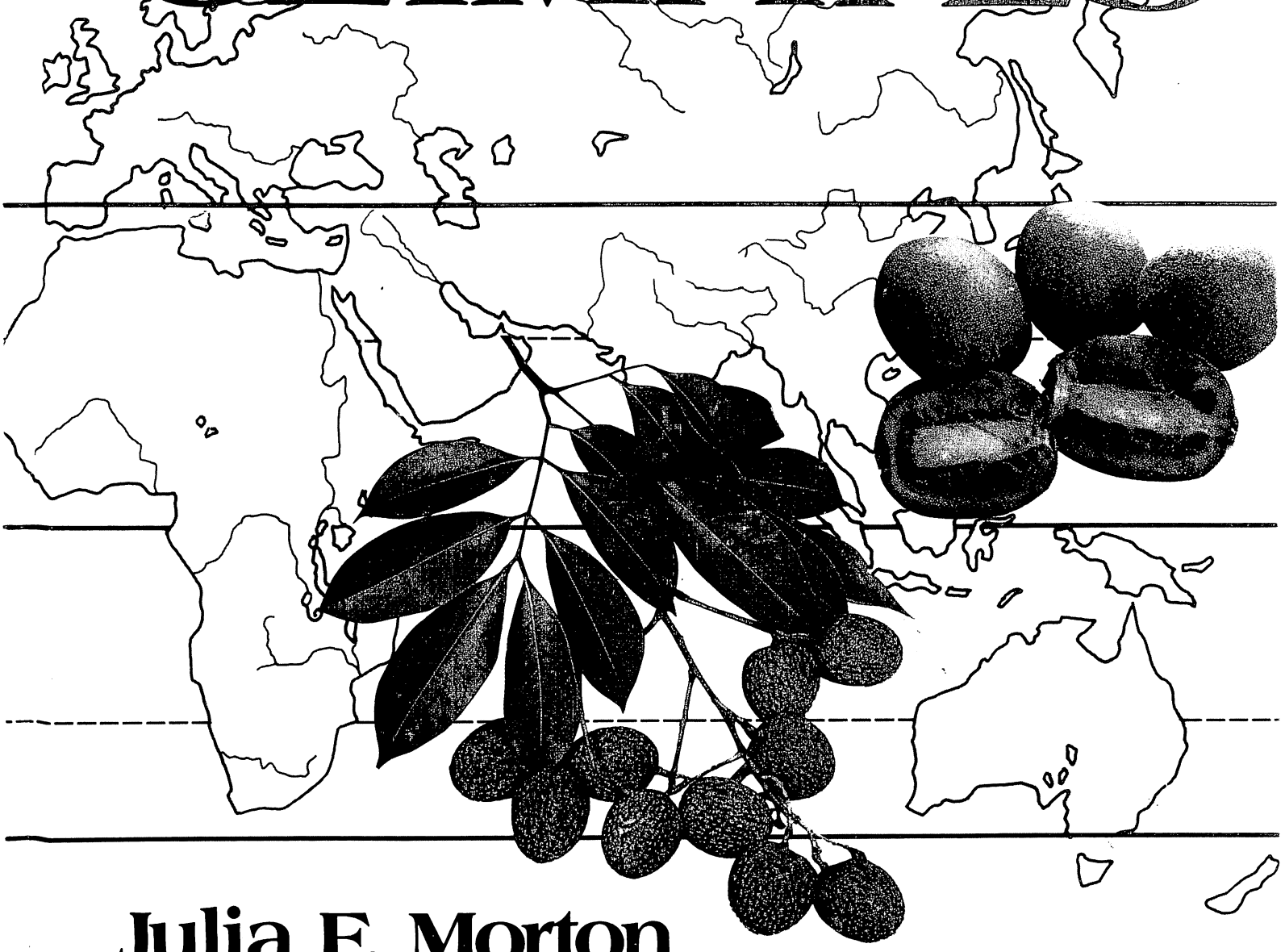
FRUITS OF WARM CLIMATES



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have no residual toxicity after 2 days. High concentrations are potent for 2 days and weaken steadily, all activity being lost after 8 days. In Mexico, the leaves are rubbed on floors and put in hen's nests to repel lice.

Other Uses

The **seed kernels** contain 14-49% of whitish or yellowish, non-drying oil with saponification index of 186.40. It has been proposed as a substitute for peanut oil in the manufacture of soap and can be detoxified by an alkali treatment and used for edible purposes. The **leaves** yield an excellent oil rich in terpenes and sesquiterpenes, mainly β-caryophyllene, which finds limited use in perfumes, giving a woody-spicy accent.

Fiber extracted from the bark has been employed for cordage. The **tree** serves as host for lac-excreting insects.

