

yields also rubichloric acid and alizarin. Among other constituents are soranjidol and chrysophanol (Leistner 1973). The latter probably accounts for the use of the bark extract on ringworm (see Medicinal Uses).

For many years, morinda dye was claimed to be inferior to the famous madder from the roots of *Rubia tinctorum* L., but, after a series of chemical studies and experiments, it was found in 1894 to be actually superior to madder (Perkin and Everest 1918). Its virtual disappearance as a commercial dye was brought about only by the development of coal-tar colors (Safford 1905).

MEDICINAL USES

On the Malay Peninsula, noni was cultivated only for its curative powers (Burkill 1935). Throughout Malaysia and Southeast Asia, the ripe fruit was (and may still be) gargled to over-

come a sore throat. Unripe fruits, charred, were applied with salt on spongy gums (Benthall 1946; Chopra et al. 1958; Ochse and Bakhuizen van den Brink, Jr. 1931; Quisumbing 1951).

In the Pacific Islands, a combination of pounded fruit, with mashed stem of black-stalk sugarcane, and root of kava (or awa) (*Piper methystichum* Forst.) was held to be a cure for tuberculosis. The juice of the fruit diluted with water, is served to participants in kava ceremonies to help avoid adverse effects (Degener 1945). In the Philippines, the whole fresh fruits were found effective in de-worming pigs (Binua and Bugaring 1982). The seeds are given to children and adults as a purgative and vermifuge (Quisumbing 1951). The mashed ripe fruit is credited with providing quick relief from a painful boil, a carbuncle, a stomach ulcer, and an inflamed elbow in Hilo, Hawaii (Stewart 1972).

The young fruit, still fresh, and mashed with salt, is applied on deep cuts and poulticed over broken bones (Kaaikamanu and Akina, 1922).

The leaves are purgative (Altschul 1973). They have a number of medical applications in Malaysia, Africa and the Pacific Islands and some of these have reached parts of the New World. In the Caribbean area, they are poulticed on wounds and rheumatic joints, and applied on the head to relieve pain and fever (Honychurch 1986). They are resorted to in some manner to overcome convulsions (Burkill 1935). Among the most widespread practices is the heating of the leaves and placing them on the abdomen in cases of swollen spleen, liver diseases and internal hemorrhages. They are plastered on the chest to relieve severe colds and coughs (May 1982; Burkill 1935; Dalziel 1948).

The people of the Marquesas made much use of the leaves, warmed over a fire, to relieve inflammation (Brown 1935). Crushed leaves in lard or camphor oil were put on the face to treat neuralgia or head colds (Little and Wadsworth 1964). In Fiji, the young leaves in oil are applied on ringworm and rheumatic pains. They are chewed and placed as a poultice on any inflammation (Parham 1943).

The leaves are wrapped around rheumatic joints, and poulticed on gout, boils and ulcers (Brown 1935). The leaf decoction is taken as a tonic and febrifuge (Benthall 1946; Chopra et al. 1958). The leaf juice is said to be very effective on wounds and ulcers (Dastur 1952?; Drury 1873). It is taken to counteract fever and headache (Dalziel 1948), and is claimed to be antiarthritic (Brown 1935).

The bark is a strong astringent, taken in malaria (Quisumbing 1951). The leaves and bark are pounded together and the decoction is taken as a treatment for tuberculosis (Degener 1945). A decoction of the root is laxative and emetic (Benthall 1946; Chopra et al. 1958), and a root extract is given to relieve hypertension (Martin 1971). In Guam, juice squeezed from the flowers is applied on sore eyes (Christopherson 1935). This practice might be inspired by the "eye-like" indentations on the fruit. The fruit pulp is used as an insecticidal shampoo (Degener 1945). Its potency may be judged by the fact that it is utilized for cleaning iron and steel (Burkill 1935).

