

# PRODUCTION OF PAPAYA (*Carica papaya* L.) IN BARBADOS



By

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PM-593



INSTITUTO INTERAMERICANO DE COOPERACION PARA LA AGRICULTURA  
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## PREFACE

*Papaya (Pawpaw) used to be one of the most popular and widely cultivated fruit in Barbados. Its popularity remains due, among other things, to the precocity of this crop, the organoleptic characteristics of the fruits, the stepped production of the plant and the rapid and easy propagations of this specie. But the "Bunchy top" disease appeared and in a short period of time practically wiped out all papayas in the Island.*

*With the introduction and selection of new cultivars relatively tolerant to this disease, the hope for the renaissance and growth of the Papaya industry is all the way on; stronger than ever because of the introduction and application of new techniques to increase the production and efficiency.*

*This bulletin is directed to technicians and farmers as part of an activity oriented to increase the knowledge regarding fruit production.*

*The publication have been possible through the contribution of the IICA'S Projects "Fruit Crop Development" and "Support of transfer of technology for the production of food crop" in Barbados.*





# PRODUCTION OF PAPAYA (*Carica papaya L.*) IN BARBADOS

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**SCIENTIFIC NAME:** *Carica papaya L.*

**FAMILY:** *Caricaceae*

**COMMON NAMES:** *Papaya, Pawpaw, fruta Bomba, Lechosa, Mamao, Papayer, Mamor e Caydu.*

## ORIGIN, HISTORY AND DISTRIBUTION

The origin of Papaya is the tropical America but it has become naturalized in many tropical regions of the world.

This appreciated Fruit was first described by the spaniard Oviedo in 1526. Papaya was quickly disseminate to Tropical and some subtropical areas of the world by Spanish and Portuguese sailors, soon after their arrival in America.

In the Caribbean Region, Papaya is a popular fruit because its mild and pleasant flavour and the fact it is an early bearing Fruit Tree.

## GENERAL DESCRIPTION

**The Plant:** It is a giant herbaceous and dicotyledonous with a soft-wooled hollow stem. Usually has a simple trunk but branching is easily induced by injury at the top. It also may develop several lateral branches as the plant becomes older. Trees may grow to a height of 2 - 6 m depending on the ecology and the care provided. Some plants have last for twenty (20) years producing fruits under excellent conditions but two (2) to three (3) years are the average for commercial production in the Caribbean Region.

Large deeply lobed leaves are borne bunched together near the apex with long hollow soft petiole.

### **The Flowers and Fruits:**

The Papaya is a polygamous specie: Plants may be male (staminate), female (pistillate) or hermaphroditic (bisexual). The sex type determines the fruit shape, being round for female flowers and elongated or ovaled for hermaphrodite.

Some plants can produce flowers which exhibit different degrees of maleness and femaleness. Climatic factors such as drought and sudden change in temperature, have been related to these changes in sexual expression. Also, there is a tendency to produce more male flowers at high temperature. In general bisexual (hermaphroditic) plants are preferred.

## PROPAGATION

Although vegetative propagation techniques are easily accomplished, they are also too laborious to justify their commercial uses in some crops. That is why papayas are commercially propagated by seeds which are produced abundantly, and

germinate readily in a short period of time (8 to 15 days). It is very important to select a good seed source to assure a maximum number of fruitful trees of good quality and tolerant to diseases.

When papayas are hand pollinated the progeny can be predicted: Pistillate flowers (Female) Pollinated by staminate flower (Male) = 50% Male 50% Female. Pistillate flowers (Female) pollinated by bisexual flowers (Hermaphroditic) = 50% Female, 50% Bisexual.

Bisexual flowers either selfed or crossed-pollinated with other bisexual = 33% Female, 67% Bisexual.

Bisexual flowers pollinated by staminated flowers = 33 % Male, 33 % Female and 33% Bisexual.

Seeds are obtained from ripe fruits. The gelatinous aril which involves the seeds should be removed.

Three (3) seeds are sown per plastic bag (seed-bed is not usually recommended); this compensates for no germination, discarded or damaged plants and later removal of male plants. (See picture 1).

Seedlings are ready to be planted in two to three months, when they are 15 to 25cm tall.

