

# Fruit-bearing forest trees

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FORESTRY  
PAPER

34



FOOD  
AND  
AGRICULTURE  
ORGANIZATION  
OF THE  
UNITED NATIONS

**fruit-bearing  
forest trees**

**technical notes**

**with the assistance of  
the swedish international development authority**

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## Foreword

This publication has been prepared within the framework of the FAO Forestry for Local Community Development Programme. It has been made possible by a special contribution from the Swedish International Development Authority (SIDA) to FAO to support this programme.

The identification and description of tree species producing fruits suitable for human consumption has wide implications in the aspects of tree improvement (improvement of fruit quality, quantity resistance to disease, climatic range and growth) as well as the aspects of the domestication of those species which are as yet unknown to the world in general. Emphasis is thus indirectly laid on the potential of natural forests to act as a source of gene material suitable for adaptation to present and future human needs, a further strong justification for the conservation in the natural state of at least a representative sample of undisturbed natural forest stands.

In making the selection of species for community plantations it is necessary to stress that consideration should be given to the nutritional value of the produce in relation to the nutritional needs of the community. Whether it is the fruits, leaves, pith or seeds of the chosen species which can be consumed there are obviously some which will yield more energy (calories) than others. Or a tree may bear fruit which has a particularly high vitamin C content. These are all matters which could be discussed with a national nutritionist who has knowledge of the area in which the plantation is being established and can give guidance on the nutritional needs of the local population. Another point to be borne in mind is that the poorest of the poor amongst rural people do not have the money, time or facilities to convert foods into sophisticated preparations such as jams and jellies; nor are these items normally included in their traditional food patterns. Fruits which can only be used in this way are, therefore, unlikely to be of much practical value unless there is a scheme for their utilization in, for example, a local cooperative endeavour or income-earning activity for a group of women. In certain cases a species could be chosen specifically because of its potential for providing rural women with resources for income generation since it is considered that women are better able to feed their families when they have their own source of income. In addition, it should be remembered that local people may not know or recall how to prepare and cook to the best advantage the produce of a species being introduced or reintroduced into their area. In such a case it should not be difficult to arrange for suitable demonstrations by home economists or other grass roots level workers.

The publication is one of several designed to make available information needed to promote community and household level forestry activities. It has been prepared for FAO by the Faculté des Sciences Agronomiques de l'Etat, Gembloux, Belgium.

Where appropriate permission has been received for reprinting illustrations from other sources and this is gratefully acknowledged.



ADANSONIA DIGITATA L.

FAMILY

Bombacaceae.

VERNACULAR NAMES

Baobab (fr.); Monkey Bread-fruit Tree.

ORIGIN AND DISTRIBUTION

The species is found throughout tropical and subtropical Africa, from Senegal to Botswana, frequently in the vicinity of villages.

ECOLOGY

A plant of dry tropical regions, principally in dry formations near the coast, where there is a long dry season, often of more than six months duration. In savanna it occurs as isolated individuals or grouped in clumps, irrespective of soil.

BOTANICAL CHARACTERISTICS

Size

A large tree up to 20 or 25 m high often with an enormous bole reaching a diameter of 3 m or even 6 m.

Bole

The trunk is swollen, in the shape of a broad bottle surmounted by an open crown of short twisted branches.

The wood is soft and spongy.

Old trees are often hollowed out or decayed in the centre.

The bark is smooth, grey, mottled with blue or purplish.

Leaves

The leaves are digitately 5-7-foliolate, with long petioles; the leaflets are entire or denticulate, acuminate, sessile, dark green above and sparsely pubescent on the lower surface.

Flowers

Large, 15-20 cm long, on a peduncle 25 cm long; petals white, leathery.



### Fruit

Up to 35 cm long by 8-15 cm broad, and suspended at the end of a long "thread".

The fruit is woody and indehiscent with an olivaceous hairy exterior; it is hard and contains a white farinaceous acid pulp, which is edible; the pulp contains small hard black seeds resembling beans.

### CULTURAL REQUIREMENTS

The rapidity of growth of this species is controversial. According to Irvine, it is slow, while Aubréville regards it as quite fast, as do Palmer and Pitman.

The seeds retain their viability for a long time, probably for several years.

### WOOD

The spongy wood is useless, even for firewood.

### USFS

The bark serves in the manufacture of ropes and fibres; the hollow trunk is used for water storage, especially in the Sudan; the fruit pulp and seeds are edible.

The leaves are used as spinach and as an emollient and febrifuge.

Young shoots of young plants are eaten like asparagus.

The fruit husk is frequently used as a fuel and the potash-rich ash serves in the manufacture of soap.

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N° 1 - Andansonia digitata



(x  $\frac{1}{5}$ )

ANACARDIUM OCCIDENTALE L.

FAMILY

Anacardiaceae

VERNACULAR NAMES

Cashew, Cashew-nut; Pomme cajou, Anacardier (fr.); Maranon (sp.).

ORIGIN AND DISTRIBUTION

The cashew-nut is native in tropical America and would have been introduced during precolumbian times to the West Indies, from which it has been spread throughout the Old World tropics. It has now become naturalized in many other countries.

ECOLOGY

It is found in warm and humid climates with a pronounced dry season, with a rainfall between 1000 and 2000 mm, from sea level to 1000 m altitude. It is reputedly resistant to strong winds and has a liking for coastal regions. Although not exacting as to substrate, it likes shallow soils, and prefers sandy to clay soils.

It is a light demanding plant colonizing open ground.

It will not tolerate frosts or saline or hydromorphic soils.

BOTANICAL CHARACTERISTICS

Size

The cashew-nut is a small to medium sized evergreen shrub or tree 6-12 m high. Trunk 15-25 cm diameter dependent on situation and cultivar.

Bole

Relatively short and stout, surmounted by a broad, deep and massive crown. The bark is light grey or brown, smooth in young specimens but becoming shallowly fissured with age. It has been used for tanning. The resinous sap gives an indelible ink.

### Leaves

Alternate, entire, thick and coriaceous, exstipulate, elliptic; they are short-stalked, and deep green, 6-15 cm long, 2-7 cm broad.

### Flowers

About 1 cm diameter, with 5 petals, pink, strongly fragrant, clustered in a panicle. Male and female flowers are present on the same tree.

### Fruit

The fruit consists of two distinct parts. a) The large fleshy swollen stalk which forms a spongy, slightly acid and astringent false fruit (very astringent when immature).

b) The small kidney-shaped nut which has an edible kernel. The shell of the nut contains a caustic and poisonous oil, sometimes used in pharmacy. For this reason uncooked seeds can cause poisoning. It is preferable either to grill them over hot ashes or to roast them and remove the shell.

### CULTURAL REQUIREMENTS

Cultivation is most frequently by direct sowing as the seedlings do not like transplanting, or by sowing in nursery beds.

The seeds are germinated in small boxes, and after germination they are planted in polythene bags 30 cm high and 10 cm diameter. Alternatively 2 or 3 seeds can be sown direct into the polythene bag, and the surplus seedlings can be transplanted into other polythene bags or thrown away.

Grafting, though not much used, would insure the production of uniform fruit.

Weeding is only required for the first two years. On account of its light demanding nature and the great crown development (often to 9 m diameter), the usual planting distance is 10 x 10 m, or 100 plants per hectare.

Seed production begins after 5 years, and continues abundantly to 30-40 years of age. Under normal conditions, the average

production of an orchard averages around 2 tonnes per hectare, with each tree carrying 3000 fruit. Higher output can be achieved by the use of grafted trees.

The cashew can also be used for hedges.

#### WOOD

The wood is whitish, brownish or pink, with average hardness and specific gravity (0.50). It is moderately resistant and works easily. When the timber is long enough it is used in construction and general carpentry. It is subject to termite attack.

The species is often used as a shade tree near houses, and has been successfully employed in the fixation of sand dunes.

The species is commonly used as firewood or in the production of charcoal.

The bark exudes a gum resembling gum arabic, and the sap of the tree makes an indelible ink.

The sweet scented flowers of cashew attract honey bees.

The young leaves boiled in water are eaten as vegetables.

It produces the two distinct "fruits" described above.

It should be noted that when roasting the nuts, good ventilation should be provided for the elimination of toxic fumes which are produced; these can cause severe irritation of the skin and eyes.

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ANACARDIUM OCCIDENTALE L.





ARTOCARPUS ALTILIS (PARK.) FOSBERG

FAMILY

Moraceae.

VERNACULAR NAMES

Bread-fruit; Arbre à pain, Fruit à pain (fr.); Arbol de pan (sp.).

ORIGIN AND DISTRIBUTION

This tree, which is grown both for its edible fruit and for its ornamental foliage, is a native of Polynesia. It is at home in and naturalised in practically all tropical regions. It is semi-wild in numerous localities at an altitude below 700 m.

ECOLOGY

It thrives in a humid tropical climate, at low altitude, especially on islands, with a rainfall from 1500 to 2500 mm and a temperature between 21 and 32°c. Young plants require a little shade, but for fruiting full sun is needed. It dislikes shallow or waterlogged soils but is otherwise tolerant.

BOTANICAL CHARACTERISTICS

Size. The bread-fruit is a beautiful tree reaching 15-20 m high with a diameter sometimes exceeding 0.60 m.

Bole

The trunk is straight, surmounted by a crown composed of a few large branches. The bark is smooth, brown, with numerous corky lenticels; when cut it exudes a white bitter-tasting latex.

Leaf

It is evergreen, with alternate stipulate leaves which are deeply cut (7-11 lobes). The leaves are very large and can reach 30-90 cm long. The upper surface is glabrous except along the principal nerves.

### Flower

The flowers are numerous and very small, unisexual on the same individual (monoecious). The male flowers are arranged in a cylindrical spike 12-35 cm long; the female inflorescence is ellipsoid or globular, 6-7 cm long.

### Fruit

There are two varieties of *Artocarpus altilis*, one seed-bearing and the other sterile. The latter is the true bread-fruit. The fruit is a globose or ovoid syncarp weighing 500 g to 3 kg. It is usually regarded as a vegetable rather than a fruit. There are very many cultivars, some of which produce seedless fruit.

### CULTURAL REQUIREMENTS

The following cultural techniques apply to the sterile variety, which is propagated by suckers, layers or root cuttings. For the latter, cuttings about 2 cm diameter are used. These are cut into pieces 10-15 cm long, planted obliquely in a light sandy soil, covered to a depth of 1 cm and given frequent watering. Afterwards, they are planted in orchards or along roadsides. In the former case the spacing used is 10 m x 10 m, or slightly closer, but never less than 8 m. Growth is rapid. The fruit is collected before it is fully ripe, or 2-3 months after the emergence of the inflorescence.

### WOOD

The wood is differentiated into a yellow or brownish yellow sap wood and heartwood which is golden speckled with orange. It is very light (density 0.27) and soft but quite resistant in spite of its low specific gravity.

### USES

Although little utilized, the wood could have a market in box making or in the manufacture of toys (it is used for surf boards in Haiti).

The latex is sometimes used as a glue for trapping birds, and the foliage can serve as forage for cattle during periods of drought.

As mentioned above, the fruit is more a vegetable than a fruit. It must be used green, because when fully mature, they become floury and insipid. The fruit is also dried and converted into flour.

#### SYNONYMS

*Artocarpus communis* Forst.; *A. incisa* (Thunb. ) L.f. .

#### FOOD VALUE

The calorific value of the fruit is 75-80 cal/100 gm.

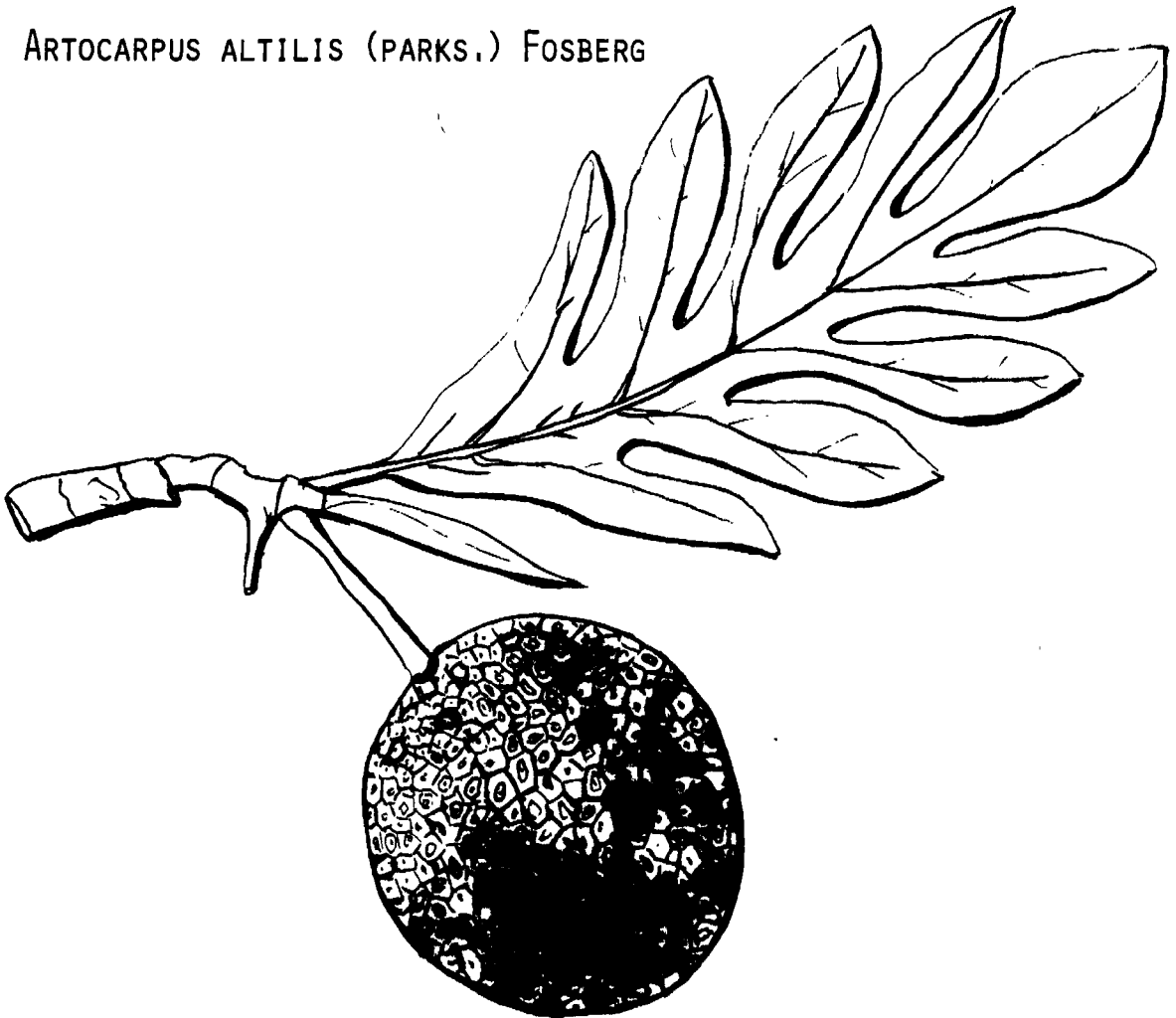
water	79.5%
protein	1.5%
lipids	0.2%
sugar and starch	17.9%
minerals	0.9%
cellulose	-
calcium	0.04%
phosphorus	0.03%
iron	0.5%
carotene	15/100 g. (I.U's.)

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du Congo Belge  
Ministère des Colonies - Bruxelles - 1956 - pp. 932

ARTOCARPUS ALTILIS (PARKS.) FOSBERG



*Artocarpus altilis*

After/según/d'après LITTLE, Elbert L. Jr : WADSWORTH, Frank  
Common trees of Puerto Rico and the Virgin Islands  
Agriculture Handbook No. 249 - U.S.D.A. - 1964 - pp. 548

ARTOCARPUS HETEROPHYLLA Lam.

FAMILY

Moraceae

VERNACULAR NAMES

Jak, Jack Fruit; Jacquier (fr.); Jaca (sp.).

ORIGIN AND DISTRIBUTION

Native of India and Malaysia and taken by the Arabs to the east coast of Africa, finally to the whole of tropical Africa and America.

ECOLOGY

The Jak is a tree of low tropical regions, but it can be cultivated at higher altitudes than the Breadfruit, up to 1500 m, although above 1200 m the quality of the fruit is inferior. It is especially sensitive to soil water, but by means of irrigation it can succeed well in arid regions. As with the Breadfruit, it dislikes shallow soils, and does well in deep, well-drained alluvial soil.

The seedlings tolerate light shade but flourish best in full sun.

BOTANICAL CHARACTERISTICS

A medium sized evergreen tree to 15 m high and a trunk diameter of 0.30 - 0.50 m, rarely reaching 20 m high.

Bole

If the best cultural conditions are given, the bole can reach 6-7 m.

The bark is smooth, grey when young, becoming rough, thick and furrowed with age. When cut it exudes an insipid white resinous latex.

Leaf

They are alternate, stipulate, elliptic, with an entire margin, glabrous, coriaceous. The upper surface is deep green and the lower much lighter. They measure 10-20 cm long by 3 - 12 cm broad.

### Flower

The flowers are unisexual with both sexes on the same individual (monoecious). The male inflorescence forms a spike 2.5-15 cm long, while the female inflorescence is globose, ellipsoid or obovoid.

### Fruit

The fruit is a large syncarp weighing up to 10 kg or even 30 kg. The cream coloured pulp is eaten raw, boiled or fried when the fruit is ripe, and when immature the fruits are cooked as vegetable or in soups. The pulp contains numerous chestnut-sized seeds which are eaten either grilled or boiled.

### CULTURAL REQUIREMENTS

The jack fruit is generally propagated by seed, but as the species is so variable, it is desirable to use grafting.

The fragility of the taproot makes transplanting difficult so it is preferable to direct sow, or sow in large polythene bags (minimum length 25 cm). The distance between plants is generally 12 m each way (80 plants per hectare).

Fruiting starts around the eighth year, but for some varieties (Singapore Jack) only 3 years after planting.

The fruit is produced for 4 months of the year. The fruiting season can be extended by using several cultivars.

Production per tree : 250-750 kg, or 20,000-60,000 kg/ha.

### WOOD

Sapwood and heartwood are bright yellow, but the heartwood darkens on exposure to light.

### USES

The wood takes a fine polish and is used for furniture making. The heartwood yields a dye which is used in Burma for dyeing the robes of priests.

The tree is sometimes used as a shade tree with coffee or in conjunction with pepper (*Piper nigrum*).

SYNONYMS

*Artocarpus integrifolia* L.f.; *Artocarpus integra* (Thunb.) Merr.

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No. 4 *Artocarpus Heterophylla* Lam.



AVERRHOA CARAMBOLA L.

FAMILY

Oxalidaceae.

VERNACULAR NAMES

Carambola (engl. and sp.); Carambolier (fr.)

ORIGIN AND DISTRIBUTION

Native of tropical Asia, especially Cambodia and Laos; long since spread to many tropical countries, principally as an ornamental species.

ECOLOGY

Planted throughout the tropics from low to medium altitude, up to 900 m. It is frost sensitive.

BOTANICAL CHARACTERISTICS

Size

A small evergreen tree to 3 - 5 m or exceptionally 10 m high.

Bole

Practically none as the species is usually multistemmed; it attains 15 cm diameter at the base. The bark is light brown, smooth or finely fissured.

Leaf

Alternate, pinnate, 15-25 cm long, disposed more or less in a horizontal plane; they are shortly petiolate with 7 - 9 pendant leaflets. They have the peculiarity of being sensitive in the same way as certain Mimosa spp.

Flower

They are produced in panicles 2-5 cm long in the axils of old leaves or axils of fallen leaves. The flowers are pentamerous, with a calyx of 5 pink sepals surrounding the purple corolla. The androecium contains 5 fertile stamens and 5 staminodes. The gynoecium bears 5 slender united styles.

### Fruit

Large indehiscent berry, between 5 and 8 cm long, with a characteristic shape in section which resembles a 5-pointed star. The colour is yellowish green, becoming orange-yellow when ripe. It has a sweet-acid taste (oxalic acid). Each cell of the fruit contains 5 arillate seeds.

### CULTURAL REQUIREMENTS

The Carambola is propagated by seed, by layering and also by budding on one-year old seedlings. The seedlings are transplanted into polythene bags, and after 6 to 12 months in the nursery, are planted out at 4 x 6 m apart. The species flowers and fruits throughout the year provided the dry season is not too severe.

### WOOD

The wood is whitish and soft and used only for firewood.

### USES

The acid fruit has the taste of rhubarb. It is a laxative on account of the oxalic acid it contains. It can be eaten raw, in which case it must be completely ripe. It is more frequently used for jams and pickles.

Apart from the fruit, the species has considerable aesthetic value and is often planted in parks and gardens.

In some countries the fruit juice is used for cleaning metal and for removing stains from linen.

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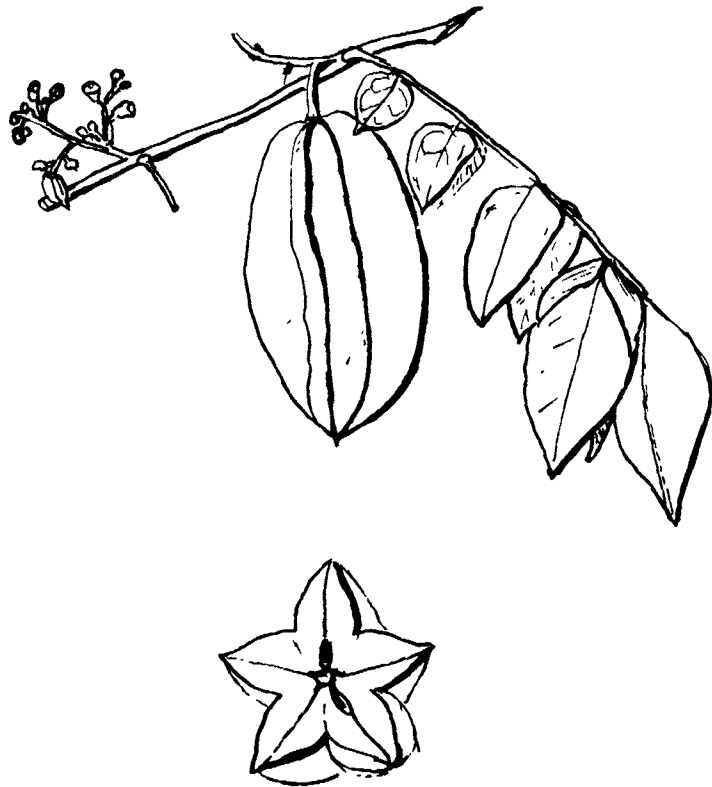
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AVERRHOA CARAMBOLA L.