OTHER *MORINDA* SPECIES

M. coreia Buch.-Ham. (syns. *M. tinctoria* Roxb.; *M. tinctoria* var. *tomentosa* Hook.; *M.*

tomentosa Roth; *M. aspera* Wight & Arn.) grows wild not only in central and southern India (Murti et al. 1959), northern India and the Deccan peninsula (Anonymous 1962), but also in Thailand, Cambodia, Laos, Vietnam (Martin 1971), and Sri Lanka (Ceylon) (Worthington 1959). In western Java, it is rare, mainly found in often-dry teak forests (Backer and Bakhuizen van den Brink, Jr. 1965).

In India, it is called al, or ack, nunaa, or munjenatie (Dastur 1951; Drury 1873; Sundararaj and Balasubramanyam 1969); in Sri Lanka, ahu, al, or mancha vanna (Worthington 1959); in southeast Asia, nhau, khor thom, or nho thom (Petelot 1953).

It is described by various authors as a small to medium tree (to 10 m high) with a straight, cylindrical stem (Anonymous 1962); the bark corky, yellow-white, vertically furrowed (Dastur 1951). The leaves are pale-green (Reddy et al. 1978), elliptic to lanceolate, 8–20 cm long, 3–8 cm wide (Petelot 1953). The fruit is round or ovoid, 1.5–2.5 cm wide (Anonymous 1962). Various parts are pubescent—corolla tube lobes (outside); peduncles, branchlets and leaves; heads pubescent or glabrous; stipules short-hairy outside. The plant is highly variable and at times hard to distinguish from *M. citrifolia* (Backer and Bakhuizen van den Brink, Jr. 1965).

The unripe, green fruits are commonly cooked in curries (Sturtevant 1919). The leaves are eaten by cattle, sheep and goats (Sundararaj and Balasubramanyam 1969).

The wood is at first light-red, sometimes yellow-streaked, eventually becoming dull-red. It is straight-grained, medium-hard to hard, weighing 15.5–21.5 kg per cu. ft., easy to work, durable but inclined to warp or split at the ends unless covered to keep it dry during seasoning. It is suitable for furniture and various utensils, also for yokes and combs (Anonymous 1962; Dastur 1951; Worthington 1959). It is rated as the best wood for gunstocks (Drury 1873).

In southern Vietnam, the roots are commonly employed in local medicine. In Cambodia, the grated root in alcohol is given to arrest vomiting in cholera (Petelot 1953). The leaves, ground with spices, are given to halt adult diarrhea and dysentery; the charred leaves with mustard are prescribed in diarrhea of infants (Dastur 1952?).

M. coreia has been used in dyeing in India, though, because of the confusion with *M. citrifolia* in the literature, it is frequently impossible to be certain of its particular uses. Reddy et al.

(1978) refer to *Morinda* dye as being used to color pharmaceuticals as well as textiles.

Drury (1873) wrote that a dye was derived from the "interior of the wood in older trees." Chemists at Delhi University, India, isolated from the shavings of the heartwood morindone, damnacanthal, and nordamnacanthal, the latter not previously found in plants (Murti et al. 1959). Later, Balakrishna et al. (1960) discovered a new glycoside of morindone, which they named morindonin, in the root bark.

Reddy et al. (1978) reported their extraction and purification of the glycoside morindin 6-pri-meveroside of morindone ($C_{26}H_{28}O_{14}$, 1,5,6-tri-hydroxy 2-methyl anthraquinone) from root bark of *M. coreia*, and testing on cockroaches and houseflies, topically. Cockroaches showed slight excitation and then died in 20–30 min. Flies were dead in 10 min., the female being more susceptible than the male.

M. lucida Benth. is a well-known species all across tropical Africa, on the fringes of forests and sometimes in wetlands. It is commonly called brimstone tree because of its yellow wood. Irvine (1961) lists seven native names all meaning "Christmas tree," and a half-dozen signifying "bitter."