## **ECOLOGY AND CULTIVATION**

Papayas prefer areas with fertile soils, good drainage and abundant rainfall. Strong winds and flooding are not tolerated. Wind breaks are useful. Tropical warm temperature is ideal for papayas cultivation.

Heavy soils should be avoided but, if necessary, land should be chiselled as deeply as possible and a good drainage system should be provided. If organic manure is easily available, spread over the ground and work into the soil (approximately twenty five (25) tons per Ha).

Additional irrigation may be needed if the dry period goes over one (1) month, since papayas are sensitive crops and flowering and production are heavily affected by drought.

## **PLANTING**

Depending on the purpose of the planting, the extension of land available, the equipment for cultural practices and the availability of labour, spacing varies from 1.0 to 3.0 m. between plants and from 2.0 to 5.0 m. between rows. Planting variations include single or double rows, and square or triangular system. The most common planting system is 2 to 3 x 2 to 3m in square pattern. Plant density go from 1000 to 2500 plants/Ha.

Intercropping is possible if a quick growing crop is used. Peas, Peppers and Beans are the most common crops used to intercrop with Papaya. Tuber crops such as Yams, Potatoes, Sweet potatoes, Cassava, etc. should be avoided. Seedlings of Papaya are planted in holes 25 x 25 x 25 cms.

When the flowers appear, the definitive best plants are selected eliminating male and off- type plants, poor growing seedlings and plants affected by any disease. One



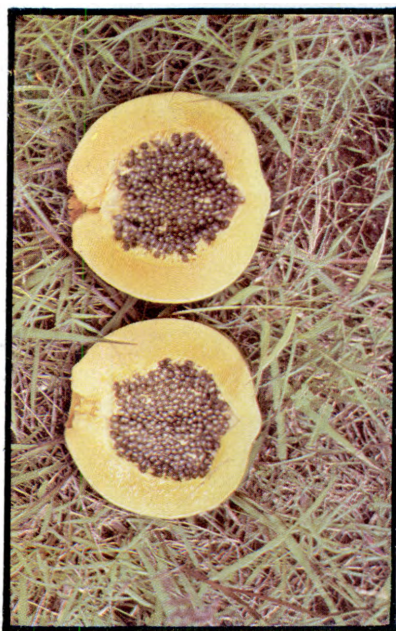
**PICTURE 1.**— *Three (3) plants per hole will guarantee at least one productive. The other two are eliminated when the sex of the flower can be identified.*



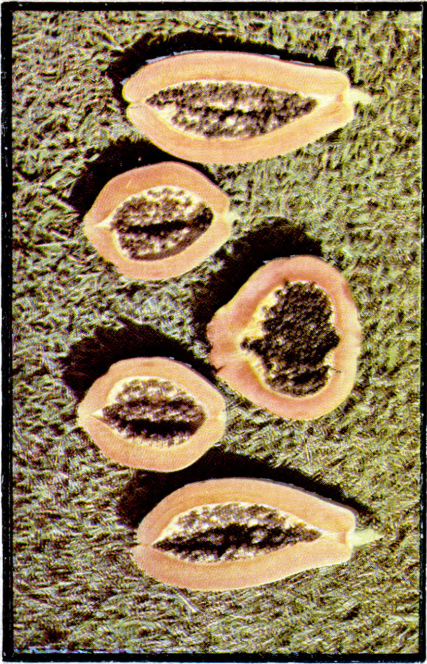
**PICTURE 2.**— *The fertilizer is spread in the entire drip area.*



**PICTURE 3.**— *The rapid incorporation of the fertilizer to the soil reduce losses especially by volatilization.*



**PICTURE 4.**— *Yellow pulp 'Solo' fruits.*



**PICTURE 5.**— *Pink pulp 'Solo' fruits.*



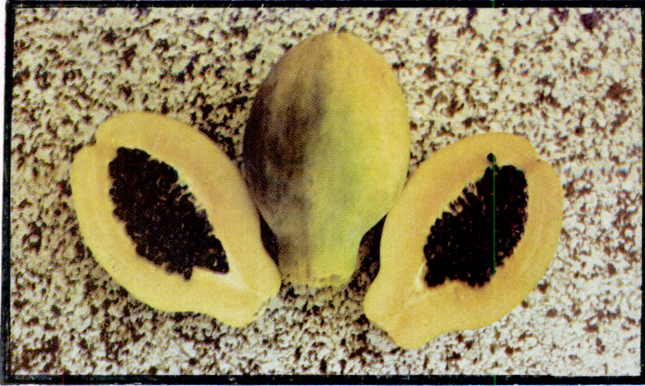
**PICTURE 7.**— *Tree of the cultivar 'Cartagena'. The tree fell down because of the heavy load.*