Averrhoa carambola  
After/según/d'après OCHSE, J.J.  
Indische vruchten  
Volkslectuur - Weltevreden - 1927 - pp. 330

BERTHOLLETIA EXCELSA HUMB. & BONPL.

FAMILY

Lecythidaceae.

VERNACULAR NAMES

Brazil-Nut, Para-Nut; Noix du Brésil (fr.)

ORIGIN AND DISTRIBUTION

Native of the Amazonian forests of Brazil and in the Guyanas; it has been introduced to Venezuela, Bolivia and Hawaii.

ECOLOGY

In its natural habitat this gregarious species forms considerable populations on alluvial ground along the Amazon and Rio Negro. It cannot tolerate the slightest frost and flourishes best in a hot wet climate without a long dry season.

BOTANICAL CHARACTERISTICS

Size

Large tree to 30 or 45 m with winglike buttresses.

Bole

In forest the bole can be very long and 0.90 to 1.20 m diameter. The bark is brown and deeply fissured.

Leaf

Alternate, simple, oblong, 20-60 cm long, entire. The lower surface is greyish and the veins are prominent on both surfaces.

Flower

The large flowers are arranged in erect terminal clusters. They have 2 sepals, 6 cream coloured petals about 2.5 cm long, and a curved staminal tube with fertile stamens at the base only.

### Fruit

The fruit is a hard, thick-walled, woody shell about 12-15 cm long; it contains 12 - 24 reniform seeds ("nuts") with a horny testa - these are the Brazil-Nuts. The Brazil-Nuts of commerce are obtained exclusively from wild trees in South America. The fruit is gathered on the ground and not picked from the trees owing to the difficulty and danger involved in working in the high crowns.

### CULTURAL REQUIREMENTS

Propagation is by seed; the seed coat must be removed, scarified or softened, otherwise germination will be poor.

### WOOD

The wood is differentiated into sapwood and heartwood; the latter is reddish brown, heavy to very heavy.

### USES

The Brazil-Nut is greatly appreciated and widely exported from tropical America. The nuts are removed after breaking the fruit with an axe or hammer; they are eaten whole or crushed, salted, toasted or sweetened; they can be blended with bread; used in sweet cakes and plain cakes, in salad, as an appetizer, in desserts, in ice cream and in many other dishes.

The oil extracted from the Brazil-Nut belongs to the semi-dry group.

The oil-cake can be used as animal feed.

### FOOD VALUE

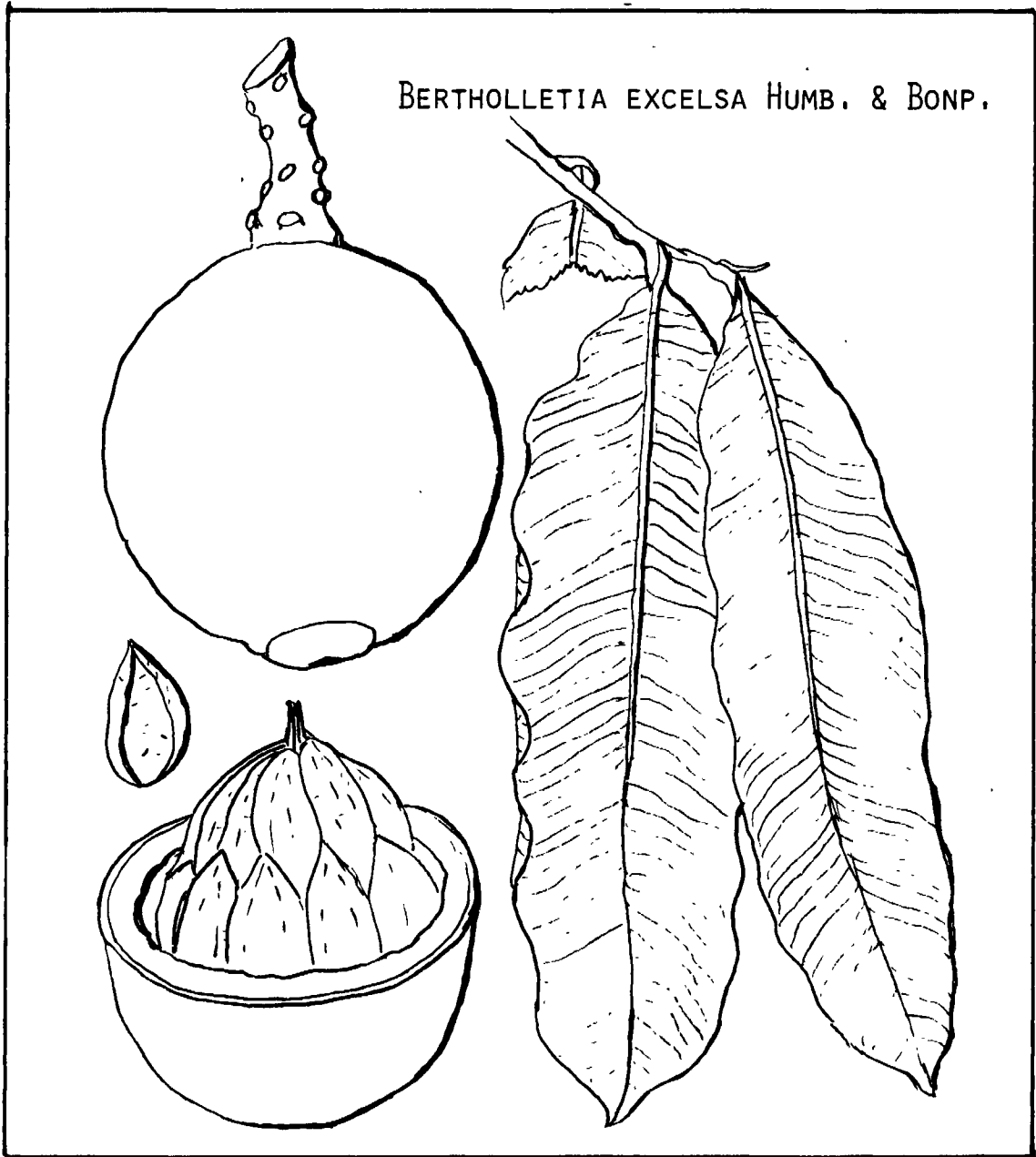
The Brazil-Nut has a high food value comparable to that of the seed of *Juglans*, this is due to the high proportion of fat it contains, up to 75% by weight of the kernel.

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*Bertholletia excelsa*

After/según/d'après MOLESWORTH ALLEN, Betty

Malayan Fruits

Donald Moore Press Ltd. Singapore - 1967 - pp. 330

BUTYROSPERMUM PARKII KOTSELY

FAMILY

Sapotaceae

VERNACULAR NAMES

Shea Butter Tree, Shea Nut; Karité (fr.)

ORIGIN AND DISTRIBUTION

A savanna species distributed from Upper Gambia to Uganda; its present-day occurrence is largely due to the influence of man.

ECOLOGY

It is a species occurring in regions with a Sudanian or Sahelian climate, with a pronounced dry season of 4-5 months. It is frequently gregarious, sometimes forming natural orchards. On the Adamaoua plateaux in Cameroun it ascends to 1200 m altitude.

BOTANICAL CHARACTERISTICS

Size

A compact tree to 9-12 m high, or exceptionally to 25 m, with a large, much branched crown, the branches recurving almost to ground level when in full leaf during the wet season.

Bole

Rather short but stout, reaching 1.5 to 1.8 m diameter. The bark is blackish, thick, horizontally and vertically fissured, somewhat resembling crocodile skin. A sparse latex exudes from the cut bark, branches and leaves.

Leaf

Spirally arranged in dense clusters at the branch tips, oblong, with an undulate margin, coriaceous and shining. They average about 20 x 7 cm. The young leaves are reddish and slightly hairy. Deciduous.

Flower

Creamish-white, fragrant and melliferous. They are produced in dense fascicles at the branch tips during the dry season, when the tree is leafless.

### Fruit

Subglobose to ovoid, the size of a large plum. The pericarp is about 1 mm thick, and exudes white latex when green. It contains a fleshy pulp which is sweet and perfumed when mature. They are generally allowed to become slightly overripe before being eaten raw. The fruit contains 1-2 large, shining, brown seeds. The kernel is whitish and rich in fats (45-55%): from it is produced the Shea Butter.

### CULTURAL REQUIREMENTS

Propagation is by seed, which germinates easily under normal conditions. Growth is slow. The seed is direct sown, because it does not transplant well. On germination, and before the appearance of the first leaves, the plant develops a strong root system. The trees are spaced 10-12 per hectare, and they start fruiting after 12 years. The average production of a tree is around 20 kg, although certain individuals have been known to bear 200 kg.

### WOOD

Red, heavy and difficult to work; it takes a fine polish. It is used for stakes and house posts on account of its durability and resistance to termites. It can also be used for shingles. It is useful for firewood and is used in charcoal production.

### USES

Apart from the uses of the wood already described, the seed is the source of Shea Butter, which is a mixture of latex and fat. In some areas, notably Upper Volta, part of Sudan and Benin, it is the only vegetable fat available to the population. The presence of latex makes it unsuitable for the production of good quality soap, but useful in pastry-making as it gives pliability to the dough.

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pp. 535-537

CARILSA CARANDAS L.

FAMILY

Apocynaceae

VERNACULAR NAME

Malaysian karanda

ORIGIN AND DISTRIBUTION

Native of Malaysia and very common in India.

ECOLOGY

It is a gregarious, pioneer species found on the dry slopes of the Himalayas, in dry sclerophyllous forest. It is able to tolerate drought and grazing by sheep and goats.

BOTANICAL CHARACTERISTICS

Size

Evergreen, spiny shrub or small tree to 6 m. The spines are sometimes forked.

Bole

Very short or none.

Leaf

The leaves are dark green, opposite, oblong or elliptic, mucronate, apex rounded or obtuse.

Flower

The white flowers occur in groups of 2-3; they are scented and pentamerous. The corolla tube is 2 cm long, while the lobes which are much smaller, give the flower a star-shaped appearance.

Fruit

These are less than 3 cm long, about the size of a cherry, and contain 3-4 seeds (up to 6 according to some authors). They are dark red to black in colour, and moderately acid.

### CULTURAL REQUIREMENTS

*Carissa carandas* is propagated either by seed or woody cuttings.

When used for hedging they are planted at 0.90 to 2 m apart and pruned on reaching a height of 1 - 1.5 m. They make a spinous barrier impenetrable to animals.

They are irrigated immediately after planting, thereafter they only require regular pruning.

### USES

Pickled in vinegar when green, they are used for making jelly. When ripe they are used for making excellent tarts and puddings and are thought to resemble gooseberries in flavour.

The tree is often planted in parks and gardens, as the white flowers and red fruits are very decorative.

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CARISSA CARANDAS L.



*Carissa carandas*

After/según/d'après OCHSE J.J.

Indische vruchten

Volkslectuur - Weltevreden - 1927 - pp. 330



CARYOCARACEAE

FAMILY

Caryocaraceae

VERNACULAR NAMES

There are several species: *C. glabrum* (Aubl.) Pers. (bois savonneux); *C. microcarpum* Ducke; *C. nuciferum* L. (noisette indienne); *C. amygdaliferum* Mutis; *C. coriaceum* Wittm.; *C. villosum* (Aubl.) Pers.

ORIGIN AND DISTRIBUTION

The Caryocars form a component of the humid tropical forests of northern South America, sometimes occurring on periodically flooded land.

BOTANICAL CHARACTERISTICS

Size

Medium to large tree 8-30(-45) m high, dependent on the situation and the species.

Bole

Large, sometimes attaining 1.20 m diameter.

Leaf

Opposite, decussate, on a long petiole; trifoliolate; the leaflets are acuminate with entire or crenate margins, coriaceous; caducous stipules are present.

Flower

The inflorescence is a terminal raceme or corymb; the flowers are hermaphrodite, pentamerous, yellowish to deep red, dependent on the species, with numerous stamens which exceed the petals.

Fruit

Ellipsoid or pyriform drupe with a coriaceous epicarp; mesocarp pulpy, white, sticky, dehiscing into 1-seeded cocci each containing a white kernel with a chestnut coloured tegument.

The kernel is eaten raw or cooked.

*C. nuciferum* produces a good quality edible oil (kernel weight = 27% of fruit).

WOOD

Differentiated into sapwood and heartwood. The colour varies according to the species: from white to pale brown sapwood, pale yellow to pink heartwood. It is generally heavy and hard, taking a fine polish, durable especially for under-water uses.

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CERATONIA SILIQUA L.

FAMILY

Leguminosae subfamily Papilionoideae

VERNACULAR NAMES

Carob tree, Locust Bean; Caroubier (fr.); Algarroba (sp.)

ORIGIN AND DISTRIBUTION

This species is a native of the Mediterranean region, probably of Syria and Iran. The Greeks spread it through Greece and Italy, and the Arabs introduced it to Morocco and Spain. It is now found throughout the semi-arid regions of the world.

ECOLOGY

A species of mediterranean and semi-arid climates. It tolerates various soils but does best on calcareous soils and "terra rossa". It occurs on hills up to a maximum altitude of 1500 m, with a rainfall between 300 and 600 m, occurring naturally in association with the Pistachio and Wild Olive.

The regions in which it can be successfully grown correspond closely with those of the orange tree.

Seedlings and young plants are frost sensitive; adult specimens can tolerate slight frost ( $-4^{\circ}\text{C}$ ) and a prolonged dry season.

BOTANICAL CHARACTERISTICS

Size

Medium sized evergreen tree from 12 to 20 m high. The crown is well developed, round, becoming very large in old trees.

Bole

Generally rather short, sometimes twisted, and becoming very stout (up to 1 m diameter).

Leaf

These are pinnate, with 2-8 pairs of ovate leaflets, shining on the upper surface, coriaceous.

### Flower

The small red flowers are arranged in axillary or terminal racemes; they are unisexual or bisexual, with the species more or less monoecious or dioecious. The sex distribution of an individual can change with age.

### Fruit

These are edible pods, 10-20 cm long, containing 20-30% sugar. At maturity they turn brown and fall from the tree.

### CULTURAL REQUIREMENTS

The Carob Tree is propagated easily from seed, but if desirable characteristics like productivity and high sugar and protein content of the fruit are sought, then vegetative propagation is to be preferred. For grafting one uses wild stock or individuals grown from seed. Due to the dominance of one sex over the other in each individual, it is necessary to get a good mixture of male and female plants to assure good pollination. Growth of young plants is slow. Planting distance should not be less than 10 to 12 m. Often this spacing is doubled to allow for interplanting, especially with cereals. Productivity depends on climate and fertility, but 1300 kg has been recorded for certain trees. In Algeria, the average weight is around 200 kg per tree. The Carob Tree suckers freely from stumps.

### WOOD

The wood is red and hard, and favoured for joinery and wheel making. It is also an excellent firewood.

### USES

The Carob is used directly as animal fodder or in the manufacture of animal feed. It is also used to make an alcoholic drink. The pods contain a sugary nutritive pulp, which when mixed with raisins, liquorice, etc. can be used to make sherbert. The Carob is used for stabilizing white cheese.

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COCCOLOBA UVIFERA (L.) L.

FAMILY

Polygonaceae

VERNACULAR NAMES

Seagrape; Raisin-Bord-de Mer (fr.); Uva de Playa (sp.)

ORIGIN AND DISTRIBUTION

The species is found along the shoreline of practically the whole of tropical America, and was possibly one of the first plants encountered by Christopher Columbus when he disembarked at the Island of San Salvador. It occurs from central and south Florida throughout the Antilles, and from northern Mexico to Colombia and Venezuela.

ECOLOGY

The seagrape is a pioneer plant, the first species to colonize sandy or rocky beaches, where it tolerates sea spray. It is very salt tolerant and grows well in saline or rocky soils along the shore.

BOTANICAL CHARACTERISTICS

Size

It is a shrub or small tree, whose form varies according to its situation. On the shoreline it is a bush with pendulous branches, whereas in more sheltered positions it can attain as much as 12 m in height.

Bole

Generally short, reaching 30 cm (exceptionally 70 cm) diameter. When young, the bark is smooth and grey; later on it peels off in small scales.

Leaf

The leaves are evergreen, alternate, entire, shortly petiolate, with a sheathing reddish-brown stipular growth at the base of the petiole (ochrea).

The limb is orbicular or reniform, thick, parchment-like, reaching 7-15 cm long and 10-20 cm broad. The midrib is thick and prominent.

#### Flower

The species is dioecious, with unisexual flowers borne on separate individuals. The racemose inflorescence bear numerous small greenish-white scented flowers. The male flowers have a rudimentary pistil, while the female flowers contain non-functional stamens (staminodes).

#### Fruit

About 2 cm diameter, ellipsoid or ovoid, purple; they are grouped in clusters resembling a bunch of grapes, and are composed of an achene 1 cm long, surrounded by edible, acidulous, sweet flesh (hypanthium).

#### CULTURAL REQUIREMENTS

The species is easily propagated by seed or cutting; the latter is favoured <sup>for</sup> producing female individuals.

#### WOOD

Differentiated into bright brown sapwood and reddish brown heartwood. The wood is hard, fairly heavy, susceptible to termite attack. It takes a fine polish and is used in turning; the finest pieces can be used for furniture, in marquetry and cabinet-work. The bark contains a tannin.

#### USES

The fruits are used in jellies, and in the same way as grapes they are used for making a type of wine. They can also be eaten raw. It is also an excellent melliferous plant. On account of its good tolerance of saline soil and spray, it is frequently utilized for windbreaks and as avenues by the sea. It prunes well and makes a good hedge.

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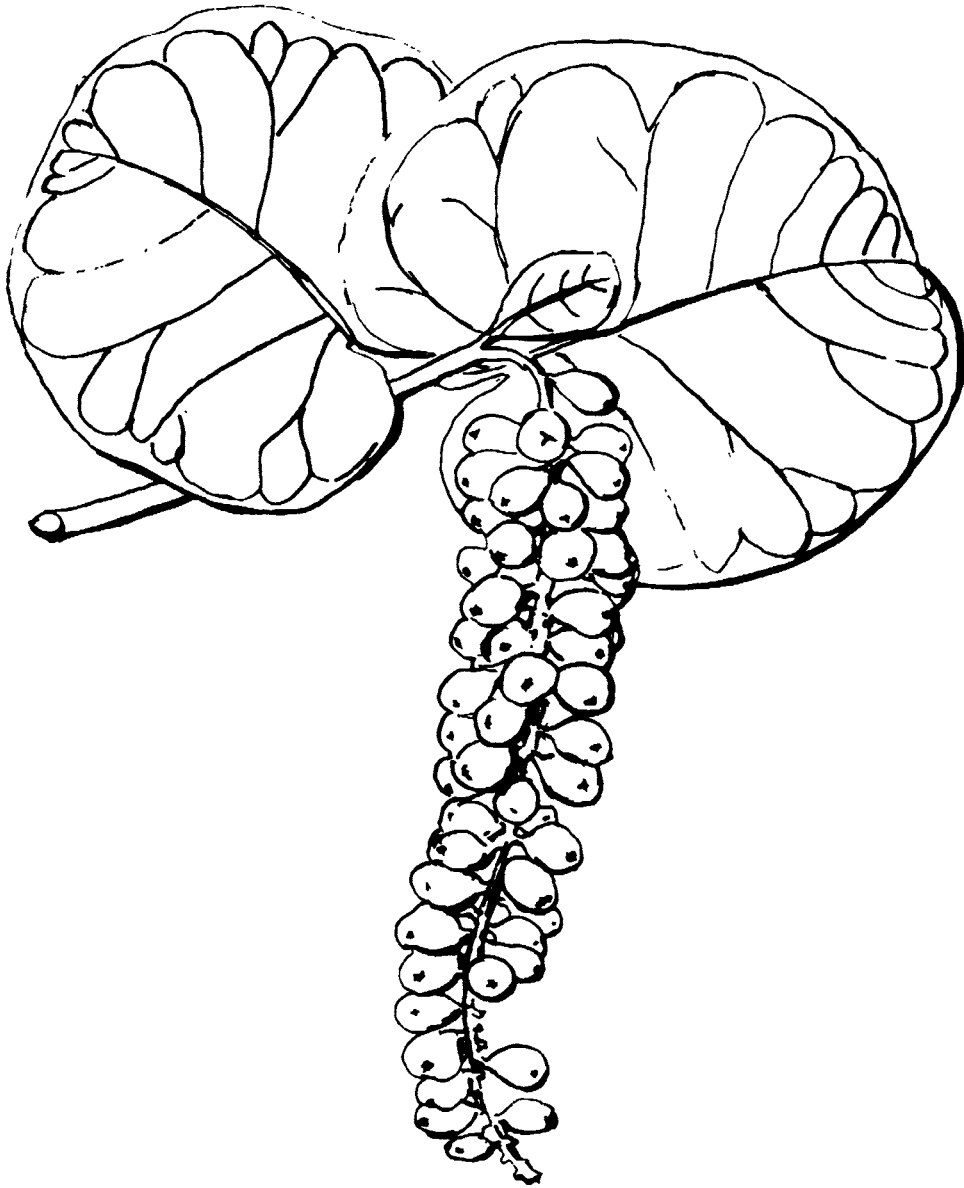
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*Coccoloba uvifera* (L.) L.



*Coccoloba uvifera*  
After/según/d'après BAILEY, L.H.  
The Standard Cyclopedia of Horticulture

COIA NITIDA (VENT.) SCHOTT. & ENDL.

FAMILY

Sterculiaceae

VERNACULAR NAMES

Bitter Cola, Kola Nut; Colatier (fr.)

ORIGIN AND DISTRIBUTION

Native of tropical west Africa; it has been spread so much by man that it is now difficult to estimate its original distribution. It is found from Senegal (planted) to western Nigeria.

ECOLOGY

It is a constituent of the dense lowland tropical forest; it needs a hot humid climate, but can withstand a dry season of 3 months or more. Where the climate is otherwise too dry, soils with ground water near the surface will permit its cultivation. In effect the culture of *C. nitida* ends where savanna conditions start. Its production is favourably influenced by the fertility and amount of humus in the soil.

BOTANICAL CHARACTERISTICS

Size

It is an evergreen tree 15-20 m high, 0.20-0.30 m diameter, rarely attaining 25 m high.

Bole

The bole is often rather short, with narrow buttresses, surmounted by a well-developed thick, low crown with tangled branches. The bark is fissured and grey, or almost black in old isolated individuals.

Leaf

Simple, rather variable in size and shape, generally oblong or elliptic, acuminate, three-nerved at the base, with the petiole swollen at both ends. The midrib is prominent on the upper surface and the secondary veins are prominent on the lower surface.

### Flower

Whitish or pale yellow with red stripes; they are unisexual, apetalous, and are produced in axillary cymes.

