

# Papaya Cultivation Guide

For small-scale papaya production in Guam



**UNIVERSITY OF GUAM**  
WESTERN PACIFIC TROPICAL  
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By Robert F. Bevacqua, Ph.D.  
and Jonae N. Sayama

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**WRITTEN BY** Robert F. Bevacqua, Ph.D.  
Jonae N. Sayama

**REVIEWED BY** Adrian Ares, Ph.D.  
Elizabeth Hahn  
Julia Hudson

**EDITED BY** Jackie Hanson

**LAYOUT BY** Conrad Calma

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## INTRODUCTION

There is much interest in growing papaya in Guam (Plate 1). It is a nutritious fruit that can be grown in a sustainable manner without the use of synthetic fertilizers and with minimal pesticides. The cultivation of this tropical crop can also contribute to island self-sufficiency in food production.

This publication is a guide to growing papaya on a small scale, either as a backyard crop or on ranches or rural properties. The publication is based on the author's experience as a professor of agriculture teaching his students to grow papaya at the University of Guam.

## BOTANY

The papaya is scientifically known as *Carica papaya L.* and is a member of the Caricaceae family. The CHamoru name is *papaya* (Topping et al., 1975). In some parts of the world, it is called *pawpaw*. Papaya is not a true tree but is a large herb. In this publication, for convenience sake, papaya will be referred to as a tree.



Plate 1: Many Guam residents are interested in growing papaya as a backyard crop.





Plate 2: Wild papaya trees are prevalent in Guam, but they produce little to no fruit.

## ORIGIN AND HISTORY

The origin of papaya is in tropical America. It was spread by the Spanish, first to the Philippines in the 1500s and to Guam in the 1600s. In a survey of plants useful to the CHamoru people in 1899-1900, Safford (1905) provides this description of papaya:

“In Guam, it appears spontaneously in waste places. Little attention is given to it by the natives. Though they eat it if other kinds of fruit are scarce, they do not appear to esteem it as an article of food.”

It has gained in popularity since Safford’s survey and is now a desirable food item.

At present, large numbers of wild papaya trees grow on the island (Plate 2). The seeds are spread by birds. These trees produce little to no fruit.



## TYPES

Papaya fruit can be classified into two main types: Mexican and Hawaiian. The Mexican papaya trees produce large, football-shaped fruit that weigh one to 10 pounds. The varieties recommended for cultivation in Guam are hybrids of the Mexican type. Hawaiian type trees produce small, pear-shaped fruit that weigh one to two pounds. They are often called “solo papayas” because the fruit are usually small enough to be eaten by one person alone. The Hawaiian type is not recommended for Guam because island consumers prefer the large-fruited Mexican type. Also, the Hawaiian type is more prone to diseases.

## FLOWERS: MALE, FEMALE, AND BISEXUAL

Papaya trees, based on the flowers they produce, can be categorized as male, female, or bisexual (also referred to as hermaphrodite) (Plate 3). Many of the wild trees in Guam, for example, are male and do not produce fruit (Plate 4). The many complications that can arise from having three genders can be avoided by planting the two recommended varieties for Guam. These seeds always produce bisexual trees with desirable fruit.



Plate 3: Papaya trees, based on their flowers, can be categorized as male, female, or bisexual. This photograph shows male flowers, which do not produce fruit.



Plate 4: Wild papaya trees in Guam tend to have male flowers and do not produce fruit.





Plate 5: The two recommended papaya varieties for Guam are "Red Lady," shown here, and "Tainung No. 2." Both are hybrids developed in Taiwan that produce bisexual flowers.

## RECOMMENDED VARIETIES

Two Mexican type papaya varieties are recommended for Guam: "Red Lady" and "Tainung No. 2" (Tuquero et al., 2016) (Plate 5). Both are hybrids developed in Taiwan by the Known-You Seed Co. The company's address is 114-6 Zhuliao Road, Dashu District, Kaohsiung 84043 Taiwan. The seeds are locally available in Guam at Guam Home Center in Dededo. These two hybrids offer many advantages:

- They are adapted to Guam's tropical climate.
- They are relatively resistant to plant diseases.
- Their flowers are always bisexual.
- Their fruits are large with red-colored flesh.
- Fruit from these types are in demand by island consumers.



