



# Mango Tree Care on Guam

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## Preface

The original version of this publication, which still applies today for successful production of mango on Guam, was written by Victor T. Artero and Phoebe Wall. It was made available to the general public by the University of Guam Cooperative Extension Service in 1990. This updated mango tree care guide is a compilation of books and publications that includes the Mango Production on Guam (1993), Mango (1997), Compendium of Mango Diseases and Disorders (2003), Traditional Trees of Pacific Islands: Their Culture, Environment, and Use (2006), and Mango Growing in the Florida Home Landscapes (2013).

This guide is tailored for Guam's climate and offers suggestions on choosing what type of mango(s) you want to grow, the right location to plant the tree, preparing the site for planting and managing the mango tree for excellent fruit production. Thanks to Dr. Thomas Marler for his helpful suggestions on this publication. The formatting of this second version was done by Emily Shipp. September, 2016.

# Introduction

The Mango, known scientifically as *Mangifera indica*, is native to India, Myanmar, and other southeastern Asian countries.

It has been cultivated in India for more than 4,000 years.

The movement of mango throughout the world began with the beginning of commerce between Europe and Asia. There are more than 1,000 varieties worldwide and over 350 are propagated in commercial nurseries.

On Guam, the mango fruit is known as “mångga” in Chamorro, and the more popular varieties are Carabao, Haden types, and local varieties. Even though the color, odor and shape of a particular variety may be nearly identical, some characteristics such as thickness of the peel, size of the seedpod, diameter of the fruit flesh, overall size of the fruit, and taste, may vary.

This mango tree care guide provides information and the steps to grow and maintain a healthy, fruit-producing tree. The first and most crucial step is planning before planting. The planning stage involves determining what type of mango(s) you want to grow, choosing the right location to plant the tree, preparing the site for planting, and most importantly, managing the mango tree after planting. Maintenance after planting includes proper watering, fertilizing, pruning, and pest management which are all essential for the success of the tree over its lifetime.

## Description

Description Mangos are long-lived trees that are cultivated in tropical and subtropical areas of the world and can grow more than 5 ft. (feet) per year under ideal conditions. Trees can reach a height and canopy width of 100 ft., depending on the cultivar, but on Guam they rarely reach this size because of typhoons and tropical storms.

## Roots

Under optimum soil conditions tap roots can reach 20 ft. deep.

There are vertical and horizontal roots that usually extend beyond the leaf canopy of the tree. The roots offer support, anchorage and provide nutrients for proper growth.

## Leaves

The new set (flush) of leaves are colored yellowish, pink, deep-rose, or wine red. As they mature, they become dark green.

Oblong leaves vary in shape and size and can be rounded or have sharp tips.

## Flowers

Mangos can bloom sporadically year-round on Guam depending on the variety and weather, but generally flower between December and April (Fig 1). Mango flowers grow on loosebranching flower clusters called panicles. They produce two types of flowers; males provide pollen and hermaphrodites (with both male and female flower parts) produce the fruit.



Figure 1. Mango panicles and flowers.

## Soil

Trees tolerate a range of soil types but prefer deep soil with good drainage.

## Spacing

In a home landscape, plant a seedling or tree at least 25-30 ft. away from buildings, concrete sidewalks, power lines, near overhead or underground utilities or other trees. Commercially, tree spacing may be 20-40 ft. between trees but may vary depending on variety and soil conditions.

## Watering

Newly planted mango trees should be watered every other day for the first week and two times a week until rainfall is sufficient. Small trees need about 1/2 in. (inch) of rain every 3-4 days. If no rain has fallen during that period the tree will need to be watered. Established juvenile plants need infrequent, deep watering during dry periods. For established mature trees, supplemental irrigation is recommended after flowering, particularly during extended dry periods.