### Fruit

This is formed of 5 ellipsoid warty follicles, each containing up to 10 seeds arranged in 2 rows (kola nuts). The fruit is dark green, becoming bright green when they are ready for harvesting. The seeds measure about 2.5 cm, red or white according to the variety, usually with two cotyledons. They are surrounded by a thin white skin; they are rich in caffeine, theobromine and kolatine.

The seeds are much sought after by the local people.

### CULTURAL REQUIREMENTS

Propagation is by seed. Germination is slow, taking between 1-3 months. The plants can be grown in polythene bags or nursery beds and then planted out when 1-2 years old.

Propagation by cuttings is preferred as a means of multiplying the white-seeded strain which is favoured by the market. The final spacing used is 10 m.

Growth is slow, with the young plant reaching only 3 m in 4 years, during which period they should be kept clear of weeds. In order to produce a forest microclimate it is also recommended that they should be interplanted with shade trees such as coffee. Once established, their cultural requirements are few.

The production of kola nuts has often been exaggerated, but an average of 300 seeds per tree is considered good.

### WOOD

Well differentiated. The sapwood is white or pinkish, the heartwood yellowish-brown and fairly heavy. It is liable to attack by boring insects. It is suitable for furniture, joinery, etc. and is used for making dishes and in sculpture.

### USES

The wild or planted trees are harvested for their seeds and are the object of an important local and international commerce. The seeds which are rich in alkaloids, caffeine, kolatine, theobromine, are used by the local population as a stimulant to counteract fatigue. Industrial exploitation is for the caffeine which is used in decoctions and non-alcoholic drinks.

### FOOD VALUE

#### Composition of Kola Nuts

Water	13.5%
Crude protein	9.5%
Fat	1.4%
Sugar and starch	45.0%
Cellulose	7.0%
Tannin	3.8%
Ash	3.0%
Theobromine	0.05%
Cafeine	2.8%

### SYNONYMS

*C. acuminata* Engl.; *C. vera* K. Schum.

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COULA EDULIS BAILL.

FAMILY

Oleaceae

VERNACULAR NAMES

African Walnut; N'coula

ORIGIN AND DISTRIBUTION

Native of western tropical Africa where it is found from Sierra Leone to Zaire.

ECOLOGY

Found principally as a dominant species of evergreen wet forest and in the understorey of semi-deciduous forest on non-flooded land. It is a gregarious species without special soil requirements.

BOTANICAL CHARACTERISTICS

Size

A medium or large tree reaching 25 m, with a large dense crown casting a deep shade.

Bole

Generally of bad form, short, bossed, branched low down, sometimes slightly swollen at the base; it does not usually exceed 6 m in length and 0.80 m diameter. The bark is thin, rather smooth lenticellate, greenish-brown, slightly fissured; slash sepia or yellow, whitish and resinous in young trees.

Leaf

Alternate, simple, exstipulate, oblong or elliptic, coriaceous, from 10-30 cm long and 4-9 cm broad. The secondary nerves are impressed on the upper surface, and prominent on the lower surface. The young shoots and leaves are covered with evanescent, rust coloured stellate hairs.

Flower

Small, in short axillary racemes and covered with a rusty tomentum. They are tetramerous or pentamerous, with rather thick, glabrous, greenish-yellow petals.

### Fruit

The fruit is an ellipsoidal drupe 3-4 cm long with an extremely hard kernel. The flesh surrounding the kernel is green or reddish, 5-6 mm thick, smooth.

The oily kernel has a taste comparable to that of a chestnut or hazelnut. It can be eaten raw, grilled or boiled. It contains 50% fat of which 87% is oleic acid.

### CULTURAL REQUIREMENTS

Because of the hard tegument, germination is poor and may take up to a year. The African Walnut can be used as a plantation tree with a final spacing of 10 x 12 m. Shading is useful when they are young.

### WOOD

The sapwood is pinkish-brown while the heartwood is dark red or violet brownish-red. It is extremely hard, heavy, close-grained, and resists water well. It is also resistant to insect attack, particularly termites. It has the disadvantage of being liable to shake and crack.

### USES

It is useful for making piles for bridges, railway ties and charcoal.

The delicious seeds are eaten raw or cooked.

### SYNONYM

*Coula cabrae* Wildem. & Th. Dur.

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N° 13 - Coula edulis Baill. (G. Kunkel)



After/según/d'après KUNKEL, G.  
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CYPHOMANDRA BETACEA (CAV.) SENDT.

FAMILY

Solanaceae

VERNACULAR NAMES

Tree Tomato; Tomate de la Paz, Arbre a Tomates (fr.);  
Tomate de Arbol (sp.)

ORIGIN AND DISTRIBUTION

A native of the forests of the Andes of Peru and Argentina at altitudes between 1800 and 3000 m. It is also cultivated in Mexico and Central America between 1200 and 2400 m.

At the present time it is found in hilly country throughout the tropics, from Malaysia, India, Ceylon, S. Africa to S. America. It's successful cultivation requires an altitude above 1000 m; below this, it flowers and fruits badly, owing to the lack of low night temperature.

Tree tomato is frequently grown as a curiosity in gardens in the temperate regions of North America.

ECOLOGY

Although it needs a lower night temperature such as is found between 1000 and 2000 m altitude in the tropics, it does not tolerate very low temperatures, so frost pockets should be avoided.

It appreciates deep, moist, well-drained, fertile soils, and should be irrigated in the event of a prolonged dry spell. It needs high atmospheric humidity, and for this reason is often cultivated at altitude in regions which are otherwise dry. In California it has been shown that although the large leaves of the plant are damaged by a temperature of -2 or -3°C, they quickly recover.

### CULTURAL REQUIREMENTS

It is propagated easily by seed, which takes about 8-15 days to germinate. The seeds are sown in nursery beds and when the plantlets are 20 cm high they are transplanted to a spacing of 2-3 m each way.

Fruit production begins 2 years after sowing and lasts for 10 - 12 years.

Maximum production lasts only 4 - 5 years, for a period of 5 months per year.

The facility of propagation and culture lends it well to small scale or garden cultivation.

Trials of propagation by cuttings have also been successful.

### BOTANICAL CHARACTERISTICS

#### Size

The Tree Tomato is a semi-woody shrub or treelet 2-3 m high, rarely 5m. It is unarmed, pubescent, with a short trunk and stout lateral branches.

The bark is grey.

#### Leaf

Alternate, simple, entire, usually grouped at the branch tips, with a robust petiole, 4-8 cm long. The limb is large, 15-30 cm long, 10-20 cm broad, ovate, shortly acuminate, with a cordate base. The young leaves are covered on both surfaces with a soft pubescence; later the upper surface becomes glabrous. The midrib and principal veins are prominent on both surfaces.

#### Flower

The flowers are flesh pink, in groups of 3-10 in axillary cymes or racemes, near the ends of the branches. They are hermaphrodite, pentamerous, fragrant, pedicellate, 13-15 mm diameter.

The calyx is campanulate with broadly ovate, subacute lobes, which are thick and accrescent in fruit.

The corolla is rotate-campanulate, 12 mm long, with 5 long, narrow, lanceolate segments, reflexed at the apex.

The 5 stamens are yellow and inserted at the throat of the corolla.

### Fruit

The fruit is an ovoid berry, measuring 4-6(-10) cm long and 3-5 cm broad. It is suspended at the end of a long stalk, and surrounded at the base by the persistent green calyx.

The skin is thin, glabrous, smooth, reddish-brown to violet changing to orange-red at maturity. Some purple-fruited varieties become deep purple at maturity.

The pulp is juicy, subacid, pink, salmon or yellow; it contains numerous small seeds.

### USES

The uses of *Cyphomandra betacea* are similar to those of *Lycopersicum esculentum* Mill. (tomato).

The acidulous flavour of the raw fruit is very refreshing.

It is also steamed, baked, made into sauce or pickled.

The Tree Tomato should be grown, wherever for one reason or another, it is difficult to cultivate or fruit the true tomato.

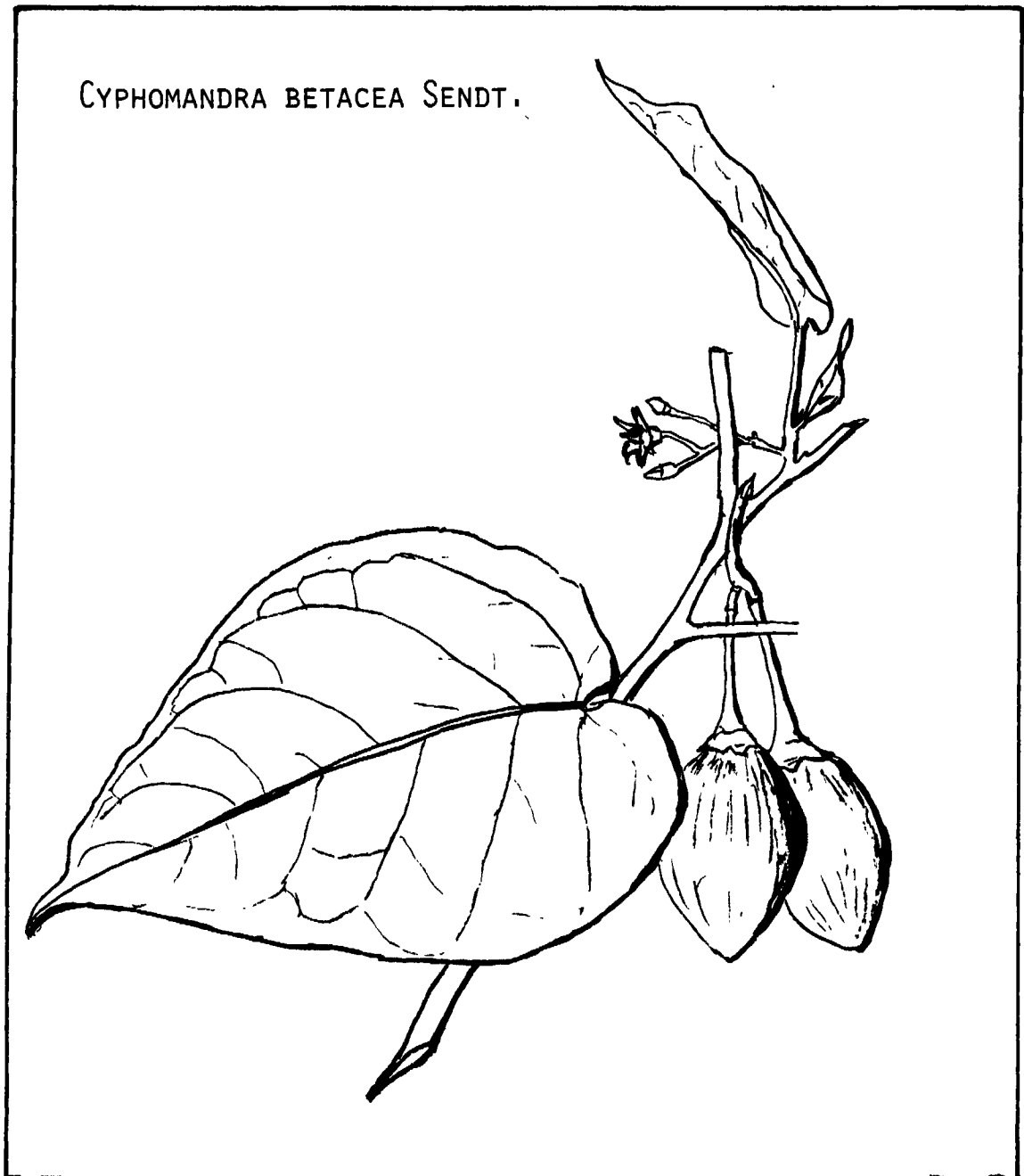
### SYNONYMS

*Cyphomandra crassifolia* Macbride; *Pionandra betacea* Miers;  
*Solanum betaceum* Cav.; *Solanum crassifolium* Ortega;  
*Solanum fragrans* Hook. ; *Solanum obliquum* Bert. ex Dun.

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*Cyphomandra betacea*

After/según/d'après OCHSE, J.J.

Indische vruchten

Volkslectuur - Weltevreden - 1927 - pp. 330

DACRYODES EDULIS (G. DON.) H. J. LAM

FAMILY

Burseraceae

VERNACULAR NAMES

Bush Butter Tree; Safoutier (fr.)

ORIGIN AND DISTRIBUTION

A forest species occurring naturally in West Africa from Sierra Leone to Angola and Uganda. It is introduced to Malaysia.

ECOLOGY

A shade-loving species of non-flooded forest in the humid tropical zone. Where there is a well marked dry season it is found only in gallery forest and on swampy ground. It occurs up to 1000 m altitude.

BOTANICAL CHARACTERISTICS

Size

A medium sized evergreen tree attaining 18-22 m in forest. As a plantation tree it does not exceed 12 m. It is generally branched from low down, with a deep, dense crown.

Bole

Rather short, slightly fluted, 0.50 - 0.70 m diameter and more or less sinuous. The scented pale grey rough bark exudes a whitish resin. Buttresses absent.

Leaf

Compound, imparipinnate with 5-8 pairs of leaflets.

Leaves glossy on the upper surface; lower surface pubescent, the pubescence disappearing with age.

Flower

The small (0.6 cm) flowers are borne in large tomentose terminal panicles. They are trimorous. The species is dioecious (flowers unisexual by abortion of one sex).

### Fruit

Ellipsoid drupes rather variable in size, from 1.5 to 7 cm long and 1-3.5 cm broad, resembling olives. Exocarp thin, pink, becoming violet at maturity; pulp firm and thin. Fruit edible when cooked and salted.

### CULTURAL REQUIPMENTS

Often found as garden tree in and around villages. It is usually propagated from seed, sown either in open ground or in long polythene bags. Apart from layering, vegetative propagation gives poor results. It would be desirable to develop other methods of vegetative propagation in order to multiply good strains of female plants.

In orchards, the recommended spacing is 10 x 10 m.

### WOOD

The sapwood and heartwood are difficult to distinguish; they are whitish, soft and light. The wood has a general use for tool handles particularly axe shafts. It is considered a good replacement for okoumé (*Canarium schweinfurthii*).

### USES

The fruit is edible after cooking or scalding, and it has a high food value. The fresh pulp is rich in fat (35-65%), with a considerable amount of palmitic and linoleic acid. The resin is used medicinally by the local people.

### SYNONYMS

*Pachylobus edulis* G. Don.; *Canarium edule* Hook. f.;  
*Canarium saphu* Engl.; *Pachylobus saphu* Engl.

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DURIO ZIBETHINUS L.

FAMILY

Bombacaceae

VERNACULAR NAMES

Durian; Dourian

ORIGIN AND DISTRIBUTION

Native of Malaysia but now introduced into many countries in tropical Asia, especially Ceylon. It's distribution is close to that of the Mangosteen, excepting the coastal areas.

ECOLOGY

It is a species of moist tropical regions, found specially along the forest margins at low altitude, up to 300 m. According to some authors, pollination is effected by bats, which would explain the difficulty encountered in introducing it to many countries.

It does well in deep, moist, alluvial soils.

It tolerates neither a cold climate nor a dry one. However, in equatorial regions it requires a relatively dry period to induce flowering. In some places (e.g. Malaya) there may occasionally be one or two years without fruit, because the dry season was too short or absent altogether.

BOTANICAL CHARACTERISTICS

Size

A large deciduous tree reaching 35 m. On mature trees the crown is conical, dense and composed of stout, horizontally arranged branches. The shape is reminiscent of a large elm.

Bole

Straight, slightly enlarged at the base. The bark is grey or reddish-brown.

Leaf

Simple and alternate, but sometimes subopposite or opposite near the inflorescence. They measure 6-22 cm long and 2.5-8 cm broad. The colour of the foliage is variable, from pale green

to dark bronze-green. The leaves are glabrous and glossy on the upper surface; the lower surface is rough (silvery-grey or yellowish scales); tip acuminate; midrib prominent on the lower surface; petiole about 2.5 cm long, thickened at the base. Small scaly stipules present.

#### Flowers

The inflorescence is sometimes reduced to only a few flowers, or sometimes bears more than 20 flowers. The large flowers are 5-7 cm long, giving off an odour of sour milk. The calyx is composed of 2 parts: the exterior of 2-3 free sepals, and the interior of 3-5 broadly cut, fused sepals. The corolla consists of 4-5 free petals which are white, streaked with green. Some varieties have red petals. The numerous stamens are grouped into 4-5 bundles.

#### Fruit

These have an exceedingly strong and offensive odour, which attracts wild animals from miles around, and are large and heavy (usually weighing from 2-3(-7) kg) and measuring about 20(-35) cm by 17 cm. They are produced on short stout branches, and their colour varies from pale brown to olive or yellowish-green.

The skin is covered with strong spines 1.5 cm long.

At maturity it opens slightly into 4-5 valves. The flesh is white, and within are found 1-7 seeds in the depressions of each segment. Each seed is surrounded by cream or pink pulp (the aril) : this is the part which is eaten. Each seed measures 5-6 x 7-8 cm.

The fruits take about 3 months to mature.

The epidermis of the fruit is very hard, almost woody, and the fruits are rarely damaged although they may fall from a great height.

Due to a chemical change within the pulp, it must be eaten within 2 days of falling from the tree, and the fruit should not be opened long before eating as the pulp goes sour. The seeds can also be eaten.

### CULTURAL REQUIREMENTS

The durian is usually propagated by seed. Germination is rapid and easily accomplished, but the viability is short - a few weeks or only a few hours if the seed is exposed to the sun.

Fruiting starts 5-7 years after planting and there are 2 harvests each year.

The durian can also be multiplied by grafting. Other methods of vegetative propagation give poor results. Final spacing of trees recommended in India is 9 x 12 m. The annual production of a tree is around 50 fruits. In some countries it is thought that attaching durian fruits to trees will prevent accidents.

### WOOD

The wood is light (density air-dried 0.54)

The sapwood is white and the heartwood reddish-brown to brown with easily visible rings. It is suitable for peeling and used for packing cases.

### USES

The pulp or aril of the fruit must be eaten fresh.

It has the reputation of being an aphrodisiac. The juice is eaten pure or mixed with coconut milk.

The seeds are sometimes grilled or boiled.

The quality of the fruit is the subject of controversy. This is because it is difficult to keep and it gives off such a strong offensive odour, likened by some to a mixture of old cheese, onions and turpentine, by others to a civet-cat, hence its botanical name.

The fruits are best eaten raw. They can be added to ice cream or used to make a good jam.

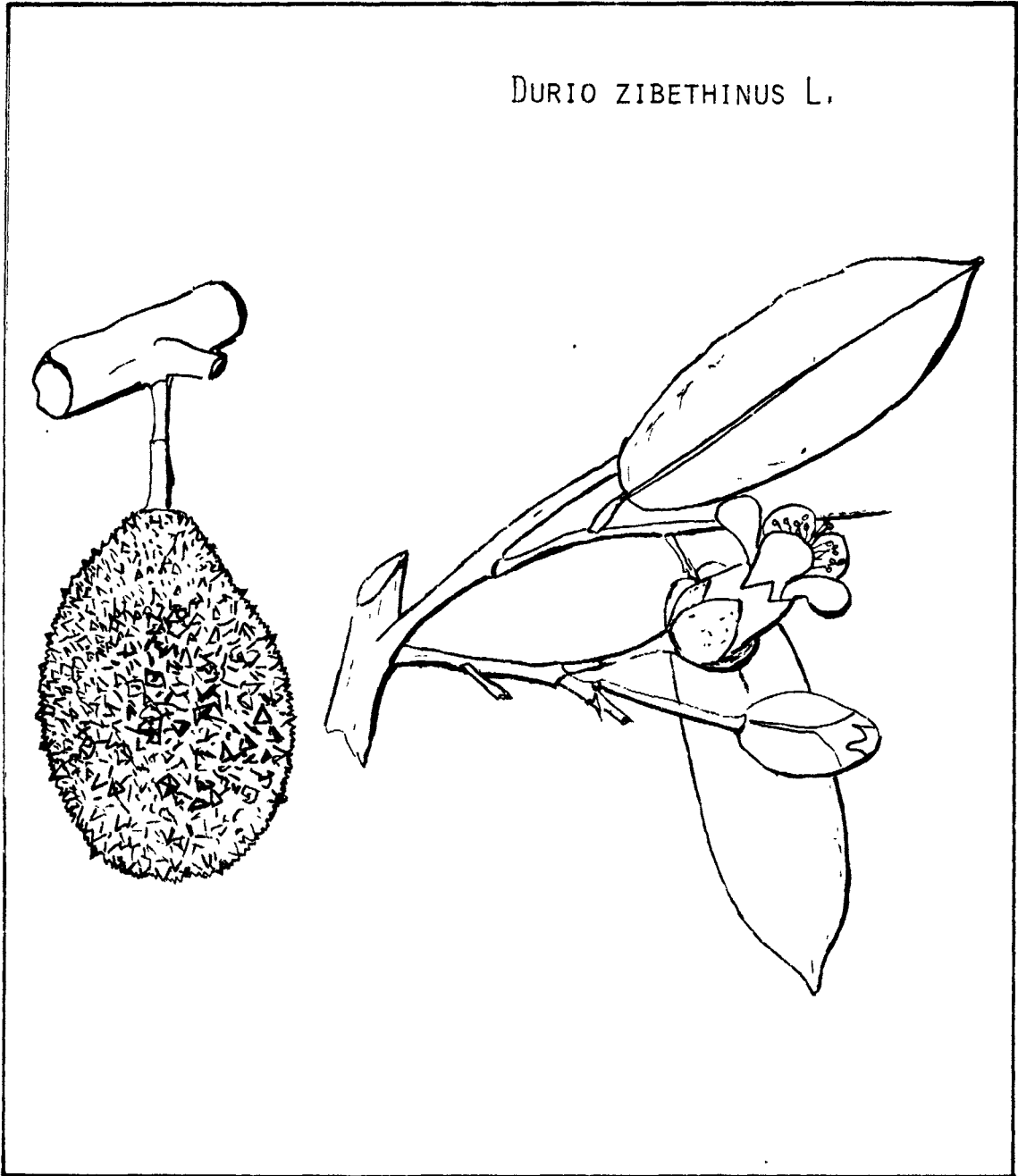
### FOOD VALUE

Their food value is very high

Water	‡ 55.5 - 58%
Protein	2.3 - 2.8 %
Fat	3.4 - 3.9%
Sugar and Starch	22.7 - 34.1%
Minerals	1.24%

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*Durio zibethinus*

After/según/d'après MOLESWORTH ALLEN, Betty  
Malayan Fruits

Donald Moore Press Ltd. - Singapore - 1967 - pp. 245

EMBLICA OFFICINALIS GAERTN. (PHYLLANTHUS EMBLICA L.)

FAMILY

Euphorbiaceae

VERNACULAR NAMES

Indian Gooseberry; Myrobalan

ORIGIN AND DISTRIBUTION

Native of tropical Asia, Ceylon, India, Burma, China, etc. It occurs at elevations up to 1300 m, in semideciduous forest.

