

# Growing Tomatoes on Guam.

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## **INTRODUCTION**

The tomato is one of the most popular vegetables in Guam. However, production is low due to low-yielding varieties, the lack of appropriate cultural practices and poor pest management. Many people from Guam and the Northern Marianas have indicated an interest in growing tomatoes that would do well in our environmental conditions. This publication is intended to guide and assist the homeowner or farmer in growing a successful tomato crop.

## **RECOMMENDED VARIETIES**

### **1. DETERMINATE VARIETIES:**

A determinate growth variety stops growing when it is about 3 feet high. It stops growing taller because the terminal bud produces a flower cluster and fruits. Most of these varieties are early maturing and are bushy in nature with short, stout stems.

Recommended varieties for Guam are: Lee's Plum, Royal Guam and Spring Giant. Lee's Plum and Royal Guam can be grown during either the dry or wet season. Production during the dry season is about eight times higher than in the wet season. In the wet season, low fruit setting and fruit number, high insect and disease damage, and cracked fruit are common. Spring Giant should only be grown during the dry season.

### **2. INDETERMINATE VARIETIES:**

An indeterminate variety will continue growing if you feed and take care of the plants well since the terminal bud continues to produce leaves, stems and flowers.

Recommended varieties for Guam are: N-11, N-63, N-65, and N-69. These four varieties can only be grown during the dry season.

## **PLANTING DATE**

The best season for growing tomatoes on Guam is from the end of October to late June. This extends from the end of the rainy season through the dry season. The best planting date for tomatoes is from the end of October through February. Lee's Plum and Royal Guam may be planted year round.

## **STARTING SEEDLINGS**

Tomato seedlings can be started in seedboxes, seedbeds, or in commercial pellets.

### **1. SEEDBOXES:**

A seedbox with a dimension of 20x15x4 inches (50x37x10 cm) is very convenient for backyard and small-scale tomato seedling production. The medium used to fill the seedbox should be an even mixture of sand, compost and garden soil to a depth of 3 to 3½ inches. Place seedbox in shade or full sunlight.

### **2. SEEDBEDS:**

For commercial farming, a seedbed 3 feet wide and 1.5 feet long (91.44 cm x 45.72 cm) may be prepared in an area fully exposed to sunlight. The seedbed should be thoroughly prepared to bring soil to a fine texture. The seeds should be sown thinly in shallow furrows (½ inch deep). Cover the furrows with soil and gently press the soil to prevent seed exposure when watering.

### **3. COMMERCIAL PELLETS:**

The commercial pellets (such as Jiffy-7) are the most convenient way to start the seedling. Peat pellets, usually consisting of peat moss and small amounts of fertilizer, are held together by a plastic netting. Peat pellets should be sprinkled with water for about 5 to 10 minutes until they swell to maximum size. Wait until they become moist and soft before planting seeds in them. Place them in shade or full sunlight. The net holding the peat pellet together should be removed before transplanting since it may restrict root growth.

## **CARE OF SEEDLINGS**

The seedbox, seedbed or commercial pellet should be moderately watered daily. Watering should be done in the early morning to prevent burning of plants. If the seeds are sown thickly in the seedbox or seed-bed, they should be thinned after 10 to 12 days from germination and/or when seedlings have developed the first true leaf. The seedling should be spaced 2x2 inches apart.

Starter solution (dissolve 2 tablespoons of 10-20-20 or 16-16-16 fertilizer per gallon of water) should be applied to the seedlings every 3 days, starting 2 weeks after germination.

## **SOIL PREPARATION**

For successful production, a soil pH range from 6.0 to 6.8 is desired. A soil pH lower or higher than the above range results in lower crop yields. A high pH or alkaline soil requires the addition of sulfur to lower the pH. If your soil pH is too low or too acidic, you will have to add lime to the soil. A light, well-drained and fertile soil is best suited for tomato production. A loam or clay loam is ideal because of a greater water holding capacity, good supply of organic matter and adequate mineral nutrients.

The field should be prepared by plowing to a depth of 6 to 8 inches to leave the soil with a fine texture.



## HARDENING SEEDLINGS

The seedlings which have been grown under shade conditions in the screenhouse or greenhouse must be hardened before you transplant them out to the field. Hardening is designed to let the seedlings get accustomed to the outdoor environmental conditions such as direct sunlight and high temperature.

