YELLOW PASSIONFRUIT IDEAL FOR FLORIDA HOME GARDENS

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Over the past three years, Florida homeowners have become increasingly distressed by the Caribbean fruit fly infestation of their dooryard fruits. Inasmuch as there is no immediate prospect of effective control of this insect, it seems appropriate to recommend a fruit that appears to be unaffected by it—a fruit which provides an attractive and flavorful juice, and which is advancing horticulturally in other countries.

COLLOQUIAL NAMES AND DESCRIPTION

The yellow passionfruit (Passiflora edulis f. flavicarpa Deg.) has a number of colloquial names such as ceibey in Cuba, maracuja peroba in Brazil, parchita maraçuyá, or simply parchita, in Venezuela, para in Puerto Rico, yellow granadilla in South Africa, grenadille or couzou in French-speaking countries, yellow lilikoi in Hawaii, and golden passionfruit in Australia.

It is borne by a woody, perennial vine, climbing by means of tendrils. The evergreen leaves are glossy, deeply 3-lobed, finely toothed, 3 to 8 inches long and, like the young stems and tendrils, tinged with red or purple. A single, fragrant flower, 2 to 3 inches wide, is borne at each node on the new growth. The bloom, which opens about noon and closes in late evening, consists of 5 white sepals, 5 white petals, a fringe-like corona of straight, white-tipped rays, rich purple at the base; also 5 stamens with large anthers, the ovary, and triple-branched style forming a prominent central structure.

The nearly round fruit, 1½ to 2½ inches wide, has a tough rind, smooth, waxy and ranging in hue from light-yellow to pumpkin-color. Within is an aromatic mass of membraneous sacs filled with orange-colored, pulpy juice and as many as 250 small, dark-brown seeds. The flavor is musky, guava-like and very acid.

HISTORY AND STATUS

The yellow passionfruit was, until recent years, largely overshadowed by the purple passionfruit (Passiflora edulis Sims.), a native of southern Brazil widely esteemed for its agreeable, less acid flavor (101). It has been stated that the yellow form is of unknown origin, but in recent Colombian writings it is presumed to be native to the Amazon region of Brazil. Speculation as to Australian origin arose through the introduction of seeds from that country into Hawaii and the United States by E. N. Reasoner in 1923.

Brazil has long had a well-established passionfruit industry with large-scale juice extraction plants. The purple passionfruit is there preferred for consuming fresh; the yellow for juice processing and the making of preserves (65). Strains being grown for these purposes include “Ouropretano”, “Muico”, “Peroba” and “Pintado” (113).

In Australia, the purple passionfruit was flourishing and partially naturalized in coastal areas of Queensland before 1900. Its cultivation, especially on abandoned banana plantations, attained great importance and the crop was considered relatively disease-free and easily managed. However, about 1943, a widespread invasion of Fusarium wilt killed the vines and forced the undertaking of research to find fungus-resistant substitutes. It was discovered
that the neglected yellow passionfruit is both wilt- and nematode-resistant and does not sucker from the roots (66). It was adopted as a rootstock and plants propagated by grafting were soon made available to planters.

The Australian taste is strongly prejudiced in favor of the purple passionfruit and growers have been reluctant to relinquish it altogether. Only in the last few years have they begun to adopt hybrids of the purple and yellow which have shown some ability to withstand the serious virus disease called “woodiness” (14). In the current year, 2 hybrids—“3-1” and “3-26”—developed at the Redlands Horticulture Research Station, have nearly replaced the purple passionfruit commercially on the coast of southern Queensland. They have a longer fruiting season, are high-yielding, with high pulp content, keep very well and meet with little market resistance. Australian breeders are still striving for a type that will have the needed characteristics and reproduce true from seed (14, 21).

New Zealand, in the early 1930's, had a small but thriving purple passionfruit industry in Auckland Province but in a few years the disease-susceptibility of this type brought about its decline (43). Good local marketing and export prospects have brought about a revival of efforts to control infestations and increase acreage, mostly in the Bay of Plenty region (40).

