



The Passion Fruit¹

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- **Scientific names:** *Passiflora edulis* Sims (purple passion fruit); *P. edulis f. flavicarpa* Deg. (yellow passion fruit); *P. quadrangularis* L. (giant granadilla).
- **Family:** Passifloraceae.
- **Origin:** American tropics
- **Distribution:** Introduced and grown in most tropical and subtropical parts of the world, passion fruit is particularly important commercially in Australia, Hawaii, South Africa and Brazil.

DESCRIPTION

Plant. - Vigorous perennial vine. The purple and yellow passion fruit have trilobed leaves 10-18 cm (4-7 in.) long with finely-toothed margins. The giant granadilla has rounded-oblong leaves 10-20 cm (4-8 in.) long and its stem is characteristically square in cross section.

Fruit. - The purple passion fruit bears dark-purple or nearly black, rounded or egg-shaped fruit about 5 cm (2 in.) long, weighing 30-45 g (1-1.5 oz.) Fruit of the yellow passion fruit is deep yellow and similar in shape but slightly longer -- 6 cm (2.5 in.) -- than the purple passion fruit. It weighs 60-90 g (2-3 oz.) and averages about 75 g (2.5 oz.) under Florida conditions. Fruits contain numerous small, black

wedge-shaped seeds that are individually surrounded by deep orange-colored sacs that contain the juice, the edible part of the fruit. The giant granadilla bears irregularly rounded or oblong-shaped fruit 10-20 cm (4-8 in.) long and has a thick, edible rind in addition to black seeds surrounded by juice sacs. It may weigh 225-450 g (8-16 oz.) or more.

Flowers. - Flowers of the purple passion fruit are normally smaller, approximately 4.5 cm (1.75 in.) in diameter, than those of the yellow form, about 6 cm (2.5 in.) in diameter. Both are dull white with very deep blue centers. Flowers of the giant granadilla are quite different; they droop like old-fashioned lampshades and their petals are deep maroon on the inner surface.

Season of bearing. - The purple passion fruit flowers in Florida in early spring and its fruit matures some 60-80 days later, so fruit may be expected from late May until early July. The yellow passion fruit flowers from spring until late fall-with a break in early summer-so that mature fruit appears at intervals from early summer into winter. The giant granadilla begins to flower in spring and its fruit matures in summer. It may continue flowering throughout the summer but ordinarily sets or produces no normal fruit at that time in southern Florida, probably because high temperatures interfere with normal fertilization after pollination. When the weather cools, this granadilla resumes setting fruit, which matures at odd times through the season.

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CLIMATE AND SOILS

The yellow passion fruit and giant granadilla are tropical plants, and thus restricted to protected sites in the southern half of Florida. The purple passion fruit is adapted to subtropical conditions and endures a few degrees of winter frost without injury, but will not tolerate severe freezes. It thrives in the Tampa Bay area and in protected spots across the mid peninsula.

Passion vines prefer a slightly acid soil, but the yellow passion vine will tolerate alkaline soils in southern Florida if adequate micronutrients are added. Well-drained soil is essential. Otherwise, root problems develop that soon destroy these plants.

CULTIVARS

No well-established cultivars are regularly available in Florida, so plants are customarily grown from seed or cuttings of vines selected for desirable characteristics. A form of yellow passion fruit that sets fruit abundantly in southern Florida from self-pollination is often grown from cuttings or seeds. Its fruit is usually smaller than that of other, cross-pollinated yellow passion fruits. Seeds of large fruited selections of yellow passion fruit were brought to Florida from Hawaii some years ago and plants from this source still are grown here occasionally. Locally selected purple passion fruit is vegetatively propagated for commercial production.

PROPAGATION

All 3 passion fruits can be propagated from seed, which should be fresh (less than 1 year old) because seeds lose viability rapidly. Seeds may be sown in flats or pots of sterile soil and kept in a moist place shaded from direct sunlight. Seeds ordinarily germinate in 10-20 days and young plants grow rapidly. Seedlings should be potted individually in small containers as soon as practical after germination. They can be transferred to a permanent location when they are 25-40 cm (10-16 in.) tall.

Purple passion fruit is sometimes grafted onto a yellow passion fruit rootstock to alleviate nematode and disease problems affecting the root system of purple passion fruit. Seedlings of both stock and scion should be about 45 cm (18 in.) tall and have a stem diameter about that of a pencil when grafted. Scions should be about 8-10 cm (3-4 in.) long and

contain at least 2 nodes. The stock should be cut off 25-30 cm (10-12 in.) above the soil line.

For grafting, a long, slanting cut is made from 1 side to the other through the base of the scion for about half its length, and a similar cut is made through the stem of the stock. The 2 cut surfaces are then placed together with cambia aligned and the graft is tied firmly with budding tape. The graft is enclosed in a small plastic bag tied shut below the graft, and placed in a warm, shady location for 10-14 days or until the union takes. Then the bag is loosened to admit air and is removed when scion buds begin to grow. The budding tape is removed before it can construct the growing stem.

Cuttings from passion fruit vines can be rooted under intermittent mist, but they should be selected carefully from healthy, productive plants to avoid spreading virus disease.