It takes at least 4 days to harden the seedlings before transplanting them. The process of hardening involves cutting down watering and moving seedlings outside for exposure to the sunlight for a few hours each day.

## TRANSPLANTING AND SPACING

When seedlings are about 3 to 4 weeks old or about 8 inches tall, they are ready for transplanting. The best time to transplant is in the later afternoon or on a cloudy day to minimize wilting of the seedlings. The tomato seedlings should be set 4 feet between rows and 1½ feet between hills at a depth of 3 to 4 inches.

## FERTILIZER APPLICATION

Tomatoes need large amounts of nutrient supply throughout the growing season. Use a basic application of 1,000 pounds per acre (or 6 ounces per plant) of a complete fertilizer such as 10-20-20. The fertilizer should be applied in 3 split applications. Apply one-third of the fertilizer (333.3 pounds per acre or 2 ounces of fertilizer per plant) for the initial application at transplanting time. Apply it in 2 bands located 3 inches to the side and 2 inches below the level of the seedlings. You may also apply the fertilizer in furrows 4 inches deep one foot wide and uniformly till it in before transplanting.

The second application should be applied when the first tomato fruits form. The third application (the remaining one-third of the fertilizer) should be applied immediately after the second harvest. The second and third fertilizer applications can be placed in 2 bands 2 inches deep and 5 inches away on each side of the tomato plant.

## IRRIGATION

Generally, tomatoes need about 1 inch of irrigation water per week for steady growth. During the first week after transplanting, soil must almost be water saturated to permit a good start for a crop in the field. During the growth period of tomatoes, irrigation is done when necessary; usually 2 to 3 times a week during the dry season. The critical stages for which water should be applied are: during early vegetative growth, at flowering, and when the fruits have formed. A long, dry period without irrigation may cause shedding of flowers and young fruits.

## PRUNING AND STAKING

### 1. DETERMINATE VARIETIES:

Pruning or individual staking is not required for determinate varieties because of their bushy type of growth. However, a modified method of staking may be needed (as shown in Fig. 1). Tangantangan or wooden poles are staked out every 10 feet, 5 inches away from the plant on both sides. Two supporting lead wires are tied to the poles at a height of 1.5 to 2.5 feet above soil surface. The advantages of these supporting wires are: to give support for branches or fruits; to reduce disease injury by preventing fruit from contacting the soil; for more convenient pesticide spraying; and for higher yield.

### 2. INDETERMINATE VARIETIES:

Pruning and staking tomato plants are needed for the indeterminate growth. Various methods of pruning and staking follow, but pruning to a single stem and tying the plant to a stake is the most common. Pruning is done by removing suckers by hand or with scissors when they are about 1 inch long (as shown in Fig. 2). Suckers are the small shoots which grow between the main stem and the leaf petioles.

The staking method can be done in 2 ways: a) Tangantangan or wooden poles can be staked 10 feet apart with wires or ropes strung between these poles at 2 and 4 feet above the soil surface. Pruned plants are tied to the wires (as shown in Fig. 3); b) Each pruned plant can be tied tightly to each stake and tied loosely around the stem of the plant.

The advantages of pruning and staking for indeterminate varieties of tomatoes are: earlier ripening, higher yield, larger fruit size, easier harvesting, and easier access for spraying for insect and disease control.

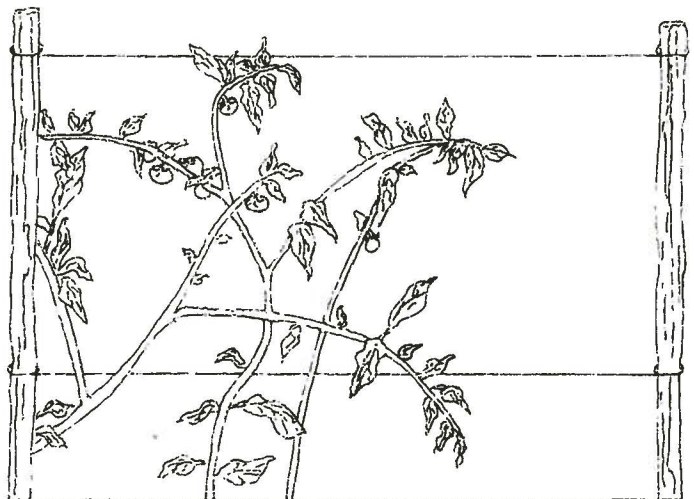


Fig. 1. Staking method for determinate variety. Two supporting lead wires are tied to the poles at a height of 1.5 and 2.5 feet above soil surface.