In Hawaii, seeds of the purple passionfruit, brought from Australia, were first planted in 1880 and the vine came to be popular in home gardens. In the 1940's a Mr. Haley attempted to market canned passionfruit juice in a small way but the product was unsatisfactory and his effort was terminated by World War II. A processor on Kauai produced a concentrate in glass jars and this project, though small, proved successful. In 1951, when Hawaiian passionfruit plantings totalled less than 5 acres, the University of Hawaii chose this fruit as the most promising crop for development and undertook to create an industry based on quick-frozen passionfruit juice concentrate. From among

![Fig. 1.—Flower of yellow passionfruit (open noon to evening) has rich purple coloring on bases of corona filaments. In flower of purple passionfruit (open from dawn to near-noon), this area is pale. —Photo by Julia Morton.](image-url)
Mr. Haley’s vines, choice strains of yellow passionfruit were selected. These gave yields of 40,000 pounds of fruit per acre with 35% juice content, as compared with purple passionfruit yields averaging less than 10,000 pounds of fruit per acre, with a juice content of 25%. By 1958, 1,200 acres were devoted to yellow passionfruit production and the industry was firmly established on a satisfactory economic level (115).

South Africa in 1947 produced 2,000 tons of purple passionfruit for domestic consumption. Production was doubled by 1950 (38). In 1965, passionfruit plantations were initiated over large areas of the Transvaal to meet the market demand and apparently there have been no serious setbacks as yet, from disease or other causes.

India, for many years, has enjoyed a moderate harvest of purple passionfruits and the vine seems to be particularly healthy and productive at altitudes between 2,000 and 4,000 ft. In many areas, it has run wild. The yellow form was unknown in India until just a few
years ago when it was introduced from Ceylon and proved well adapted to low elevations in South India. It was quickly approved as having a more pronounced flavor than the purple and producing within a year of planting heavier and more regular crops (117).

Passionfruit vines are found wild and cultivated to some extent in other parts of the Old World—including Java, Sumatra, Malaya, Kenya, Papua and New Guinea, Fiji, and Formosa. From the last 5 sources considerable quantities of yellow passionfruit juice and pulp are exported to Australia, causing some protests from Queensland growers (18, 53, 61).

In South America, interest in yellow passionfruit culture has recently intensified in Colombia and Venezuela. In Colombia, trial plantings in the Cauca Valley in mid-1963 yielded in 10 months, producing 12 tons per hectare, and a second crop was harvested the same year. The best performing variety proved to be the "Hawaiiana".

Since the introduction of the yellow passionfruit from Brazil into Venezuela in 1954, it has achieved industrial status and national popularity. Venezuelan production in 1966 amounted to 3,600 long tons (23). Much effort is being devoted to improving the yield to better meet the demand for the extracted juice, passionfruit ice cream, and other appealing products such as bottled passionfruit-and-rum cocktail. The strains grown are known as "Brasilera amarilla", "Brasilera rosada", and "Hawaiiana" (82).

Such enterprise is in marked contrast to the general lack of enthusiasm for the passionfruit which has prevailed in the West Indies, the Bahamas and Florida. In this State, where much energy has been spent in the extolling of less worthy fruits, the failure to appreciate the passionfruit is rather surprising. In the Index to the Proceedings of the Florida State Horticultural Society through Volume 68, it appears only once and this solitary citation merely leads one to John Schnabel's statement in 1913...
that *Passiflora edulis* does fairly well among "Ornamental Vines for Florida".

At the University of Florida's Subtropical Experiment Station in Homestead, limited trials with the purple and yellow passionfruits resulted in some amplification of the brief discussion of these fruits in the well-known bulletin, *Miscellaneous Tropical and Subtropical Florida Fruits*, when revised by the late Dr. George Ruehle in 1953, but mostly with words of discouragement, the purple vine in particular having proved so susceptible to disease (72).