## PROPAGATION

Papaya is cultivated from seeds that are started in trays with potting soil. At six weeks, the seedlings can be transferred to individual pots (Plate 6). At 12 weeks, they can be transplanted to the field.

## SOILS

Papaya grows well in a wide variety of soil types. They can produce acceptable yields even in soils of low fertility. A critical factor is that the soils are well-drained. Soils that puddle favor root rots that can quickly kill a tree.

## SITE SELECTION

There are several important factors to consider in selecting a site to plant papaya. These factors will have a major impact on the ultimate success of the planting:

- Abundant sunlight.
- Ample rainfall and/or irrigation through the year.
- Protection from strong winds.
- Removal of wild papaya trees from the surrounding area to prevent disease spread.
- Well-drained soil free from flooding or puddling.
- A secure area protected from thieves.



Plate 6: Papaya is propagated by seed. Seedlings can be transplanted into the field at 12 weeks of age.



## SPACING

The goal in spacing is to allow air to freely circulate around the canopy. This minimizes the threat of fungal diseases. It also allows sunlight to penetrate the canopy, which favors flowering and fruit development. Recommended spacing is eight feet by eight feet.

## PLANTING

Papaya can be planted at any time of the year, but the very best time is at the start of the rainy season, usually in May or June. A hole should be dug 18 inches deep. One pound of an organic fertilizer high in phosphorus, such as bone meal (7:12:0), and five pounds of material high in organic matter, such as compost or aged manure, are then mixed in the bottom of the hole with the original soil. Fertilizer treatments will be discussed in more detail in the following section. The site should be covered in mulch and watered generously. Mulching will be discussed in a following section.

## FERTILIZER

Greenhouse experiments conducted by agriculture students at the University of Guam clearly showed that organic fertilizers can dramatically increase papaya growth when compared to plants receiving no fertilizer (Plate 7). Fertilizers are materials that are typically added to the soil to supply nutrients or plant foods for the growth of plants. Two of the primary nutrients required by plants in Guam are phosphorus (P) and nitrogen (N). In the past, these two nutrients were provided by synthetic or commercial fertilizers, such as triple super phosphate, 0:46:0, and ammonium sulfate, 21:0:0. Both of these products are now known to contribute to water pollution and environmental degradation. For this reason, their use is no longer recommended. Instead, organic fertilizers and composts are recommended as alternate sources of nutrients. They are sustainable or environmentally friendly products made from recycled or natural parent materials.



Plate 7: Potting soil reinforced with one-half cup of bone meal, 7:12:0, per gallon of soil, results in seedlings superior to those without this organic fertilizer.

A general characteristic of Pacific Island soils is a deficiency of phosphorus, and this is especially true for Guam's soils. To address this deficiency, prior to planting it is recommended that one pound of an organic fertilizer high in phosphorus, such as bone meal, 7:12:0, be mixed into the root zone. This is a product made from dried and pulverized pig bones.

Organic matter (OM), or humus, is the portion of the soil that is made up of decayed plants and animals. OM usually accounts for only a small percentage, i.e., 3% of the total soil volume, but has a strong effect on soil qualities and plant productivity. The gradual decomposition of OM, most importantly, releases nitrogen into the soil that is available for absorption by plants. Twice-a-year applications of materials rich in decomposed plant material are needed



to maintain adequate levels of OM in the soil. In Guam the best material to apply is compost – either broadcast and raked into the top soil or applied as a thick layer of mulch. (See following section on mulch.) Alternative materials could be aged manures, leaf litter, or grass clippings. The minimum application should be 22 pounds per tree twice-a-year. An alternative method of supplying nitrogen is to broadcast blood meal, 12:0:0, under the drip line, twice-a-year, at a rate of one to two pounds and rake into the surface soil. The blood meal fertilizer and compost can be applied at the same time.

Foliar sprays can be used to supplement a fertilizer program. A recommended product is fish fertilizer or fish emulsion, 5:1:1, that can be mixed at a rate of 2 Tbsp. in one gallon of water. The mixture is then sprayed on the leaves or applied as a soil drench. Fish fertilizer is especially useful when growing young plants in the greenhouse or nursery.

## MULCH

A mulch is a layer of material applied to the surface of the soil (Plate 8). Reasons for applying mulch include conservation of soil moisture, improving



Plate 8: A mulch is a layer of material, preferably compost or leaf litter, that is applied to the surface of the soil. Reasons for applying mulch is to conserve soil moisture, improve soil health, provide nitrogen, and reduce weed growth. This photo shows an acceptable, but less desirable, mulch of shredded copy paper.



fertility and health of the soil, reducing weed growth, and enhancing the visual appeal of a planting.

