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EDIBLE FRUITED PASSIFLORA ADAPTED TO SOUTH FLORIDA GROWING CONDITIONS

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Abstract. **Species of** Passiflora **bearing edible fruits are discussed with particular emphasis to those varieties adapted to South Florida growing conditions. A summary is made of those** Passiflora **species and hybrids which are currently being grown in the South Florida area and deals with fruit, flower, and foliage characteristics as well as resistance to nematodes, soil-borne fungi, and pollen self-compatibility. Some discussion is also given to high altitude** Passifloras **which have been unsuccessful in fruiting in South Florida.**

Probably no other plant family is represented by as many fruiting species as the *Passifloraceae*. The number of varieties grown in South Florida has increased each year due to new introductions and production of hybrids. As the number of varieties increased so has confusion over the identity of many *Passiflora* species. In the following article I shall attempt to describe the major species grown locally as well as some of the more common hybrids. Among the more widely grown fruiting *Passifloras* in South Florida are the Yellow Granadilla (*Passiflora edulis f. flavicarpa* Degener), the Scarlet Passionflower (*P. coccinea* Aubl.), and a hybrid of the Giant Granadilla (*P. quadrangularis* L.).

In the first group of passionfruit are the Purple Granadilla (*P. edulis* Sims), the Yellow Granadilla (*P. edulis f. flavicarpa*), and hybrids between these two. The fruit of the Purple Granadilla ranges from round to oval and in size is about 2″ in diameter. The edible yellow pulp is sub-acid to sweet, highly aromatic, and contains black seeds, all of which is enclosed in a purple fruit. The Yellow Granadilla also ranges in shape from round to oval (oval fruit produce more pulp) and varies in size, although the fruits are usually larger than the purple form (up to 3½″ diameter); the aromatic pulp is yellow to deep orange and is much more acid and not of as high a quality as is that of the purple form. The pulp surrounds brown seeds and is enclosed in a yellow fruit. The fruit of the hybrid is generally red and intermediate in characteristics between the yellow and purple forms with much seedling variation. The Yellow Granadilla is generally considered to be a botanical variety of the Purple Granadilla (4). Both varieties have variable leaves that are mostly trilobed with two large glands at the apex of the petiole. Each species also has similar white petaled flowers with a purple corona. There are some slight differences between the two: *P. edulis* has clear green stems, leaves, and tendrils with no traces of red, *P. edulis f. flavicarpa* has a suffusion of red into its stems, leaves, and tendrils. In the purple form the flowers open in the early morning and close at noon while the yellow form's flowers open around noon and close late at night. There is also a difference in the two forms flowering cycles: *P. edulis* has only one flowering period in the early Spring where *P. edulis f. flavicarpa* has flowering periods during Spring, Summer, and Fall (2). The Purple Granadilla also prefers a cooler climate than the Yellow Granadilla and is susceptible to *Fusarium* wilt and more susceptible to nematodes than the Yellow Granadilla, upon which it is sometimes grafted. The greatest difference between *P. edulis* and *P. edulis f. flavicarpa* lies in their pollination requirements—most plants of the Purple Granadilla set fruit from their own pollen while most (but not all) Yellow Granadillas are pollen self-incompatible. The hybrid between the two forms has characteristics intermediate between them and varies in degree of pollen self-compatibility (2).

The next group of passionfruit contains the Giant Granadilla (*P. quadrangularis* L.) and the Fragrant Granadilla (*P. alata* Dryand). The Giant Granadilla is the largest of the passionfruit reaching a length of 12″ and a weight of 6 pounds. What's more not only is the pulp edible but so is the thickened mesocarp which is eaten like a melon. From my observations a hybrid of *P. quadrangularis* is widely grown in South Florida (probably a cross with *P. alata*). The Giant and Fragrant Granadillas each possess winged square stems (hence their names) and large unlobed leaves. The leaves of *P. quadrangularis* have 10-12 lateral veins, 6 petiolar glands, and large stipules; *P. alata* has leaves with 7-8 lateral veins, 2-4 petiolar glands, and narrow stipules. The large flowers of the Giant Granadilla have pinkish-white petals which remain pendalus while those of the Fragrant Granadilla have crimson petals which lie in a plane. Both the flowers and the fruit of *P. alata* are highly fragrant. *P. alata's* fruit is thin-skinned, yellow, and obovoid (4″ l x 1½″ w) with whitish pulp. *P. quadrangularis* exists in two common fruiting forms. In the smaller form the flowers are generally self-compatible and produce large crops of fruit 6-8″ long. The other form, referred to as *P. quadrangularis var. marocarpa* Mast. has flowers that appear to be self-incompatible but the lack of fruiting may be due to non-viable pollen (1), it produces larger fruit (up to 12″ and 6 pounds) with fewer seeds, and smaller crops. Either of the Giant Granadilla fruits are yellowish-green with a pink tint, have pulp that is sub-acid to sweet, and bland whitish mesocarp. The *P. quadrangularis* hybrid has flowers and foliage that resemble *P. alata* while the fruit is more like that of *P. quadrangularis*.