Some yellow passionfruit vines were known to exist and bear fruit year after year here and there in the southern and central areas of the State. In 1953, I requested seeds of good strains of purple and yellow passionfruits from the Queensland Department of Agriculture and Stock and I gave seeds of the yellow to Laymond Hardy for planting. In 1955, he reported that one vine was flourishing at Pinecrest and, from the reports of hunters camping beyond that locality, it appears that bird-transported seeds have produced fruiting vines in outlying Everglades hammocks.

In 1957, Robert Read brought to me the largest yellow passionfruit I have ever seen which he had found lying on the path in Matheson Hammock. The vine, fruiting high in the trees, was probably an escape from the fruitful specimen cultivated at that time by Mr. Benjamin Blumberg in Coconut Grove.

Various species of *Passiflora* have reached the United States Plant Introduction Station in Miami in the routine course of plant accession, and in 1958 horticulturists at the Station took interest in the death of certain of the vines from *Fusarium* attack and in the poor fruiting performance of survivors. These observations resulted in two reports by Dr. Robert Knight and Harold F. Winters on the pollination of the yellow passionfruit in the Florida State Horticultural Proceedings Volumes 75 and 76, in 1962 and 1963 respectively. The authors point...
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out the problems affecting yield, a dim view of economical juice production, and the need for extensive field studies, and they offer plant material to anyone qualified to undertake such work (56,67).

Last August, I noticed that "edible passionfruit" seeds were offered for sale in an advertisement in the Florida Market Bulletin by Mr. E. M. Placie, Land O'Lakes, Pasco County. I ordered a packet and asked Mr. Placie to tell me about his vine. He wrote that he has seedlings of the purple passionfruit, now three years old. During their first winter, he covered the stems to a height of 3 ft. with a 4-inch-thick wrapping of fiber glass. Upper parts not covered suffered cold injury but were cut back, the plants were fed heavily with manure and later with grove fertilizer and grew "enormous". They began flowering in May of this year and by July were laden with fruits. He said that though he found the pulp delicious he had "not attempted to use the fruit for anything except to sell the seeds."

A noteworthy example of a homeowner who grows and utilizes the yellow passionfruit is Mrs. Gisella Fleischer of 6620 S. W. 71st Court, Miami, whose clothesline for the past few years has served as a passionvine trellis. Her original vine, having succumbed through unknown causes, was replaced in late 1965 by two plants provided by Dr. Robert Knight, one of them known to be large-fruited. The first combined crop for two weeks of August of this year was 160 fruits of assorted sizes up to 2½ inches in diameter, which yielded 3 pints of juice. Adding 1½ pints of water, ¼ cup of lime juice and 3 lbs. of sugar, Mrs. Fleischer produced a little more than 10 half-pints of jelly. This is an excellent product rivalling in flavor the finest made from any other fruit, in my opinion, and it has been praised by all whom I have invited to sample it.

On the average, a bushel of passionfruits in Australia weighs 36 lbs., yields 13½ lbs. of pulp from which is obtained 1 gal. (10.7 lbs.)
of juice and 2.6 lbs. of seeds. With some strains in Hawaii the juice yield is much higher.

OTHER FOOD USES

The fruit is of easy preparation. One needs only cut it in half and scoop out the seedy pulp with a spoon. For home use, Australians do not trouble to remove the seeds but eat the pulp with cream and sugar or use it in fruit salads (131) or in beverages, seeds and all. Elsewhere it is usually squeezed through two thicknesses of cheesecloth or pressed through a strainer to remove the seeds. Mechanical extractors are, of course, used industrially. The resulting rich juice, which has been called a natural concentrate (53), can be sweetened and diluted with water or other juices to make cold drinks, or may be boiled down to sirup. The fresh juice or the sirup can be used in making sauce, gelatin desserts (81), candy, ice cream, sherbet, cake icing, meringue or chiffon pie (68), cold fruit soup, or in cocktails. Recipes for passionfruit highball and passionfruit punch are given in a new Hawaiian cookbook, Pineapples, Passion Fruit and Poi, published by Charles Tuttle of Rutland, Vt. (41). The flavor of passionfruit juice is impaired by heat preservation unless it is done by agitated or "spin" pasteurization in the can (96). The frozen juice can be kept without deterioration for 1 year at 0 deg. F. (53)