## WEED CONTROL

Weeds reduce tomato yields by competing for light, water, carbon dioxide and nutrients, and by serving as alternate hosts for pests and diseases. Good land preparation may serve as a control for weeds. Application of a pre-emergence herbicide such as Treflan is also an effective method.

During crop growth, shallow cultivation is required for weed control, and hand hoeing is the most effective method.

## INSECT PESTS

The major insect pests of tomatoes are listed below:

### 1. TOMATO FRUIT WORM:

The tomato fruit worm is the most destructive insect infesting tomatoes. Newly-hatched larvae crawl over the young leaves and stems and feed voraciously on the tissues. At fruit set, the larvae tunnel into the fruit. During severe infestation, fruits dry up and fall.

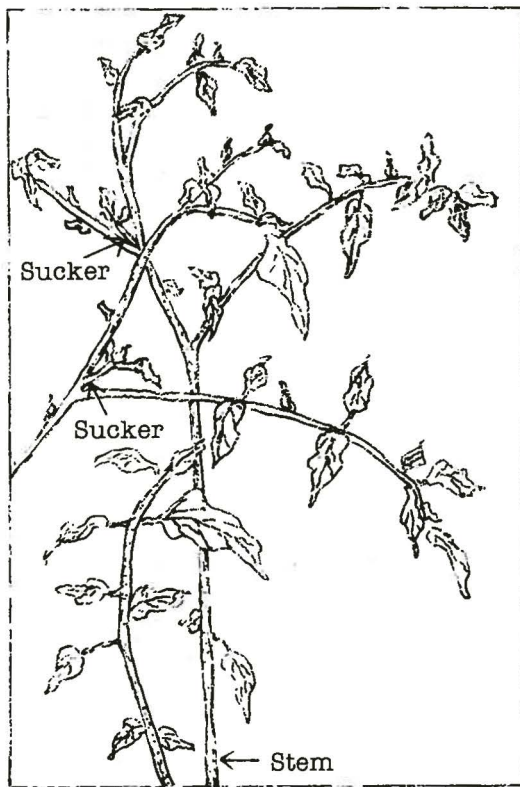


Fig. 2. Removal of suckers at an early stage for indeterminate variety.

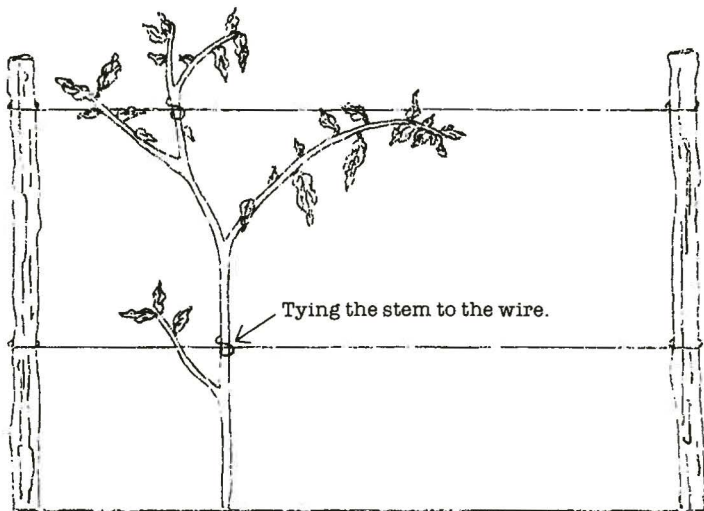
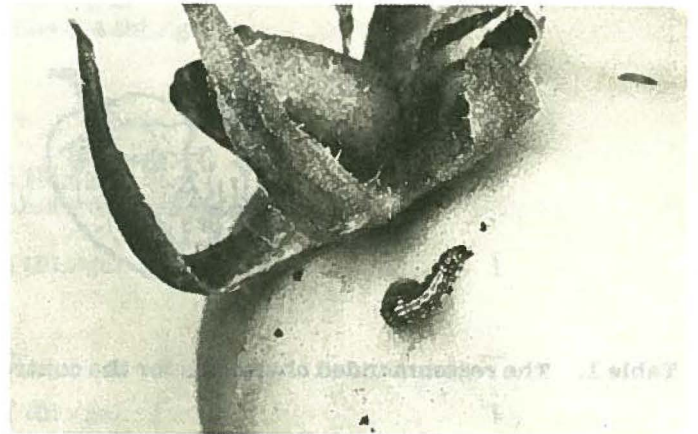


Fig. 3. Staking method for indeterminate variety. Two wires are strung at 2 and 4 feet above the soil surface and pruned plants are tied to the wires.