Medicinal Uses: In India the crushed leaves are sniffed to overcome hysteria and fainting spells; they are also applied on ulcers and wounds and a leaf decoction is taken in cases of dysentery. Throughout tropical America, a decoction of the leaves alone or with those of other plants is imbibed either as an emmenagogue, febrifuge, tonic, cold remedy, digestive, or to clarify the urine. The leaf decoction is also employed in baths to alleviate rheumatic pain. The green fruit, very astringent, is employed against diarrhea in El Salvador. In India, the crushed ripe fruit, mixed with salt, is applied on tumors. The bark and roots are both highly astringent. The bark decoction is given as a tonic and to halt diarrhea. The root, because of its strong purgative action, is administered as a drastic treatment for dysentery and other ailments.

Food Value Per 100 g of Edible Portion*	
Calories	88.9-95.7 g
Moisture	69.8-75.18 g
Fat	0.26-1.10 g
Carbohydrates**	19.16-25.19 g
Crude Fiber	1.14-2.50 g
Protein	1.53-2.38 g
Amino Acids:	
Tryptophan	9-10 mg
Methionine	7-8 mg
Lysine	54-69 mg
Minerals:	
Ash	0.55-1.34 mg
Phosphorus	23.6-55.3 mg
Calcium	19.4-44.7 mg
Iron	0.28-1.34 mg
Vitamins:	
Carotene	5-7 I.U.
Thiamine	0.100-0.13 mg
Riboflavin	0.113-0.167 mg
Niacin	0.654-0.931 mg
Ascorbic Acid	34.7-42.2 mg

*Minimum and maximum levels of constituents from analyses made in the Philippines, Central America and Cuba.

**The average sugar content is 14.58% and is about 50-50 glucose and sucrose.

Atemoya (Plate IX)

The atemoya, *Annona squamosa* X *A. cherimola,* is a hybrid of the sugar apple and cherimoya, qq.v. It was for many years mistakenly called custard apple or cherimoya in Queensland and New South Wales. The name applied in Venezuela is *chirimoriñon.*

Description

The tree closely resembles that of the cherimoya; is fast-growing; may reach 25 to 30 ft (7.5-9 m) and is short-trunked, the branches typically drooping and the lowest touching the ground. The leaves are deciduous, alternate, elliptical, leathery, less hairy than those of the cherimoya; and up to 6 in (15 cm) in length. The flowers are long-stalked, triangular, yellow, 2⅜ in (6 cm) long and 1½ to 2 in (4-5 cm) wide. The fruit is conical or heart-shaped, generally to 4 in (10 cm) long and to 3¾ in (9.5 cm) wide; some weighing as much as 5 lbs (2.25 kg); pale bluish-green or pea-green, and slightly yellowish between the areoles. The rind, ⅛ in (3 mm) thick, is composed of fused areoles more prominent and angular than those of the sugar apple, with tips that are rounded or slightly upturned; firm, pliable, and indehiscent. The fragrant flesh is snowy-white, of fine texture, almost solid, not conspicuously divided into segments, with fewer seeds than the sugar apple; sweet and subacid at the same time and resembling the cherimoya in flavor. The seeds are cylindrical, ¾ in (2 cm) long and 5/16 in (8 mm) wide; so dark a brown as to appear black; hard and smooth.

Origin and Distribution

The first cross was made by the horticulturist, P.J. Wester, at the United States Department of Agriculture's subtropical laboratory, Miami, in 1908. Seedlings were planted out in 1910. Other crosses made in 1910 fruited in 1911 and seeds were taken by Wester to the Philippines. The hybrids grew there to 7½ ft (2.3 m) high in one year, had to be moved to another location; one bloomed in 1913 and was pollinated by the custard apple, q.v. The rest of the plants fruited in 1914.

Resulting fruits were superior in quality to the sugar apple and were given the name "atemoya", a combination of "ate", an old Mexican name for sugar apple, and "moya" from cherimoya. Cuttings of 9 of the hybrids were sent by Wester to the United States Department of Agriculture in January of 1915. (S.P.I. Nos. 39808-39816), #39809 representing the hybrid tree pollinated by the custard apple. In 1917, Wester sent cuttings of #39809 under the name "cuatemoya" to the United States Department of Agriculture (S.P.I. Nos. 44671-44673). In the meantime, Edward Simmons, at the Plant Introduction Field Station, Miami, had successfully grown hybrids and they had survived an early February 1917 drop in temperature to 26.5°F (-3.10°C), showing the hardiness derived from the cherimoya. Another introduction was received from the Philippines in 1918 (S.P.I. #45571).

