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THE PONGAM TREE, UNFIT FOR FLORIDA LANDSCAPING, HAS MULTIPLE PRACTICAL USES IN UNDER-DEVELOPED LANDS

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Abstract. **The pongam tree, *Pongamia pinnata* (Linn.) Merr. (*P. glabra* Vent. *nom illeg.*) (7), grows wild on seashores and along inland waterways from India and Malaysia to northern Australia, the Philippines and Polynesia. It was introduced into Hawaii by Hillebrand in the 1860's. The U.S. Department of Agriculture received seeds from Sri Lanka in 1910, from Mauritius in 1911, from India in 1912, from Egypt in 1916, and from India in 1926. The tree never became popular in Florida because of its faults: breadth; bareness an entire month in spring; trashy leaf and flower fall; pods that remain on the tree all year and then litter the ground and are a hazard to pedestrians; and spreading surface roots. The flowers emit a respiratory and skin irritant. The seeds are toxic to fish and a potential risk to children. All parts of the tree induce vomiting. In under-developed lands, the pongam has practical uses: foliage for fodder and fertilizer and insect-repellent in stored grain; seed oil for illumination, lubrication, and soap, and as a synergist enhancing the potency of insecticides. The leaves, roots and oil are employed in folk medicine.**

The pongam has undergone a number of changes in botanical name and recently has been referred to as *Millettia* sp. (41), but most botanists have long separated the pongam from that genus mainly because its seedpods do not open naturally while those of *Millettia* dehisce. In 1972, S. R. Bennet, an Indian taxonomist gave the pongam a new name, *Derris indica* (Lamk.) Bennet, but this change has not been generally adopted (32).

The most commonly and widely used vernacular name, pongam, was taken directly from the Tamil language in India. The Tamilese may also refer to the tree as ponga or pungam. In Hindi, the preferred name is karanja or karanj (23, 26, 38, 50, 53, 58, 61). There are at least 70 other regional names for the tree in India and Malaysia (21, 23, 24). Malayans usually call it mempare or seashore mempari (25). In Sarawak and Brunei, the local name is biansu (14). Throughout Indonesia there is a plethora of regional names but Indonesian authors usually prefer Indian beech (24) and this name is important in Australia (42). In the Philippines, the common name is bani (13, 55); in Vietnam, day lim or day mau; in Laos, dok kom koi (54).

Description

The pongam tree ranges from 30 to 75 ft in height, has a relatively short, stout trunk, 10 ft or more in circumference, with smooth, light-grey or pinkish bark. The helmet-shaped crown of spreading, drooping branches may span 50 or 60 ft. Alternate, odd-pinnate leaves, red at first, become 6 to 14 in long; have 3 to 9 opposite, elliptic or obovate leaflets, 2 to 6 in long, pointed at the apex, dark-green, glossy on the upper surface, paler, dull, with prominent veins on the underside. The strongly fragrant, pea-like flowers, ½ in long, may be white, pale-pink, or lavender with purple calyx; are borne in axillary racemes to 10 in long. The short-stalked pods, borne in great abundance 3 to 4 months after blooming, are somewhat almond-shaped, with a short, recurved beak at the apex. They are about ¼ in thick, 1½ to 2½ in long, ¾ to 1½ in wide; bright-green and waxy when immature; light-brown when mature and dry; leathery and durable; remain on the tree all year, are difficult to crush on the ground, creating a long-lasting litter. In the words of Cowen (26): "The ground below is always covered with a crackling carpet." They do not open naturally and the "shell" must decay before the seed can germinate (12). There is usually one flattened, elliptical or kidney-shaped seed, occasionally two, in each pod (3, 5, 7, 10, 12, 14, 23, 26, 29, 30, 36, 43, 46, 51, 56, 63).

Origin and Distribution

The pongam grows wild on dry (7, 34), rocky seashores (34, 63), and along inland waterways in southern Japan and China, Southeast Asia (54), and from Pakistan (27), India and Malaysia to northern Australia (15), the Philippines and Polynesia (56). It is one of the commonest trees in coastal India and Sri Lanka (22, 23, 24) and in India ranges some distance inland (21). It was introduced into Hawaii by Hillebrand in the 1860's (29) and was still rare there in 1965 (52). In 1910, Dr. David Fairchild brought in seeds from Sri Lanka (P. I. #27570) and raised a tree at his home, "The Kampong", in Coconut Grove, Miami, Florida. The United States Department of Agriculture received more seeds from Mauritius in 1911 (P. I. #30959), from India in 1912 (P. I. #33580); from Egypt in 1916 (P.

