

The Encyclopedia of Fruit & Nuts

Edited by

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recorded. The economic importance of these pests and diseases is unknown. In some cases, pests or pathogens only attack parts of the plant, causing superficial damage.

Fruit flies (*Anastrepha* spp.) attack the fruit and do reach a level of economic loss in low density planting. The leaves are attacked by the sauva ant (*Atta*) and by *Stiphra robusta* Leitão. The terminal branches are attacked by larvae and the seeds and endocarps are damaged by weevils.

The major pathogens include *Glomerella cingulata*, which causes anthracnose in leaves, inflorescences and fruit. *Sphaceloma spondiadis* causes round rough-textured lesions on leaflets and fruit characterized by cream-coloured centres and light brown borders. *Botryosphaeria rhodina* causes resinosis, with the development of dark cankers that are sometimes cracked, and abundant gum exudation, and when the lesion surrounds the trunk or branch it causes yellowing, wilting or death of the branch or the whole plant. Cercosporiosis disease caused by *Mycosphaerella mombin* affects the leaves and begins with small, round pit spots that become darker and coalesce, causing yellowing and leaflet fall. Nematodes (*Meloidogyne* spp.) attack both adult plants and plantlets. The wood is easily attacked by termites.

MAIN CULTIVARS AND BREEDING There are no reports of clones or varieties of superior quality that might be recommended for cultivation. EMBRAPA Tropical Agroindustry in Brazil is evaluating the behaviour of a number of clones with promising results. Heloisa Almeida Cunha Filgueiras and Francisco Xavier de Souza

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Spondias purpurea red mombin

The red mombin, *Spondias purpurea* L. (Anacardiaceae), is an aromatic fruit, highly valued for local people in the tropics since old times. The species is probably native to southern Mexico and Central America, where wild populations are still found. Early Spanish navigators took the red mombin to the Philippines. In Jalisco (Mexico) during the 19th century, red mombin was one of the most important fruit crops. Nowadays, fruit can be readily

found in local markets. In Ecuador, it is commercialized and found in some supermarkets of the big cities.

The most widespread vernacular name in South America and Philippines is ciruelo, although in Central America and Mexico it is also widely known as jocote, and in some parts of South America as ovo. Many orthographic and phonetic variants of these common names have been recorded.

World production

The red mombin is the most cultivated species in the genus *Spondias*. It has been cultivated widely throughout the neotropics, from central Mexico and the West Indies, to Peru and Brazil. It is naturalized in the Antilles from cultivation, including the Bahamas, and has also been cultivated in Florida, USA (Popenoe, 1979). There are no data for world production. In Ecuador, yields of more than 4500 t/year were reported within the period 1987 and 1990–1992. In an Ecuadorean Andean dry area, the average yield ranged between 2250 to 5000 kg/ha from dry season varieties (Macía and Barfod, 2000).

Uses and nutritional composition

The tree is commonly planted as a living fence. The ripe red mombin fruit are mainly eaten fresh, but sometimes are harvested green and eaten with salt as a snack. In Mexico, ripe fruit are sometimes boiled in water with or without salt and only eaten dried afterwards. In Florida, dried slices of ripe fruit have been occasionally commercialized. The soft exocarp is easily injured and so the mesocarp is processed into marmalade, juice, wine and liquor. The pulp is used as a flavouring for ice cream.

The fruit of red mombin have a good calorific density (Table A.16) due to the high concentration of total carbohydrates (19.1%). Fructose, glucose and sucrose together account for 65% of the total soluble solids. It is a moderate source of potassium and starch, and a good source of vitamin C (Koziol and Macía, 1998). The main flavour compound is 2-hexenal.

Botany

TAXONOMY AND NOMENCLATURE *Spondias* is a pantropical genus composed of approximately 18 species, with the centre of diversity in South-east Asia. In tropical America, there are nine species. Some of the species (*Spondias dulcis* and *Spondias mombin*) have been introduced throughout the tropics to the drier areas in Africa, Asia and the South Pacific for their edible fruit. *Spondias purpurea* is a well-defined and taxonomically separate species (Barfod, 1987). No taxonomic treatment is available of the varieties nor of the species' genetic diversity.

DESCRIPTION *Spondias purpurea* is a small deciduous tree, 3–15 m high, with grey and usually smooth bark. A rather thick and transparent exudate exudes from cuts and bruises. The imparipinnate leaves are 6–28 cm long and 5–27-foliolate with a 15–20 cm rachis. The leaflets are usually 3–6 cm long and 1–2.5 cm wide, elliptic to oblanceolate. The axillary inflorescences are 1–10 cm long, few-flowered, usually produced at older and defoliate nodes. The petals are usually

Table A.16. Chemical composition of red mombin (*Spondias purpurea*) per 100 g (Source: Koziol and Macía, 1998).