## Flower and Fruit Production

For optimum flowering and fruiting, the mango tree requires distinct rainy and dry seasons. The dry season should be long and uninterrupted for good flower production. The dry weather will also help with good fruit “set” and decrease the amount of fungal disease on the developing flowers and fruits. Depending on the variety it takes 100-150 days for the fruit to mature after flowering. The yield from the tree depends on variety, spacing, age of tree, fertility, and weather. In some parts of the world mangos can produce 800-3,000 fruits/tree. However, on a good year in Guam each mango tree bears an average of 200-300 fruits.

## Propagating Mangos

Mangos are propagated sexually (by seed) or asexually (grafting and airlayering). Starting a plant from seed is much easier but the seedling will most likely not be like the mother plant and may take 10-12 years to bear fruit. A plant propagated asexually will bear fruit in 3-5 years and the plant will be true-to-type, or a “clone” of the mother plant.

## Sexual Production

Mango seeds are either monoembryonic (a seed with one embryo that produces one seedling) or polyembryonic (a seed with multiple embryos and seedlings). Most Indian mangos, such as Haden, are monoembryonic that are usually not true-to-type because they have genes from both parents. The effects are not seen until the seeds eventually become mature plants. Mangos from Southeast Asia, such as Carabao, are primarily polyembryonic and produce offspring that are usually genetically the same as the mother tree.

## Scarification

When planting mango seeds they should be “scarified”, to make shallow incisions so germination will occur quicker than if the seeds are planted directly into the soil. There are several ways to scarify mango seeds. The following methods are used to ensure seeds infected with seed weevils are not planted. One method is to carefully remove all the pulp from a fully ripe mango fruit with a sharp knife. Then carefully cut across the thin side of the seed husk to break it open (Fig 2). Be careful not to cut too deep and damage the seed. Carefully open the hard, thick seed husk and remove the mango embryo to insure that there are no mango seed weevils inside. If the seed is free of weevils it can be planted (Fig 3).



Figure 2. Split seed husk on the thin side.



Figure 3. Remove seed for planting.

## Planting a Seed

After preparing the seed it should be planted in a pot immediately. After the second day, the germination rate reduces rapidly after the seed husk is opened. The concave side (belly button side) of the seed should be facing down and planted approximately 4 in. deep, preferably in a two-gallon pot with good potting mix and good drainage.

## Asexual Propagation

When propagating mangos asexually, the identical variety as the mother plant will be produced. The two most common ways to asexually propagate mangos are grafting and air layering, also known as “marcotting”. On Guam, the terms “grafting” and “air layering” are often commonly misused.

Grafting involves the union of a healthy detached bud or shoot (scion) from the branch of a desired healthy mature plant with a healthy seedling (rootstock) or a healthy trunk of a mature tree (top working). Generally, the upper portion of the rootstock is removed completely and is replaced with the scion. Seedlings that are grafted can produce mango fruits in as little as 3-5 years. Two of the easiest ways to graft mango are wedge grafting (Fig 4) and side approach grafting (Fig 5).

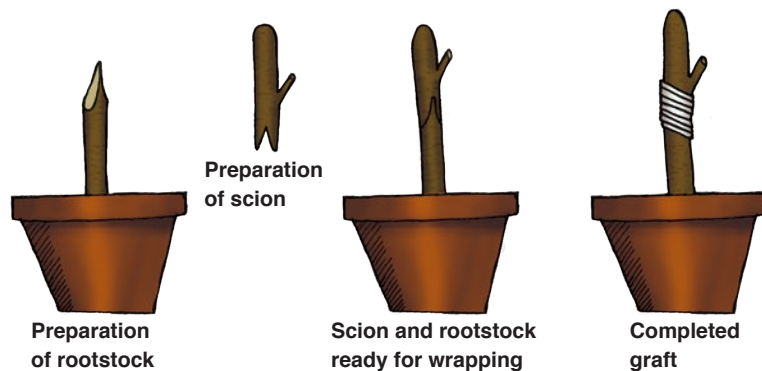


Figure 4. Wedge graft.



Figure 5. Side approach graft.