P. coccinea Aubl. (the Scarlet Passionflower) is the most commonly grown red *Passiflora* in South Florida, it is usually sold in nurseries as an ornamental. Another red is *P. vitifolia* HBK., the Grape-leaved Passionfruit. Both species have downy stems and leaves. The leaves of *P. coccinea* are unlobed while those of *P. vitifolia* are trilobed, both species have two glands on the stem at the base of the petiole. In nature, bees seldom visit red passionflowers and as such are pollinated by hummingbirds; locally the flowers must be hand pollinated for fruit set. *P.*

coccinea's flowers are usually self-incompatible. The fruit of each species has white pulp that is generally sweet. The fruit of the Scarlet Passionflower is round 1½-2" in diam and quite ornamental with its green stripes. Fruit of the Grape-leaved Passionfruit is yellow, thin-shelled, and ovoid (2" l x 1¼" w) and is very fragrant. Locally a hybrid was produced between *P. coccinea* and *P. vitifolia* and known by the cultivar name 'Cordelia'. The hybrid has variable leaves from unlobed to trilobed and red flowers. It has not yet fruited. A second hybrid of *P. coccinea* has been distributed, this one made with *P. edulis f. flavicarpa*. The foliage of this hybrid closely resembles that of the Scarlet Passionflower except that the leaves are more pointed and the glands are on the middle of the petiole. This hybrid has not yet flowered to my knowledge.

Another group of red *Passifloras* are part of the spectacular sub-genus Tacsonia. In this sub-genus are also the pink-flowering Banana Passionfruit of the Andes. The Tacsonias are easily distinguished from other *Passifloras* by their possession of a long calyx tube. Most Tacsonias come from high altitudes and therefore do not grow well in South Florida. Exceptions are *P. racemosa* Brot. (syn. *P. princeps* Lodd.) and *P. manicata* (Juss.) Pers. which were grown for a short time in South Florida (1). *P. racemosa* probably has the most outstanding flowering of any *Passiflora*—its brilliant red flowers are produced in racemes of 8 or more at the terminal ends of its branches. It is usually cultivated for its flowers but in some South American regions it is grown for its fruit. *P. manicata* is another Tacsonia with red flowers and a brilliant royal blue corona. It has medium sized trilobed leaves and bears an edible fruit. *P. manicata* was introduced by the U.S.D.A. and is under test at the present. The Banana Passionfruits (*P. mollissima* (HBK) Bailey, *P. mixta* L., *P. antioquiensis* Karst., and others) are considered to produce the finest juice and drinks of all the passionfruits. Unfortunately they have not done well here. In the mountains of Hawaii *P. mollissima* is found as an escape. In New Zealand *P. antio-quiensis* Karst. (syn. *P. van-volxemii* Lemaire.) is commercially grown at the higher altitudes. Both these species have trilobed leaves and pendulous rose-colored flowers. In nature the Tacsonias freely hybridize among themselves (3).

Another high altitude passionfruit is the Sweet Granadilla of Mexico (*P. ligularis* Juss.). The white pulp is sweet and has a distinctive flavor. The Sweet Granadilla has been grown on and off in Florida for over 30 years but has not fruited. This plant requires the cooler climate of the mountainous tropics and as such only puts out heavy growth during the Winter months. It strongly dislikes August heat and usually does not survive it without special care. *P. ligularis* can at once be recognized by the 4-6 half-inch-long glands on the petiole of its large cordate leaves.