The better mulches are organic in nature. Some examples of organic mulches are compost, leaf litter, and aged manure. The very best mulch is compost. Composting is a natural process that breaks down plant waste into a soil-like material, rich in organic matter, that can be used as a mulch or a soil amendment to improve soil qualities. Green waste or yard debris, such as leaves, grass clippings, and chipped branches, can be used in making compost. A compost mulch is applied in a layer several inches thick beneath and around the tree twice a year. Soil productivity will improve as earthworms and other organisms incorporate the compost into the soil.

### **IRRIGATION**

During the dry season from December through May, the trees would benefit from irrigation. Drip or micro irrigation is the recommended technique for providing water to the root zone. Irrigation may extend the harvests into more months of the year. During the wet season from June through November, rainfall is generally sufficient for tree growth. No irrigation is required. During the dry season, growers in northern Guam will find it necessary to irrigate frequently. On the Big Island of Hawaii, growers with well-drained soil will apply 10 gallons of water per tree per day to bearing trees in order to maintain fruit production (Chia et al., 1989).

### **POLLINATION**

The recommended varieties, "Red Lady" and "Tainung No. 2," produce trees with bisexual flowers. This means the flowers contain both male and female organs and are capable of self-pollination. Honey bees or other pollinating agents are not needed.

### **CATFACING**

Catfacing or carpellody is when the developing fruit are deformed and are not



Plate 9: It is recommended to remove catfaced or deformed fruit and leave more room for desirably shaped fruit.

marketable (Plate 9). This disorder can be caused by a combination of factors – especially environmental ones. In Guam, it is thought to be aggravated by high moisture during the rainy season. As soon as it is apparent a fruit is catfaced, it should be removed.

### **FRUIT THINNING**

A bearing tree can become over-crowded with developing fruit. This can contribute to misshapen fruit. The problem can be alleviated by thinning or removing any deformed or catfaced fruit and leaving more space on the tree for marketable fruit.

### **SEASONALITY**

Papaya can be harvested throughout the year in Guam (Bamba et al., 2010), but fruit to be eaten fresh (ripe) develops best in the dry season months of January through May. The warm, dry



conditions of these months produce a very sweet fruit.

### **HARVESTING**

Fruit to be pickled or used in cooking should be picked at a mature green stage. Fruit to be eaten as a fresh fruit should be picked when a streak or splash of yellow or orange color appears on the green fruit (Plate 10). The fruit should then be allowed to shelf-ripen. Fruits can be picked by hand using a sharp knife. A plumber's helper or plunger (Plate 11) can be used to harvest fruit on tall trees. The goal of harvesting is to remove fruit with minimal damage to the tree. Fruit should never be allowed to touch the ground as this can generate rot diseases.

### **HANDLING**

Care should be taken at all times to avoid bruising the fruit. Shelf life can be extended by picking in the early morning, trimming the stems, bathing the harvested fruit in cold water for 10 to 15 minutes, and keeping the fruit in the shade at all times.

### **YIELD**

Trees begin to produce fruit at the end of the first year and continue to produce for two to three years. Production is highest in the first year of harvest and then gradually declines. A healthy tree can produce two to four fruits per week (Plate 12).