PLANTING AND TRELLISING

Ideally, young passion vines should be set in the field early in spring after danger of frost is past. In Florida, passion vines are planted 3-4.5 m (10-15 ft.) apart in rows 4.5-6 m (15-20 ft.) apart.

Horizontal trellises have cross-pieces at the top of each post with 2-4 wires strung horizontally 60 cm (2 ft.) apart along the top of each cross-piece. Vertical trellises consist of heavy posts without cross-pieces, with 2 or 3 wires strung along the row like barbed wire fencing, attached to the posts from the top down at intervals about 30-40 cm (12-16 in.) apart.

Trellis wires should be No. 9 or 10 galvanized steel. The posts need to be stout enough to withstand the weight of the vines throughout a season that normally includes the buffeting of strong winds. Ideally they should be long enough to provide a trellis height of 1.5 m (5 ft.), with 45-75 cm (18-30 in.) in the ground. Trellis rows should be oriented north-south for maximum exposure to sunlight, and the vines should be allowed to grow together along the trellises to promote cross-pollination.

POLLINATION

Pollination is essential for fruit production on passion vines. Flowers of the purple passion vine normally set fruit when self-pollinated, but many yellow passion vines will not set fruit unless their flowers are dusted with pollen from a different vine

that is genetically compatible. Thus, 2 plants grown from cuttings taken from the same vine cannot pollinate each other. Moreover, some vines from a group of seedlings can cross-pollinate and others cannot. This must be learned by trial and error as the plants develop. Ordinarily, many opportunities for cross-pollination exist in a large seedling population.

The most effective insect for pollinating passion fruit is the carpenter bee (Apidae, subfamily Anthophoridae), a large, solitary bee similar to the bumble bee in appearance. The native bee population may ensure adequate pollination in areas where wild maypops fruit naturally. Elsewhere, other means must be supplied. Carpenter bees can be encouraged by placing hollow logs in the field near the vines. Honeybees are less effective because of their small size and because they prefer to work other flowers at the time *Passiflora* is in bloom. They may be successful with the relatively small-flowered (and self-compatible) purple passion fruit under some conditions, however.

The giant granadilla also needs pollination to ensure fruit set. It requires mild temperatures for normal fruiting and may bloom but set no fruit (or misshapen fruit) during the hottest part of the summer. Hand pollination may be the easiest way to ensure fruit production on a few passion vines growing in the home garden.

FERTILIZATION

A balanced fertilizer that supplies nitrogen, phosphorus and potassium in approximately equal proportions, as well as essential micronutrients (magnesium, manganese, copper, zinc and iron), is adequate for passion vines on the slightly acid, sandy soils characteristic of central Florida. On the alkaline, rocky soils of southeastern Florida, phosphorus is needed less than nitrogen and potash, but micronutrients must be applied for normal growth and production. These can be applied 4 times a year in foliar sprays. In addition, iron chelates can be applied directly in solution to the soil near the roots.

Fertilizer should be applied in early spring before growth begins. Light applications should be given 4- to 6-week intervals through July in the northern part of this crop's cultural range, and through October in southern Florida. Passion vines are heavy feeders, but over-fertilization will damage the roots, and possibly destroy the plant. The amount to apply depends on the size of the plant, and can be

determined by experience. No more than 110-170 g (4-6 oz.) of low-analysis (6-6-6, 5-7-5, etc.) fertilizer should be applied at one time until it has been determined that more can be applied safely. It should be evenly spread in a circle of about 45 cm (18 in.) radius about the stem, and then watered in.

PRUNING AND TRAINING

Passion vines in their native state clamber up available trees or rocks and spread out to catch the available sunlight. The yellow passion fruit has naturalized in this manner in some parts of southern Florida. In cultivation, vines should be trained to cover the wires of the trellis or fence on which they are grown.

Young vines are trained by aiming a growing up toward the top of the trellis and once there, allowing a shoot to grow along each wire in each direction. A 2-wire trellis provides 4 sprouts growing along the trellis away from the vine's trunk. Once started, the vine should be allowed to grow without pruning throughout the season, since the more vine there is, the more bearing surface there will be. With self-incompatible forms of yellow passion fruit it is particularly desirable to allow 2 different, cross-fertile vines to grow through each other and intertwine so as to promote heavy fruit production.

Vines should be pruned in late winter when they are not actively growing. All dead and weak wood should be cut out and the vine pruned back to vigorous, well-budded stems so that it can resume healthy, active growth in early spring. Disinfect pruning shears between each pruning to avoid spreading disease from vine to vine. A good time to make the first fertilizer application is after pruning.

The passion vine is a short-lived perennial. Some yellow passion fruit vines in southern Florida have persisted in the field for 10 years, but this is exceptional. A more realistic life expectation is 3-5 years. A vine that appears to have excessive deadwood may have lost so much vigor that it should be removed and replaced with a young, healthy plant.