FOOD VALUE

Much attention has been given the physico-chemical composition of passionfruit juice, seeds and rind by J. S. Pruthi of the Central Food Technological Research Institute, Mysore, India, and other investigators (48, 89, 94, 95, 98, 103, 104, 106, 108, etc.). The average composition of 100 g. of juice of the yellow variety was reported in Hawaii in 1955 as follows: moisture, 82.0 g.; ether ext, 0.6 g.; soluble solids, 15.0 g.; acidity, 4.0 g.; reducing sugars, 7.0 g.; total sugars (as invert), 10.0 g.; crude fiber, 0.2 g.; protein, 0.8 g.; calcium, 5.0 mg.; phosphorus, 18.0 mg.; iron, 0.3 mg., ascorbic acid, 12.0 mg.; carotene (i.u. Vitamin A), 570 (53). The juice has a pH of from 2.5 to 3.0 (53, 65).

The yellow passionfruit has somewhat less ascorbic acid than the purple but is richer in total acid (mainly citric), and in carotene content (53, 89). It is an excellent source of niacin and a good source of riboflavin, but lacks, or has only a trace of, thiamine (68).

Passionfruits contain starch (amylopectin) which may be evident as a whitish or gray residue in stored juice; and it also causes jelling during heat pasteurization (53). Passionfruit seed meal contains too much crude fiber to be useful as cattlefeed. Refined flour made from the seeds has been proposed as a partial rice substitute in India, and the rind can be utilized as a source of pectin (99, 103).

CULTURE

Extensive information on the cultivation and training of the yellow passionvine and handling of the crop appears in the 134 references listed at the end of this paper. The following is a brief summation.

The yellow passionfruit is usually grown from seed. If planted soon after removal from the fruit, seeds will germinate in 2 to 3 weeks. Cleaned and stored seeds have a lower and slower rate of germination. Sprouting may be hastened by chipping the seed (28). Soaking, often recommended, has not proved helpful (100). Seeds are planted ½ inch deep in beds and seedlings may be transplanted when 10 inches high. If taller (up to 3 ft.) the tops should be cut back and the plants heavily watered (10). Root-pruning should precede transplanting by 2 weeks. Transplanting is best done on a cool, overcast day. The soil should be prepared and enriched organically a month in advance if possible.

Cuttings of new but matured wood, ½ inch thick and with 3 or 4 nodes, should be well rooted and ready for setting out in 90 days. Rooting may be hastened by hormone treatment. Other means of propagation are layering, approach-grafting and cleft-grafting using yellow passionfruit seedlings as rootstocks. Cleft-grafting is employed on a commercial scale in perpetuating hybrids. Grafted vines must be planted with the union well above ground, not covered by soil or mulch, otherwise the disease resistance will be lost (87).

Vines in plantations are set at various distances, but studies in Venezuela indicate that highest yields are obtained when vines are set 10 feet apart each way. Commercially, vines are trained to strongly-supported wire trellises at least 7 ft. high. However, for the benefit of
the homeowner, it should be pointed out that
the yellow passionfruit is more productive if
allowed to climb a tall tree (130). In some
areas, trellis-grown vines require hand pollina-
tion to assist fruit set. In the home garden,
at least two vines of different parentage should
be planted and allowed to intertwine for cross-
pollination. The carpenter bee and the honey
bee are the main pollinating insects (74).

After a vine attains 2 years of age, pruning
once a year will stimulate new growth and con-
sequently more flower and fruit production (33).
Regular watering will keep a vine flowering and
fruited almost continuously. Least flowers
develop during the winter season due to short
day length (124). Water requirement is high
when fruits are approaching maturity. If soil
is dry, fruits may shrivel and fall prematurely
(67). Fertilizer (10-5-20) should be applied at
the rate of 3 lbs. per plant 4 times a year.