It reaches 12–15 m in height (Dalziel 1948; Irvine 1961), has smooth, gray bark, often with purple layers (Eggeling 1951), a dense crown of slender branches and evergreen leaves, elliptic to ovate, 20 cm long, 12.5 cm wide, that turn dark-purple or black when dry (Irvine 1961). The fragrant flowers, 1.25–2.50 cm long (Eggeling 1951) and all-white, are borne in terminal or axillary heads (Dalziel 1948). The fruits, irregular in form and only 2 cm wide, are red when fresh, finally black (Asuzu and Chineme 1990).

The bitter root is employed as a flavoring for food and alcoholic beverages (Dalziel 1948). The leaves are useful for cleaning and scouring calabash shells (Walker and Sillans 1961).

The timber darkens to yellow-brown in the sapwood and to dark-brown in the heartwood. It is hard, durable, resistant to moisture, termites, and other pests, valued for construction, mining props, furniture, canoes, poles and fuel (Dalziel 1948; Irvine 1961). It is excellent for making charcoal (Eggeling 1951).

In some areas of Central Africa, the tree is cultivated around villages where the roots are taken up as a source of dye. The roots are also marketed for this purpose. Propagation of the tree is by seeds and cuttings. The roots yield a

yellow dye, the bark a red dye, and a green dye is made by combining the leaves with those of *Lonchocarpus* trees (Irvine 1961).

The tree's medicinal uses are many. Here, a few examples should suffice. All parts are astringent, in general, purgative, emetic and diuretic (Oliver 1960). A decoction of the bark is an external and internal remedy for fever, hemorrhoids and dysentery. The bark and roots are often combined. The root decoction serves as an emmenagogue. A decoction of the roots and leaves prevents abortion. Bark and leaves are boiled together and the fluid used to treat jaundice. An infusion of the leaves, twigs and spices is given to control infant diarrhea. A bundle of leaves wrapped in a piece of banana leaf is scalded and soaked in cold water, and the bitter black infusion is given as a febrifuge (Dalziel 1948; Irvine 1961). Bathing in the leaf decoction or inhaling the vapor of boiling leaves is said to have a diuretic effect (Watt and Breyer-Brandwijk 1962).

According to Asuzu and Chineme (1990), *M. lucida* root extracts are commonly employed against malaria induced by *Plasmodium* spp. These investigators tested leaf extracts of *M. lucida* against *Trypanosoma brucei brucei*, the blood protozoan parasite causing trypanosomiasis. Oral doses led to acute purgation in infected mice (as happens in humans afflicted with malaria) and produced significant trypanocidal effects without entirely eliminating the parasites in the blood.

M. umbellata L. (NOT Lour.) has a number of synonyms: *M. scandens* Roxb., *M. microcephala* L., *M. padavara* Juss., *M. tetrandra* Jack, *Stigmanthus cymosus* Lour., and *Stigmatanthus cymosus* Roem. & Schult. (Anonymous 1962; Petelot 1953). It is native from southern India and the Deccan Peninsula (Anonymous 1962) to Burma, China, also in Sri Lanka, Southeast Asia, the Philippines, northern Australia and Japan, in some regions ascending to altitudes of 1500 m (Anonymous 1962; Petelot 1953; Watt 1908). In India it may be called nuna, noona-marum, mulughudu, or moolooghoodoo, maddi chekhe, mang-koudu, or chota alka (Drury 1873; Perkin and Everest 1918; Watt 1908). In the Philippines it is known as halon or nino (Quisumbing 1951); in Sri Lanka, maha-kiri-vel or nuna (Alston 1938). In Malaya, there are mengkudu akar, buah butang (button fruit), and several other vernacular names (Burkill 1935). It is called yah yan in Thailand (Burkill 1935); in Laos, khua mak mah

pa; in Vietnam, nghe ba, day dat or doc vo (Petelot 1953).