PRODUCTION AND HARVEST

Seedlings set in the spring will spend most of the first season in the field in vigorous vegetative growth, although a few flowers and fruit may appear in late summer on vines of the yellow passion fruit. Vines grown from cuttings flower more profusely and set

more fruit the first year in the field than do seedlings, but cutting-grown vines are more expensive to produce and often less vigorous than seedlings. Furthermore, one must exercise great caution to keep the plants from which cuttings are taken free of disease, a task that is not necessary when seedlings are used.

Approximately 3.5-7 kg (7.5-15 lbs.) of fruit per plant is likely to be the best production that can be expected of the yellow passion fruit in Florida until more productive cultivars become available. With these levels of production and a spacing of 3 x 4.5m (10 x 15 ft.), one might optimistically expect a production of 2.5-5 metric tons/ha (2,200-4,400 lb./acre) of yellow passion fruit here. At best, the purple passion fruit would likely produce yields only $\frac{1}{3}$ as great. Insufficient data are available to predict yields of the giant granadilla in Florida.

RIPENING AND STORAGE

The entire crop of purple passion in fruit and the early crop of the yellow form matures in late spring and early summer. Then the vines grow vegetatively and most do not flower when days are longest, from about June 21 to July 4. Yellow passion fruit vines begin the season's second flowering in the latter half of July, usually peaking in mid-August and continuing until October or November. Fruit set from the second flowering ripens from September through early February.

Developing passion fruit remains green until fully mature, then colors rapidly within a few days. Both yellow and purple fruits drop to the ground when ripe. The fruit should not be harvested until it drops, because fruit picked from the vine has an unripe "woody" taste. In some regions, the soil beneath the vines is kept weed free and the newly fallen fruit is collected once or twice a week for market. In Florida, the fall crop is easily collected from the ground twice a week where raccoons and other animal pests are not abundant. Summer fruit is better collected daily because of higher temperatures and the danger of sun-scalding.

Both purple and yellow passion fruits begin to lose moisture as soon as they fall and quickly become quite wrinkled if held under hot, dry conditions. Juice in these fruits is wholesome, but they are unsightly and thus unmarketable. Clean fruit can be stored in polyethylene bags at 10°C (50°F) for as long as 3 weeks without loss.

Experimentally, wire netting strung on inclined frames beneath passion vines has been used to collect ripe fruit which falls and rolls forward to be gathered easily like eggs from a battery.

Fruit of the giant granadilla turns deep golden when fully ripe and may be picked for local consumption at this stage. Giant granadilla fruit to ship may be picked just as the area immediately surrounding the fruit's stem turns yellow.

USES

Passion fruit juice is a good source of ascorbic acid (vitamin C) and carotenoids (vitamin A). It is rich-flavored and strongly, but pleasantly aromatic. The undiluted juice is highly concentrated but is an excellent additive to other fruit juices, or it may be drunk as an ade if water and sugar are added. The juice makes an excellent jelly, pie filling or cake frosting. Seeds with the surrounding juice sacs are often added to fruit salads in Australia. Fruit of the purple passion fruit (sweeter and less acid than the yellow) may be eaten by itself, seeds and all. Juice of the giant granadilla has a milder flavor than that of the others and is used in confections or drinks. Its melonlike, edible flesh also can be pulverized and used in pies.

PESTS

Few pests attack the fruit of this crop. A stink bug may puncture young passion fruit, but the fruit usually continues to develop more or less normally.

Nematodes and fungi that invade the roots are the most common pests on *Passiflora* species in Florida. The purple passion fruit, in fact, is impossible to grow in most parts of southeastern Florida unless grafted on the root of the yellow passion fruit or another resistant species. Nematodes and 2 fungi, species of *Phytophthora* and *Fusarium*, have been found on the roots of declining or drying vines. The yellow passion vine is more resistant to harmful soil organisms than the purple, but it is not immune. Vines may show cankers or stem lesions near the soil line, and slowly decline after growing for as long as 5-7 years. When this happens, it is advisable to start new vines, preferably in a new site, for replacements. Root troubles are less common on passion vines in central Florida than farther south.

Virus diseases affect passion fruit production in Australia. They have also been discovered in Hawaii

and in an ornamental cultivar grown in Florida. In view of the trouble viruses cause papaya growers in Florida, all practical means should be used to protect passion fruit plantings from possible viral infections. Any vines whose leaves show mosaic or vein-clearing symptoms should be removed and destroyed. Also, plants should be propagated from seed whenever possible. A vine used as a source of cuttings should be kept insect free in a screen house to protect it from viral infections.

RELATED SPECIES

Several ornamental passion flowers are available in Florida, but they should not be confused with the three fruiting vines discussed here. Ordinarily, these ornamental vines do not bear fruit. These are the Red Passion-flower, *Passiflora coccinea* Aubl. and 2 hybrids *P. alato-caerulea* (sometimes called *P. pfordtii*) and *Passiflora* 'Incense' (*P. incarnata* L. x *P. cincinnata* Masters). The 2 hybrids bear spectacular blue and mauve flowers, respectively. Thus, flower color distinguishes these ornamentals from the fruit-bearing species with their dull white or drooping maroon flowers. A wild species native from central Florida north to Pennsylvania and westward to southern Illinois, Missouri and Kansas is the maypop, *Passiflora incarnata* L., which bears a small but edible fruit.