

THE PITAYA (*Hylocereus undatus* and other spp.) IN FLORIDA
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Other Common Names: English: Strawberry pear, dragon fruit, night blooming cereus. Spanish: pitahaya, tuna, nopal, pitajaya. Only the native name Pitaya should be used. Other common names should not be used.

Synonyms: *Cereus undatus*, *Acanthocereus* spp.

Family : *Cactaceae*

¹ Most of the discussion refers to *H. undatus*
Relatives in the Family: *Opuntia*, other cacti

Some Pitaya Species:

Table 1. Skin and pulp color of some pitaya species.

Species	Color	
	Skin	Pulp
<i>Hylocereus undatus</i> ¹	Red	White
<i>Hylocereus triangularis</i> ¹	Yellow	White
<i>Hylocereus costaricensis</i>	Red	Red
<i>Hylocereus polyrhizus</i>	Red	Red
<i>Hylocereus ocamponis</i> ²	Red	Red
<i>Selenicereus megalanthus</i> ¹	Yellow	White
<i>Cereus triangularis</i> ¹	Yellow	White
<i>Acanthocereus pitajaya</i> ¹	Yellow	White
<i>Cereus ocamponis</i> ²	Red	Red

^{1,2} Synonyms

Botanical Description

Stem. These fast growing cacti are perennial, terrestrial, epiphytic or climbing vines (Fig.1). They have triangular (3-sided; Fig. 2), sometimes 4 or 5-sided, green, fleshy, jointed, many branched, stems. Each stem segment has 3 flat wavy wings, (ribs) with corneous margins and 1-3 small spines or spineless and form aerial roots to adhere or climb. The stem may reach about 20 ft.



Figure 1. Pitaya vine growing on the branches of a dead tree.

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Flowers. Hermaphroditic, some species and cultivars are self incompatible. The extremely showy, edible, white, (pink in other species) flowers, are very large, very fragrant, nocturnal, bell shaped and may be 14 in. long and 9 in. wide (Fig. 3). The stamens and lobed stigmas are cream colored.



Figure 2. Triangular stem.

Fruit. The fruit is a fleshy berry, oblong about 4.5 in. thick with red or yellow skin with scales and without or with spines (Fig. 4). The pulp may be white, yellow or red (Fig. 5) depending on the species.



Figure 3. Pitaya flower.

Seeds. Are very small, numerous and black within the pulp (Fig. 5).

Season of Bearing.
Summer and Fall.

Origin.

Tropical America; Southern Mexico, Pacific side of Guatemala, Costa Rica and El Salvador; Venezuela, Colombia, Ecuador, Curacao, Panama, Brazil and Uruguay

Distribution.

Tropical and subtropical America, South Florida, Caribbean, Hawaii, Asia and Australia. Taiwan, Viet Nam, Malaysia, Israel, S.E.



Figure 4. Pitaya fruit.

Importance.

Since pre-Columbian times, pitayas have been very common in their native countries where they are consumed by the general population. Recently, pitayas are being traded in international markets and have become the most important export fruit of Viet Nam. Demand will increase for many years as this delicious fruit becomes better known in other markets.



Figure 5. Fruit with white and red pulp and black seeds.

Potential Yield.

Most countries estimate production at 10,000 to 25,000 lbs per acre.

Climate.

Pitayas grow well in tropical and subtropical climates, mostly free of frosts and freezes. They tolerate cool or warm climates provided temperatures do not go to 100° F or above. They tolerate some shade and may be injured by extreme sunlight. They are considered a full sunlight crop in their native countries. Initial estimates from native areas indicate that optimum temperatures are 65-77° F.

Insolation (sunburning).

Severe vine damage has been reported from some countries specially those with low humidity or high altitude. About 30% shading is recommended where insolation is damaging. Too much shade results in low production and poor quality.

Soil Moisture and Humidity.

In contrast with other cacti which are from dry desert areas, pitayas originated in areas with a good amount of rain 68 to 100 in. per year. However, high or excessive ambient humidity favors bacterial infections of the stem and anthracnose on stems and fruit while excessive soil moisture causes bacterial and fungal rots. Vines are tolerant to drought which induces flowering. Rains and irrigation during fruit development and prolonged droughts are beneficial.

Altitude.

Pitayas grow very well from low elevations to 2600 to 5280 ft above sea level.

Soils.

Pitayas are adapted to a wide range of soils provided they are well drained. They are doing well in the initial plantings in the well drained calcareous soils of South Florida. As with other fruit crops, they may show minor element deficiencies in the poor high pH soils of South Florida. Pitayas thrive in soils high in organic matter or where manure is added.

Cold.

Pitayas are damaged by below freezing temperatures of long duration. They recover rapidly from light freezing injury.