**PICTURE 6.**— *Fruit of the cultivar 'Cartagena'. It can reach over 10 pounds.*



**PICTURE 8.**— *Fruits of the cultivar 'Solo Hawaiana'. Round shaped fruits are from female plants, but elongated ones come from hermaphroditic flowers type plants.*



**PICTURE 9.**— *Fruits of the cultivar 'Homestead'. The Homestead is entirely female and all its fruits are round.*



**PICTURE 10.**— *The cultivar Homestead is so productive that some times the fruits are borne so close together that <sup>they</sup> can be smashed by themselves as they grow.*



**PICTURE 11.**— *One of the characteristics to identify 'Bunchy Top' is that when an incision is done with a knife to the top near the apex the latex do not flow profusely.*



**PICTURE 12.**— After cutting back plants affected by 'Bunchy Top' the new shoots may show symptoms of the disease from the very beginning. The cut in the picture was done too high.

**PICTURE 13.**— In spite of the height of the cut, new shoots came healthy and may grow well to produce a reasonable economic crop.



**PICTURE 14.**— Damage by Anthracnose (*Colletotrichum* sp.) on fruits still on the tree.

**PICTURE 15.**— The typical spots of Anthracnose are more noticeable as the fruit reach the maturing stage.



or two plants per site are kept, depending on the planting system and the density per area. If the percentage of female plants is high (over 30%) it is wise to leave one male per every 10 female.

## **WEED CONTROL**

Weeds must be early controlled to avoid competition and eliminate host for vectors and other insects. It is wise to keep a round area (drip area) of at least one (1)m in diameter completely clean. This area could be molded taking care of leaving the trunk free.

Contact Herbicides such as Paraquat may be used later, taking enough care to avoid drift on the plant, and doing the spray early in the morning when wind blows smooth.

## **IRRIGATION**

As mentioned before Papayas are very sensitive to drought. No fruit is set under dry conditions, growth is retarded and young fruits drop. Complimentary irrigation is needed during the dry season.

Irrigation with 25mm of water every week, will permit continuous growth and good production.

## **FERTILIZATION**

Nitrogen and Phosphorus are especially important. The first application with a quarter pound (1/4 lb) per tree of 12-12-17-2 should be done at planting time or soon after. During the next three (3) months repeat the same application every twenty (20) days. After this period apply three quarters (3/4) of a pound of the same mixture every month, increasing to one (1) pound after the seventh month. Reapply fertilizer if unusual hard rains occur.

The fertilizer should be spread around the trunk of the tree covering the entire drip area. (See Picture 2). The incorporation of the fertilizer to the soil is essential, to reduce the volatilization of the nitrogen (See picture 3).

## **CULTIVARS**

The complex genetic make-up of Papaya make it difficult to talk about true cultivars. However, they are few which present uniformity in horticultural characters when seeds result from close controlled pollination. The leading are the 'Solo' Papayas (originally from Barbados).

The 'Solo' Papayas comprise a group of selections which present a high degree of natural self pollination of their bisexual flowers main reason for their constancy in character expression. Selections may also be classified by the color of the pulp of the fruit ranging from yellow (See picture 4) to a deep pink color (See picture 5).

The 'Sunrise Solo' is a result of vigorous breeding work of improving characteristic. Other cultivars, selection or strains among the Solo group include Kapoho, Waimanalo, line 5, line 7, line 8, Hawaiana, etc..

New cultivars in other countries include Betty, Homestead and Fairchild (Florida); Graham (Texas, USA); Cartagena (Dom. Rep.); Hortus Gold, Coorg Honey (South Africa); Petersen, Guinea Gold, Sunny Bank (Australia); Madhu Bindu, Honey Dew (India); Santa Cruz Giant, Cedro, Singapore Pink (Trinidad); Verde, Gialla, Cera, Mamey, Chichona (Mexico); Maradol (Cuba); Singapore (Malaysia); Red Panama (Camerum).