It is a sprawling or climbing shrub with long, hairy, slender branches (Quisumbing 1951), with elliptic, oblong or lanceolate leaves (Anonymous 1962), 5–13 cm long, hairy, with red veins on the underside (Alston 1938; Quisumbing 1951). It bears terminal umbels of 3–7 fragrant, greenish-white, 4-lobed flowers and subglobose, irregularly lobed, red fruits, 2.25 cm wide (Petelot 1953).

The ripe fruits are eaten raw (Burkill 1935). Unripe (green) fruits are eaten in curries (Anonymous 1962).

The tough stems are used as ropes in Sri Lanka (Burkill 1935).

The root bark contains morindone and morindin, much rubichloric acid, low levels of trihydroxymethyl anthraquinone methyl ethyl, morindanigrin, $C_{16}H_{10}O_5$, 1,3-dihydroxy-6-methyl anthraquinone, a derivative of dimethyl anthraquinone, $C_{16}H_{12}O_6$ and a hydroxy-methyl anthraquinone carboxylic acid $C_{16}H_{10}O_5$ (Anonymous 1962).

The roots are hardly used for dyeing in India but in Java the dye, called mang-kudu, has been highly prized for the permanent red shades it imparts to batiks. This effect is achieved by first washing or steeping the roots in water to remove undesirable acid principles (Perkin and Everest 1918; Watt 1908).

In India and Vietnam, the leaves and roots are employed for treating dysentery (Anonymous 1962; Petelot 1954). The leaves are also used to expel intestinal worms. The boiled roots are poulticed on dropsy (Burkill 1935). In 1929, the roots were reported to be utilized as a drastic purgative in American medical practice (Quisumbing 1951).

M. royoc L. (syn. *M. yucatanensis* Greenman) is the dominant representative of the genus in the New World. It is very commonly found in thickets and pinelands, on limestone, and not far from the seacoast of southeastern Florida and the Florida Keys, or actually coastal. It is also a very familiar plant in the Bahamas, the Caicos Islands, the West Indies, Cayman Islands, Aruba, Bonaire and Curacao, Central America, Yucatan, and coastal northern South America—Venezuela, Colombia and Ecuador. It was listed as a plant of Bermuda in 1845 and 1910 but had seemingly vanished by 1918 (Adams 1972; Alain 1962; Barker and Dardeau 1930; Britton 1918; Buswell 1946; Correll and Correll 1982; Pierre-

Noel 1971; Proctor 1984; Roig y Mesa 1945; Small 1919, 1933; Standley 1931b; Standley and Williams 1975). Regional names are plentiful (see Table 2).

There really is no vernacular name for the plant in Florida where Buswell (1946) referred to it as a weed. Small (1929) recorded it on Big Pine Key as "cheese-shrub," a term that would better fit *M. citrifolia*.

M. royoc is a sprawling and clambering shrub, ascending to a height of 6 m. Its evergreen leaves are opposite or in whorls of 3, narrow-lanceolate or oblong-elliptic, 5–10 cm in length, 1.5–4 cm wide, dark-green, glossy, faintly rough on the upper surface with a few hairs beneath. Small, white or sometimes reddish, 5-lobed flowers are borne in dense heads 7–10 mm wide. The yellow, somewhat raspberry-form fruits, 2–3.5 cm long and 2 cm wide, are juicy and present all year. The stone is ovalish, 5 mm long, and buoyant, having the cavity and pits that keep those of seagoing *M. citrifolia* afloat (Guppy 1917; Alain 1962; Arnoldo 1964; Britton and Millspaugh 1920; Buswell 1946; Fawcett and Rendle 1936; Hayden and Dwyer 1969; Long and Lakela 1971; Schne 1984; Small 1933).