**2. PHILIPPINE LADY BEETLE:**

Both larvae and adults feed voraciously on the leaves, scraping succulent tissues away and leaving the thin epidermis and veins. When numerous, the plants are severely defoliated.



Adult

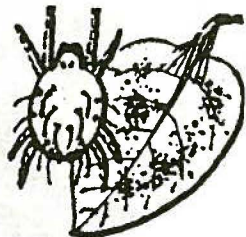


Larva

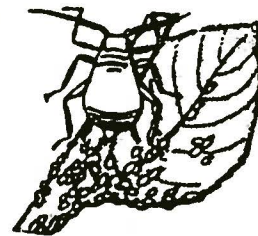
**3. BROAD MITE:**

Nymphs and adults feed by sucking the plant juices. Injured leaves will show pale mottling or striping on the upper surface and may be deformed or curled.

Broad Mite



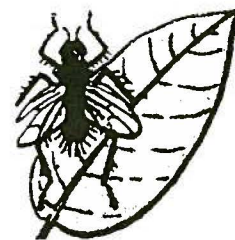
Aphids



**4. APHID:**

Aphids cause injury by sucking the cell sap of the plant. When numerous, the vigor of the plant is greatly reduced or stunted, and leaves curl down at the edges.

Leaf Miners



**5. LEAF MINER:**

Larvae feed between the upper and lower leaf surfaces where they make blisters, blotch mines or serpentine tunnels, removing leaf tissue and weakening the plant. This reduces yield.

The recommended chemical controls for these insect pests are shown in Table 1.

**Table 1. The recommended chemicals for the control of insects on tomatoes.**

Insect	Insecticide	Dosage	Minimum days from last application to harvest
Tomato fruit worm	Lannate L or Orthene	2 tsp./gal.	2
Philippine lady beetle	Sevin 50% WP	1 tbl./gal.	1
Broad Mite	Ethion 25% WP or Kelthane	2 tsp./gal.	2
Aphid	Malathion 50% EC	2 tsp./gal.	1
Leaf Miner	Diazinon Ag500, 4EC or Cygon 267 EC	2 tsp./gal.	1

## DISEASES

The tomato is subject to the attacks of many diseases affecting all parts of the plant including roots, leaves, and fruits. The common diseases found in Guam are listed below.

### 1. DAMPING-OFF AND ROOT ROT:

These are caused by soil-borne fungi. Young seedlings usually wilt and topple over. Another common symptom is small, brown, dry or water-soaked blotches on the stem at the soil line. The entire root system may be brown and rotted.

### 2. BACTERIAL WILT:

The disease is caused by bacteria. Symptoms of the disease are leaf wilting and the center part of the lower stem getting brown. When severely affected stems or roots are cut and allowed to stand a short time; a dingy gray to yellowish ooze; may appear from the darkened circle inside the stem.

**Table 2. The recommended chemical control for the diseases of tomatoes.**

Disease	Pesticide	Dosage	Minimum days from last application to harvest
Damping-off and root rot	Captan 50% WP plus Terrachlor 75% WP	2 tbl./gal. plus 3-4 tbl./gal.	0
Bacterial wilt	Not available*	—	—
Bacterial leaf and leaf spot	Dithane M-22 or M-45 plus Copper sulfate	1 tbl./gal. plus 2 tbl./gal.	1
Leaf mold	Dithane M-22 or M-45 or Manzate D	1 tbl./gal.	1
Mosaic	Not available**	—	—
Late blight	Dithane M-22 or M-45 or Manzate D plus Copper sulfate	1 tbl./gal. plus 2 tbl./gal.	1
Root knot nematodes	***	—	—
Fusarium wilt	***	—	—
Southern blight	Captan 50% WP plus Terrachlor 75% WP	2 tbl./gal. plus 3-4 tbl./gal.	0
Phomopsis fruit	Dithane M-22 or M-45 or Manzate D	1 tbl./gal.	1

\* prevent moving infected plants or soil from infested field to other fields.

\*\* remove infected plants from field and destroy as soon as symptoms are noticed.

\*\*\* use resistant varieties.