Wind.

Being a cactus, pitayas may tolerate wind. However, with very strong winds or hurricanes, expect considerable damage to trellises or supports and consequently to vines.

Salt.

Pitayas may tolerate salts in the soil. Some references classify them from moderate to highly tolerant to salts.

Cultivars.

At the present time, there are some named cultivars. For planting, growers are using several species with varying skin and pulp colors. There are breeding programs in Taiwan, Viet Nam and Israel. In countries where they are native, selections from the wild are being used while many of these have been introduced into countries that are interested in growing them.

Pollination.

Self incompatibility has been reported in several cultivars. To be safe, new plantings should use 2 or 3 different genetic types (not the same clone). Thus, cross pollination

between the different types in the planting will assure a better fruit set and size. Moths and bats are good pollinators since flowers open at night when there is no bee activity. All species interpollinate with each other.

Propagation.

Seeds can be used but there is plant and fruit character variability and about a 7 year wait for fruiting. Asexual propagation is preferred and the use of stem cuttings is widespread. Usually, entire stem segments of 6 to 15in. are used. A slanted cut is made at the stem base and then, the cuttings are inserted in the soil or once separated, the cuttings are treated with a fungicide and then left to cure for 7-8 days in a dry, shady location before planting directly in the field or in a well drained media in pots. Some propagators apply a root hormone to the cuttings after curing before planting them. Cuttings grow very fast -1.2 in. per day, and many produce fruit in 6 to 9 months. Longer cuttings usually reach the trellis supports faster than shorter ones. Pitayas can also be grafted but this system is not used. Grafting has potential for selected roots stalks. It takes about 4-6 months for the cuttings to develop a good root system in pots and be ready for planting.

Spacing.

Consider the size of machinery to be used in the maintenance of the planting and also the type of trellis to be used before deciding on the spacing. Table 2 shows some common spacings and number of plants per acre.

Variations in the spacing from plant to plant in the row could occur in the future as there is better air circulation and light penetration with larger spacings and this may result in less disease problems and more effective sprays.

Trellising.

One thing to keep in mind is the cost of the trellis system. Costs must be kept down if growers want to be able to compete. Elaborate trellises may not be cost effective. One reference gives the cost of \$12800 per acre. However, weak trellises are very susceptible to falling down during strong wind events. Be sure to have 2-3 types of trellises to consider and develop a budget for each and choose the most durable and economical one. Do not use wires, because stems can be cut. Wires must be covered by hoses. It is estimated that a 3-4 year old vine weighs about 220 lbs. The life of a pitaya planting is estimated at 20 years. There are trellises for individual vines consisting of a post and a structure at the top to support the vines (Figs. 6 and 7). Individual vine trellises are probable the most commonly used in our area. Often, trellises are continuous with hose covered wires along the row at the top or forming a T with three hose covered wires on the top. An arbor can also be used, specially in a small area but it may be expensive for large areas. Individual vines growing on a short tree or on a pile of rocks or blocks could also be used as supports for a few vines. Several trellises are shown in Figures 6 and 7 with their dimensions.

Table 2. Common spacings for pitayas with plants per acre.

Spacing (ft.)		No. of plants per acre
Between Rows	In Rows	435
10	10	335
13	10	272
16	10	302
12	12	



Figure 6. Pitaya trellises.

Planting.

There are two methods of planting. One is to plant a cured cutting directly into the soil in the field. The second and highly recommended system is to plant the cured cuttings in pots, and let them develop a good root system for 4-6 months and then plant them in the field.

Planting may be done any time in south Florida if an adequate irrigation system is available. The warm, rainy season is always a good time to plant in South Florida (late spring to early fall). Make planting holes at

least twice the diameter of the pots (usually 3-gallon pots). Augured or back hoed holes 24 to 36 in. diameter will suffice. All the literature on pitayas recommend the use of well decomposed manure or compost mixed with the soil dug from the hole. Pitayas respond very well to additions of organic matter. Irrigate before planting if it has not rained. Carefully remove the vines from the pots so the root ball stays intact without crumbling. Place the vine in the center of the hole and at the same level it was in the pot. Fill the hole with the same soil that came out of the hole, mixed with manure or compost, lightly pressing the soil down half way before filling and another time when finishing filling it. Do not press down the soil with your feet because it breaks roots. Build a berm around the plant and water well to fill pore spaces. Keep the soil at a good moisture level but do not over water. Trellising and planting must be well coordinated. Individual vine support or trellising should be finished before planting. The opposite (planting before trellising) may result in severe root or stem injuries.

Training.