ECOLOGY

It is especially widespread in riparian forest along the Indus, with a moist tropical climate, and a distinct dry season. It is sensitive to both drought and cold, and it is absent from arid regions.

It is a light demanding species requiring full light for best development. Growth is fast at first but soon slows down.

BOTANICAL CHARACTERISTICS

Size

A medium-sized tree reaching about 18 m high. It is a deciduous species but does not lose all its leaves in the dry season. The globular crown casts a light shade.

Bole

The bole<sup>which</sup> is often short, is straight and cylindrical. The smooth grey bark peels off in irregular scales. It is quite rich in tannin.

Leaf

The leaves are alternate, pinnate, with numerous pale green leaflets.

Fruit

Almost sessile, smooth, globular, greenish-yellow, about the size of marbles. They have a nut-like hexagonal endocarp

which contains 4-6 dark brown tetragonous seeds. The flesh of some fruit, especially some wild varieties, is very acid, bitter and astringent.

#### CULTURAL REQUIREMENTS

As plants produced from seed bear fruit of inferior quality, it is necessary to use vegetative means of propagation to keep good varieties. Budding gives the best results, and is carried out on stools of about 1 cm diameter. The grafted plants are spaced out at 8 x 10 m at the beginning of the rainy season. Many plants drop their leaves on transplanting but new foliage soon appears. Copious watering is needed during the dry period. Some weeding is required during the early stages of growth but once transplanted to their final positions, they need very little attention. The trees begin to bear fruit after 8 years.

#### WOOD

The wood which is not or only slightly differentiated, is red, hard, fissile and durable in water. It is used for agricultural implements, pit props, for cheap furniture and in construction.

On drying, the wood is liable to twist and split.

It is regarded as an excellent firewood.

#### USES

The raw fruit is an important source of vitamin C. The fruit juice contains 300 times as much vitamin C as the same quantity of orange juice. When dried and powdered, the fruit is more efficacious than synthetic vitamin C in treating scurvy.

It is also used in jams and pickles. The bark, leaves and fruits contain high proportions of tannic substances.

SYNONYM

*Emblica officinalis* Gaertn.

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ERIOBOTRYA JAPONICA (THUNB.) LINDL.

FAMILY

Rosaceae

VERNACULAR NAMES

Loquat; Néflier du Japon, Bibacier (fr.); Níspero de España (sp.)

ORIGIN AND DISTRIBUTION

This species is actually a native of central China, but it has been cultivated in Japan since time immemorial, and it has now been spread to all the subtropical, mediterranean and warm temperate regions of the world.

ECOLOGY

Originally from regions with a subtropical climate, this species requires a mild climate with a rainfall of between 650 and 1000 mm evenly spread through the year, without excessive heat especially when the fruit is ripening.

The most favourable conditions for productivity and quality of fruit are to be found near the sea. In the tropics its culture is possible between 1000 and 2200 m altitude.

It is tolerant of drought and of slight frost. Temperatures lower than  $-5^{\circ}\text{C}$  damage the flowers, and lower than  $-12^{\circ}\text{C}$  are fatal.

It will grow in a great variety of soils from sands to heavy clays; however, the best growth is found in light, well-drained, deep, moist alluvial soils (gritty subsoil about 1.5 m deep)

BOTANICAL CHARACTERISTICS

Size

Evergreen shrub or small tree from 6 - 8 m high.

Ornamental.

### Bole

Usually rather short, from 0.60 - 1 m long, surmounted by a dense ovoid or globular crown.

The bark is grey and shallowly fissured; on young branches it is pale brown and hairy.

### Leaf

Alternate, coriaceous, lanceolate or elliptic, margin serrate, 12-30 cm long, 4-10 cm broad. The lower surface is covered with grey or reddish hairs.

### Flower

The terminal panicles 10-20 cm long, white, fragrant.

### Fruit

The size and shape varies according to the variety: generally globular, ovoid or pyriform from 3.5 - 6 cm long, pale yellow to red, slightly downy when young. They contain 4-10, brownish, oblong seeds 1-2 cm long, in a firm pale yellow flesh which is agreeably perfumed and slightly acid.

### CULTURAL REQUIREMENTS

Planting distances are either 3.5 x 7 m or 6 x 6 m. For good productivity, manuring and interplanting with a leguminous crop is recommended. Manuring should be carried out every 2 years at the rate of 40-50 kg per tree, or 12-14 tonnes/hectare. After planting the trees are pruned 60-75 cm above ground level in order to promote the growth of 3-5 branches. They are also pruned immediately after harvesting in order to limit the number of fruit and even out production.

Propagation is generally by seed, though due to market requirements, various techniques for grafting and budding should be investigated. Seedlings or stools are placed in 10 cm pots. When they reach a diameter of about 1 cm budding or grafting can proceed (the eye with a strip of bark is taken from young wood which has lost its pubescence and its leaves). Immediately after

planting out, the plants are cut down to 5-10 cm above the graft. They start producing fruit 2-3 years after planting.

There are numerous varieties which vary greatly in the form of the fruit and in productivity.

#### WOOD

It does not have a market, except as firewood.

#### FOOD VALUE

Composition:	water	84.00-89.00%
	protein	0.32-0.35%
	lipids	0.03-0.6%
	sugar and starch	9.89-12.79%
	cellulose	0.30-0.37%
	ash	0.29-0.36%

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No. 18 *Eriobotrya Japonica* (Thunb.) Lindl



EUGENIA JAMBOS L.

FAMILY

Myrtaceae

VERNACULAR NAMES

Rose-Apple; Pommier Rose, Jamboisier (fr.); Pomarrosa (sp.)

ORIGIN AND DISTRIBUTION

This species is native in the tropics of South East Asia, especially the Malay Archipelago. It has been spread throughout the tropics of the world, and has become naturalized in many countries.

ECOLOGY

It is a species of low altitude preferring wet coastal tropical climates and humid locations such as the banks of large rivers. It withstands drought better than low temperature. It is a shade loving plant, especially when young. Young plants exposed to full light die very rapidly.

BOTANICAL CHARACTERISTICS

Size

A small tree to 5 or 10 m high with evergreen leaves. The crown is broad, deep and dense.

Bole

Generally twisted at the base. It's diameter varies between 10 and 20 cm. The bark is brown, with numerous furrows, smooth between the furrows.

Leaf

Opposite, lanceolate, long acuminate, deep green, shining, with numerous transparent gland dots. They are often covered with a "bloom" which gives them a darker appearance.

Flower

Yellowish-white or pink, scented, with 4 rather large sepals and petals. The scent resembles that of a rose. They are arranged in 4-5-flowered terminal corymbs.

Fruit

Fragrant, yellowish sometimes tinted with red, ovoid or globose, 3-5 cm diameter. A firm and only slightly juicy flesh surrounds 1-2 seeds. Although the maximum fruiting takes place during the summer, flowers and fruit are present throughout the year.

CULTURAL REQUIREMENTS

Propagation is from seed. The geminative power of the seed is good, and the seeds are liable to germinate immediately after harvesting. Polyembryony has often been recorded. The seeds are germinated in shade and the young plants progressively introduced to lighter conditions. Layering is also successful. It is essential during the early stages of growth to ensure adequate shade and to avoid drying out by the sun. It is often necessary to irrigate the young plants during the dry season. The recommended final spacing for plantations is 5 to 6 m. Growth is slow.

WOOD

Differentiated. The dark brown heartwood is heavy and hard. It is not durable in soil, as it is very susceptible to termite attack. When it attains suitable dimensions, which is not often, it is a valuable construction timber. It is good for both firewood and charcoal.

USES

The fruit can be eaten raw, but it is rather insipid and not popular. It is preferred cooked, in preserves, and in this form it is greatly appreciated. Because of its high pectin content it is used as a setting agent for conserves. It is also a useful melliferous and ornamental species.

FOOD VALUE

Water	89.1%
raw protein	0.7%
fat	0.2%
sugar and starch	9.7%
cellulose	0.0%
mineral material	0.3%

SYNONYMS

Jambosa jambos (L.) Millsp.; Jambosa vulgaris DC.;  
Syzygium jambos (L.) Alston; Caryophyllus jambos (L.) Stokes.

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EUGENIA MALACCENSIS L.

FAMILY

Myrtaceae

VERNACULAR NAMES

Malay Apple; Jamelac, Jambosier Rouge, Pomme de Tahiti (fr.);  
Manzana Malaya (sp.)

ORIGIN AND DISTRIBUTION

Probably native of the Malay Archipelago or Malay Peninsula. It is naturalized or semi naturalized in South East Asia, where it forms pure stands. It is cultivated practically throughout the tropics.

ECOLOGY

A characteristic plant of the humid tropics, intolerant of long periods of drought and large temperature fluctuations. It is frost sensitive and confined to low or medium altitude below 1000 m.

BOTANICAL CHARACTERISTICS

Size

A small to medium sized evergreen tree up to 15 m high, with a narrow, dense, columnar crown.

Bole

The bole is thick and straight but short, soon branching, sometimes exceeding 0.30 m diameter. The bark is brown, smooth or slightly verrucose and corky.

Leaf

Opposite, large, oblong. The limb is slightly recurved, generally with a dark green, shining upper surface, and a paler green lower surface. The coriaceous limb bears numerous transparent gland dots.

Flower

The flowers are arranged in paniculate or racemose inflorescences. The calyx is of 4 sepals which persist on the fruit. There are 4 purplish-red petals. The stamens are very numerous, and on falling, form a red carpet under the trees.

### Fruit

The fruit is a subovoid or pyriform purple berry, 5-7 cm long, 3-5 cm broad, with a short peduncle. The skin is thin and sweet, and covers a white, spongy, juicy flesh, whose scent recalls that of a rose or apple. The exact taste of the fruit is strongly disputed, owing to the existence of numerous varieties.

The species flowers and fruits throughout the year.

### CULTURAL REQUIREMENTS

The species is easily propagated from seed, but vegetative multiplication is advised if fruits of consistent quality are required.

Budding on to seedling stock gives good results.

The growth of both seedlings and grafted stock is reasonably fast.

The final spacing is 8-10 m.

As the Malay Apple is attacked by termites, it is prudent to keep some extra plants in the nursery, in the event of replacements being needed.

### WOOD

The wood is differentiated: the sapwood is light brown; the heartwood is brown, hard, smooth to touch and very heavy; however it has a tendency to warp and is difficult to work. It is useful for making furniture, if it is of sufficient size. It makes excellent charcoal.

### USES

The Malay Apple is sometimes cultivated as an ornamental, but its primary importance is as a fruit tree. The fruit can be eaten raw, cooked, or made into preserves; it can also be used for wine-making. The stamens, which are slightly acid, can be used in salads.

### SYNONYMS

*Jambosa malaccensis* (L.) DC.; *Syzygium malaccense* (L.)  
Merrill & Perry

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EUGENIA MALACCENSIS L.



*Eugenia malaccensis*

After/según/d'après OCHSE, J.J.

Indische vruchten

Volkslectuur - Weltevreden - 1927 - pp. 330

EUGENIA UNIFLORA L.

FAMILY

Myrtaceae

VERNACULAR NAMES

Surinam Cherry, Pitanga; Cerisier de Cayenne, Cerise Carée (fr.); Cereza de Cayena (sp.)

ORIGIN AND DISTRIBUTION

Native of tropical America where it occurs in the forests of Brazil, Guyana, Bolivia and Argentina. Due to the high quality of its fruit, it is now found in many other tropical countries.

ECOLOGY

Tropical and subtropical with a range extension as far as the Mediterranean regions. It will tolerate temperatures approaching 0°C. Its productivity is much higher in hot, wet climates than in dry or semi-arid climates. It is very tolerant of soil conditions, but prefers well-drained sandy soil. It will also tolerate relatively high levels of CaCO<sub>3</sub>

BOTANICAL CHARACTERISTICS

Size

Usually a shrub or small tree around 4-5 m high, exceptionally reaching 8 m.

Bole

Generally short and not more than 10 cm diameter.

Leaf

Opposite, ovate, acuminate, entire, upper surface glossy dark green, lower surface light green; the limb bears gland dots which give off a spicy odour when the leaf is bruised. In Brazil, the leaves are spread out on the ground, having the reputation for keeping away flies and also perfuming the house.

Flower

Small, white or pinkish, tetramerous, in lax-flowered panicles; the petals are rapidly caducous and the sepals persist on the fruit.

### Fruit

Red or sometimes blackish berry, somewhat resembling a cherry or small tomato, 2-3 cm diameter, broader than long, with 8 vertical furrows. The flesh is sugary, slightly acid and very juicy.

### CULTURAL REQUIREMENTS

Propagation by seed is easy and one often finds numerous seedlings beneath the present tree. The seeds lose their viability within 2-3 weeks. Young plants of around 0.30 m high are planted out at a spacing of 3 to 6 m. Growth is slow, and as it does not begin to bear fruit for 4-5 years, interplanting with another crop is recommended during the 5-6 years needed to establish the orchard. It is not demanding as to soil conditions and can be planted anywhere. In dry areas it is recommended that the trees be given copious irrigation when the fruits begin to colour, in order to ensure good production. Mulching is also recommended. In areas where the dry season is short and indistinct the tree bears fruit practically all year.

### WOOD

The wood is not used except for firewood.

### USES

The fruit is very tasty and fragrant when fully ripe and can be eaten raw. They can be made into jellies, sorbets, syrup and even a liqueur. The leaves are sometimes used for infusions. It is also a very valuable ornamental species.

### FOOD VALUE

Water	90.7%
protein	1.01%
fat	0.66%
sugar and starch	7.50%
cellulose	0.34%
ash	0.34%

### SYNONYM

*Eugenia micheli* Lam.

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FEIJOA SELLOWIANA BERG.

FAMILY

Myrtaceae

VERNACULAR NAMES

Pineapple Guava; Feijoa (fr., sp.); Guayaba chilena (sp.)

ORIGIN AND DISTRIBUTION

Feijoa is a small tree native in the forests of southern Brazil (Rio Grande do Sul), western Paraguay, Uruguay and north eastern Argentina. It is at home in all olive-growing regions. On the other hand, trials in Cuba, southern Florida and several other tropical areas have met with little success. Good results are obtained at medium altitudes in a temperate climate where the rainfall does not exceed one metre per year.

ECOLOGY

Feijoa is a plant of subtropical countries with a temperate, not too wet climate. The average rainfall is of the order of 750-1000 mm.

It is tolerant of drought, but in cultivation irrigation is necessary to ensure maximum production and good quality fruit. In dry conditions the fruit becomes lignified and ripening is retarded.

The species does not like rapid changes of temperature, but it is frost tolerant, resisting without damage  $-8^{\circ}\text{C}$ . The ideal soil for the species is clay-sand, rich in humus, but it will grow in poorer soils if they are well-drained.

BOTANICAL CHARACTERISTICS

Size

A shrub or small tree 3-6 m high with a well-developed crown, which is usually broader than high. The young branches, lower surface of the leaf, calyx and corolla are silvery-grey tomentose.



### Leaf

They are opposite, simple, elliptic or ovate-oblong, entire, 3-7 cm long, 1.5-4 cm broad. The petiole is about 4 mm. They are persistent, green on the upper side and covered with a greyish-white tomentum on the lower side. The midrib is prominent below.

### Flower

The flowers are axillary, solitary or in fascicles, with a peduncle 1.2-2 cm long, with 4 sepals (the 2 outer c 8 mm long, the 2 inner ovate 10 mm, obtuse).

The 4 petals are cyathiform, 18-20 mm long, 8-10 mm broad, white on the exterior face, purplish-scarlet inside.

There are numerous, long exserted (2.5 cm long) scarlet stamens.

### Fruit

The fruit is a pruinose, ovoid or oblong berry, 2-7 cm long and 2-5 cm broad, in colour it is pale green, perhaps with a touch of red at maturity. It is tomentose at first, then glabrous. The flesh is pulpy, granular, translucent, yellowish-white. It contains 20-30 small seeds.

### CULTURAL REQUIREMENTS

Propagation of Feijoa is by seed, cuttings, layering or grafting.

The seed takes 15-25 days to germinate and thereafter development is slow, with the young plants not planted out until 2 years old. The final spacing is 4.5-6 m each way. Grafting is easily carried out on young material.

Pruning should not be too vigorous, nor too weak.

A slow-release organic manure is most suitable; regular small doses of active chemical fertilizer should also be applied.

In dry areas, mulching is recommended, and it is advised not to work the soil too close to the base of the tree, in order to avoid damaging the roots, which would affect fruit production.

### USES

To obtain the best flavour, the fruit must be eaten at precisely the right moment of ripeness. The pulp has a taste recalling a mixture of strawberries, guavas and pineapple; it is generally eaten raw with the seeds which are very small. The fruit can also be used for preserves, jelly, jams or preserved in brandy. As the fruit contains easily assimilated iodine, it would be useful in the prevention of goitre.

Lastly, the beauty of its flower justifies its use in ornamental horticulture.

### FOOD VALUE

The composition of the ripe fruit is as follows: (Univ. of California)

water	84.88%
protein	0.82%
fat	0.24%
carbohydrate	4.24%
ash	0.56%
cellulose	3.35%

### SYNONYM

*Orthostemon sellowianus* Berg.

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GARCINIA MANGOSTANA L.

FAMILY

Clusiaceae (Guttiferae)

VERNACULAR NAMES

Mangosteen, Mangostan, Mangis; Mangostán (sp.); Mangoustan, Mangoustanier, Mangouste, Mangoustier (fr.)

ORIGIN AND DISTRIBUTION

The mangosteen is native in the Sunda Isles and Malay Peninsula, and it does not often occur outside the countries of the Far East. It is cultivated on a fairly important scale in Indochina (Cochin China), Java, Sumatra, Malay Peninsula, the Philippines, the Moluccas and Ceylon. Everywhere else where it has been introduced, it is found only in very limited numbers.

ECOLOGY

The mangosteen demands an equatorial climate. In fact it requires very special conditions of heat, moisture and soil which only certain tropical countries are able to provide, and this accounts for its rather feeble distribution. Tropical temperatures and abundant rain distributed regularly throughout the year are the factors essential for the success of its cultivation. The lower parts of Ceylon which receive the south west monsoon rains are particularly favourable. It grows very well in a clay soil. It favours moist soils, with one qualification - the water must not be stagnant. It should be cultivated in situations sheltered from wind and sun.

BOTANICAL CHARACTERISTICS

Size

The mangosteen is a beautiful tree which can attain a height of 20 m, but in general does not exceed 10 m in cultivation (trunk 0.25 - 0.35 m diameter).

It is characterized by its conical form, straight trunk with brown-black, thick, rugose bark which exudes a pale yellow latex when cut. It has thick angular branches. It's root system is poorly developed.

### Leaf

Opposite, ovate, elliptic or oblong, apex obtusely acuminate, base acute, obtuse or rounded; margin entire. The leaves are relatively thick and coriaceous, deep green or yellowish-green above, shining, yellowish-green below, glabrous on both surfaces. They are 12 to 23 cm long and 4.5 to 10 cm broad. The petiole 1.5-2 cm long, is swollen at the base and subtends an axillary bud.

### Flower

Flowers hermaphrodite or unisexual by abortion of the stamens, solitary or paired at the branch tips. They have 4 sepals, 4 petals, 16-17 small stamens with long filaments and 2-celled fertile anthers, a sessile subglobular 4-8-locular ovary, with a sessile stigma.

### Fruit

Generally solitary or in pairs. The fruit is a round berry 5-7 cm diameter, with a persistent calyx, and surmounted by a persistent stigma. The violet-purple pericarp is very thick (0.8-1 cm) and leathery. It encloses a variable number (5-7) of aril segments which may or may not surround the seeds. The pericarp is not edible on account of the presence of the very bitter pale yellow latex. It is the aril segments which form the edible part of the fruit; the snow-white flesh has an exquisite taste, considered by some to resemble grapes and peaches, and a scent of great delicacy.

### CULTURAL REQUIREMENTS

The species has very slow growth and bears little fruit before reaching 10 or 15 years old, and does not enter full production until at least 20 years old.

Propagation can be by seed, cuttings, layering or grafting; whatever method is used, the delicate techniques required must be followed closely if one wishes to establish the mangosteen in a new country. Once separated from the fruit, the seeds

lose their viability after a few days: sowing is therefore recommended as soon as possible. If the seed remains in the fruit, then their viability will remain 3-5 weeks. Seeds are planted in open ground or in large polythene bags, in which case the seedlings are transplanted before reaching 60 cm high, or when they have 6 pairs of leaves.

#### Propagation by cuttings

Cuttings are taken from well ripened branches; they root easily in sand in a closed container; bottom heat as well as the use of hormone powder will increase the take. Mangosteen can also be grafted on to the stock of related species in the same genus such as *Garcinia xanthochymus* Hook. f., a resistant and vigorous species. Budding also gives good results: the buds should be green, soft, non-petiolate and 2.5-4 cm long.

#### Cultivation

On leaving the nursery the young plants are planted in holes previously filled with fertile humic soil. At first the plants must be shaded, for example with palm leaves. Great care should be taken that the last pair of young leaves do not wither, as this will result in a severe check or death. The spacing of the plants should be 10m each way. In order to make better use of the land, other crops can be planted between the mangosteen, at least during the first 10 years. Arrow-root, ginger or pepper can be used for this purpose. The mangosteen benefits from the cultivation and manuring of the intercalated crops. The species is apparently unable to make use of high concentrations of nutritive material, and soils with a high proportion of organic material are undoubtedly the best. It pays to keep up the proportion of organic matter, and spreading a thick mulch or manure under the trees is an excellent practice.

Pruning is limited to the removal of dead or dying branches, and to the suppression of long shoots or slender branches situated in the interior of the crown.

### Harvest

The mangosteen generally flowers only once a year; however, in certain climates it can flower twice, thereby giving two harvest as is the case in Ceylon. The fruit must be collected while the pericarp is still soft. As the fruit can be damaged on falling from the tree, it is recommended that they should be picked by hand using ladders and a fruit-basket.

### WOOD

The wood is heavy, black and durable; its density is only slightly less than that of water. It is useful for cabinet work and construction, but its use is limited by its small size.

### USES

The fruit tempts the appetite and can be eaten in large quantities without harm. Putting it in conserves results in a loss of flavour, but by cooking with sugar an acceptable jam can be made. Transport of the fruit over long distances is possible if they are picked when unripe.

The fruit is recommended for bilious fevers; they are also used as a purgative and as an antidysenteric.

Analysis of the white pulp reveals 1.2% levulose and 1% dextrose. One can make jelly from it. The rind of the fruit contains mangosteensterine, a phytosterine, as well as about 13% of tannins.

### FOOD VALUE

The edible part represents about 30% by weight of the fruit. Its composition is as follows:

water	84.9%
protein	0.5%
fat	0.1%
mineral material	0.2%
carbohydrate	14.3%

The seeds contain 45% fat.