The Sweet Calabash or Conch Apple (*P. maliformis* L.) is one of the better passionfruit that does well at Sea Level. The white sweet pulp is said to have the flavor of grapes and is enclosed in a globose green to orange colored shell that is so hard that a hammer is often needed to open it. The vine is a fast grower but is susceptible to nematodes. The leaves are ovate with 2 glands in the center of the petiole. *P. maliformis* has self-compatible flowers (1). Unlike *P. maliformis, P. laurifolia* L. (the Water Lemon or Jamaican Honeysuckle) seldom sets fruit from its own pollen. This passionvine grows well on Florida's sandy soils and is resistant to nematodes. The Water Lemon quite often is a shy flowerer, so large crops are uncommon. The yellow to orange fruit has white, sweet pulp with the flavor of pear. The fruit is ovoid (1½-4" l x 1¼-2½" w) and borne on a vine with oblong leaves with 2 petiolar glands. *P. laurifolia* cv. 'Java' released by the USDA is cross compatible with all known Jamaican cultivars (3).

Two other locally grown passionfruit that also require pollinators are the Montesa Granadilla (*P. platyloba* Killip.) and Tagua-Tagua (*P. serrato-digitata* L.). Both species will bear in South Florida when cross-pollinated, unfortunately few cultivars of each species is available. *P. platyloba* has trilobed leaves with long petioles with two glands in the center and 4 large glands on the undersides of its leaves. Its fruit is small and ellipsoidal with a hard shell; the pulp is very acid. *P. serrato-digitata* has 7-lobed leaves with 2 pair of cup-shaped glands on the petiole. The fruit of Tagua-Tagua is globose (1¼" diam.), yellow with white pulp that is acid to sweet and said to resemble guava.

P. seemanni Griseb. is a species closely related to *P. ligularis, P. maliformis,* and *P. platyloba* that is adapted to Sea Level. I have not seen plants growing locally but suspect that plants are being grown in South Florida since *P. seemanni* is widely grown in the Tropics. The plant has cordate leaves with four cup-shaped petiolar glands. *P. seemanni* is cultivated in Australia, Hawaii, Mexico, and Nicaragua, and exists as an escape in some parts of Jamaica.

Although there are several species of *Passiflora* native to the United States only one bears a worthwhile fruit, the Maypop or Vine Apricot (*P. incarnata* L.). This little lavender-flowering vine grows wild throughout the Eastern United States—as far north as Pennsylvania, as far south as Florida, and as far west as Missouri (where the flowers are usually white). This frost hardy vine dies back during the Winter and suckers the following Spring. *P. incarnata* has medium-sized trilobed leaves with two glands at the apex of the petiole. *P. incarnata*'s fruit is yellow, oval (1½-2" diam.), with a pulp having a melting taste similar to a tart apricot. The Maypop's cold-hardiness has made it desirable to use in the production of cold-hardy *Passiflora* hybrids. One such hybrid has been made at the USDA. *P. incarnata* was crossed with pollen from the 'Crato' Passionvine (*P. cincinnata* Mast.), the resulting hybrid has been released under the cultivar name 'Incense'. 'Incense' has proven hardy in Pennsylvania and Maryland. The flowers of 'Incense' are large and quite showy, they are a deep lavendar to blue color, almost identical to the flowers of *P. cincinnata*; 'Incense' does not produce a viable pollen but will set fruit when pollinated by another species. The 'Crato' Passionvine is one of the most vigorous growing *Passifloras* in South Florida, suckering quite freely; *P. cincinnata* has pinnately compound leaves with 2 large glands near the base of the long petiole. The large purple, fragrant flowers of *P. cincinnata* are among the showiest of the *Passifloraceae*. Some vines of the 'Crato' Passionvine are self-compatible, while others are incompatible. The fruit is yellow, 1½-2" in diameter, with a white subacid to sweet pulp which takes up to 3 months to mature. Hybrids have been made between *P. cincinnata* and *P. edulis* and *P. edulis f. flavicarpa,* they have resembled the latter parent in foliage characteristics but have thus far not flowered.

The last widely grown passionvine is usually grown for its flowers, although its fruit is quite edible, it is *P. caerulea* L. (the Blue Passionflower). *P. caerulea* has 5-7 lobed leaves and 2-4 stalked glands on the petiole. The pinkish to lavendar flowers are fragrant. This species is the parent to several hybrids, notably *P. Xalato-caerulea* Lindley (syn. *P. pfordtii*) the widely sold ornamental Blue Passionflower which is a *P. alata* x *P. caerulea* cross. This hybrid does not produce a fruit.

In conclusion it should be noted that many other species of *Passiflora* are adapted to growth at sea level conditions similar to South Florida and as such should be introduced and hybridized (1). In addition to the above mentioned species there are several unidentified species growing locally, some of which have fruited in South Florida.