A few experimental growers in southern Florida maintained atemoya trees (apparently distributed by the United States Department of Agriculture) for many years while there was a general lapse of interest in this fruit. Today, there are a few small commercial plantings and the fruits are being sent to some northern fruit dealers.

In the early 1930's or 1940's, what were apparently chance hybrids between adjacent sugar apple and cherimoya orchards attracted attention in Israel and work was begun to choose and standardize the best of these for vegetative propagation.

Varieties

One of the first named selections of atemoya was the **'Page'**, so-named by Roy Page of Coral Gables who took budwood from superior atemoya trees on the property of Morrison Page in the Redlands. Perhaps the second was the **'Bradley'** which the Newcomb Nursery sold grafted onto custard apple.

An early hybrid that arose in Queensland after the introduction of cherimoya seeds from South America, was named **'Mammoth'** (or 'Pink's Prolific', or 'Pink's Mammoth') and became the basis of the commercial production of atemoyas there and on the north coast of New South Wales, though the flesh of this cultivar immediately below the rind is usually brownish and bitter. **'Island Beauty'**, a vigorous selection with excellent fruit quality was grown to a lesser extent. 'Mammoth' was introduced into Hawaii from Queensland in 1960 and grafted plants were soon being distributed by agricultural stations of the University of Hawaii in Kona and Hilo, and being sold by nurseries in Honolulu.

'African Pride' is an improved clone that originated in South Africa. It was introduced into Queensland by Langbecker Nurseries and 3,000 trees were released for commercial planting in July 1961. It was quickly adopted as a replacement for 'Mammoth' as it was free of the discoloration and bitterness next to the skin. In 1963, 6 plants of 'African Pride' were obtained from Landbecker's by private experimenters and planted at several locations in southern Florida. They began fruiting in 1965. The fruits appeared to be superior in quality to the 'Page' and 'Bradley'.

Israeli selections tried at the University of Florida's Agricultural Research and Education Center, Homestead, and the United States Department of Agriculture's Subtropical Horticulture Research Unit, Miami, are **'Geffner', 'Malamud', 'Bernitski', 'Kabri'** and **'Malai #1'.** Other named selections that have been grown in Florida over the years are **'Caves', Chirimoriñon** A, B and C, **'Island Gem', 'Kaller', 'Lindstrom', 'Priestly'** and **'Stermer'.** 'Geffner' is being propagated at the AREC, Homestead; 'Priestly' by the Zill Nursery in Boynton Beach. None of the others have outstanding features; some develop hard spots in the flesh. In 'Kaller' there is frequently a black membrane around each seed-containing carpel.

'Cherimata' and **'Finny'** are Egyptian clones. 'Finny' is somewhat cylindrical, is more productive than 'Cherimata', has been grown in Egypt for many years and is considered the best for commercial production in coastal districts.

Pollination

The atemoya and other annona trees bear hermaphroditic protogynous flowers and self-pollination is rare. Atemoyas are sometimes misshapen, underdeveloped on one side, as the result of inadequate pollination. The flower, in its female stage, opens between 2 and 4 o'clock in the afternoon. Between 3 and 5 o'clock on the following afternoon, the flower converts to its male stage. In cold and humid climates it releases pollen even though it is sticky. Where the climate is hot and the humidity low at the blooming season, the carpels are short-lived and the stigmatic surface soon dries up and insects are necessary to transfer the pollen. Studies in Israel have identified the principal insect pollinators as nitidulid beetles—*Carpophilus hemipterus, C. mutilatus, Haptoncus luteolus,* and *Uroporus humeralis.* Even where these beetles are present, hand-pollination will enhance fruit-setting and this is commonly practiced in Egypt. Spraying the flowers several times with gibberellin at 1,000 ppm has increased fruit yield. The resulting fruits are seedless but smaller and less flavorful than fruits with seeds.

Climate

The atemoya is slightly hardier than the sugar apple but still is limited to tropical or near-tropical lowlands. In New South Wales, it is said to do best near the coast where rainfall and humidity are high and winters are warm. Rainy weather during the ripening season, however, may cause the fruits to split.

Soil

The tree thrives in various types of soil, from sandy loam to red basalt or heavy clay, but best growth and productivity occur in deep, rich loam of medium texture, with good organic content and a moderate amount of moisture. Good drainage is essential; waterlogging is fatal.

Propagation

Atemoyas for rootstocks are raised from seeds which germinate in about 4 weeks in seedbeds. Seedlings are

transplanted to nursery rows when they are a year old and they are placed 18 in (45 cm) apart in rows 3 ft (90 cm) apart. Grafting is done in the spring, using the whip- or tongue-graft. If older trees are top-worked, it is done by cleft- or bark-grafting. Scion wood is taken from selected cultivars after the leaves have fallen. In Florida and India, the atemoya is usually grafted onto the custard apple or sugar apple. Cherimoya is used as a rootstock in Israel.