Air layering, on the other hand, is a method of producing a new plant by initiating roots on a stem. When air layering, the stem is girdled - complete removal of a strip of bark (Fig 6A), covered with moist peat moss or soil (Fig 6B), enclosed in plastic or foil, and securely tied at each end (Fig 6C). This will prevent water from entering the root ball and rotting the growing roots. After the root system has developed on the stem in 2-3 months (Fig 6D) it is severed below the root ball and planted in a pot.

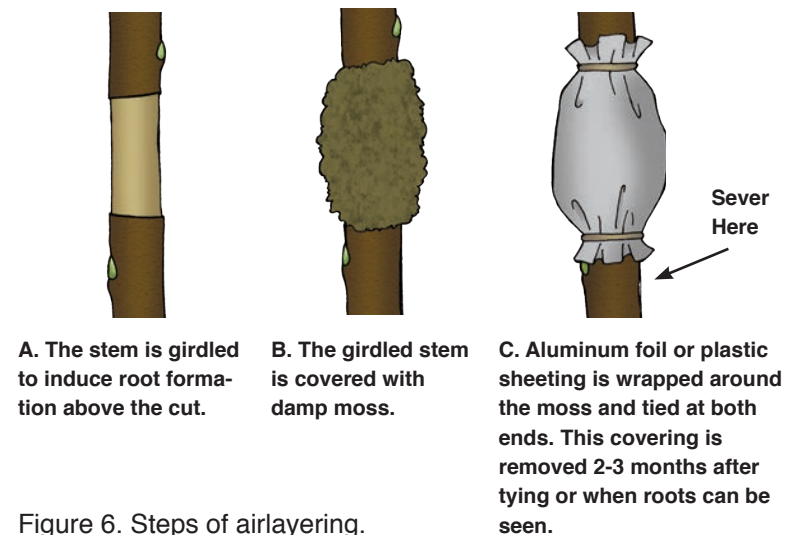


Figure 6. Steps of air layering.



Figure 6D. Developed airlayered root system.

### Planting

Planting a young mango properly will provide the tree with what it needs to grow rapidly and establish a strong canopy. It is highly recommended that mango seeds be first planted in a pot rather than planting directly in soil. Seedlings should be grown in at least two-gallon pots to avoid the plant from becoming root bound. After the plant has reached a height of 2-4 ft., it should be transplanted into the ground. The planting hole should be at least twice the diameter of the pot. The depth of the hole should be no deeper than the depth of the root ball. It is not necessary to add fertilizer before the plant is placed in the hole. After transplanting, fill the hole with excavated soil until the top of the root ball is even with the existing soil line (Fig 7). Water the plant thoroughly after transplanting. Preferably, the transplant should be planted at the beginning or during the rainy season (July through November) to take advantage of the free water.