Pitayas are fast growers and vines with a good root system will reach the trellis in a short period. Periodic loose tying as vines grow towards the trellis is essential. If tying is not done, vines may topple and severe injury may occur to them. All lateral branches are removed as vines grow up towards the trellis. Once the trellis is reached, free branching is allowed but occasional lateral stem tying is needed to keep them within the allotted space. Cutting the tip of the main stem above the trellis induces lateral branching. Use a fungicide where cuts are made.

Fertilization.

Wait about a month after planting or until vines begin to grow to begin fertilizing.

Fertilization in the first year should be frequent (every 2 month) with light applications of 0.25 lb per vine. Use 6-6-6, 8-3-9, 8-4-12 (palm special) all with 2-3% magnesium or similar formula. Most references recommend the addition of about 4 lbs of well decomposed manure or compost, the first year. Also, use 4 to 6 minor element sprays from late March to September. Drench the soil around each vine with 0.25-0.5oz of chelated iron for alkaline soils. The rainy, warm season is the best for the application of minor elements. For the second and third years, gradually increase the amount of dry fertilizer to 0.3-0.4lb per plant every two months using any of the above formulas. Gradually uncrease the amount of manure or compost to about 6 lbs per plant. Use the same number of minor element sprays and gradually increase the iron chelate soil drench to 0.75-1.00 oz per vine. The fourth year and after, apply 0.50 to 0.75 lbs per vine of the above formulas using 3 to 4 applications per year and the same minor element and iron chelate recommendations.

Apply manure or compost at 5 lbs each application, twice per year. Since pitayas are a new crop in our area and there has not been any local research about fertilization or other practices, use the suggested amounts as guidelines and adapt them to your own conditions.

Irrigation Management.

Even though pitayas are members of the cactus family which are usually native to dry, desertic areas, they have fairly high water requirements. The required precipitation varies from 45 to 100 in. per year for good yields. Excessive soil moisture will result in the development of bacterial and fungous diseases. Drought periods without supplemental irrigation will result in poor production. However, a dry period is

required for abundant bloom induction.



Figure 7. Pitaya trellises.

Pitayas bloom after a drought period. The idea is to maintain a good soil moisture level from bloom to harvest and no irrigation in the prebloom period (spring). Pitayas are cold sensitive so a high volume irrigation system for cold protection is highly recommended. The effectiveness of a microsprinkler system that discharges water

to cover each vine, using 20-30 gal/hour heads, may offer some protection but needs to be tested. Fruit splitting may result from rains after drought or by not maintaining a good soil moisture level.

Pruning.

There are two types of pruning that need to be carried out to obtain maximum production of healthy, good quality fruits. The first one involves training the growing vines until they reach the trellis, eliminating any lateral stems until they reach the trellis and tying them. Then, soon after vines reach the trellis their tips are cut to induce branching and the new laterals are trained and tied to the trellis. This phase is called training or vine structural formation. The second phase is called production pruning. Pitayas are fast growers and produce exuberant growth. If no pruning is done, there will soon be a very dense mass of stems that will prevent light penetration and interfere with harvesting the fruits. A dense mass of stems will result in increased incidence of insect and disease problems. Pruning is an essential practice for pitayas. Production pruning involves the removal of damaged, diseased or dead stems and those that reach the soil. Also, remove stems that interfere with cultural practices and harvesting. Train and tie the stems to the trellis to prevent the above mentioned problems. Try to select healthy, strong stems. Because of vine vigor, pruning may be needed once to three times per year. Cuts should be treated with a fungicide to prevent diseases. Pruning cuts induce flower and stem production. Prune soon after harvesting. Remove all pruned stems from the field. The cut stems could be taken to a location away from the field where they can be composted.

Off Season Crops.

Artificial lighting and potassium nitrate can be used to induce off-season crops.

Weed Control.

It is essential to keep plantings free of weeds as weeds compete for water, nutrients and provide hiding places for animals that may eat the stems or fruits. Because pitayas are grown in trellises, it is important to control weed vines (Virginia creeper, *Cissus* spp, balsam apple, etc.) before reaching the trellis. Once vines reach the trellis, hand removal is the only way to control them. At the present time, there no chemicals registered for weed control in pitaya orchards.

Insects, Nematodes, Animals and Birds.

Some damage by mites, thrips, ants, scales and mealybugs, beetles, borers (*Diatrea*) slugs and fruit flies has been reported. Racoons, possums, rats and birds also cause damage. Severe scale infestations on stems have occurred in cacti in Florida.

Diseases.

Several important diseases attack pitayas. The bacterium *Xanthomonas compestris* causes severe stem rot. *Dothiorella* and anthracnose have also been reported. Severe anthracnose damage to newly planted vines has been observed in Florida. Anthracnose also attacks the fruits. *Fusarium oxysporum* has also attacked vines

Yield.