Fig. 1. A pongam tree in full foliage. It is a "space hog" with a 52-ft-wide crown. Another tree nearby has a spread of 64 ft and a trunk 12 ft in circumference. (Photo by Julia Morton).

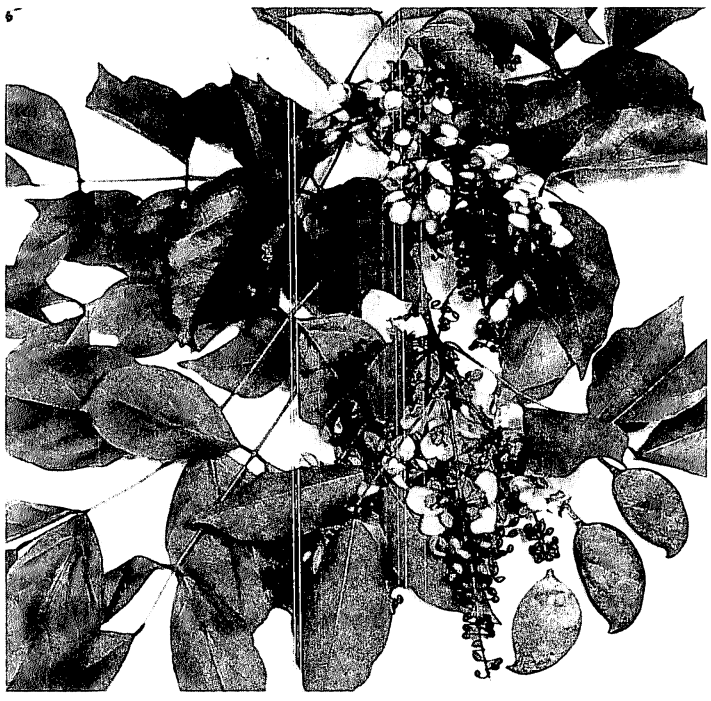

Fig. 2. Pongam flowers appear briefly (usually in May) along with the new foliage, while old seedpods are still on the tree. (Photo by Julia Morton)

I. #43662): and from India in 1926 (P. I. #66152) (15, 16, 17, 18, 20).

Ricker, in Bailey's *Standard Cyclopedia of Horticulture*, 1947 printing (8), wrote: "Grown in S. Calif.", but van Rensselaer in 1948 listed it only in his *Addenda* of "trees rarely cultivated in California or not represented in this region by really notable specimens", and merely saying that it was "Offered by Souther California Acclimating Association in 1908 and 1911 and by Montarioso Nursery in 1910" (66). Hoyt did not mention it in his comprehensive *Check Lists for Ornamental Plants of Subtropical Regions* (specifically California) in 1958.

Dr. F. B. Power of the U.S. Bureau of Chemistry reported in 1919 that the tree "flourishes luxuriantly in south Florida" (19). Around 1926, Dr. Charles Torrey Simpson was given a list of plants recommended by J. C. Curtis, Superintendent of Parks in Miami. The pongam was among them, along with the odious *Melaleuca quinquenervia, Albizia lebbeck, Ficus benjamina, F. altissima,* and *F. elastica* (62). Mowry included it in the University of Florida's Bulletin, *Ornamental Trees,* in 1938 (44). Sturrock and Menninger in 1946 (67) wrote that it was graceful on wide parkways "but it sheds leaves and pods heavily and is a 'trashy' tree on the lawn" (65). Dr. R. Bruce Ledin, at the University of Florida's Subtropical Experiment Station, Homestead, praised it in 1955—"one of the best shade trees, with graceful, weeping branches" (39). Watkins (67) admired it in 1951. Still, Barrett located only 26 specimens from Key West to Naples in her 1955 survey (10).