MINOR ROLE OF *MORINDA ROYOC* IN DYEING

Guppy (1917), in writing of *M. royoc* in the Cayman Islands, said: "It furnishes a yellow dye. In its use as a dye plant it resembled *Morinda citrifolia* in the Old World, which has long served this purpose in the East." Apart from this, I have only two statements by Standley (1930a) and Standley and Record (1936) that the plant was used by the Mayas for dyeing.

In 1974, University of Miami art students who had been practicing weaving, wanted to dye the wool with a natural product. I encouraged them to dig roots of *M. royoc* and they were gratified to produce various shades of yellow and orange using different mordants with the *M. royoc* extract.

The following year, hoping to interest others in this dye-plant, I sent dried roots and literature on *Morinda* dyeing to Dr. Norman Doorenbos at the University of Mississippi and he assigned a student, Young Park, to study them. He reported in 1976 that she had identified 4 constituents responsible for the coloring activity (N. J. Doorenbos, pers. comm.), but apparently did not publish the results.

TABLE 2. VERNACULAR NAMES OF *MORINDA ROYOC*.

batata geel	Aruba, Bonaire and Curacao	Arnoldo 1964
cheese-shrub	Florida	Small 1919
conchado huevo	Honduras	Pierre-Noel 1971
curamaguey	Cuba	Roig y Mesa 1945
curamaguey amarillo	Cuba	Pierre-Noel 1971
hooyoc	Yucatan	Standley 1930a
hooyok	Yucatan	Martinez 1959
hoyoc	Guatemala	Standley and Williams 1975
	Yucatan	Standley 1930a
joyoc	Yucatan	Standley 1926
lumbra machu	Aruba, Bonaire and Curacao	Arnoldo 1964
paja de ratón	Venezuela	Schnee 1984
palo garañon	Cuba	Roig y Mesa 1945
palo zapatero	Aruba, Bonaire and Curacao	Arnoldo 1964
pan de diabel	Aruba, Bonaire and Curacao	Arnoldo 1964
pepa de ratón	Venezuela	Schnee 1984
piña de ratón	Cuba	Roig y Mesa 1945
piñipiñi	Cuba	Roig y Mesa 1945
piñuela	Guatemala	Standley and Williams 1975
	Yucatan	Martinez 1959; Standley 1930a
quidive	Colombia	Pierre-Noel 1971
raiz de añil	Cuba	Roig y Mesa 1945
raiz de indio	Cuba	Roig y Mesa 1945
red gal	Jamaica	Adams 1972; Asprey and Thornton 1953
reviento caballo	Cuba	Roig y Mesa 1945
rhubarb	Bahamas	Britton and Millspaugh 1920; Correll and Correll 1982
		Proctor 1984
rhubarb root	Cayman Islands	Proctor 1984
ruibarbo de la tierra	Cuba	Roig y Mesa 1945
safran	Haiti	Barker and Dardeau 1930
saw weed	Bermuda	Britton 1918
strongback	Jamaica	Adams 1972
wild egg	Guyana	Pierre-Noel 1971
wild mulberry	Bahamas	Britton and Millspaugh 1920; Correll and Correll 1982
		Standley and Williams 1975; Standley 1930a
xhoyencab	Guatemala, Yucatan	Standley and Williams 1975; Standley 1930a
x-hoyencab	Yucatan	Martinez 1959
xhoyac	Guatemala	Standley and Williams 1975
xhoyoc	Guatemala	Standley and Williams 1975
	Yucatan	Standley 1930a
xhoyok	Yucatan	Martinez 1959
xo-yen-cab	Yucatan	Standley 1926; Standley 1930a
yaw weed	Cuba, Haiti, Jamaica	Griesbach 1864
yellow ginger	Jamaica	Asprey and Thornton 1953
yellow root	Cayman Islands	Proctor 1984
zhoyoc	Belize and Yucatan	Standley 1930a; Standley and Record 1936

MEDICINAL USES OF *M. ROYOC*

In Cuba, the root decoction is taken as a purgative and aphrodisiac (Alain 1962). The powdered root serves as a stomachic and laxative in small doses, while large doses are drastically purgative. It serves as an emmenagogue and treatment for dysentery and jaundice. To achieve the aphrodisiacal effect, one must carry a piece of

the wood in one's pocket (Roig y Mesa 1945). The alleged reaction has caused the root to be nicknamed "gangway" in Belize (Richard Siegel, pers. comm.).