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GREWIA ASIATICA L.

FAMILY

Tiliaceae

VERNACULAR NAMES

Paristia, Phalsa, Palisa, Pharsa

ORIGIN AND DISTRIBUTION

It's origin is uncertain. Some authors consider it to be native to India, where it occurs throughout the country, except at high elevation; others consider South China or Vietnam as the centre of origin.

Whichever may be the case, it behaves as a species of tropical Asia. It's introduction on a large scale to the arid regions of tropical Asia is feasible as quite high returns per hectare have already been recorded.

ECOLOGY

*Grewia asiatica* is primarily a plant of subtropical regions, but it will also tolerate other climates, except at high altitude. It is very resistant, and capable of existing under severe conditions. It will resist a certain amount of frost and tolerates drought and is therefore suitable for arid regions. Once established it needs little attention, and in many regions of India irrigation is considered superfluous.

It tolerates almost any soil conditions. A rich alluvial soil is considered ideal, although the results obtained from clay or sandy soil may be satisfactory, and better than those obtained with other fruit bearing species.

BOTANICAL CHARACTERISTICS

Size

A tree of 7-8 m high with a bushy habit; branches grey or reddish, young branches covered with stellate hairs.

### Leaf

Deciduous, ovate-acuminate, to suborbicular, frequently oblique, subcordate at the base and 6-nerved from the base. They are 11-13 cm long (12-18 cm in the variety "arborea". In the variety "nan" the limb is subelliptic, with irregular teeth, and glandular.

Stipules falcate, lanceolate, 7-8 mm long.

### Flower

The flowers are coloured yellow, or red with yellow.

Each peduncle is 3-flowered, 16-25 cm long. Sometimes the peduncles are clustered in groups 10-11 cm long. Receptacle 3 mm long, hairy in the upper half.

Sepals 5, oblong, 1-5 cm, almost glabrous inside, 3-5-nerved. Petals 5, 6-7 mm long, equalling the androecium, with a raised gland 2 mm long, glabrous, with reticulate nervation.

Stamens numerous, grouped in bunches of 10-15; filaments glabrous, almost as long as the style. Style glabrous, terminated by 4-5 short glandular stigmatic lobes.

Ovules arranged in 2 series with a false septum developing between them, superposed and ascending.

### Fruit

A dark purple, globular, 1-4-seeded drupe. Slightly lobed at the apex, 8-9 mm long and broad. The edible flesh is sugary and acidulous.

### CULTURAL REQUIREMENTS

As it is a perishable fruit, its culture is restricted to locations near to large towns or other places where it can be marketed quickly.

It is usually propagated by seed, but grafting and cuttings can also be used.

Cuttings in open ground give poor results, but under closed conditions, with hormone treatment, they are good.

The young plants remain in the nursery one year and are planted out at a spacing of 3-4.5 m at the beginning of the wet season.

As they are often planted in infertile soil, a good amount of well rotted farmyard manure should be placed around the planting hole.

Harvest: it begins to bear fruit after only 2 years, but does not produce marketable fruit until the third year. They ripen in May or June, and the average crop is 5-8 kg/plant.

Pruning is an essential part of their cultivation, and it is recommended 1.20 to 1.35 m above ground level, as long as there is no risk of late frosts. It should be done every year, as the new growth bears the fruit.

#### WOOD

In India the wood is sometimes used for construction. The bark is utilized for its fibre.

#### USES

Pressed phalsa or phalsa syrup prepared from the juice is considered a delicacy in northern India, throughout the hot months of summer. Although it is very popular, it has not achieved great importance on account of its delicacy and perishability. Also it has to be harvested repeatedly during the fruiting season, which adds considerably to its cost.

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IRVINGIA GABONENSIS (AUBRY-LECOMTE) BAILL.

FAMILY

Irvingiaceae

VERNACULAR NAMES

Wild Mango, Duiker Nut; Boborous, Manguier Sauvage (fr.)

ORIGIN AND DISTRIBUTION

This species occurs from the Casamance region of Senegal to Zaire and in Angola and Uganda. It is often found in towns or at the edge of villages.

ECOLOGY

It is a species of dense, moist forests, in gallery forests and in semi-deciduous forests. It does not have any particular soil preference, except that it avoids swampy or marshy places.

BOTANICAL CHARACTERISTICS

Size

It is a large tree reaching or even exceeding 40 m high. The crown is well developed, dense and much branched.

Bole

More or less cylindrical, rather short, only exceptionally exceeding 1 m diameter, sometimes more or less sinuous, and with well developed buttresses.

Bark grey-green to grey-brown, rather thin, exfoliating in small elongate scales.

Leaf

Alternate, simple, elliptic, glabrous, coriaceous and shining on both surfaces; acute stipules 1.5 cm long.

Flower

Arranged in axillary racemes; they are fragrant, small, greenish-yellow, pentamerous and hermaphrodite. They contain a bright yellow disk, below which are inserted the stamens.

Fruit

Greenish yellow drupe, resembling a small fibrous compressed mango, 5-6 cm long by 4 cm broad.

### WOOD

The wood is differentiated: the sapwood is yellowish-white and the heartwood greenish-brown. It is hard, heavy and durable. It has a fine grain and takes a beautiful polish. It is reputedly resistant to termites. It can be used for building the superstructure of boats.

### USES

The pulp of the fruit is sometimes eaten, although it is bitter and gives off a strong smell of turpentine. The oily seed is edible and consumed in numerous parts of West Africa. The fruits are often left to ferment, which removes the smell which adheres to the seeds. The kernel of the seed is crushed, grilled, and used to prepare a sort of batter: this is the dika, odika or pain de dika, also known as "chocolat du Gabon". One can also extract an oil used in soap making and of some alimentary value. For cattle, the oil-cake has a food value equal to that of the oil-cake of coconut.

### SYNONYMS

*Mangifera gabonensis* Aubry-Lecomte ex O'Rorke; *Irvingia tenuifolia* Hook. f.; *Irvingia barteri* Hook. f.

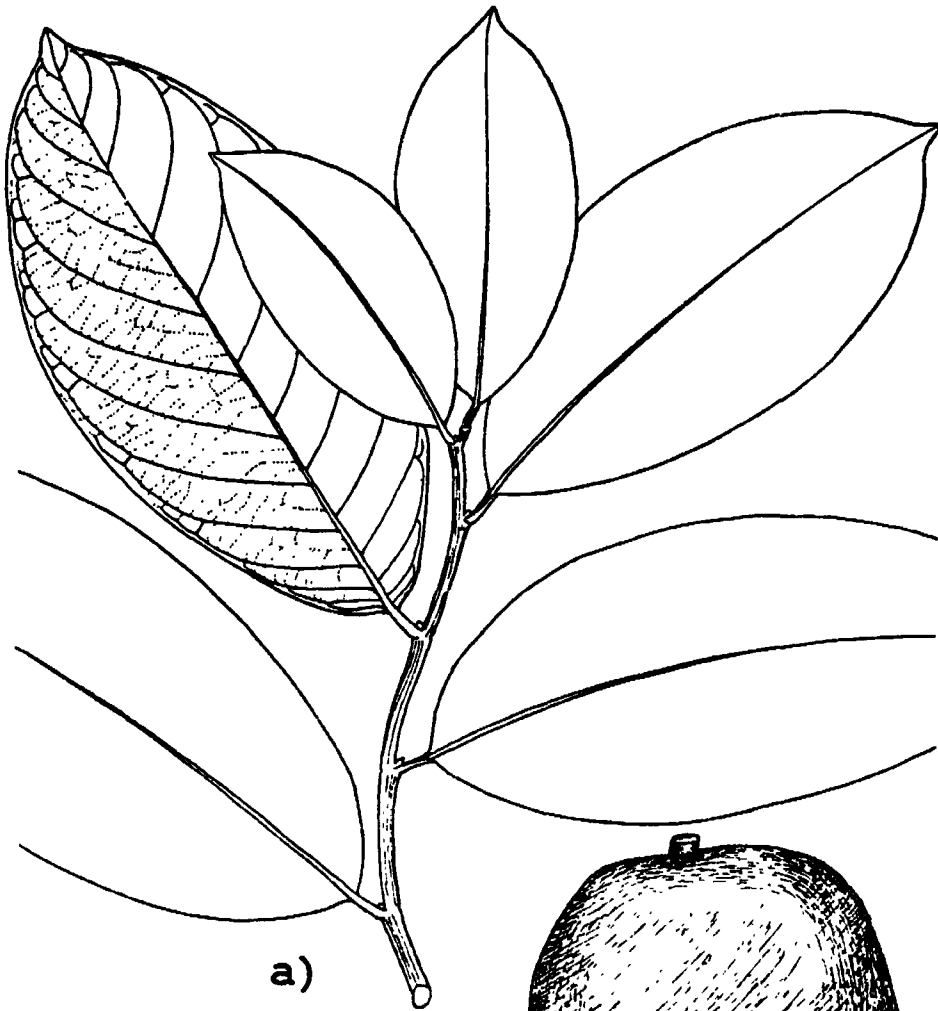
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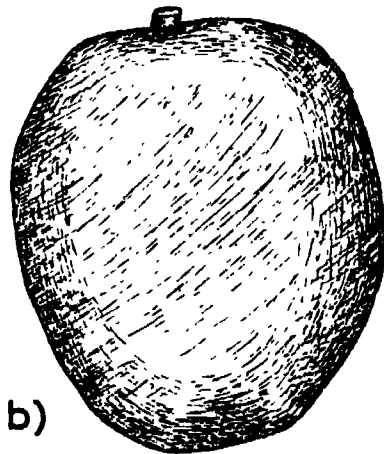


N° 25 - Irvingia gabonensis (G. Kunkel)



a)

branch with leaves  $\frac{2}{3}$



b)

fruits  $\frac{2}{3}$

LITCHI CHINENSIS SONN.

FAMILY

Sapindaceae

VERNACULAR NAMES

Litchi, Litchee

ORIGIN AND DISTRIBUTION

The Litchi originated in south eastern China, and is considered one of the most popular fruits in China. It has now reached many other countries: all South East Asia, Formosa, Japan, Hawaii, Australia, South Africa, the Antilles, Brazil and Florida.

ECOLOGY

The range of the Litchi is limited by its precise ecological tolerances. It requires a moist tropical climate without frost; without hot or dry winds, and deep rich soil well provided with water. Carefully controlled irrigation can compensate for low atmospheric humidity. It needs a period of cold, without frost, and for good flowering and fruiting it requires a considerable temperature fluctuation. Optimum rainfall, in those areas where it is native, is distributed throughout the year and measures around 1500 mm. It can grow in numerous types of soil, so long as they are well drained. The best soils are alluvial, rich in organic matter, and slightly acid. The Litchi will, however, tolerate a certain amount of  $\text{CaCO}_3$  in the soil.

BOTANICAL CHARACTERISTICS

Size

Evergreen tree 10-12 m high, with a round dense crown, useful for ornamental purposes.

The bark is grey-brown and rugose.

Leaf

Pinnate with 2-4 pairs of elliptic or lanceolate, acuminate, glabrous leaflets 5-7 cm long, deep green on the upper surface and grey-green on the lower surface.

### Flower

Arranged in terminal (sometimes axillary) panicles about 30 cm long. They are small and apetalous, unisexual, bisexual or intermediate. Although flowers of two sexes may be borne on the same tree (monoecious), variations are seen, where the male flowers appear first. Also in bisexual flowers the anthers may be indehiscent, so the flower is functionally female.

### Fruit

Variable in number on each panicle, more or less ovoid, resembling strawberries in form and colour, 2.5-4 cm long. The seed is surrounded by an edible aril (about 70% by weight of the fruit).

### CULTURAL REQUIREMENTS

Propagation by seed, air layering and by cuttings.

There are many varieties, so vegetative propagation is recommended.

Seed rapidly loses its viability; when dried they keep for only a week at the most, but if kept moist, then this period is raised to 8 weeks.

The young plants are very delicate, and losses after planting are high. It is necessary to shade the plantlets during this period.

Seedlings begin to bear fruit after 8 - 12 years, whereas trees produced from layering or cuttings take only 3 - 6 years. Full production is achieved after around 25 years.

The species is very long-lived and some individuals have been known to reach 600 years.

The usual spacing of the trees is 9 x 9 to 12 x 12 m. However, in rich soils, well endowed with organic material this may be increased to 15 x 15 m, while in drier situations it can be reduced to 7.5 x 7.5 m.

As the growth of the Litchi is strongly dependent on mycorrhizal activity, it is important to raise the young plants on land

which has already carried Litchi, so that they have the best chance of mycorrhizal infection. It is most important to irrigate during prolonged spells which may adversely effect mycorrhizal activity.

Although the exact requirements of the species for manure are not known, heavy doses of organic manure are advised, as good production seems to be intimately linked to this.

The average production of adult trees is around 4000 - 5000 fruits, or 100-150 kg. In China these figures reach 600 or even 700 kg, or 30 tonnes per hectare.

The fruit are eaten fresh or dried. Generally artificially dried fruit are prized less than those dried in the sun. Freezing the fruit to  $-25^{\circ}\text{C}$  in polythene bags permits their conservation for more than 1 year.

#### WOOD

The wood is hard and brittle and has few uses. It makes mediocre firewood.

#### USES

The fruit is eaten fresh or dried, and is today often tinned. It is an ornamental tree, utilized for decorative purposes in parks and gardens.

#### FOOD VALUE

Dried fruit:	moisture	18.00%
	protein	2.90%
	sugar & starch	77.50%
	lipid	0.20%

Calorific value per kilo of pulp : 3234

#### SYNONYM

*Nephelium litchi* Camb.

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N° 26 - Lichi chinensis



MADHUCA BUTYRACEA GM. or AESANDRA BUTYRACEA (ROXB.) BAEHNI

FAMILY

Sapotaceae

VERNACULAR NAMES

Butter Tree; Illipé (fr.) Pholwara (local name)

ORIGIN AND DISTRIBUTION

*Madhuca butyracea* occurs naturally in the Himalayan foothills between 300 and 1500 m altitude, with its greatest frequency in Kumaon and Gharwal.

It occurs at higher elevations than *Madhuca latifolia* Macbr. It is now distributed throughout tropical Asia, especially India.

BOTANICAL CHARACTERISTICS

Size

The species is a large deciduous tree with rapid growth (average increase in circumference per year 4-5.3 cm).

Bole

The bark is dark grey.

Leaf

Petiolate, obovate or obovate-oblong, coriaceous, silky or tomentose on the lower surface when young.

Flower

The calyx is composed of 4-5 sepals.

The corolla consists of a campanulate tube surmounted by petaloid lobes, numbering 8-12 and slightly longer than the tube.

There are 30-45 stamens with glabrous filaments equalling the lanceolate acuminate anthers.

The ovary is around 10-locular, surmounted by a linear style.

Fruit

A berry with a more or less fleshy pericarp, about the size of a plum. Each fruit contains <sup>an</sup> ellipsoid seed which represents about 28% of the volume of the fruit. The hilum is long and rather broad. The very fleshy cotyledons fill the entire seed, and the endosperm is reduced to a thin easily separated layer.

### WOOD

The wood is grouped with that of other species of the same genus under the commercial name "Madhuca". All have a very hard, heavy, durable timber and are used in construction, for furniture and cabinet work.

### USES

The kernel of this species provides "Phulwara Butter", characterized by its whiteness and firmness. It gives a higher yield than any of the related species of Madhuca. Due to its high content of saponin, the oilcake has been long utilized with shikakai (*Acacia concinna*) for shampoo in southern India. The oilcake is scarcely ever used as a soil manure owing to its low content of nitrogen and slow nitrification. The bark contains 17% tannin and is utilized for tanning and dyeing.

In local medicine, astringent, stimulant, emollient and nutritive properties are attributed to this species. The bark is also used in the treatment of rheumatism, ulcers, itching, haemorrhage, inflammation of the tonsils, leprosy and diabetes. The flowers are an aperient, aphrodisiac and expectorant. They may be beneficial in some cases of heart trouble, burns and ear-ache.

### FOOD VALUE

The butter produced by this species is of high quality. It is 46% olein and 54% palmitin. It is whiter and firmer than that of species of Madhuca. It melts at a temperature of 48-49°C, and has an agreeable smell and flavour. The kernel contains 60-67% fat, dependent on provenance.

The seed is 23-34% shell and 66-77% kernel.

### SYNONYMS

*Diploknema butyracea*; *Bassia butyracea* Roxb.



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MANGIFERA INDICA L.

FAMILY

Anacardiaceae

VERNACULAR NAMES

Mango, Manguier (fr.)

ORIGIN AND DISTRIBUTION

Native in tropical Asia, probably in the area bounded by eastern India and Vietnam, also in Sri Lanka. It has been cultivated by man for 4000 years, and is now found throughout the tropics of the world, often semi-naturalized.

ECOLOGY

A species of tropical climates at low and medium altitudes. Continually wet climates of equatorial regions suit it less well and hinder good fruiting. The timing of the rainfall is as important as the quantity. It does not tolerate frost. Temperatures above 45°C accompanied by strong winds will damage the fruit. It needs a wind break. The root system is strong and deep, and it tolerates most soils. However, it prefers deep alluvial soils; it dislikes soils with a rocky sub-soil, compact clays and calcareous soils.

BOTANICAL CHARACTERISTICS

Size

A beautiful evergreen tree of medium size attaining 20-25 m high. It has a broad dense crown.

Bole

The trunk can reach 1 m diameter; the bark which is brown and smooth or only slightly fissured when young, becomes almost black and rugose with age. It exudes a resinous latex when damaged.

Leaf

They are alternate, lanceolate to oblong, entire, coriaceous, deep green; they are reddish-brown when they first appear. The leaf measures 15-30 cm long by 4-8 cm broad.

### Flower

In terminal panicles, pentamerous, small, greenish-yellow to pink. The androecium contains 5 stamens, of which only 2 are fertile. The ovary is superior, with a short style, and contains a single ovule.

### Fruit

An oblong to reniform drupe, dependent on variety, yellow flushed with red or green, 8-10 cm long, 6-7 cm broad. The stone is usually 1-seeded, and its dimensions depend on the variety; it is more or less fibrous. Some fruits have a marked smell of turpentine; trees grown from seed often have this characteristic.

### CULTURAL REQUIREMENTS

The mango can be propagated by seed, which germinates about 1 month after planting. However, as this method of propagation cannot be relied on to maintain the parental characteristics, it is not recommended except for the production of stock.

Various techniques of grafting have been practised with success, but inarching is the most frequently used.

Whichever method is used, the stock plants should be raised in a partly shaded nursery bed in pots or polythene bags, until 45-60 cm high and 12-15 mm diameter.

The soil should be carefully cultivated and levelled; after deep preparation, the soil of the whole orchard area can be prepared, or just the planting holes.

According to the conditions, the planting distance should be 12 m, or in drier or less fertile regions 9-10 m. Under conditions of normal rainfall, planting should be carried out at the beginning of the rainy period. If the dry season is poorly marked and abundant rainfall likely, planting is recommended some weeks before the rains arrive.

The young plants must be shaded when planted out.

Grafted trees can flower in the first year of planting, but removal of the flower is recommended for the first two years, to

encourage the development of the tree. At 4 years, the trees begin to bear 10-15 fruits, and it is not until 20-40 years that maximum production (1000-3000 fruits) is reached.

#### WOOD

The wood is differentiated into cream or pale brown sapwood and pale yellow or brown heartwood, often dotted or streaked with darker areas. The growth rings are clearly marked. The heartwood is of average hardness and weight (D=0.62); it is not durable.

It is a poor quality wood, polishing badly and suitable only for packing cases or firewood.

#### FOOD VALUE

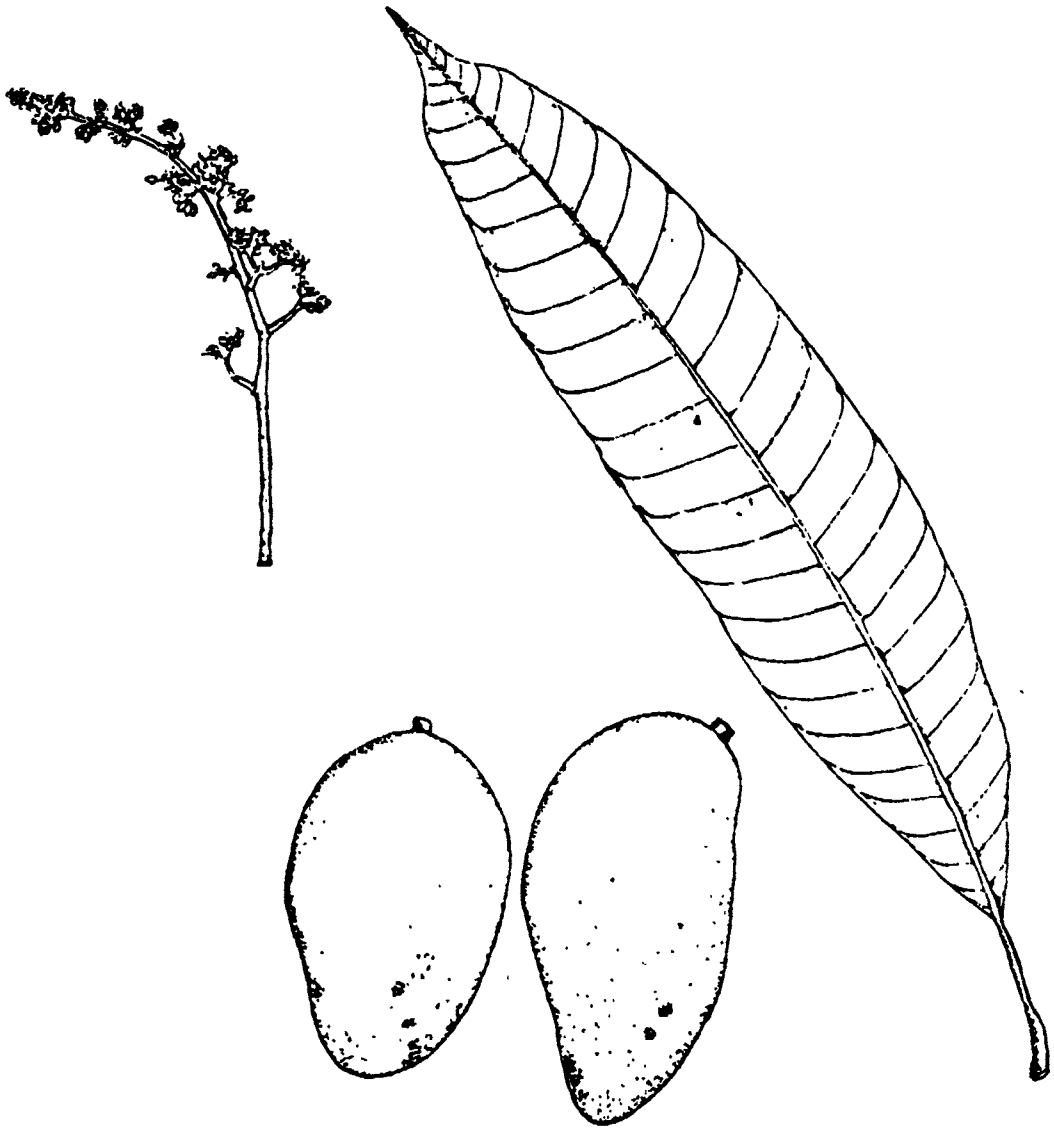
	<u>Green fruit</u>	<u>Ripe Fruit</u>
water	90.00%	86.00%
protein	0.70%	0.60%
fat	0.10%	0.10%
mineral materials	0.40%	0.30%
cellulose	-	1.10%
carbohydrate	8.80%	11.80%

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N° 28 - Mangifera indica L.