The "Flowering Tree Man", Edwin Menninger, did not list the pongam in his 1953 or 1956 catalogs. In his 1968 edition of *What Flowering Tree Is That? (44),* he squeezed it in, in small type, saying "flowers . . . are brightly pretty, but the pongam is a dirty tree and sheds an enormous number of leaves, useful for mulch but unsightly". In his *Flowering Trees of the World for Tropics and Warm Climates* (1962), he mentions the pongam only in Chapter 8, "Flowering trees that were left out of the book". He gave it only 3 lines: "*Pongamia pinnata,* occasionally used (unfortunately) as a street tree in Miami, produces quantities of blue pea flowers among the dense foliage but they last only a day or two and the trees are excessively 'dirty'" (45). In his *Seaside Plants of the World* (1964), he dealt with it briefly as "Occasionally planted in Florida" (46). Long and Lakela included the pongam in their *Flora of Tropical Florida* (1971) as "doubtfully spontaneous" (40), but I have had reports of seedlings coming up abundantly under and around the parent tree.

The pongam grows rapidly from seed or from branch cuttings set in wet soil (12). Multiple suckers may spring up around the base of the trunk.

Diseases and Pests

In India, the pongam tree is "attacked by a large number of insects and a few fungi" (5). Alfieri *et al* (2) cataloged 4 organisms as producing leaf spot on pongams: *Alternaria* sp., *Cercospora pongamiae, Gloeosporium* sp. and *Phyllosticta* sp. They also recorded *Pythium* sp. as a cause of root rot.

Commecial growers in Florida have maintained that the pongam is relatively free from serious pests (64). Watkins (68) cites only "caterpillars". In Miami, in 1981, a nurseryman was astonished to find 5 green caterpillars, 1½ in long, on a pongam branch. They had defoliated about 1 ft of an adjacent branch tip (R. Glenn, personal communication). Perhaps the defoliator was the bean leaf roller which is common on other legumes. Larvae of *Selenisa sueroides* (a noctuid looper) were observed attacking pongam foliage at the Smith Nursery in Ft. Lauderdale in 1960, and *Polygonus leo* (formerly *P. lividus savigny*), hammock skipper, also *Chrysomphalus aonidum,* Florida red scale, have been found feeding on pongam by the same plant inspector (Curtis Dowling, personal communication).

The computerized data bank of the Florida Department of Agriculture and Consumer Services' Division of Plant Industry, Bureau of Entomology, has yielded a list

Fig. 3. The same tree as in Fig. 1 exhibiting annual defoliation (usually in April), littering the ground, and conspicuously ugly for at least a month. (Photo by Julia Morton)

Fig. 4. The same tree as in Figs. 1 and 2. Note the clump of suckers around the base, and the hazardous, far-reaching surface roots. (Photo by Julia Morton).

of the last 3 pests named above and 23 other enemies of the pongam: *Paraleyrodes naranjae,* a whitefly; *Tetraleurodes acaciae,* acacia whitefly; *Pseudomus inflatus,* seagrape weevil; *Artipus floridanus,* a weevil; *Philephedra tuberculosa,* a scale; *Pulvinaria* sp., a fluted scale; *Coccus hesperidum,* brown soft scale; *Coccus longulus,* long brown scale; *Ischnapspis longirostris,* black thread scale; *Eucalymnatus tessalatus,* tessellated scale; *Diaprepes abreviatus,* sugarcane rootstalk borer; *Stephanoderes* sp., an ambrosia beetle; *Buseius sibelius,* a predacious mite; *Planococcus citri,* citrus mealybug; *Platypus compositus,* a platypodid; *Pseudocaecillus citricola,* a procoptera; *Toxoptera aurantii,* black citrus aphid; an Embioptera (web spinner), *Oligotoma saundersii; Franklinella bispinosa,* a thrips; *Prochalia pygmaea,* a psychid moth; and a Scolytidae *Xyleborus lecontei*; also *Practicolella grissola,* a snail. (Harold Denmark, personal communication).

The eriophyid mite (*Eriophyes cherianei*) causes leaf galls on pongam in India (9). In Java, the flowers are "frequently transformed into globose galls which might be mistaken for fruits" (7).