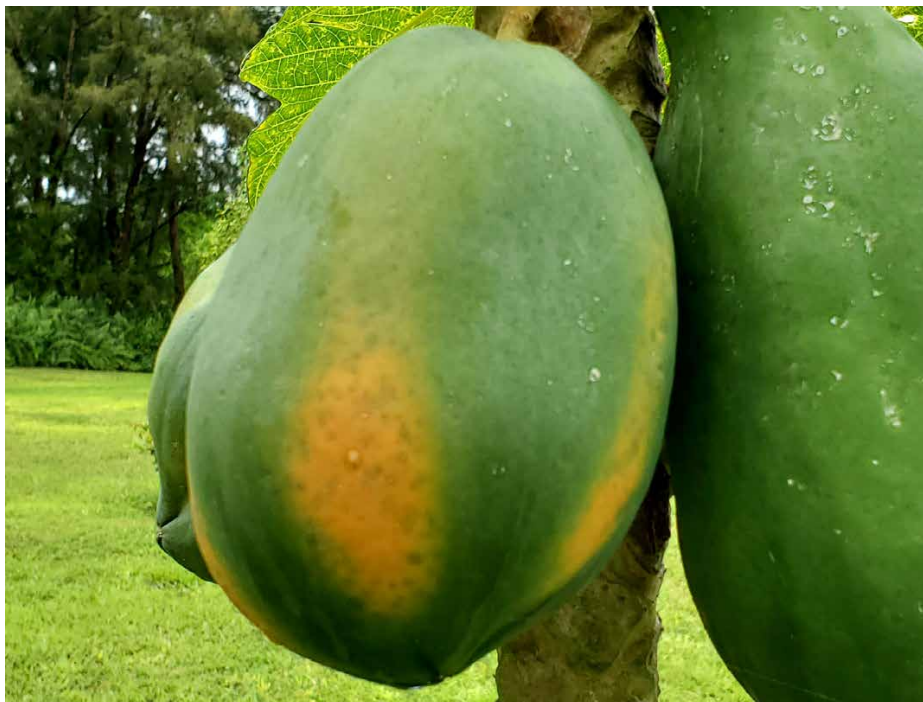


Plate 10: Fruit that is to be eaten ripe should be picked when an orange color emerges and allowed to shelf-ripen.



Plate 11: For harvesting, a plumber's helper or plunger with an extended handle can be used to pick fruit on tall trees.





Plate 12: A healthy papaya tree can yield two to four fruit per week for a period of one to two years.



Plate 13: There are many uses for papaya fruit. When mature green, they can be pickled or cooked as a vegetable or when ripe, as shown above, they can be consumed as breakfast or dessert fruit.

## USES

There are many uses for papaya fruit. When picked at a firm, green stage, the fruit can be pickled or cooked as a vegetable. When picked at color break, when yellow begins to show, and allowed to shelf-ripen, the fruit can be consumed fresh as a breakfast or dessert fruit (Plate 13). Ripe fruit can be dried or used in jams, fruit juices, or ice cream. Papaya seeds can be used in salad dressings. Meat tenderizer can be derived from the latex in green fruit. Deformed or catfaced fruit can be fed to pigs and cattle.

## DISEASES AND INSECT PESTS

The threats posed by diseases and insect pests can be minimized through careful site selection, the use of recommended varieties, and field sanitation. What damage does occur is often minor and growers are encouraged to tolerate it. The use of pesticides is typically not warranted. This policy of tolerating minor damage and avoiding pesticide use can promote the natural enemies of the pests and, eventually, lead to a desirable balance between pests and predators.



Occasional insect pests are scale, leafhoppers, thrips, mites, mealybug, and whitefly. Possible disease threats are of two types: fungal and viral. The former includes root rots, anthracnose, black spot, powdery mildew, and Phytophthora. The latter include papaya ring spot virus and papaya mosaic virus. Other occasional threats are giant African snails, wild chickens, and feral pigs.

### **THEFT**

A very real threat to fruit production in Guam is theft. Steps must be taken to protect the crop, or losses to theft can be significant. The threat begins in the nursery with the stealing of potted seedlings. This may be triggered by the high cost of seed. Ten grams of the recommended variety “Red Lady” cost \$90 in 2022. The threat reaches a peak when mature fruit are on the tree. The firm, green fruit can be easily stolen.

### **AGROFORESTRY**

Papaya is a good candidate for inclusion in an agroforestry planting (Plate 14). Agroforestry has deep roots in the Pacific Islands. It is a traditional island practice to integrate trees with crops and livestock (Elevitch and Wilkinson, 2000). For thousands of years agroforestry was one of the factors that enabled the isolated islands in the Pacific to be self-sufficient (Elevitch et al., 2014). Current guidelines for agroforestry for the Pacific Islands recommend a mix of plant species selected for their different heights and life spans (Elevitch and Logan, 2019). The result is a multi-story planting with several layers of vegetation. Papaya could be a short-term component of an agroforestry planting. It would provide fruit for a one to two-year period.



Plate 14: Papaya is a good candidate for inclusion in an agroforestry planting. This photograph of Triton Farm shows a windbreak of ironwood trees protecting a mixed planting of taro, banana, tapioca, calamansi, and breadfruit.



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