Culture

When transferred to the field at the near-dormant period, grafted plants are spaced 28 to 30 ft (8.5-9 m) apart each way and cut back to a height of 24 to 30 in (60-75 cm). Weeds are eliminated to avoid competition with the spreading, shallow root system. During the next 2 or 3 years, the trees are kept pruned to form a strong frame. Thereafter, only light pruning is done. No fertilizer is applied until after the trees are well established, since the young roots are very sensitive. A 6-10-16 formula is recommended for broadcasting over the root area, the amount gradually increased to 10 to 12 lbs (4.5-5.4 kg) annually for mature trees. Half is given in the spring a month before flowering. Irrigation during flowering and fruit-setting improves yield and fruit quality.

Season

In Florida, the atemoya ripens in the fall. In Queensland, the main blooming period is October and November and the fruits mature in April and May. If there is light fruit set in October/November, flowering may continue to February and the fruit from such late blooms may have to be picked prematurely and ripened artificially to avoid cold night temperatures, but it will not develop the highest quality.

Harvesting

The fruits must be clipped from the branch, taking care that the stalk left on the fruit does not protrude beyond the shoulders. Frequent picking is necessary to harvest the fruit at the ideal stage, that is, when creamy lines appear around the areoles showing that the spaces between them are widening. If picked too soon, the fruit will not ripen but will darken and shrivel.

Fruits colonized by mealybugs have to be cleaned by brushing or the use of compressed air before marketing. The fruits should not be wrapped because this will speed ripening, but they need to be packed in boxes with padding between layers. Because of the irregular form, the fruits must be carefully fitted together with the base of each fruit against the wall of the container and the more delicate apex inward.

Yield

The atemoya is a shy yielder, mainly for the reason mentioned under "Pollination". Trees 5 years old are expected to bear 50 fruits annually. In Queensland, commercial groves have produced 5 bushels of fruit per tree — 67 bushels per acre (165.5 bu/ha). An exceptionally large atemoya tree in Florida yielded 11 bushels of fruits in the 1972 season.

Keeping Quality

Atemoyas keep very well in cool, shady, well-ventilated storage for at least 3 weeks. The rind may darken before the interior shows any signs of spoilage. The ideal temperature for refrigerated storage is 68°F (20°C), though an acceptable temperature range is 59° to 77°F (15°-25°C). Lower temperatures cause chilling injury.

Pests and Diseases

The citrus mealybug, *Planococcus citri,* which congregates around the base of the fruit, is the most common pest, and sooty mold develops on its exudate.

In Queensland, the protective activities of the natural enemies of the mealybug are disrupted by the coastal brown ant, *Pheidole megacephala,* which carries mealybugs up the trunk and around between the fruits. Australian growers have tried sticky-banding the trunks and this has reduced the numbers of ants but not sufficiently.

The chalcid fly that lays eggs in the seeds and makes exit holes in the fruit permitting entrance of fungi, occasionally causes mummification of the atemoya. White wax, pink wax, and brown olive scales may be found on the foliage but are shed along with the leaves.

A condition called "littleleaf" is not a disease but zinc deficiency which can be corrected by foliar spraying.

Atemoyas are prone to collar rot *(Phytophthora* sp.), the first sign being an exudation of gum near the base of the trunk and on the crown roots.

Food Uses

The atemoya, preferably chilled, is one of the most delicious of fruits. It needs no seasoning. It may be simply cut in half or quartered and the flesh eaten from the

Food Value Per 100 g of Edible Portion of Ripe Fruit*	
Calories	94
Moisture	71.48-78.7 g
Protein	1.07-1.4 g
Fat	0.4-0.6 g
Carbohydrates	24 g
Fiber	0.05-2.5 g
Ash	0.4-0.75 g
Sodium	4-5 mg
Potassium	250 mg
Iron	0.3 mg
Calcium	17 mg
Magnesium	32 mg
Zinc	0.2 mg
Thiamine	0.05 mg
Riboflavin	0.07 mg
Niacin	0.8 mg
α-carotene	10 mcg
β-carotene	10 mcg
Cryptoxanthin	10 mcg
Ascorbic Acid	50 mg

*Analyses made in Florida, the Philippines and at the University of New South Wales.

"shell" with a spoon. Slices or cubes of the pulp may be added to fruit cups or salads or various dessert recipes. Some people blend the pulp with orange juice, lime juice and cream and freeze as ice cream.

Toxicity

The seeds, like those of all *Annona* species, are toxic and care should be taken to seed the pulp before it is mechanically blended.