MANILKARA ZAPOTA (L.) V. ROYEN

FAMILY

Sapotaceae

VERNACULAR NAMES

Sapodilla; Sapodillier (fr.); Nispero (sp.)

ORIGIN AND DISTRIBUTION

Native of tropical America from Mexico to Costa Rica. It has now been spread to most tropical countries.

ECOLOGY

A species of lowland rain forest from sea level to about 900 m altitude, with an annual precipitation of between 1250 and 2500 mm. The best production is obtained from coastal regions. Fruiting is not adversely affected by heavy rainfall, but high temperatures (42-43°C) are harmful. When young it is frost sensitive, when older it is able to withstand slight frosts of short duration.

The tree has an extensive root system and prefers well-drained soils: alluvial or sandy sediments, situated near the sea. It dislikes clay soils.

BOTANICAL CHARACTERISTICS

ze

The Sapodilla is a large evergreen forest tree (more than 30m, diameter up to 1.5 m); well branched.

Under cultivation, depending on the location, it varies between 9 and 15 m and generally does not exceed 0.50 m diameter.

It produces a strong, dense crown. It has a characteristic branching system (sympodial) in which the young branches are arranged horizontally.

Bole

The bole is cylindrical and long, especially in forest-grown individuals. The bark is dark brown, deeply fissured, forming small rectangular pieces. When cut it exudes a sticky white latex (chicle), used in the manufacture of chewing gum.

### Leaf

Spirally arranged and clustered at the branch tips, simple, elliptic or oblong, apex obtuse to shortly acuminate, coriaceous, shining, glabrous when mature. Secondary veins making a wide angle with the midrib.

### Flower

Greenish, solitary, axillary, cyathiform or campanulate, with a brown, pubescent peduncle; 6 sepals, 6 corolla lobes. They flower and fruit throughout the year.

### Fruit

Globular to ovoid berry with a rough brown skin, containing 1-12 shining, brown or black seeds (frequently 5), surrounded by a brownish, sweet, juicy, scented flesh.

The fruit is highly prized and considered one of the best in Central America.

### CULTURAL REQUIREMENTS

Commercial varieties are cultivated by vegetative means: air-layering and grafting. For air-layering one uses 2 year old branches, 45-60 cm long, 1 cm diameter and suitably leafy. The air-layered material is removed from the mother tree after about 5 months (2 months to callose and 3 months for rooting). For grafting, seedlings are used as the stock, or seedlings of *Mimusops* or *Madhuca* (related genera in the same family). Saddle grafting and budding are practised. Deep cultivation followed by harrowing is recommended before planting. Planting a strong wind-break is also advised to protect against prevailing winds.

In adequately irrigated situations the recommended spacing is 9 m, or in drier positions 7.5 m.

If necessary, the young plants should be staked.

Interplanting with a crop of legumes is suggested for the first 6 years.

Pruning to shape the young trees is practised for the first 5 or 6 years.



WOOD

It is homogeneous, deep red, very hard, dense, resistant and durable. It is suitable for heavy construction, furniture, joinery, tool handles, etc.

USES

Wild trees in their native area are tapped for chicle, but it is cultivated for its fruits and as an ornamental. The fruit is eaten raw, or made into jam, preferably when slightly overripe. They keep for about 6 weeks in a refrigerator at around 0°C.

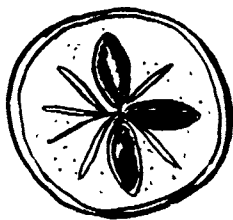
SYNONYMS

Achras zapota L.; Sapota achras Miller; Manilkara zapotilla (Jacq.) Gilly.

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MANILKARA ZAPOTA (L) v. ROYEN



Manilkara zapota

After/según/d'après OCHSE, J.J.

Indische vruchten

Volkslectuur - Weltevreden - 1927 - pp. 330

MORINGA OLEIFERA LAM

FAMILY

Moringaceae

VERNACULAR NAMES

Horse-Radish Tree, Ben Oil Tree; Acacia Blanc, Ben ailé (fr.)  
Reseda, Paraiso Frances (sp.).

ORIGIN AND DISTRIBUTION

Native in India and Arabia, it has now been spread throughout the tropics and is naturalized and semi-wild in numerous countries.

ECOLOGY

It is a colonizing species of recent alluvium and it is found in similar situations in its countries of adoption along water courses and by ponds. The species grows easily and rapidly almost everywhere. It is extraordinarily vigorous, even in dry climates on mediocre soils, tolerating temperatures of 48°C in the shade. Rainfall 760-2250 mm.

BOTANICAL CHARACTERISTICS

Size

Moringa oleifera is a shrub or small tree to 12 m high, with rapid growth. It has an umbrella shaped open crown.

Leaf

The leaves are alternate, bi- or tripinnate, 20-70 cm long; the leaflets are opposite in 2-5 pairs; they are short-stalked elliptic, ovate or obovate, dark green on the upper surface, glaucous and almost whitish on the lower surface.

Flower

They are arranged in pendulous axillary panicles; they are zygomorphic, about 2.5 cm diameter, white, fragrant, with 10 stamens, 5 with anthers and 5 without; the unilocular ovary is superior.

Fruit

These are long, narrow septicidal capsules opening by 3 valves. They can attain up to 45 cm in length. They contain a series of seeds which are remarkable on account of their 3 winglike expansions. The seeds contain large fleshy oily cotyledons which can contain up to 42% of an edible oil which keeps well.

### CULTURAL REQUIREMENTS

They are propagated by cuttings and seeds, generally the latter. It sprouts well from stumps. It is usually planted in hedgerows. It is pruned to promote branching and to facilitate harvesting.

### WOOD

The wood which is very soft, is practically useless for carpentry. It is however greatly appreciated as firewood in savanna regions.

### USES

A non-desiccative oil (Oil of Ben) is obtained from this plant, which is very sweet, turns rancid only very slowly, sets with difficulty, and is a purgative. It is used as a salad oil and for making soap. It also has numerous industrial uses, notably as a lubricant for clock mechanisms, and for the extraction of essential oils in perfumery (jasmine, tuberose), but it's price is high.

The crushed root is a rubefacient and the gum with water gives a pink and astringent jelly. The leaves and young shoots have a taste resembling that of watercress, and are eaten as spinach or in salads. The cylindrical pods are eaten when young, in the manner of green beans. In India the very young seeds are eaten as we eat green peas.

The flowers and the bark are utilized in local medicine ; the juice is taken as an appetizer and digestive.

The foliage is utilized as cattle and camel fodder.

It is also a useful melliferous species and also quite ornamental.

### FOOD VALUE

The seeds are 30% husk. The kernel contains 6.18% water and 40% oils.

The composition of the kernel is:

water	4.90%
nitrogeneous matter	34.12%
fats	41.65%

The oil, carefully extracted from well preserved seeds is slightly yellowish, odourless and sweet. Its density is 0.912 at 15°C.

The cake remaining after oil extraction has, according to M.P. Ammann, a certain value

water	10.3%
nitrogenous matter	40.3%
fat	10.8%
sugar and starch	14.2%
crude cellulose	4.14%
ash	3.80%

It could be utilized as fodder or manure.

#### SYNONYMS

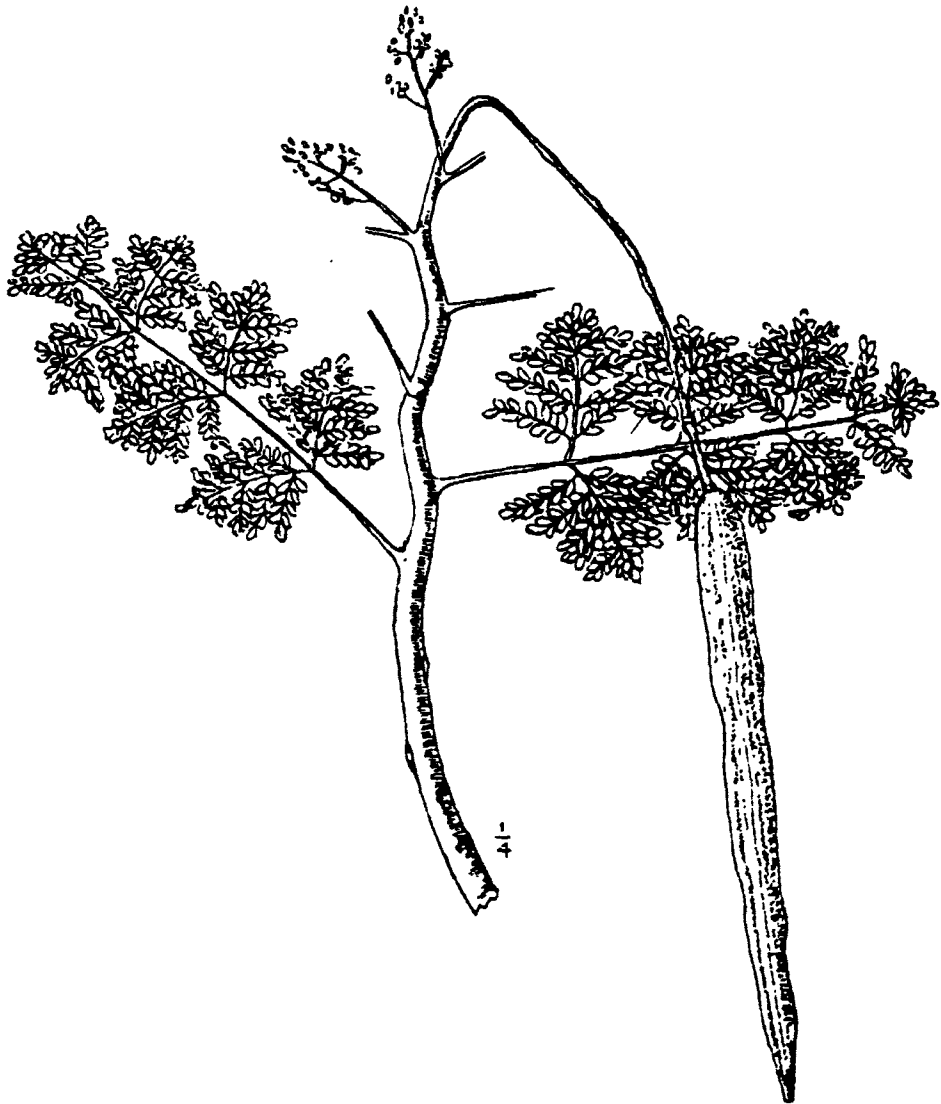
*Moringa pterygosperma* Gaertn.; *Moringa moringa* (L.) Millsp.

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1951 - pp. 609

N° 30 - Moringa oleifera, Lam.



After/según/d'après OCHSE, J.J.  
Tropische groenten

NEPHELIUM LAPPACEUM L.

FAMILY

Sapindaceae

VERNACULAR NAMES

Rambutan, Ramtum; Ramboutan, Litchi Chevelu (fr.);

Ramustan (sp.)

ORIGIN AND DISTRIBUTION

The Rambutan is native in the Malay Archipelago where it is extremely popular and cultivated on a large scale, notably in Java, but also in Cochinchina and Cambodia. In many other countries it is semi-wild and the object of cultivation, so that its numerous varieties have now been spread to all the low lying regions of tropical Asia.

It is cultivated in the Central Basin of Zaire and in Lower Zaire, where it is highly appreciated. Many parts of tropical America are suitable for its introduction.

ECOLOGY

It does well only in deep soils in hot, wet tropical regions up to 600 m altitude. Apart from the depth, it is tolerant of other soil conditions. It does very well on red lateritic soils. The best growth is found on rich, deep, moist soils which are well-drained, and have a rainfall of 2500-3000 mm, well distributed throughout the year.

BOTANICAL CHARACTERISTICS

Size

Tree 12-25 m high.

Bole

Straight, clear 40-60 cm diameter with a much branched crown of erect branches. The bark is dark greyish-brown. The branches bear numerous lenticels; the branchlets have a dense reddish pubescence, and become glabrescent and finely wrinkled.



### Leaf

Alternate, petiolate, pinnate with 2-4 pairs of alternate or subopposite leaflets; leaflets ovate or elliptic, coriaceous; the rhachis is stout, rounded, reddish-brown, strongly thickened at the base, pubescent at first, becoming glabrous; it measures 7-30 cm long.

### Flower

In fasciculate or racemose inflorescences with a dense reddish pubescence; shortly pedunculate. The unisexual flowers are borne on different individuals (dioecious); they are 0.25-0.40 cm diameter, slightly scented.

The pedicels are slender, rounded, greenish-yellow, with a dense reddish pubescence.

The calyx is cupular with 4-5 sepals fused at the base, yellowish-green, with a reddish tomentum on the outside.

The corolla is absent; there is a 4-6-angled, lemon-coloured, shining disk.

Stamens 5-8, placed within the disk.

### Fruit

The fruit is ellipsoidal, up to 6 cm long and 3-4 cm broad. The pericarp is covered with numerous long soft hooked or recurved spines. The pericarp is 0.20-0.40 cm thick, and bright red at maturity. It contains a large seed, 2.5-3.5 cm long and 1-1.5 cm broad. This is surrounded by a whitish fleshy, sweet, juicy, very appetizing aril about 0.4-0.8 cm thick, adhering to the thin testa. It has an acidulous flavour recalling that of a grape.

### CULTURAL REQUIREMENTS

At the present time, trials are being undertaken to achieve uniformity of size, taste, thickness of the pulp, etc, with a view to future mechanization. The production of a single tree can attain 250-300 kg.

Propagation is either by seed or by vegetative means (layering, grafting or budding).

Plants produced from seed grow slowly, and in addition the viability of the seed is very short - only a few days; they are also very heterogeneous.

For plantations, the spacing required is 10 to 12m. The soil must be kept continually moist, with additional irrigation if the rainfall is insufficient.

Numerous varieties are cultivated.

#### USES

The Rambutan is a table fruit of exceptional quality. It can be eaten fresh, and the detached aril mixed with other fruits makes an excellent salad. The seeds are sometimes roasted.

It is certainly one of the finest tropical fruits, more highly prized than the mangosteen by many Europeans.

However, in certain years the fruit are so acid that even the monkeys won't eat them.

As with the Litchi, the fruit is now being tinned commercially.

#### FOOD VALUE

Selection trials are directed at obtaining a very juicy, sugary fruit with a thick aril. The seed contains up to 31% dry weight of fat. Analysis of the aril has given 7.8% saccharose, 2.25% dextrose; 1.25% of levulose (Popenoe)

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PARINARI CURATELLIFOLIA PLANCH. EX BENTH.

FAMILY

Chrysobalanaceae

VERNACULAR NAME

Mupunda

ORIGIN AND DISTRIBUTION

Native of tropical Africa in an area bounded by Senegal to Sudan and Zaire to Uganda.

ECOLOGY

An evergreen sclerophyllous species, never truly gregarious, occurring in savanna and several types of woodland, especially along water courses.

BOTANICAL CHARACTERISTICS

Size

Varies according to the situation; a shrub or small tree from 7.5 to 9m high, occasionally attaining 20 m under very favourable conditions.

Bole

Usually short (about 3 m); diameter c. 0.50 m.

The bark is greyish-black, lenticellate, rugose and deeply fissured in older specimens.

The globular crown is densely branched.

Leaf

Simple, entire, oblong-elliptic, obtuse with a rounded or slightly attenuate base, coriaceous, shining on the upper surface, lower surface covered with a greyish or reddish tomentum.

Flower

The inflorescence is a terminal panicle bearing many white flowers, borne on long pedicels which are thickened toward the top and tomentose.

Fruit

The fruit is considered to be one of the best wild fruits of tropical Africa. It is a reddish-brown ovoid drupe, 3-4 cm long, with a fibrous skin bearing greyish lenticels, with a

hard kernel and tasty reddish mesocarp.

The seeds contain a drying oil which may be used for making varnish or paint.

#### WOOD

The wood, sometimes pale brown, sometimes pale red or pink, is resistant, dense, hard, of uniform texture, and difficult to work when dry. It is used for traditional construction as round timber, and especially for firewood.

#### USES

The fruit is considered to be one of the best among those found wild in tropical Africa. As mentioned above, the seeds provide an oil used in paint and varnish.

*Parinari curatellifolia* is also employed medicinally in an infusion, against fever; by application, for fractures. Vermoesen says they are used as a bait to trap animals such as antelope.

#### FOOD VALUE

The percentage of oil in the kernel is 37.5%, and in the whole seed 17.7%

Characteristics of the oil:

refractive index	1.4768 (45°)
saponification value	161.8
iodine value	213
nonsaponifiable material (%)	4.2

Composition of oil-cake:

water	5.1%
protein	11.0%
sugar and starch	51.5%
raw cellulose	31.2%
mineral matter	0.9%

It appears that the value of the oil cake as a food for cattle is reduced due to the high content of cellulose. However it could be used as manure.

SYNONYM

*Parinarium curatellifolium* Pland.

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PASSIFLORA EDULIS SIMS.

FAMILY

Passifloraceae

VERNACULAR NAMES

Purple Grenadilla, Purple Passion-Fruit; Grenadille (fr.); Granadilla (sp.)

ORIGIN AND DISTRIBUTION

Its origin is uncertain but it is probably native in lowland tropical Brazil. The area of its cultivation now extends to Brazil, Venezuela, Colombia, Peru, South Africa, Kenya, Australia, Fiji Islands, Hawaii, Sri Lanka, Formosa, Japan, New Guinea. Small scale production goes on in Ivory Coast, Cameroun, the Antilles and Reunion, and recent trials have been started in southern Italy and Corsica.

ECOLOGY

It occurs in a wide variety of soils and climate. However it prefers a moderate climate, without extremes of temperature, with an alternation of wet and dry seasons. It needs maximum exposure of light in order to flower well.

It withstands cold quite well.

Heavy, badly drained soil should be avoided.

BOTANICAL CHARACTERISTICS

Size

It is a vigorous liana, glabrous and becoming woody at the base. The stem reaches 20-50, or even 80 m long, and bears tendrils longer than the leaves (20-40 cm)

Leaf

They are alternate, deeply 3-lobed, 5-10(-18) cm long, 7-12 cm broad, acute or acuminate, rarely obtuse, dentate, sub-coriaceous. The young leaves are sometimes entire.

The leaf base is rounded; the upper surface is shining dark green, and the lower paler and dull.

They are stipulate: stipules acute, 5-15 mm long.

The petiole is 2-5 cm long, and bears a pair of glands between the middle and the junction with the lamina.

### Flower

Solitary, fragrant, 5-8 cm long.

The calyx tube is campanulate, with oblong lobes 2-3 cm long and 1 cm broad, yellowish green outside, white inside.

The petals are oblong or linear-oblong, 2-3 cm long, 5-7 mm broad, obtuse, white, often tinted with violet.

The corona has 4-5 rows of filaments, the 2 exterior filiform, 1.5-2.5 cm long, white in the upper part and violet at the base; the 3 interior rows are composed of white tubercles 2-2.5 mm broad.

Peduncle 5-7 cm long.

### Fruit

The yellow variety has a globular berry, and the violet variety an ovoid berry. Both measure around 5-8 cm long, 4.5-7 cm broad, rounded at the base, rounded to abruptly acuminate at the apex. Dependant on variety, the epicarp is yellow or violet, glabrous, smooth, shining. The mesocarp is green. The endocarp is white and within is a small cavity containing numerous small reticulate seeds (100 seeds = 1.8-2.0 g.) in a juicy yellow aril.

### CULTURAL REQUIREMENTS

*Passiflora edulis* is the most often cultivated member of the genus. It is now the object of commercial horticulture in regions far removed from its native land, notably in Australia. The yellow variety, although inferior in quality to the purple one, is cultivated more, due to its great productivity. Fruit bearing begins 18-24 months after planting (sometimes earlier). The average weight of the fruit varies between 65 and 90 grams, and production per hectare varies from 12-15 tonnes, but can reach 30 tonnes or more.

The weight of the seeds, aril and juice represents 40-50% of the weight of the fruit.

The following spacing is recommended: along the row 4-6 m; between the rows 2.5-4m. If the spacing is greater, then an



inter-row crop of fruit or vegetables (such as papaya, strawberry, tomato, aubergine) would be feasible.

Vertical training gives the best results, and mulching is recommended at the base of the plant.

Propagation is by 3 methods.

1) For many years seed was the only method of propagation, but this has now been given up for large scale plantation due to the heterogeneity of production and quality.

2) By cuttings, which is very simple and so long as the material is carefully chosen, can considerably improve the onset of fruiting. Stem cuttings of well lignified wood and 15-20 cm long are planted out when they have produced shoots about 20 cm long. Sometimes the cuttings are planted out directly.

3) Grafting is utilized in Australia, South Africa and Réunion for the purple variety. It gives the better quality of this variety on the more productive stock of the yellow variety.

Apart from commercial utilization, small scale cultivation should be promoted in gardens and farms.

#### WOOD

As a vine that becomes woody at the base, it can be used as firewood.

#### USES

The aril, which is scented and slightly acid, is generally eaten raw, but the main use is for the drink industry for which the juice is often mixed with others.

The pulp is also utilized for fruit salads, ices and sorbets.

World production is 150,000 tonnes.

*Passiflora edulis* is also a useful decorative plant on account of the large flowers.

SYNONYMS

Passifloradiaden Vell.; Passiflora middletoniana Paxton;  
Passiflora pallidiflora Bert., ; Passiflora rigidula Jacq.;  
Passiflora rubricaulis Jacq.; Passiflora vernicosa Barb.  
Rodr.; Passiflora verrucifera Lindl.

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PERSEA AMERICANA MILL.

FAMILY

Lauraceae

VERNACULAR NAMES

Avocado; Alligator Pear; Avocatier; Aguacate.

ORIGIN AND DISTRIBUTION

The Avocado is native in tropical America, especially in Central America and south eastern Mexico. It is now planted throughout the tropics and subtropics, and in places with a Mediterranean climate (Mediterranean basin, Florida, California, South Africa, Australia). It has become naturalized and semi-wild in many places.