The root decoction is bitter and astringent. In Yucatan, it is taken as a digestive and to relieve liver troubles (Martinez 1959). People in Curacao rely on it as a remedy for diarrhea and ve-

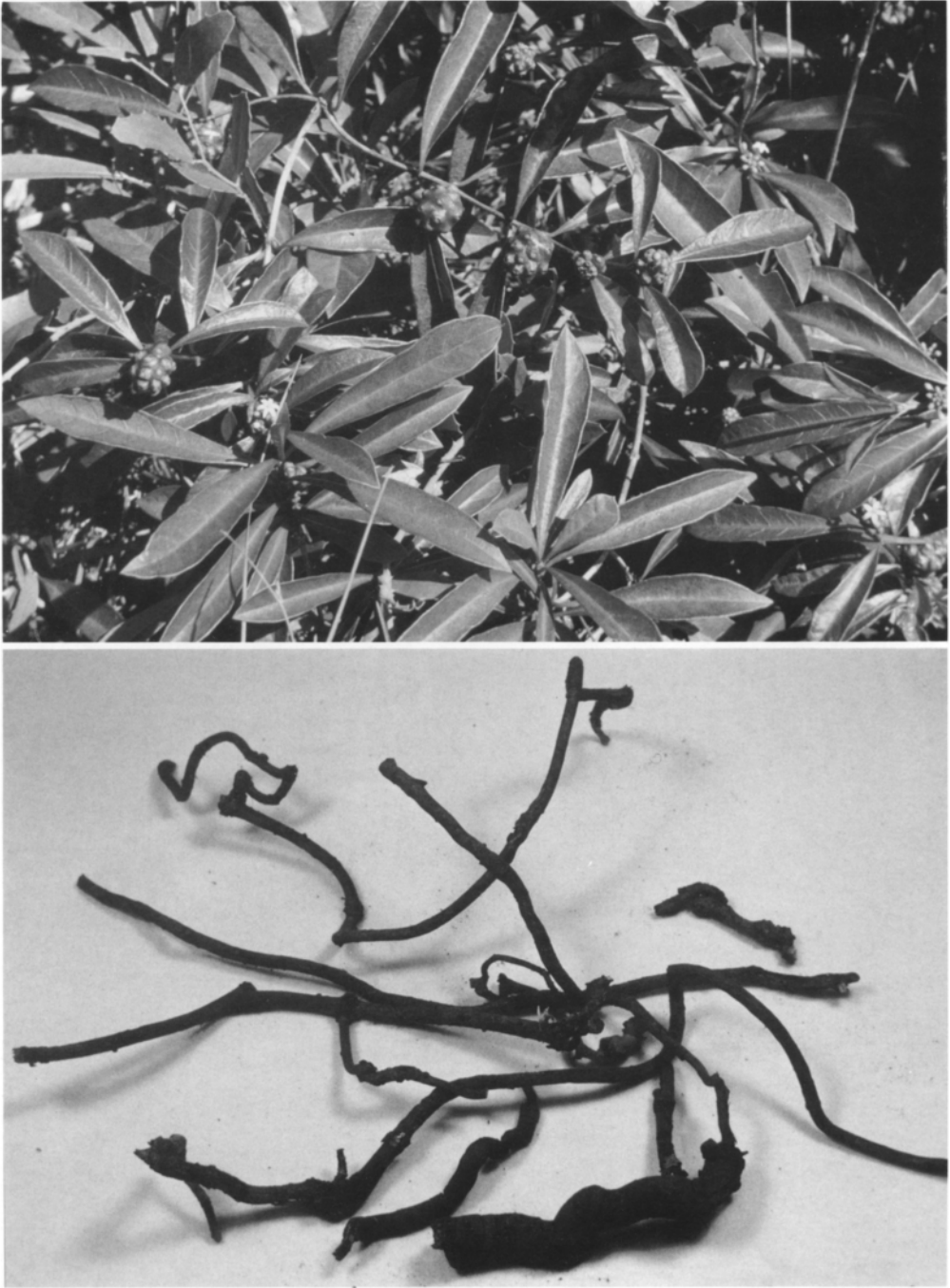


Fig. 4, 5. Fig. 4. (Above). The flowering and fruiting, somewhat raspberry-form heads of *Morinda royoc* turn from dark-green to yellow on maturity. Fig. 5. (Below). Circuitous and twisted, *M. royoc* roots are very dark-brown on the outside, rich-yellow on the inside, become hard and barely flexible when dried. They yield yellow or orange dye.

nereal diseases (Morton 1981a). According to Roig y Mesa (1945), the root contains tannin and calcium oxalate. Standley (1930b) wrote in his *Rubiaceae of Colombia* that he found an herbarium specimen of this plant and a note by Schott: "Said to be very poisonous. Sea water taken internally acts as an emetic and as an antidote."

In 1959, I supplied roots of Florida specimens to the chemist, Dr. August Pacini, and he extracted a yellow, laxative substance (August Pacini, pers. comm.).

In Guatemala, the fruits are rubbed on warts (Standley and Williams 1975). One might assume that this practice was inspired by the "warty" aspect of the fruits, but Standley (1930a), in his *Flora of Yucatan*, declared it to be an infallible remedy.

OTHER *MORINDA* SPECIES IN THE NEW WORLD

There are only a few other native American species of *Morinda*. Quite unlike *M. royoc* is the woody *M. panamensis* Seem., a shrub or tree to 7.5 m with leaves to 25 cm long (Woodson and Schery 1980), found from Panama to Mexico and Colombia, sometimes in wet thickets and swamps (Standley 1931a), and up to 500 m altitude (Standley and Williams 1975). Its range