### 3. BACTERIAL LEAF AND FRUIT SPOT:

The disease is caused by bacteria. Small, odd-shaped, dark spots appear on leaves and stems. After some time, these spots develop a narrow, yellow border. On green fruit, the disease can be identified by small, water-soaked, scattered spots on the surface. They are surrounded by a light-colored band which disappears as the spot becomes light brown, sunken and rough.

### 4. LEAF MOLD:

The disease is caused by a fungus. The first symptom of the disease is the appearance of grey-colored spots on the top of the leaves that are at the bottom of the plant. The spots are small at first, but enlarge rapidly and turn yellow.

### 5. MOSAIC:

There are several mosaic diseases of tomatoes caused by viruses. Tomato (tobacco) mosaic is a serious problem on Guam. Generally, the virus causes light and dark green mottling (or various shapes) on the leaves. Infected plants are stunted and have low yield. It is highly contagious and is spread easily by humans having direct contact with infected plants. It also is transmitted by insects such as aphids and leafhoppers. Hands should always be washed with soap and water before handling plants to prevent spreading the disease. Infected plants should be immediately removed from the field. In simple terms, DON'T SMOKE WHILE TENDING YOUR TOMATOES!

### 6. LATE BLIGHT:

This disease is caused by a fungus. The infected plant first has pale green blotches on the leaves. The blotches enlarge rapidly. It is most severe during the wet season.

### 7. ROOT-KNOT NEMATODES:

Nematodes are round worms invisible to the eye which cause damage by feeding on the roots of plants. Symptoms of damage include stunting and wilting of the plant. Roots often reveal knots, twists, swellings, and black or decaying roots.

### 8. FUSARIUM WILT:

This disease is caused by a fungus that enters the plant through the roots and plugs the water system that travels through the root. The first symptom of disease is a slight wilt of plants during the day and a quick recovery at night. Leaves become yellow along the edges and between the veins. Plants become stunted and wilt severely during the day. The inside of the stem shows a reddish-brown color when cut.

### 9. SOUTHERN BLIGHT:

This disease is caused by a fungus. It produces an abundance of white surface material on the plant. There are also hard round bubbles that are brown in color at the base of the stem, near the ground. It chokes the main stem and causes a wilting of the tops and eventual death of the plant.

### 10. PHOMOPSIS FRUIT ROT:

The disease is caused by a fungus. It is carried in seeds and survives in crop debris and piles of soil. It can appear in a crop after living in the debris between crop plantings. Round, brown spots with a lot of black areas appear on the leaves. The fruit develops spots with pale sunken areas that gradually turn black.

The recommended chemical controls for these diseases are listed in Table 2.

## HARVESTING

The stage of maturity at which the fruits are harvested depends upon the purpose for which they are grown and the distance they are to be transported. Five stages of maturity are recognized. They are 1) immature green fruits - fruits have not yet reached full size; 2) mature green - fruits have reached full size and whitish green color shows on the blossom end; 3) turn - fruits show some pink color on the blossom end; 4) half-ripe or pink - fruits have developed full color but are usually firm; 5) ripe. The fruits intended for use as ripe fruit should never be harvested in a less mature stage than mature green and, where feasible, they should be allowed to reach the turning stage.

Because of the soft texture of tomatoes, they should be handled gently to avoid bruising and breaking the skin. Harvesting is accomplished by twisting the fruit from the calyx by hand.

## PRODUCING AND STORING SEEDS

You should never collect seeds from hybrid varieties for your planting since characteristics of the plant would not remain the same as the hybrid varieties in the next generation. Open-pollinated varieties, such as Lee's Plum and Royal Guam, are the only varieties recommended for seed collection from the parent plant in Guam. The procedures to produce seeds from the parent plants of open-pollinated varieties are as follows:

- Select the high quality fruits of tomatoes and harvest at the completely red ripe stage.
- Squeeze the fruits into pulp and place pulp with seeds into glass jars up to two-thirds of the volume of the jar.
- Cover the glass jar and leave in room temperature for 48 hours.
- Rinse the seeds with water several times until seeds are cleaned and completely free from pulp residue.
- Dry the seeds outdoors in direct sunlight or under light bulbs for 3 to 4 days until seeds are completely dry.
- Keep seeds in small sealed jars.

The seeds kept in the small sealed jars should be stored in a refrigerator. Well-kept tomato seeds will be viable for about 5 years.