ECOLOGY

It's ecological requirements vary greatly according to variety and ecological race. The Mexican varieties are tolerant of cold, while the Antillean varieties are not and require a humid tropical climate. Its requirements are generally less tropical than those of the mango. It responds well to manuring and is rather particular in this respect. It needs a humid atmosphere and abundant rain (minimum 1500 mm). It accommodates well to most soils, provided they are not saline and have good drainage.

However the best results are obtained on deep well-drained alluvium; if the rainfall is insufficient then irrigation must be provided.

It is a heliophile demanding full light.

BOTANICAL CHARACTERISTICS

Size

The size varies according to whether they are wild stock or grafted material. In the former case they may reach 20 m, while the latter have a maximum of 8-10 m and 60 m diameter.

Bole

Straight and relatively short, surmounted by a strong dense crown. Old specimens often have drooping branches.

The bark is brown or grey, more or less rugose and deeply fissured; the inner bark is orange-brown, with a slight spicy scent.

The branches are green, angular and slightly pubescent.

#### Leaf

Evergreen, alternate, exstipulate, coriaceous, petiolate, elliptic to oblong-ovate or ovate, entire, slightly pubescent along the veins, glaucous below, with numerous transparent gland dots.

#### Flower

Hermaphrodite, in axillary or terminal panicles, small, in 2 whorls of 3, greenish-cream in colour, tomentose; very fragrant.

#### Fruit

Large berry usually with the form of a pear, but in some varieties they are ovoid or subspherical; the skin is smooth or rather scaly, from dark green to violet.

The flesh is firm, greasy and melting, whitish to greenish.

The seed is variable in size and form, most frequently ovoid-acute. It's weight accounts for perhaps half the weight of the fruit. (In some trees grown from seed, the seed itself occupies nearly all the fruit).

#### CULTURAL REQUIREMENTS

Propagation is by seed, grafting and cuttings; however, the last technique is rarely used.

Propagation by seed gives a very heterogeneous population, so most of the avocado orchards are now established by grafting. As it is difficult to keep the seeds, they are sown in the nursery bed as soon as possible, either in open ground (spaced 60 cm between the rows and 30-45 cm between plants in the row) or in polythene bags 10 cm diameter and 35 cm high. The seeds are placed, with the pointed end uppermost just below the surface (1.5 cm below the surface is sufficient).

Shade is required, and frequent small waterings. When the seedling has reached the thickness of a pencil or about 2 months after germination, grafting can commence. The grafting material is chosen from the best cultivars. One uses terminal shoots 10-12 cm long, at the moment when, after a dormant period, the buds begin to swell. Cleft grafting is the method used. The binding must be flexible (fine rubber or polythene film).

The grafted plants are moved out of the nursery bed after 9-30 months (duration dependent on the climatic conditions). Dependent on the vigour of the cultivar, the planting distance varies between 6 and 12 m. each way. Often the spacing used is 10.50 m between the rows, and 5.25 m between individuals with 1 in 2 individuals being removed later as necessary. If the plants have not been grown in polythene bags, they should be moved with a root ball on each to avoid checking. Seedling avocados start producing fruit after 5-6 years, those produced by vegetative means after 3-4 years. Fruit production tends to alternate: one good year followed by a poor year.

As the wood is fragile, the plantation should be protected by a wind-break.

Pruning is restricted to that necessary to shape the tree, for example topping strong growing plants to promote lateral branches, which facilitates harvesting of the fruit. Later on, the only pruning needed is the removal of dead wood.

#### WOOD

The wood is differentiated into whitish sapwood and bright brown heartwood. It is moderately soft and dense (0.6); it is fragile, not durable and very sensitive to termite attack. It is rarely used, except for firewood, and that of very mediocre quality.

#### USES

The fruit is eaten as a fresh vegetable or in salads, either salted and spiced or with vinegar. They are rich in fats, and the oil extracted is of a similar quality to olive oil,

and is used in the cosmetic industry. The seed contains a reddish brown colouring substance used for dyeing textiles. It is also a melliferous tree of some repute.

#### FOOD VALUE

They have a high food value: around 215 calories per 100 gm. The chemical composition is as follows:

water	73.6%
protein	1.7%
lipids	14.0-22.8%
mineral matter	1.1%
sugar and starch	0.8%

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No. 34 *Persea americana* Mill.



PHYSALIS PERUVIANA L.

FAMILY

Solanaceae

VERNACULAR NAME

Cape Gooseberry, Ground Cherry; Coqueret du Pérou, Groseillier du Cap (fr.); Amer en Bolsa, Tomate Sylvestre (sp.)

ORIGIN AND DISTRIBUTION

The Cape Gooseberry is native in the Andine regions of Peru, Venezuela, Colombia and Chile between 800 and 3000 m altitude. It does well in the Mediterranean zone and especially in Central France where it is now cultivated.

It has acclimatized well to many tropical countries where it is now semi-wild.

ECOLOGY

It is a tolerant species and although originating from the warmer regions of the earth, it does well in a Mediterranean climate. It accommodates well to any soil type.

BOTANICAL CHARACTERISTICS

Size

An erect herbaceous plant with spreading branches, 0.30-1.20 m high. It is often densely hairy. It is perennial by means of its creeping rootstock.

Leaf

Alternate, simple, petiolate; the limb is broadly ovate, 5-12 cm long and almost as broad, apex acute, base cordate or truncate; margin toothed or more frequently entire; pubescent.

Flower

Hermaphrodite, solitary, axillary, with a peduncle 1-2 cm long; the calyx is campanulate, about 7 mm long, with 5 acuminate lobes equally the tube; it is accrescent. The corolla is campanulate, about 1.2 cm long and 1.5 cm across, yellowish with deep bluish-purple spots at the base. The anthers are purplish-red.

### Fruit

The fruit is a globular berry enclosed in a membranous bag about 4 cm long formed by the accrescent calyx. The berry measures 1-2.5 cm long and 1-3 cm broad; it has a thin, glabrous, smooth, greenish-yellow to amber-yellow skin, and contains numerous small whitish seeds in a soft, juicy, translucent pulp.

When completely ripe it gives off an agreeable scent, and is about the size and shape of a cherry.

### CULTURAL REQUIREMENTS

Cultivation of this species is simple. Propagation is generally by seed, although cuttings take very easily. The seed is collected from robust plants with large fruit and is sown broadcast. It takes 10-15 days to germinate. The seed is planted at the beginning of the dry season, and covered with a thin layer of earth. When they have developed 2 or 3 leaves, they are transplanted to 10 cm apart, and when 15 cm high they are put in their final spacing of 80 cm each way. Weak plants should be supported. Although perennial the plant is cultivated as an annual; this gives higher production. At the beginning of the wet season the plants are cut down to ground level, as the rains cause the fruit to rot. A sustained and abundant crop is ensured by hoeing, weeding and frequent watering, if necessary.

### USES

The fruit has an agreeable smell and an aromatic, sugary and slightly acid taste; it is eaten raw, but is especially used for making tarts and for jam-making. The skin is often bitter and should be removed before utilization.

### SYNONYMS

*Alkekengi pubescens* Moench.; *Physalis barbadensis* Jacq.;  
*Physalis edulis* Sims.; *Physalis esculenta* Salisb.;  
*Physalis latifolia* Lam.; *Physalis pubescens* R. Br.;  
*Physalis tomatosa* Medic.

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Elevage Publ. de l'Etat Indép. du Congo - Bruxelles -  
1907 - 21 fig. - pp. 180

PSIDIUM GUAJAVA L.

FAMILY

Myrtaceae

VERNACULAR NAMES

Common Guava; Goyavier (fr.); Guayaba (sp.)

ORIGIN AND DISTRIBUTION

Native of tropical America, where it is distributed from north western Mexico (Sonora) through Central America to South America as far as Peru and eastern Brazil. It is cultivated in the Antilles, where it is also semi-wild, and it has been spread throughout the Old World tropics from sea level to about 1500 m. altitude. It is an invasive species.

ECOLOGY

The Guava adapts well to most hot climates with a rainfall not exceeding 2000 mm. It is quite tolerant of drought and high temperature (up to 45°C) so has possibilities for cultivation in arid regions. It is however very sensitive to frost.

It is not over-particular about soil conditions, and does well on shallow soils so long as they have good drainage. However, the best results are obtained on a deep, rich alluvium.

It responds well to both inorganic and organic manure. It is a tough, long-lived plant.

BOTANICAL CHARACTERISTICS

Size

A shrub or small tree to 10 m high.

Bole

When present, short and twisted, up to 30(-60) cm diameter.

Leaf

5-10 cm long, 2.5-5 cm broad, opposite, entire, without stipules. The limb is elliptic or ovate-lanceolate, coriaceous, borne on a short petiole. It is covered with translucent dots.

The yellowish lower surface is covered with fine hairs. The secondary veins are parallel and prominent. The leaves are strongly aromatic when crushed. The young branches are tetragonous.

#### Flower

The flowers are axillary, solitary or in 2's or 3's, white, scented. They have 4 or 5 petals and numerous stamens 1.5-2 cm long. They flower and fruit throughout the year in some areas.

#### Fruit

A large berry surmounted by the persistent calyx. The form differs according to the variety and may be round, ovoid or pyriform, 3-10 cm long, usually yellow, fragrant when ripe.

The pinkish or yellowish flesh contains numerous small, hard, reniform seeds. It is sugary, aromatic, with, for some people, the smell and taste of strawberries.

#### CULTURAL REQUIREMENTS

Generally propagated by seed, sometimes by cuttings in closed conditions, or by layering the roots. Seed kept under favourable conditions, i.e. buried in charcoal and placed in hermetically sealed containers in a cool place, keep their viability for up to a year. After germinating in boxes the seedlings are transplanted when 5-7 cm high, either into beds at 20 cm spacing or in polythene bags. One year after sowing they measure 30-45 cm high. They are then ready for planting out at their final spacing.

As trees produced from seed do not reproduce the characteristics of the parent, it is also advisable to use vegetative propagation, either grafting or air-layering.

The final spacing depends on the prevailing ecological conditions, the variety and the soil conditions. In poor soil 4.5-6 m each way is sufficient; in rich soils 6-7.5 m will be



advisable. In the case of grafted plants it is advisable to remove all shoots which appear on the stock, which can happen during the first 5 years of growth. If possible, the soil beneath the tree should be weeded and manured.

Until the tree canopy is established, inter-row crops such as beans or marrows can be grown.

Pruning is aimed at producing 3 or 4 main branches. In trees grown by vegetative means, fruiting begins in quantity after 3 years, at which time they should be pinched out to prevent too many developing. From flowering to ripening of the fruit takes 5 months. An adult tree can produce 20 to 90 kg of fruit.

#### WOOD

The wood is differentiated into brown sapwood and reddish-brown heartwood. The latter is hard, heavy and resistant (density 0.80). It is useful for the handles of agricultural implements and other tools. It carves well. Apart from these uses it is utilized only for firewood, and perhaps for charcoal.

#### USES

Principally cultivated for its fruit, which is often eaten fresh; it can also be used for making jam. Commercially the juice is extracted, or the fruit is pulped. The leaves and bark are used in popular medicine against dysentery.

#### FOOD VALUE

The guava is very rich in vitamin C: its content of this is much higher than that of Citrus.

The nutritive value is from 38-66 cal/100g.

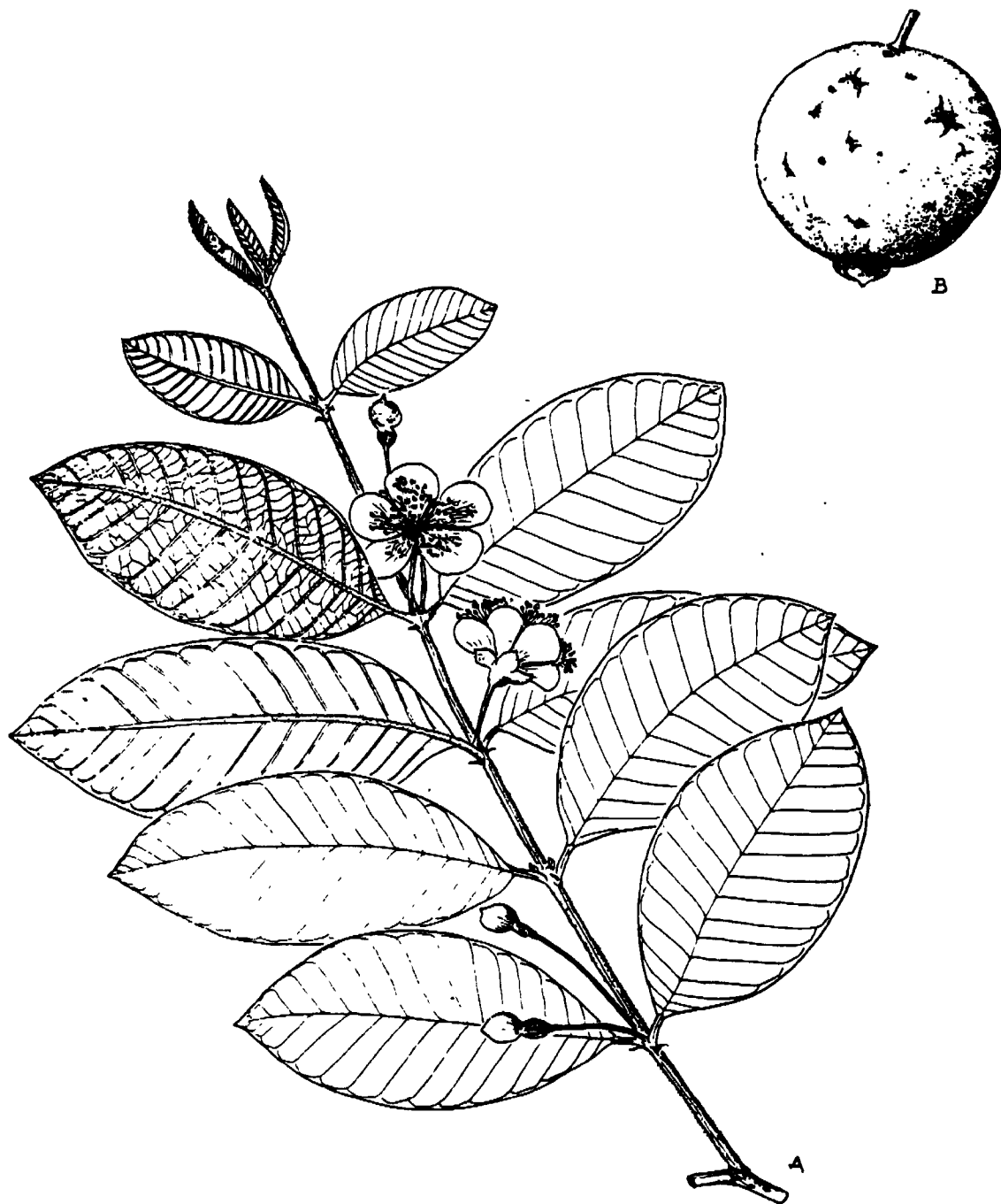
The chemical composition is as follows:

water	76.0-85.0%
protein	0.1-1.5%
fat	0.2%
ash	0.6-0.8%
cellulose	4.8-6.9%
sugar & starch	8.0-14.5%

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N° 36 - *Psidium guajava* L.



*Psidium guajava*

After/según/d'après PENNINGTON, T.D. and SARUKHAN, J.

Manuel para la Identificación en Campo de los  
Principales Arboles Tropicales de México  
UNDP/FAO/INIF 1968. 393 pp.

PUNICA GRANATUM L.

FAMILY

Punicaceae (closely related to Myrtaceae)

VERNACULAR NAMES

Pomegranate; Grenadier (fr.); Granada (sp.)

ORIGIN AND DISTRIBUTION

Native of Southern Asia, particularly Iran and Afghanistan. It has been cultivated for many years in the countries of the Mediterranean basin. Now, it is cultivated in most of the warmer regions of the world, especially in the subtropics.

ECOLOGY

It is a species of hot continental climates characterized by hot dry summers and fairly pronounced winters. It is very tolerant of climatic conditions, and can be cultivated from sea level to 1800 m. The best fruit is obtained where the summers are hot and dry. On the other hand it can also be cultivated successfully where there is no dry season at all. Under the latter condition, the species is evergreen, but where there is a pronounced winter, it is deciduous. It is drought tolerant.

Most soils suit the pomegranate, even those which will not support other fruit-bearing species. It tolerates a certain amount of alkalinity, and according to some it is quite tolerant of salts.

BOTANICAL CHARACTERISTICS

Size

A shrub or small tree, under favourable conditions attaining 6 m high.

Bole

Trunk generally absent or very short; most often multi-stemmed; stems rarely exceeding 10 cm diameter. Branches slender and sometimes spinous.

### Leaf

Usually deciduous but under certain conditions (see above) evergreen. They are opposite, entire, elliptic or oblong, relatively small, shortly petiolate; the limb is thick, coriaceous, shining; the veins are more or less reddish.

### Flower

Solitary or grouped in an inflorescence of up to 5 flowers, campanulate in form, and generally red-scarlet. The calyx is of 5-7 red, yellow or white, obovate sepals.

The stamens are very numerous.

The ovary contains 3-7 radiating loculi, each with numerous ovules.

### Fruit

The fruit is a berry about the size of a large apple, with a thick and coriaceous skin, and crowned with the persistent calyx. The more or less angular seeds are surrounded by a reddish juicy coating, with a sweet-acid taste, which is used to make refreshing drinks.

### CULTURAL REQUIREMENTS

The pomegranate can be propagated by seed, but this method gives fruit of variable form and quality. Propagation by cuttings is preferable, and easy, the only condition being that the wood used should be at least 6 months old and not more than 2 years old. The cuttings, which should have the leaves removed, are planted in the shade, and they are ready for transplanting after 9 months. However it is common practice to leave them for one or two years. Depending on the terrain the spacing should be 3-6 m, and frequent irrigation is recommended. Young plants begin to bear 10-20 fruits 4-5 years after planting out, and full production is not reached until the tenth year, and this continues 25-30 years. Inter-row cultivation with vegetables is recommended up to the tenth year, or until they are in full production.

The plants have the tendency to produce numerous suckers, which should be removed as they appear. They are unproductive, especially when they result in single stemmed trees.

#### WOOD

The wood has no use apart from firewood.

#### USES

Certain varieties are used to produce pomegranate syrup. The bark and the skin of the fruit are used in popular medicine for dysentery and diarrhoea. The skin of the fruit is also used for dyeing cloth.

#### FOOD VALUE

Water	.78%
crude protein	1.6%
lipids	-
sugar & starch	14.6%
cellulose	5.1%
mineral matter	0.7%

65 cal/100 g.

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SOLANUM QUITOENSE LAM.

FAMILY

Solanaceae

VERNACULAR NAMES

Naranjilla; Naranjille, Orange de Quito (fr.)

ORIGIN AND DISTRIBUTION

Native on the Amazonian slopes of the Andes, between 1300 and 1800 m altitude, in Colombia and especially Ecuador. Since the end of the second world war, it has been introduced to many tropical and subtropical regions.

ECOLOGY

In the tropics it grows between 600 and 2300 m altitude, with a rainfall of 1500-3800 mm per year, with low levels of sunshine. It is tolerant of soil conditions provided the drainage is good. New land should be used for each plantation, probably due to nemstode infestations.

BOTANICAL CHARACTERISTICS

Size

An erect, semi-herbaceous plant 1-2.5 m high, with a few stout stems with grey bark.

Leaf

Leaves alternate; the uppermost simple, ovate or elliptic, with a strong terete petiole 5-10(-15) cm long. The lower leaves are up to 45 cm long and 35 cm broad, acute or acuminate, with an undulate margin with 11-14 lobes, green in colour. The midrib and secondary veins, which are slightly prominent on both surfaces, are violet above and whitish or violet below when young.

Flower

The inflorescence is a short axillary cyme of 4-5 flowers, on a peduncle 6 mm long. The flowers are hemaphrodite, white or lilac, on a pedicel 1-1.5 cm long; calyx campanulate, 1.4-1.6



cm broad, with ovate-lanceolate, acute lobes; corolla about 2 cm across, with oblong or linear, subobtuse segments, 6 mm broad; there are 5 large yellow stamens.

### Fruit

Globular berry 3-5 cm long, 4-6 cm diameter, bright orange to golden yellow at maturity, scented, covered with short downy, easily removed hairs; epicarp thick and leathery; it contains numerous small seeds embedded in a translucent, very juicy greenish pulp.

### CULTURAL REQUIREMENTS

Propagation is by seed or cuttings, with the first being the preferred method. As the plant is sensitive to nematode attack, grafting can also be used. *Solanum macrantherum* Dun., *S. torvum* Sw. and *S. verbascifolium* L. are used as stock plants.

The planting distance should be 2-2.5 m each way.

The plant begins to fruit when 6-12 months old and continues for 2-3 years or longer with careful phytosanitary control. Given the speed of growth of the naranjilla and its importance as a crop, it is advisable to add fertilizer to the soil frequently, preferably once a month; irrigation is required in dry periods .

Fruit production continues all year.

The fruit weighs 40-70 g, and under favourable conditions returns can be between 1500 and 3000 kg per hectare. By intensive cultivation these figures can be still further increased.

### USES

The greenish aromatic juice extracted from the pulp has an acid-sweet taste, and is made into a refreshing drink which is very popular in the Andes. In Ecuador the freshly pressed juice is made into sorbets, or fruit cocktails. In Guatemala the fresh juice is converted into frozen concentrate which

can be tinned and kept indefinitely. The fruits are also used to give an aroma to ice cream, jam, jelly, cakes, etc.

SYNONYMS

Solanum angulatum Ruiz & Pavon; Solanum macrocarpon Pav.;  
Solanum quitense H.B.K.

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SPONDIAS MOMBIN L.

FAMILY

Anacardiaceae

VERNACULAR NAMES

Hog Plum, Yellow Mombin; Mombin Jaune, Prunier Mombin (fr.)  
Jobo, Jobo Gusanero (sp.)

ORIGIN AND DISTRIBUTION

Native of Central and South America, extending from Guyana to Matto Grosso in central Brazil. It is semi-wild in central Africa.

ECOLOGY

It occurs in a great variety of humid-tropical climates, often in secondary vegetation derived from evergreen lowland forest or semi-deciduous forest. It does well in a great variety of soils, such as shallow sandy soils, gravel, or heavy clays, but best results are obtained in rich, moist, relatively heavy soil.

BOTANICAL CHARACTERISTICS

Size

Tree from 8-20 m high or more, with a thick light brown or grey corky bark and exuding a clear sticky resin when cut.

Bole

Often thick and sometimes as much as 90 cm diameter at the base.