The production per acre of pitayas is high in their native environment. Some areas where they have been introduced for commercial production also report excellent yields. Other areas with too low humidity, high light intensity, too cool or where

temperatures are very high, report reduced or light production. It is too early to tell how high or low production will be in Florida but good production is expected. Yields, of 10,000 to 25,000lbs per acre have been obtained in some countries. Fruit thinning improves size and is recommended where small size is a problem

Precocity.

Pitayas enter production in a short time and good yields have been already reported in the second year. The period from fruit set to ripening varies according to the species. Several references give a ripening period of 90-180 days for *Selenicereus megalanthus* (yellow) and two references state only 30-50 days from fruit set to ripening for *H. undatus*.

Harvesting.

Thorny pitayas are more difficult to harvest than thornless ones. Leather gloves and appropriate long sleeved shirts are recommended for harvesting thorny pitayas. Hand pruners should be used to remove fruits from the vines. The ripening season for *H. undatus* in Florida, judging from the first plantings, goes from June to November. This period will probably cover most of the ripening season for pitaya species. This long ripening season is very good for marketing as fruit will be at the stores for a long time. However, for the growers, it is harder as they have to go through the plantings 2 to 3 times per week during the ripening season.

Fruits should be cut from vines with pruners, being careful not to damage them and not leaving a stub at the peduncle (stem attachment) by cutting the peduncle flush to the fruit surface. Harvested fruit should be well colored with good quality and should

be carefully placed in shallow containers that hold a reduced number of fruits. Full containers should be placed in a cool, shady area in the field and should be taken to the packing facility as soon as possible where they should be refrigerated, hydrocooled or force air cooled. Overripe fruits have less shelf life and have a tendency to split.

Sizes and Containers.

For shipping to the markets 5 and 10-lb containers are preferred. The approximate dimensions for the 5-lb cartons or flats are 12 in. x 8 in. x 3.5 in. Those for the 10-lb flats are: 16 in. x 12 in. x 3.5 in. These boxes should have holes for air circulation. Fruit should be separated by sizes after the elimination of undersized, damaged, spotted, malformed fruits. An effort should be made to pack fruit with about the same color in the boxes. Fruit sizes vary but common sizes are: 5, 6, 7, 9, 11, 13 and 14 oz. Common fruit dimensions vary from 3-6 in. long and 2.4 - 4.0 in. in diameter. The weight of red Nicaraguan pitayas varies from 8 to 18oz. Cushioning the bottom of boxes is recommended. Also, not more than two layers of fruit per box should be used. One layer of fruit per box is preferred.

Storage.

Pitayas for the fresh market should be stored at 45-50° F and 85-90% relative humidity. The estimated life of refrigerated pitayas is about 4-5 weeks. Pitaya frozen pulp is also sold and this alternative market is becoming popular. Fresh pitayas are subject to fruit fly quarantines while the frozen pulp is not.

Uses.

Most pitayas are consumed fresh. The frozen pulp can be used to make ice cream, yogurt, jelly, preserve, marmalade, juice,

candy and pastries. The food and cosmetic industries use red pitayas as a color ingredient. They are also used in gourmet dishes and salads. Unopened flower buds can be cooked and eaten as a vegetable.

Pitaya fruits contain captin, a medication for heart problems. Seeds contain an oil that is a sure and mild laxative. Table 3 shows the nutrition value of some pitaya species.

Table 3. Nutritive value of three pitaya species.

Nutrient	SPECIES		
	H. guatemalensis ¹	H. undatus ²	S.megalanthus ²
Water	82.5-83.0g	89.4g	85.4g
Protein	0.16-0.23g	0.5g	0.4g
Fat	0.21-0.61g	0.1g	0.1g
Fiber	0.7-0.9g	0.3g	0.5g
Ash	0.54-0.68g	0.5g	0.4g
Calcium	6.3-8.8mg	6.0mg	10.0mg
Phosphorus	30.2-36.1mg	19.0mg	16.0mg
Iron	0.55-0.65mg	0.4mg	0.3mg
Carotene	0.005-0.012mg	?	?
Thiamine	0.28-0.043mg	0	0
Riboflavin	0.28-0.045mg	0	0
Niacin	0.297-0.430mg	0.2	0.2
Ascorbic Acid	8.0-9.0mg	25.0mg	4.0mg

Table 3 Nutritive Value per 100g of Pulp

1. From: Julia F. Morton. 1987. Fruits of Warm Climates, 505p.

2. From: Tabla de Composicion de Alimentos. 1992.ICBF.6ta Ed. INCAPYFAO y FAO

(From: El Cultivo de Pitaya y su Posicionamiento en el Mercado, 19 p.,

<http://www.angelfire.com/ia2/ingenieriaagricola/pitaya.htm>)