Status of the Pongam in Florida

The pongam tree never became popular in South Florida because of its shedding of leaves in spring and remaining a full month in shabbiness before blooming briefly and shedding of flowers with the reappearance of foliage, and, later, heavy production of pods, and also because of its aggressive, wide-spreading, surface roots. But, in 1984, it was announced that the contractors for the MetroRail (elevated railway) in Miami had chosen the pongam and the equally undesirable earleaf acacia (See Proc. Fla. State Hort. Soc., 98, 1985) because of fast growth, and they arranged with nurserymen to supply hundreds of both for planting along the MetroRail route. A Dade-County Citizens Transportation Advisory Group was quickly formed and prevailed against the use of these "trash trees". Nurseries were left with large stocks and both trees soon became popular with developers, the pongam especially, not only because of availability and rapidity, but also for its salt-tolerance (5) and wind- and drought-resistance (64, 68). In the November 15, 1990 issue of the *PLANTFINDER—WHOLESALE GUIDE TO FOLIAGE AND ORNAMENTAL PLANTS* (6), there are 26 nurseries listed as stocking small seedlings, or 4- to 18-ft trees at $6 to $9.50 per ft.

It is time to call attention to the pongam's negative aspects and halt this trend, for the tree is definitely not an asset in Florida landscaping for the reasons already mentioned. In addition, if seedpods drop on sidewalks or other paving, they are a hazard to pedestrians because they are convex on both sides and, if one is stepped on, it can cause the foot to wobble. This has resulted in falling and severe injury—in one case, a broken hip. The seed kernels are toxic to cold-blooded animals and might be dangerous if consumed in quantity by children. All parts of the tree are known to induce vomiting if ingested (69). In Florida, the flowers emit a respiratory-, skin-, and eye-irritant.

Economic Value in the Tropics

In under-developed countries, the pongam has multiple, practical uses. Because grass will grow beneath it, it is planted for shade in pastures. And it has been close-planted as a windbreak for tea plantations in Sri Lanka (21). In India, the tree is a host of the useful lac insect (5).

Wood: The wood is moderately hard, close-grained, tough and strong, 40 lb/cu ft (12), but not durable (52), not insect-resistant; may warp and split during seasoning (14); can be improved by seasoning in water (42). It lends itself to bending (42) and has been used in construction and cabinetwork (56) and for yokes, solid cart wheels, oil mills, plows and combs (14, 21) as well as for posts and fuel (26). The ash is employed in dyeing (27).

Root: The root, roasted, pounded and put in shallow water in the evening stupefies fish. In the morning, people gather them up for eating (14). The seeds can also be used as fish poison (27). Leaves are less effective as fish poison (21).

Bark: String, twine or rope can be made from the fibrous bark (13).

Leaves: The leaves provide fodder for cattle (14) and are said to increase the flow of milk (23). Fresh leaves are placed in stored grain to repel insects. An alcoholic extract

Fig. 5. A bad choice for a parking lot, the "trashy" pongam drops flowers, leaves and pods on cars and walking spaces, and its roots rupture paving. (Photo by Julia Morton).

is lethal to houseflies (24). Fallen leaves are used as fertilizer on sugarcane (30) or rice fields (26).

Twigs: These are used as chewsticks; that is, one end is chewed till frayed and thereafter the stick is employed as a toothbrush (14).

Flowers: Pongam flowers are considered a good source of pollen for honeybees in India (5), and they yield adequate nectar but I have observed in Florida that, though bees collect the nectar regularly, they produce dark honey with a chalky aftertaste. Decomposed flowers are valued in the Tropics as rich nutrition for special plants, especially when grown in greenhouses (26).

Seed oil: Oil is the most important product of the pongam tree and vast amounts of the seeds are collected in India and stored for commercial processing for industrial uses (24). It has been found that the seeds contain 27-40% of a thick, yellow or reddish-brown oil and that 270 oz of mature pods will yield about 135 oz of husked kernels. Extracted oil amounts to 13.4% of the whole seedpod; 26.97% of the kernels. The oil has a specific gravity of 0.9371 at 60°F (19).

Pongam seed oil was formerly indispensable as an illuminant in lamps (14, 26), but has been largely replaced by kerosene (12).