Leaf

Alternate, imparipinnate, up to 50 cm long; the 5-15 leaflets are opposite or subopposite, with a petiolule about 5 mm long, oblong-lanceolate, asymmetrical (except the terminal one), 4-13 cm long, 2.5- 5 cm broad, obtusely cuspidate to acuminate at the apex; unequal-sided and obtuse at the base, entire, glabrous; midrib and secondary veins prominent below.

Flower

In pyramidal terminal panicles 20-40 cm long, with short hairs on the pedicels, bracts and bracteoles; the flowers

are unisexual on different trees (dioecious), small, yellowish-white, scented; calyx of 5 broadly triangular acute lobes, about 1 mm long, glabrous; petals 5, valvate, 2.5-3 mm long, elliptic, apex subacute, glabrous; 8-10 stamens; male flowers with well developed stamens and reduced ovary; female with reduced stamens and swollen ovary.

### Fruit

Ovoid or obovoid drupe 2.5-4 cm long, 2-2.5 cm broad; epicarp thin, yellow or yellowish-orange, glabrous; mesocarp fleshy, juicy; endocarp ovoid, woody, wrinkled, 2-2.5 cm long, very thick.

### CULTURAL REQUIREMENTS

Propagation is by means of seed or cuttings. The seed needs 35-75 days for germination. P.J. Wester recommends ripened cuttings 50-70 cm long (wood from the previous season or older), placed in the soil to a depth of 30 cm at their final spacing. The planting distance should be 7.5-9 m each way. In many countries the fruits are attacked by insect larvae, so some precautionary spraying is recommended.

### WOOD

The sapwood is whitish or cream. The fresh heartwood is the same colour, but turns golden brown on drying. It is particularly sensitive to insect attack, especially termites, and to fungal rot, so cannot be used for permanent work unless protected, and previously treated against the destructive agencies. Though without any notable qualities, it can be used for interior joinery. As it is soft, porous and light, it lends itself well for veneer, and is turned into plywood, fibre board or chipboard. It is also utilized for making boxes and matches. Its hardness, density and light colour make it useful for wood pulp. The resulting paper has good resistance to tension and tearing, but a poor reaction to folding.

### USES

The taste of the fruit pulp varies from slightly astringent and more or less acidulous to acid-sweet. It is especially used for syrups, drinks and jellies. The fruit can also be eaten fresh, or boiled or dried.

Some varieties are rather sour, and others have very little flesh: these are used for pig or cattle food. The best ones have a pleasant taste, and are about the size of a large olive. It is also a useful melliferous tree.

### SYNONYMS

*Mauria juglandifolia* Benth. ex Engl.; *Spondias aurantiaca* Schum. & Thonn.; *Spondias brasiliensis* Mart. ex Engl.; *Spondias lucida* Salisb.; *Spondias lutea* L.; *Spondias myrobalanus* L.; *Spondias pseudomyrobalanus* Tuss.

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Macmillan Co. - New York - 1920 - pp. 473

N° 39 - Spondias mombin L.



SYZYGIUM CUMINII SKEELS (Eugenia cumini (L.) Bruce)

FAMILY

Myrtaceae

VERNACULAR NAMES

Black Plum, Java Plum, Jambolan; Duhat (sp.)

ORIGIN AND DISTRIBUTION

Native of India, Burma, Vietnam, Malay Archipelago and Australia.

It grows in tropical regions and in the hottest parts of the subtropics. There are numerous varieties in the Far East. The fruits of the tree have now been distributed to many tropical gardens especially in Vietnam.

The best forms are frequently cultivated in Java, below 300 m altitude. Large specimens grow in southern Florida. Trials have also been undertaken in the Mediterranean region notably Algeria.

ECOLOGY

*Syzygium cumini* is a gregarious species of tropical and subtropical regions, especially along rivers and in wet low lying places. It is found especially in Dipterocarp forest. When young it is a light demander and very frost sensitive. It requires a rainfall between 900 and 5000 mm. It occurs on a great variety of soils, alluvial, lateritic, sandy alluvia, etc. It can grow on shallow rocky soils provided the rainfall is sufficient. Such wide tolerance suggests many varieties some of which will tolerate saline soil.

BOTANICAL CHARACTERISTICS

Size

Medium sized tree 10-20 m.

Bole

Short and stout, 40-75 cm diameter, sometimes more. A tree with a circumference of 6.25 m has been recorded (Indian Forester XXIX (1950) p. 152). Crown irregular or globular. Bark thick, brown or dark grey.



### Leaf

The leaves are opposite, long petiolate, broadly obovate, elliptic or elliptic-oblong, base cuneate or rounded, apex rounded or obtuse; they are entire with a narrow transparent margin, thick, coriaceous and glabrous. The upper surface is dark green, and the lower grass green or yellowish and dull; they measure 8-18 cm long, 5-9 cm broad.

### Flower

White or pink, in many flowered dense pyramidal panicles 5-12 cm long; they are generally borne on the leafless branches. The flowers are small and scented. The calyx is broadly campanulate; petals 4, free, imbricate, greenish or pink, rapidly turning brown and falling. The 2-3-locular ovary has a white style 0.6-0.7 cm long.

### Fruit

The fruit is an ovoid-oblong berry, often curved, dark violet, 1-2 cm long; the pulp is greyish-yellow or pale violet, juicy, almost odourless, with a pleasant, slightly bitter and astringent taste.

Numerous varieties have large tasty fruits, but too often the berries are small and of poor quality. The quality of the fruit is inferior to that of the guava.

The superposed oblong seeds are strongly astringent and slightly bitter.

The cotyledons are pale green.

### CULTURAL REQUIREMENTS

The seeds germinate very well when fresh, but they lose their viability quickly. Propagation is by seed or by budding. The spacing should be between 12 and 14 m.

### WOOD

The heartwood is reddish-grey or reddish brown. It is relatively hard and slightly durable. It is fine-grained and is utilized in exterior joinery and carpentry. It is used for bridge and boat building, and for making musical instruments, particularly guitars. It is an excellent firewood.

USES

The fruit is generally eaten fresh, while those which are too sour or astringent are used for jam-making. The seeds and bark are well-known remedies in the Far East for treatment of diabetes, dysentery and other illnesses. In Europe too, use of the bark was fashionable at one time, but due to the contradictory therapeutic results, it is now more or less abandoned. It can also be used as a street tree, windbreak or ornamental.

SYNONYMS

*Eugenia cumini* (L.) Merrill; *Syzygium jambolanum* DC.;  
*Myrtus cumini* L; *Syzygium cumini* Skeels.

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SYZYGIUM CUMINII SKEELS



*Syzygium cuminii*  
after/según/d'après WORTHINGTON, T.B.

Ceylan Trees  
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TAMARINDUS INDICA L.

FAMILY

Leguminosae subfamily Caesalpinioideae

VERNACULAR NAMES

Tamarind; Tamarinier (fr.); Tamarindo (sp.)

ORIGIN AND DISTRIBUTION

Native in Ethiopia and Central Africa, but now disseminated throughout the tropics: to India, Central and South America, the Antilles and Florida. According to Indian legend it existed in Ecuador in the pre-Colombian era.

ECOLOGY

A species of hot climates, unable to withstand frost, but tolerant of drought and therefore suitable for regions with a well-marked dry season. It is often found under the same conditions as baobab. It has a preference for deep alluvial soils. It is often encountered near villages, on termite mounds. It's growth is relatively slow.

BOTANICAL CHARACTERISTICS

A small to medium-sized tree to 15 m, rarely reaching 30 m, and 35 cm diameter, with a strong dense crown.

Bole

The bole is straight and rather short, and the bark rough, strongly fissured, thick, grey or brown.

Leaf

Alternate, pinnate, with 9-20 pairs of sessile leaflets, 1.5-2.5 cm long, 0.5-0.6 cm broad, with prominent veins.

Flower

Inflorescence a few-flowered raceme about 5 cm long; the dark coloured buds open to reveal yellow petals streaked with red.

Fruit

An indehiscent, weakly recurved pod, about 12 cm long; the deep brown seeds are surrounded by fibrous, brown, very acid pulp, which is edible and used as a condiment.

### CULTURAL REQUIREMENTS

The Tamarind is especially used as a street tree and shade tree. The fact that the soil beneath it is almost bare is frequently utilized in creating fire-breaks.

The viability of the seed is relatively good; it is not necessary to scald them before sowing. They can be sown in nursery beds or directly in open ground. Under favourable conditions (frequent watering) they can attain 0.60 m in the first year and 1.20 m in the second year. The best results are obtained in porous soils, with the plants protected from the sun and frequently weeded. Transplanting bare-rooted individuals causes a considerable check, unless all the leaves are first removed.

To make fire-breaks, the seeds are sown in polythene bags and transplanted the first year at a spacing of 2.5 x 2.5 m or 3 x 3 m. The plantation should be weeded during the first year, and after that only hoeing is needed around the trees; 1 plant in 2, or 2 plants in 3 can later be removed if the spacing is too close.

### WOOD

Differentiated into bright yellow sapwood and brown-violet heartwood; it is dense and very hard, and takes a fine polish. It is resistant and durable but susceptible to termite attack. In Africa it is used for canoe building; it is also useful for making tool handles, furniture, and turning, but is regarded as difficult to work.

### USES

The wood burns well and it is used to make charcoal for gunpowder. The edible pods are used to make sweets, jams and drinks.

The nectariferous flowers furnish an abundant and high quality honey. A yellow colouring matter is also extracted from them.

The fruit pulp is used in home medicine as a laxative.

It is also cultivated for forage, as the foliage has a high food value and is greatly relished by cattle.

The species is also in demand as a shade tree and street tree.

FOOD VALUE

water	15.0-47.0%
protein	1.4-3.4%
lipids	0.9-1.0%
sugar & starch	62.5%
cellulose	5.1%
ash	1.5-4.2%
Ca	0.074
P	0.113

It is an excellent source of vitamin B (thiamine, niacine); contains a small amount of carotene and vitamin C.

The tamarind juice is an ingredient of Worcestershire Sauce.

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TAMARINDUS INDICA L.



*Tamarindus indica*

After/según/d'après BAILEY, L.H.

The Standard Cyclopedia of Horticulture

TERMINALIA CATAPPA L.

FAMILY

Combretacea

VERNACULAR NAMES

Indian Almond, Tropical Almond; Myrobolanier, Badamier, Amandier des Antilles (fr.); Almendra, Almendro de la India (sp).

ORIGIN AND DISTRIBUTION

Native in Indonesia and the Pacific, now spread to many tropical countries : India, the Antilles, Mascarene Islands, tropical Africa, tropical America.

ECOLOGY

A gregarious pioneer species colonizing sand banks and shores in tropical regions. It grows best near the sea, and does not acclimatize well to high altitude. It is tolerant of most shallow soils, including saline ones. It cannot stand tornadoes or windy climates.

BOTANICAL CHARACTERISTICS

Size

A medium sized tree 15-20 m high, evergreen (deciduous in dry climates).

Bole

The average diameter is about 30 cm; the bark is grey, thin and smooth. The crown is thick, and composed of spreading horizontally arranged branches.

Leaf

Alternate, 15-30 cm long, arranged in large rosettes at the ends of the branches, entire, coriaceous; the upper surface is dark green and shining, and the lower paler and covered with a thin brown tomentum. The leaves greatly resemble those of *Fagraea crenulata* Maing. They turn red shortly before falling, and are often attacked by insects (thrips).



### Flower

Small, whitish, with a slight disagreeable scent. They are arranged in spikes about 18 cm long, composed of numerous male flowers with a few hermaphrodite at the base. The apetalous campanulate flowers have a 5-lobed calyx which soon falls, and 10 stamens.

### Fruit

The fruit is a soft drupe, 2.5-5 cm long, slightly compressed with 2 ridges, green or yellow; with a coriaceous skin, with a hard kernel containing 1 or 2 oily seeds which resemble an almond, and can be eaten fresh or grilled.

Flowers and fruit are produced throughout the year.

### WOOD

The heartwood is reddish-brown, traversed by slightly darker lines; the sapwood is slightly paler. The wood is hard, moderately heavy, porous, flexible, resistant but not durable and it is susceptible to termite attack. Drying does not require any special precautions. It is easily worked; however it planes badly and is difficult to turn. It is used for carpentry and box making, ply and pulp.

### USES

It is planted in many tropical countries as an ornamental and shade tree, as a fruit tree (edible seeds), and as a producer of tan. The oil (from the seed) is utilized for food and has a potential in soap-making.

The roots, bark, green fruit and leaves contain tannin and are used for tanning skins. The bark contains 25% first quality tannin.

The thick crown of this species suggests a possible use for fire breaks.

### FOOD VALUE

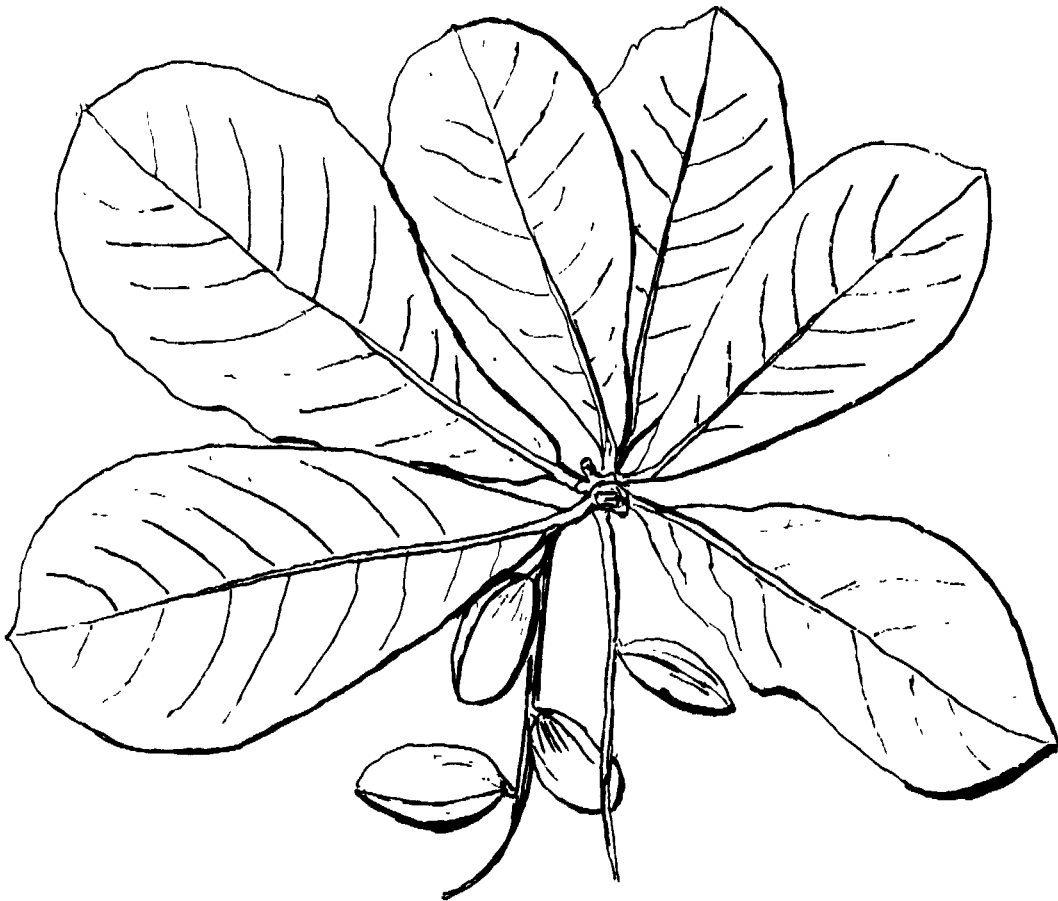
According to Fritsch, the seed contains 28% edible oil, finer and sweeter than almond oil, and it does not go rancid easily. Its density is 0.915 at 15°C, and it consists of 54% stearine, 46% palmitine and olein.

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TERMINALIA CATAPPA L.



*Terminalia catappa*

After/según/d'après WORTHINGTON, T.B.

Ceylan Trees

The Colombo Apothecaries Co. Ltd. - 1959

ZIZIPHUS MAURITIANA IAM.

FAMILY

Rhamnaceae

VERNACULAR NAMES

India Jujube; Jujubier (fr.); Yugube afim (sp.)

ORIGIN AND DISTRIBUTION

Native in the arid and semi-arid zones of Africa, Arabia, India and South East Asia, and introduced into many other countries.

ECOLOGY

This species does best in hot, dry climates with adequate rain during the vegetative period. Its distribution and area of culture are limited by high atmospheric humidity. It is found in places with a rainfall between 125 and 2300 mm and extreme temperatures of  $-6^{\circ}\text{C}$  and  $49^{\circ}\text{C}$  (even  $55^{\circ}\text{C}$ ). From these figures it can be seen that it tolerates slight frost in winter and very high temperatures in summer. Late frosts are very damaging.

It is a gregarious species.

It has a strong and deep root system, growing in a variety of soils, but avoiding clay. The best development results in deep sandy alluvium with a neutral or slightly alkaline pH.

BOTANICAL CHARACTERISTICS

Size

It is a small or medium sized tree rarely exceeding 12 m high and 0.30 m diameter. The branches are slender and downy, and bear paired, straight or slightly hooked brown spines.

Bole

The bole is short; the bark dark grey, turning black and longitudinally fissured. It is fibrous and reddish within.

Leaf

Alternate, elliptic, dentate, 3-nerved at the base; tomentose on the lower surface. There are slender stipules at the base of the petiole.

### Flower

Pentamerous, small, numerous, downy, greenish-yellow.

### Fruit

A drupe, 1.5-2 cm long in wild plants, and about 4 cm in horticultural varieties; 2-seeded; orange or red when ripe; with a fleshy, sugary, acidulous pulp.

### CULTURAL REQUIREMENTS

Propagation is by seed, root cuttings or grafting. Seed is sown directly in the plantation position, as the seedlings do not transplant easily. Germination is slow and difficult and many seeds are empty. When sown in containers, the young plants are moved out 2-3 months after germination. Because of the great crown development, the final spacing is from 10-12 m each way (80-115 trees per hectare)

Cleft grafting or budding is also practised.

The species requires little attention; however, irrigation is advisable if rain is absent at the time of fruiting.

Pruning and shaping the tree has a considerable influence on the production of large fruit, and should be done in the dry season, following the harvest.

Fruit can be conserved fresh in the refrigerator, in open boxes, at a temperature around 0°C. They cannot be kept for more than 6 weeks.

### WOOD

It is generally only used for firewood, or perhaps for construction or carpentry. Apart from firewood, it makes good quality charcoal.

### USES

The fruit is pleasant, and with a food value close to that of the banana, it could be of considerable alimentary importance in periods of scarcity.

It can be eaten fresh or dried. In the latter case, after reducing to pulp or powder, it is used for cake-making or confectionary.

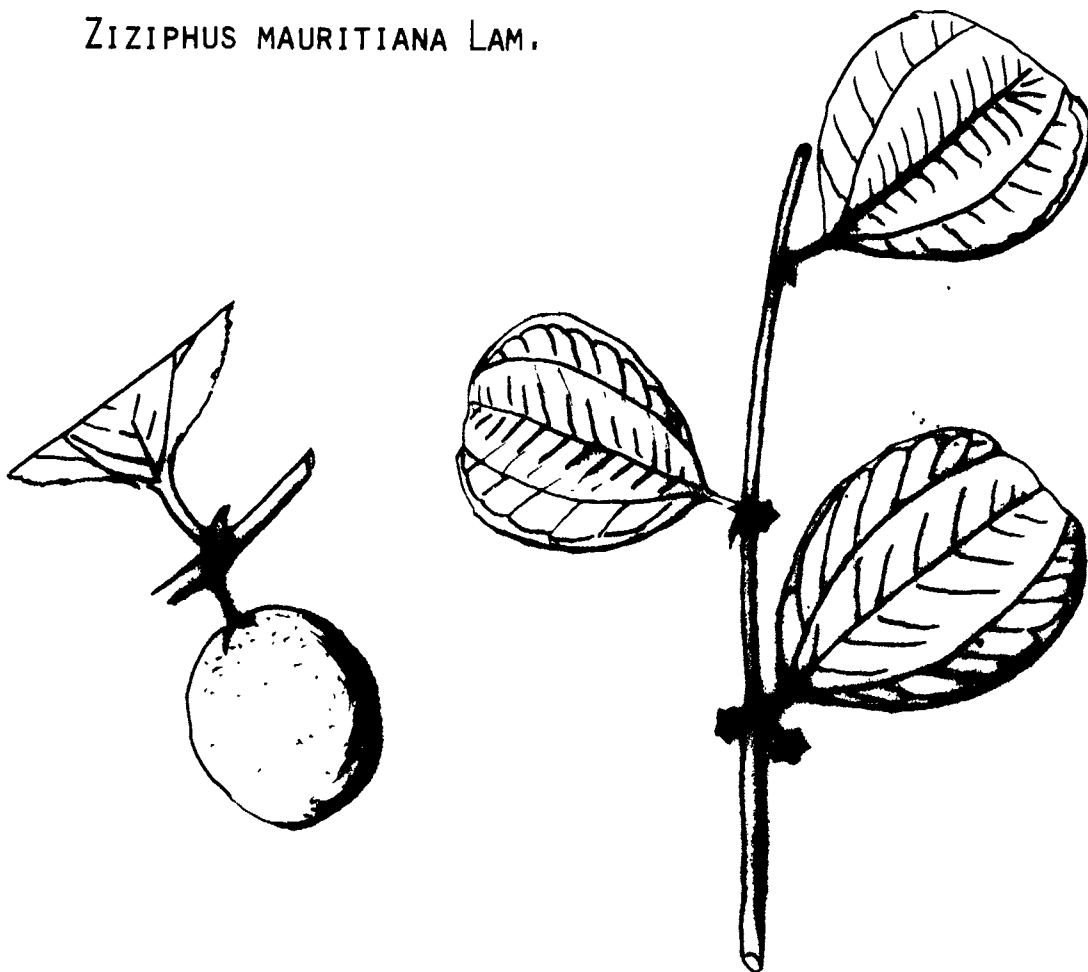
Formerly it was used in pharmacy for making chest poultices. The foliage is used for cattle fodder and for raising silkworms. Apart from its cultivation for fruit, it is also used for windbreaks and as a shade tree. It is also used for raising insects which produce lacquer.

FOOD VALUE

The average composition of the fresh fruit is as follows:

water	64.0-85.0%
protein	0.8-2.2%
lipids	0.1-0.3%
sugar & starch	20.0-32.0%
mineral matter	0.4-0.7%
calorific value	55-135 cal/100 g.

ZIZIPHUS MAURITIANA LAM.



*Ziziphus mauritiana*

After/según/d'après LITTLE, Elbert L. Jr ; WOODBURY, R.O. ; WADSWORTH, F.H.  
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