Proximate	Range	Average
	g	g
Moisture	65.0–87.0	77.6
Food energy (kcal)	61–86	74
Protein	0.1–1.0	0.7
Fat	0.03–0.8	0.2
Total carbohydrates	16.0–22.3	19.1
Fibre	0.2–0.7	0.5
Minerals (ash)	0.3–1.1	0.7
Minerals	mg	mg
Calcium	6–25	17
Iron	0.09–1.22	0.72
Phosphorus	32–56	42
Sodium	2–9	6
Potassium	230–270	250
Zinc	–	20
Vitamins	mg	mg
Ascorbic acid	26–73	49
Thiamine	0.033–0.110	0.084
Riboflavin	0.014–0.080	0.040
Niacin	0.4–1.8	1.0
Carotene c	0.004–0.225	0.119
Pulp composition	units	
pH	%	3.29
Total soluble solids	g	18
Starch	g	2.47
Pectins	g	0.22
Fructose	g	2.53
Glucose	g	2.00
Reducing sugars	g	8.08
Sucrose	g	6.59
Citric acid	mg	30
Malic acid	mg	110
Oxalic acid	mg	30
Tartaric acid	mg	20

red to purple, 2.5–3.5 mm long at anthesis. The fruit is a drupe, which is oblong to obovoid or subglobose 1.5–4.5 cm long and 1–3.5 cm wide. When ripe, the fruit is usually red but sometimes yellowish or orange. The mesocarp is fleshy and juicy, and the endocarp is 1.5–3.5 cm long.

ECOLOGY AND CLIMATIC REQUIREMENTS Natural populations of red mombin in Mexico and Central America are found in both dry and wet areas, including a wide range of semi-deciduous forests. It has been cultivated from 0 to 2000 m elevation with an average annual precipitation varying from 300 to 1800 mm. The tree is able to grow normally on rocky substrates, slopes or different soil types including those of little agricultural value due to a wide physiological and anatomical plasticity (Pimenta-Barrios and Ramírez-Hernández, 2003). A mycorrhizal symbiosis can be associated with the root and this favours plant growth by promoting phosphorus absorption.

REPRODUCTIVE BIOLOGY Flowering time varies with climate, but usually occurs during the dry season when trees are defoliated or just as the young new leaves emerge. New vegetative shoots are produced and may constitute the major part of the potentially flower-bearing ramets. In areas with more year-round precipitation, flowering may occur nearly all year round. In dry areas, depending upon the tree's phenology, flowering can be controlled by carefully planned irrigation (Macía and Barfod, 2000). If trees are treated with 12% urea to induce defoliation, flowering is advanced by 30–40 days (Almaguer-Vargas *et al.*, 1991). There is no information on pollination.

FRUIT DEVELOPMENT The fruit develop parthenocarpically and take about 115 days from anthesis to the start of ripening (De Melo and Pereira, 2001). The new vegetative shoots and the fruit mature at the same time. Fruit usually ripen during the dry season, so that a high number of hours of exposure to full sunlight produces more sugars and hence better fruit quality. Fruit harvested at the skin-breaker stage (Plate 11) do not develop the characteristic full red colour and the fruit after harvest need to be sorted by colour (Plate 12). The best storage temperature is about 15°C for a maximum of 10 days. Harvested fruit held at 25°C ripen in 3–5 days (Manzano, 1998).

Horticulture

PROPAGATION Since the tree only infrequently produces viable seeds (Juliano, 1932), propagation is by vegetative cuttings. After the harvest, when the leaves have been shed and flowering has just started, cuttings 1–2.5 m long are obtained from the best clones. The cuttings are left in the shade for about a week and then planted 3–7 m apart, at a depth of 30–40 cm. The soil is irrigated after transplanting to stimulate rooting. Grafting on other rootstocks such as *Spondias pinnata* is possible. In Mexico and Ecuador, pruning is mainly done to keep the trees short and to facilitate harvesting from the ground. No fertilization requirements have been reported.

DISEASES, PESTS AND WEEDS No important diseases and pests have been recorded. Fruit flies may cause serious damage to ripe fruit. In dry areas just before flowering, the branches are cleaned to remove epiphytes. In Ecuador orchards have been fumigated by smoke from fires along the margins of the orchard, but occasionally chemical insecticides have been used. Weeding is necessary one or two times a year in dry areas while three or four times a year in wet regions.

MAIN CULTIVARS AND BREEDING There are two main groups of non-commercial varieties: dry-season and wet-season red mombins. Fruit of the first variety are smaller, albeit sweeter and slightly less acidic than those of the second variety (Macía, 1997). The fruit of the first variety are 2.7–3.9 cm long by 1.9–3 cm wide, compared to the larger fruit of the second variety, which are 3.1–4.5 cm long by 2.4–3.5 cm wide. Often cultivars bear the name of the area of origin or fruit characteristics. Dry-season mombin varieties include 'Tronador', 'Crillo', 'Nica', 'Morado', and 'Rojo Ácido', while the wet-season mombins are 'Corona', 'Petapa' and 'Cabeza de loro' (Leon and Shaw, 1990).
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Tapirira guianensis wild mombin

Wild mombin, *Tapirira guianensis* Aublet. (*Anacardiaceae*), is a tropical species found from Mexico south to Amazonia, to Peru and Bolivia and Paraguay. In Brazil, it is found on the