Because of long delays in transfer and poor storage conditions, there is serious fungal infection of stored seeds by at least a dozen species—*Aspergillus* spp., *Penicillium* sp., *Chaetomium* sp. and *Dothiorella* sp. predominating the year-around. Studies have been conducted to determine the most effective means of control (35).

In recent years, pongam oil has been tested as a synergist to increase the potency of insecticides. It has been found equal to sesame oil in this regard in treating houseflies and cockroaches; inferior in tests with flour beetles (53, 61).

Further studies with active properties of pongam oil—karanjin and pongamol—with certain modern insecticides (Sevin, Isolan, Pyrolan, Endrin and Heptachlor) showed that effectiveness varied with insect species and the toxicity of the pesticides. It was tentatively concluded that the less toxic insecticides show a higher degree of synergism, while insecticides with higher toxicity show less synergism (61).

The presscake (seed residue) after oil extraction is bitter and unfit for use as a sole animal feed. It is high in protein but possesses several toxic factors, particularly karanjin, pongamol and tannin. It has been fed experimentally to sheep, calves and poultry and in some trials has caused poor growth. Therefore, it is suggested as a short-term substitute for other protein sources but never serving as more than a 75% replacement (22). It is rich in nitrogen and in demand as a fertilizer for sugarcane and coffee, and also in home gardening as it repels red ants (5).

Results of Some Chemical Studies

Gibbs (33) reports that the pongam possesses saponins, several chalcones, and related compounds.

Leaves: Indian scientists have isolated glabrachrome, C_{22}, H_{20}, O_4, (59, 60), B-sitosterol, kaempferol, quercetin, and pongapin (34).

Bark of the root and stem: Pongachromene, a dimethylchromeneflavone, is a minor constituent of pongam bark (49), which contains also 3 flavonols: kanugin, demethoxykanugin, and tetra-O-methylfisetin which was found in root bark in 1969 was previously unknown in nature (48). Roots yield the pigment, pinnatin, which was synthesized in 1967 (1).

Flowers: Studies in 1974 showed y-sitosterol, kaempferol, pinnatin and gamatin (37). According to more recent investigations (1983), benzene extraction has revealed the major constituents to be: 4 fluranoflavones (karanjin, kanjone, pongaglabrone, gamatin) and 2 flavonols (kaempferol and quercetin) (31).

Seeds: Karanjin, the major crystalline principle of pongam seeds, has been found to act as a nitrification inhibitor (57, 58). The seeds contain 5 other furanoflavones: pongapin, pinnatin, gamatin, kanjone and pongaglabrone, and the diketone pongamol (49); also an optically active compound, isolonchocarpin (37).

Seed oil: This oil contains behenic acid and the fatty acids—myristic, palmitic, stearic, arachidic, lignoceric, dyhydroxystearic, linoleic and oleic (55). It has a long history in the soap and leather industries (38) and has been considered potentially useful in modern soap-manufacture but has the drawback of darkening with age due to the presence of (–)isolonchocarpin and dimethoxykanugin (50). Moist seeds when stored in bulk develop heat as a result of respiration of the seed, and this increases the color of the oil (38).

In 1973, Indian scientists isolated from the oil karanjachromene, a chromeno analogue of the major furanoflavone, karanjin. It had been synthesized, but this was the first discovery in nature (51).

It has been suggested that pongam oil might be best used by splitting and then distilling the fatty acids (38).

Medicinal Uses

Leaves: The leaves (especially young shoots (21)) are steeped in hot water and the infusion used as a bath to relieve rheumatism (28). The leaf decoction is a cough remedy for children in the Philippines. Expressed juice is used on herpes and itches (55). In India, crushed leaves, applied as a poultice on "sycosis barbae", caused violent dermatitis and crusting (11).

Bark of stem and root: Fresh stem bark is applied to reduce enlargement of the spleen (4). It is astringent and taken internally to relieve bleeding hemorrhoids while a poultice of young leaves is laid on externally (28). However, a bark extract administered experimentally to frogs caused repeated vomiting and death (21) within 40 hours (42). In the Moluccas, root bark scrapings were, in olden days, standard treatment for wounds inflicted by the poisonous barb of a fish (21). The bark contains a bitter alkaloid and is employed by the people of Guimaras island in the Philippines as an abortifacient (55).