The yellow passionfruit is fast-growing and
will begin to bear in 1 to 3 years. Ripening
occurs 70 days after flowering. Even with high-
climbing vines there is no harvesting problem
for the ripe fruit falls to the ground and need
be collected no oftener than twice a week. It
does not attract flies or ants and keeps well.
Though the rind shrivels, the contents remain
unimpaired for several weeks (68).

DISEASES AND PESTS

As already stated, the yellow passionfruit is
resistant to Fusarium wilt and to nematodes.
The virus disease, “woodiness” or “bullet”, is
now the most serious plague of the purple
variety in Australia, but it has little effect on
the yellow form (51). Brown spot, caused by the
fungus Alternaria passiflorae in warm weather,
is controlled by spraying with captan, maneb,
zineb or copper fungicide. Scab requires spray-
ing with Bordeaux mixture. Base rot is often
induced by injury to the base of the vines by
mowers or other mechanical equipment, the use
of which near the plants should be avoided also because of the hazard to the shallow root system. Hand weeding around the main stems is strongly recommended.

In Florida, the yellow passionfruit is commonly found to be superficially punctured by the stinkbug (Chondrocerca laticornis) affecting only its appearance. There has been no report of attack by the Caribbean fruit fly (Anastrepha suspensa) in this State, though Anastrepha infestation was on one occasion observed by Mr. Curtis Dowling in Passiflora fruits in Costa Rica. In Brazil, fruit flies of the genus Anastrepha (65), and in Hawaii the Oriental fruit fly and the melon fly, deposit eggs in the very young, tender fruits. In these the larvae seem able to develop and cause the immature fruits to shrivel and fall. If fruits are punctured when nearly mature, the only effect is an external scar (4). The same is reported concerning the Queensland fruit fly and the Mediterranean fruit fly in Australia (77). In Hawaii and Australia, mite infestations in dry weather are eliminated by applying wettable sulphur. Less troublesome pests are various scales and aphids (4). The passionvine leaf hopper (Scolypopa australis) requires protective measures in Queensland (13).

**Conclusion**

The yellow passionfruit's ability to tolerate light frost and its adaptability to a wide range of soils, as well as its apparent immunity to Caribbean fruit fly damage, make it suitable for home planting through much of south and central Florida. Both the foliage and the flowers are highly ornamental and even a moderate crop of fruit will contribute to the gustatory pleasure of family and friends. Through individual experience, means of achieving higher yields may ultimately be found here as they have elsewhere.*

In contacts with our West Indian and tropical American neighbors, we will be rendering a service in encouraging their cultivation of this crop on a commercial scale. In 1965, the Laboratorie de Recherche des Produits Nestlé, Vevey, Switzerland, placed the passionfruit among the three insufficiently-known tropical fruits having the greatest potential for nectar processing for the European market (132).

The impracticality of attempting large-scale cultivation in Florida is evident in the following statement just received from Dr. A. E. Willson, Vice President, Minute Maid Company, Orlando: "A couple of years ago, we started a variety study for the yellow passion fruit at Indian-town. The selections came from Bob Knight [Dr. Robert J. Knight]. We found the fruit was entirely satisfactory for our products. However, we concluded that passion fruit could not be grown [commercially] in Florida for the following reasons: The yields are not as large as in more tropical areas where the plant remains productive all year round. Our plants went out of production during the winter season. During the windy spring months of March and April, the vines are badly damaged and no flowers are set until sometime in May. We also found that the passion fruit were expensive to harvest. The fruit has to fall on the ground and sometimes it gets hung up in the vines. There is a continual collection of small quantities of fruit throughout the year. Special equipment is needed to obtain the juice from the fruit without bits of the calyx showing up as objectionable black specks. This equipment is costly and can only be justified when a large volume of fruit is being processed."

**Related Literature**