Local selections such as 'Wakefield', 'Graeme 7' and 'Graeme 5' are now available. They, as well as the imported 'Cartagena', produce big fruits. (See pictures 6 and 7). The latter has shown to be relatively tolerant to the Bunchy Top disease in preliminary tests. The fruit of 'Cartagena' (Brix 11) is big and has a yellow sweet pulp. Its weight ranges from 3 to 10 or more pounds. This cultivar is good for processing as well as for the local fresh market.

The 'Solo Hawaiana' (See picture 8) is an improved 'Solo papaya' which produces a high number of fruits, of very high quality. The pulp is very sweet (Brix 14), pink in color and very firm. The Fruit ranges from one (1) to two (2) pounds depending on the line of selection. Each plant, however, produces very uniform fruits. The quality, productivity, size and the relative tolerance to virus and virus-like diseases, in Barbados, of the Solo Hawaiana, put it as the number one choice when recommending cultivars for the export market. Other selections of 'Solo' tested in this island are very susceptible to 'Bunchy top' and 'Distortion ring spot virus'.

The 'Homestead' is a round shaped papaya of a very high quality and productivity. (See pictures 9 and 10). The fruit pulp is sweet and yellow. The pleasant flavour and the 'bouquet' are factors of the high quality of this cultivar. The 'Homestead' fruit is so sweet that the Brix can reach as much as 18.

## PESTS AND CONTROL

World wide, the most important pests that affect Papaya are

- The papaya fruit fly *Toxotrypana curvicauda*
- The papaya webworm *Homolopalpia dalera*
- The papaya Whitefly *Trialeuroides variabilis* and
- The papaya leafhopper *Empoasca papayae*

The first three (3) pests have not been reported in Barbados. The papaya leafhopper is the main vector of 'Bunchy Top', and there its importance.

Other pest of minor importance known to occur in Barbados are aphids, scales mites and nematodes.

The *Aphis spiraeicola* is the major vector of the papaya mosaic virus.

Mealy-bugs (*Pseudococcus* sp) sometimes build up to a high population and affect papaya.

Birds are a major pests of all fruits in Barbados, especially the Brown Sparrow *Loxigilla noctus*) and the yellow sparrow (*Coereba flaveola*)



Monkeys can be responsible for substantial losses of Papayas fruits, to which they are very attracted. They can be serious pests particularly in non-urban areas. Harvesting the fruits before they turn yellow reduces the chances of monkey attack.

The control of pests in Papaya should be mostly directed to keep away the vectors of virus & virus like diseases because they constitute the major limiting factor to grow this crop in Barbados.

However most Pyrethroids used to control leaf hoppers will have also effect in other pests. They include Decis, Ambush, Belmark, Sherpac, etc.. The Organo-Phosphates, such as Malathion, also provide good control of the leaf hoppers and some scales.

Systemics insecticides are also helpfull, specially when it is difficult to reach the top leaves of the tree. They include Metasytox-R, Anthio, Orthene, Furadan, etc.

When spraying with contact insecticides, special care must be taken to cover the undersides parts of the leaves as these could be sometimes folded over protecting the offending pest.

## DISEASES OF PAPAYA

'Bunchy Top' is by far the major disease of Papaya in Barbados (See picture 11). Its is caused by a mycoplasma organism, and its effect could be so devastating that the entire orchard may be destroyed before any fruit can be harvested.

The 'Bunchy Top' is transmitted by the Papaya leafhopper (*Empoasca papayae*). Other Empoasca species such as *E. dilitaria* have been suggested as possible vectors. The control of the vector(s) is the most economical control measure. The selection of tolerant cultivars guarantee that at least a considerable amount of fruits can be harvested before the plant is affected.

The practice of cutting back the affected plants and letting the trunk reshoot, have shown erratic results. The new growth may or may not produce a crop before being affected again (See pictures 12 and 13). The best results are obtained when the plants are cutted back in slant, about one foot from the ground, as soon as the first symptom of Bunchy Top appears.

Once "Bunchy Top" attack the plant the conversion of Carbohydrates to sugar practically stop. This is the main reason why fruits from affected plants are useless for the fresh market. However they can be used for processing where sugar is added.