The root juice is antiseptic and is put on sores and foul ulcers (23): and also used to clean the teeth (26). A root paste is applied on enlarged organs (28).

Flowers: The flowers are claimed to have antidiabetic action (28, 55).

Seeds: A seed powder is given as an expectorant in bronchitis and whooping cough (23). It is also prescribed as a febrifuge and tonic. Seed paste is spread on sores and rheumatic parts (28).

Seed oil: Seed oil, bitter in taste (56), due to a resin (13), has no culinary uses (21). It is rubbed as liniment on skin diseases and rheumatic parts (3). Internally, it is given as

a stomachic and cholagogue in dyspepsia and cases of sluggish liver (28).

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ANNUAL RHUBARB PRODUCTION IN FLORIDA

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Abstract. **Yield and quality of seed- and vegetatively-propagated rhubarb (*Rheum rhabarbarum* L.) for annual production were evaluated for 4 seasons. Field planting of transplants or crown divisions in late October or early November resulted in harvests beginning in early to late January and continuing until late April. Selection of 'Victoria' seedlings based on petiole color was not effective in increasing the proportion of red mature petioles. Yields from seed-propagated annual 'Victoria' rhubarb were always higher than yields from 'McDonald' single-bud crown divisions and higher than yields from 'McDonald' crown-divisions in 1 of 2 years. The 4-year average yield for 'Victoria' seed-propagated rhubarb was 9.1 tons/acre whereas 'McDonald' crown-division-propagated rhubarb had a 2-year average yield of 7.0 tons/acre. Conversely, petiole color of vegetatively-propagated rhubarb was always superior to that of seed-propagated rhubarb. GA applications increased early yield from 'McDonald' single-bud divisions, but reduced early and total harvest petiole weight. Seed-propagated 'Victoria' rhubarb has potential for commercial production in Florida for direct marketing, whereas crown-division-propagated 'McDonald' rhubarb has potential as a commercial crop for the wholesale market. Both systems are adaptable to home garden culture.**

Rhubarb, *Rheum rhabarbarum* L., is grown for its large, fleshy petioles or leafstalks which are used mainly for sauces and pies. The plant is herbaceous with an underground portion consisting of large, fleshy, and somewhat woody rhizomes, and a fibrous root system. The leaves which grow from the crown provide the petioles that are used for food (8).

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Rhubarb is a cool-weather perennial. It does not thrive, and is rarely grown, where summer mean temperatures exceed 75°F or where winter mean temperatures are higher than 40°F. Temperatures below 50°F are required to break dormancy. As a perennial, rhubarb is poorly adapted to the southern half of the United States (9). Nonetheless, production of perennial rhubarb was proposed by Walker (12) in northern Arkansas at an elevation of 1500 ft, and methods for annual production in Louisiana were outlined by Tiebout (10).

Rhubarb is normally propagated by division of the crowns to maintain the clonal characteristics of the cultivar. Seed propagation is possible but the resulting plants are variable and do not maintain the characteristics of the clone from which the seed were obtained (9).

Because of interest in alternative crops for local sales and shipping, these studies were initiated to determine methods for rhubarb crop establishment and production as an annual crop in west-central Florida.

Materials and Methods

Rhubarb propagating material and cultural methods for production of annual rhubarb were studied for four growing season at the Gulf Coast Research and Education Center, Bradenton, FL.

General procedures. Experiments were conducted on EauGallie fine sand (sandy, silicaceous, hypothermic Alfic, haplaquod) with a spodic layer 3 ft deep. Raised beds were prepared in early October of each year with a portion of the fertilizer incorporated in the bed before final pressing and the remainder of the fertilizer placed in shallow grooves near the shoulders of the bed (Table 1). The beds were covered with white polyethylene in the first 3 seasons, whereas black polyethylene was used in the 1988-89 season. The plots were seepage irrigated from irrigation/drainage ditches every 7 beds in the first 3 seasons and every 6 beds in 1988-89.

Transplants or crown divisions were set in holes punched in the polyethylene mulch at 2.5 ft in-row spacing. Weed control between the mulched beds was by cultivation. Pesticides were not applied since insects and diseases were not apparent.