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MINERAL COMPOSITION OF AVOCADO LEAVES IN FLORIDA[1]

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Abstract. **Avocado** (Persea americana **Mill.) leaves of 'Tonnage' trees growing on sand, muck, and calcareous rock soils and 'Lula,' 'Taylor,' and 'Booth 8' trees on sand and rock were collected in 1974 and 1975 and analyzed for concns of N, P, K, Ca, Mg, Mn, Cu, Zn, and Fe. Differences in levels of the 9 elements occurred with differences in soil types, cultivar, and fruiting status of the shoot. Variations generally were greater on sand than on muck or rock soils. Higher levels of Mn, Cu, and Zn were found on sand than on muck or rock, regardless of fertilizer or spray programs. There were differences among cultivars, but no consistent trend in nutrient absorption was found. The rank in level of the 9 elements was mixed and seemingly without bias among cultivars. N, P, and Mg were signicantly lower both years, and K in 1975, in leaves on fruiting shoots than on nonfruiting shoots. There was no significant effect of fruit on leaf levels of the other elements examined. Branch girdling had no important effect on leaf level of minerals. The difference in level of minerals in leaves of the 1st flush, and the 2nd which matured about a month later, was associated with leaf age. Methods for sampling avocado leaves are discussed.**

Increased costs of fertilization have caused fruit growers to seek more efficient use of fertilizer materials. With fruit crops in general, one approach to this has been the use of leaf analysis as an aid in planning the fertilizer program. In California, the mineral concn of avocado (*Persea americana* Mill.) leaves has been examined extensively (1, 2, 3, 4, 5, 9, 10, 11) and tentative levels of minerals to use in diagnosing the nutrient status of mature trees have been set (5). Relatively little work on avocado leaf analysis has been done in Florida. The relationship of boron to alternate bearing (6) and a leaf analysis survey in which 3 cultivars were sampled one time in 25 commercial groves, mostly on calcareous rock soil (14), have been reported. More information is needed before leaf analysis can be of measurable help in planning an efficient fertilizer program for avocados in Florida. Recently, the effects of leaf age, leaf position on shoot, fruiting status of the shoot, cultivar, and soil on the levels of 9 minerals in Florida avocado leaves were examined (8, 18). This paper summarizes the range found in the mineral concn of leaves of several cultivars in Florida as affected by various factors. Some steps for collecting avocado leaf samples that will enhance the probability of getting reproducible analytical results are listed.

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Materials and Methods

Leaf samples for examining the range in mineral concns were collected from mature trees of 'Tonnage,' 'Lula,' 'Taylor,' and 'Booth 8' on Astatula fine sand in the Ridge district of Highlands County; from 'Tonnage' on Torry muck near Canal Point in Palm Beach County; and from 'Tonnage,' 'Lula,' 'Taylor,' and 'Booth 8' on Rockdale soil in the Redlands district of Dade County.

Avocados in Florida generally make 2 or more flushes of growth at intervals of several weeks during the year. After leaves of these different flushes have matured, they cannot readily be distinguished without marking for identification (3). It has been shown that levels of minerals in avocado leaves may vary with age (1, 3, 8, 11, 16). To insure having leaves of uniform age in all sets of samples, the shoots from which leaves were to be taken were marked with plastic ribbon at the terminal when the leaves were fully expanded and hardened in May or June. Thirty nonfruiting shoots on each of 3 trees of each cultivar on each soil were selected for sampling. In addition, 5 extra shoots were marked by color code on each tree to substitute for any loss in the original 30. These shoots were located at a ht of about 3 to 8 ft around the periphery of the tree.

Four-month-old leaves were sampled in 1974 and 1975. Each sample consisted of one leaf from approx the middle of each of the 30 marked flushes on each tree. A 2nd set of samples was taken at this time from the trees on sand and rock soils to examine the effects of fruiting on leaf level of minerals in these cultivars. These 30-leaf samples were from the midsection of fruiting shoots near the marked nonfruiting shoots on the same trees.

Leaves (blades and petioles) of each sample were washed individually on both sides with soap solution, rinsed in tap water, followed by 5% HCl solution and finally in 3 changes of distilled water. They were oven-dried at 65°C and ground. The samples were analyzed for N, P, K, Ca, Mg, Mn, Cu, Zn, and Fe by methods described elsewhere (17).