extends from southern Mexico along the Atlantic coast to Panama and Colombia. Vernacular names include calabaza and palo de peine in Mexico; yellowwood and turkey victuals in Belize; canche in Guatemala; and concha de huevo in Honduras (Standley and Williams 1975). It is known as yema de huevo in Colombia (Standley 1930b). The dark-yellow, fairly hard wood is used for railway ties (Standley and Williams 1975).

Little known are *M. buchii* Urb., endemic to the Dominican Republic and Haiti (Barker and Dardeau 1930; Moscoso 1943), and *M. mouensis* Alain, endemic in Cuba (Alain 1962).

REPORTED BIOLOGICAL ACTIVITY OF EXOTIC SPECIES

Morinda reticulata Benth., of the Cape York Peninsula in Queensland, Australia, has been known since 1923 to be a selenium accumulator, even where the level of selenium in the soil is very low, and has caused grave selenosis in local horses that graze on the young shoots (Knott et al. 1958; Everist 1974). This is the only species

that Gibbs (1974) lists as a selenium indicator. Nevertheless, before adopting any species of *Morinda* as a food, fodder or medicinal plant, one should ascertain whether or not the species tends to accumulate selenium. The fruit of *M. citrifolia* is thought toxic in Barbados (Gooding et al. 1965), so the chemistry may vary with the locale.

Morinda species deserve more study. The oriental hong-zhu-teng (or bai-yen-teng), *M. parvifolia* Bartl., used in China to relieve pulmonary complaints, has been investigated at the University of North Carolina and Southern Methodist University and found to have antitumor/antileukemic activity (Chang et al. 1982; Chang and Lee 1985; Khanpure and Biehl 1989).

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