The Papaya Mosaic Virus (PMV) and the Distortion Ringspot Virus (DRV) are of major importance in other areas. In Barbados they are less known to affect papaya and their effect, if any, at this stage is only serious when associated in a complex with 'Bunchy Top'.

Other diseases of Papaya known to occur in Barbados are

- Anthracnose *Colletotrichum* sp
- Powdery mildew *Oidium* spp i. e. *caricae*
- Root or Foot Rot *Phytophthora* sp
- Fruit Rot *Phytophthora* sp

The Anthracnose (See pictures 14 and 15) could be a serious disease if preventive measurements are not taken to control it in early stage. Benomyl (Benlate) is effective in its control. The double dipping method of hot and cool water (43 to 49°C. for 20 min.) is also effective in controlling this fungus, to avoid quick spoiling in harvested fruits. Modification of this method include the vapor of heat (43°C. 40% R.H. for 6 to 8 hours then 100% R.H. up to 47°C. for 4 hours.)

## USES

As fresh fruit, Papayas are most commonly eaten in breakfast. After lunch or dinner papayas are served as a dessert. They can be served alone or in combination with other fruits in fruit salads. The subproducts from processed papayas include Juice, Syrup, Nectar, Slices, Marmalades, Jams, Chutney, etc. The green fruits are used in making Pickles, Sauces, Conserves, etc.

Papain is an enzyme prepared from the dried latex of immature fruits. It is utilized in the preparation of cosmetics and meat tenderizers. The Papain is also used in the clarification of beer and as a drug for digestive ailments.

The young leaves, the seeds, the flowers and the young fruits are also used in preparation of different exotic dishes in several places around the World.

## NUTRITIONAL VALUE OF THE FRUIT

The nutritional value of the Papaya Fruit depends on the cultivar, the ecological factors during the development phases of the fruit and the maturing stage when it is consumed.

The datas presented below are given for 100 grams of the edible portion of raw, fullripened Solo Papaya.

### NUTRITIONAL VALUE OF THE FRUIT\*

Water:	88.7%	Phosphorus:	16 miligrams
Food Energy:	39 Calories	Iron:	.3 miligrams
Protein:	.6 grams	Sodium:	3 miligrams
Fat:	.1 gram	Potassium:	234 miligrams
Carbohydrate		Vitamin A:	1750 Int. Unit
Total:	10 grams	Thiamine:	.04 miligrams
Fibre:	.9 grams	Riboflavin:	.4 miligrams
ASH:	.6 grams	Niacin:	.3 miligrams
Calcium:	20 miligrams	Ascorbic Acid:	56 miligrams

\* Source: HANDBOOK of the Nutritional contents of Food. USDA. 1975.

## PICKING AND HANDLING

Papaya Fruits are delicate and highly perishable when ripe. In many places, including Barbados, the wrong practice of harvesting the Papaya Fruit when it turns to a complete yellow colour, is common. This practice reduces the shelf life of the fruit leaving less time in which the fruit can be marketed.

The fruit should be picked when the first yellow stripe shows up. Harvesting at this stage allows five (5) to ten (10) days to full ripeness if kept cool and well ventilated. It will also be more tolerant to the common damage occurring during the transport (Bruising) and lengthens the time for the fruit to be marketed.

The External and Internal Quality, the Shelf life and the Market are affected by improper handling of the fruit and common mistakes when harvesting. Some of these mistakes are listed below:\*

- Harvesting of immature fruit.
- Leaving the fruit on the plant until it is overripe or oversized.
- Harvesting by pulling or twisting instead of using clippers or knives.
- Harvesting during high temperatures.

The proper Post Harvest care of the fruit is as well important. Some of the most common mistakes in Post Harvest are listed below.

- Exposure of produce to the Sun.
- Overheating of produce in bags (paper, plastic, jute).
- Overheating of produce during transport in non-ventilated vans or trucks.
- Storing produce at the wrong temperature or relative humidity.
- Mixing different types of produce with different temperature requirements.
- Leaving cold stores open.
- Packing and grading produce on the floor instead of using clean grading tables.
- Tight filling of cartons or boxes with rough interior or sharp edges.
- Multiple handling resulting in mechanical damage, bruising, rotting and so on.
- Rough handling of produce and cartons.
- Treating perishables like general cargo.

\* Source: Barbados Agricultural Statistical Information Service: October Report 1983.

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