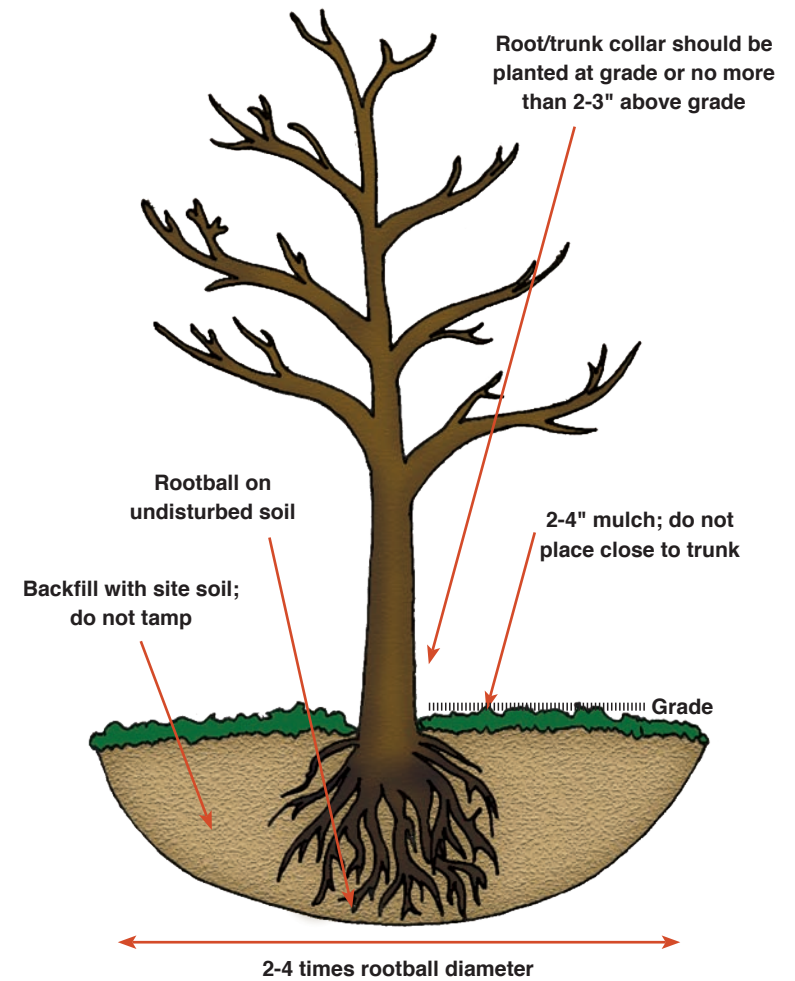


Figure 7. Planting a mango tree.

### Pruning

A mango tree usually does not require pruning when growing. However, selective pruning or training of limbs at a young age will help develop a strong manageable canopy height and width for mango trees grown in a home landscape or an orchard. Yearly pruning maintenance will also improve mango tree health by allowing air and sunlight to penetrate into the canopy, reduce pest and disease problems, enhance fruit color, and allow for easier fruit harvesting.

## Common Pests of Mango

There are numerous pests of the mango but only a few cause significant damage. Pests such as insects and diseases that cause significant damage are called “economic” pests. If the damage caused by a pest reduces a plant’s potential production by an amount greater than the cost of treatment it is considered an “economic” pest. In this section, only those diseases and insect pests of mango having economic significance are discussed.

### Disease Pests

University of Guam College of Natural & Applied Sciences (CNAS) plant pathologists have reported many different diseases of mango on island. A fungal disease called Anthracnose, however, is by far the most economically important disease affecting mangos on Guam (Fig 8). The other diseases, such as scab and algal leaf spot/lichens although found infecting mango plants, create less economic damage to date.



Figure 8. Anthracnose on mango.

### Insects and Insect-like Pests

Almost 40 different insect pests of mango have been reported on island by CNAS entomologists. Some insects cause relatively minor damage, whereas others can severely reduce yield. Many insects that attack the mango can be found attacking other plants, as well. Insects that cause significant damage to mango include the fruit piercing moth, mango blotch miner, mango bud mite, mango shoot caterpillar, mealybugs, red banded thrips, seed weevil, and scales.

There are two other insects that commonly fly around mango trees and are often mistaken as economic pests. Flies (Fig 9) and a large, black beetle are seen frequenting mangos, especially during flowering time. One should not be alarmed if flies are seen hovering around mango flowers because they spread pollen that is necessary for fruit production. If certain insecticides are sprayed on the tree, these beneficial pollinators may die and fruit production will be decreased. The large black beetle, called the oriental flower beetle (*Proteatia orientalis*), flies around like a bumblebee and is not usually considered an economic pest of mango; contrary to popular belief. While feeding on pollen, however, it can break off flowers due to its weight.



Figure 9. Fly pollinator.

## Fertilizers

Most fruit trees can survive in the environment without additional fertilization. However, mango trees, as well as other plants, generally need a complete fertilizer (Fig 10) to maintain or improve the health of the tree, enhance growth, increase yields, and reduce pest problems.



Figure 10. Bag of a complete fertilizer.

The application of fertilizer varies with the age of the tree and the type and condition of the soil. Young non-bearing and fruit-bearing trees require some type of complete fertilizer such as 16-16-16, 10-20-20, or 10-30-10 on a regular basis. The numbers on the fertilizer bag represent the content of three primary elements: % Nitrogen (N), % P<sub>2</sub>O<sub>5</sub> (Available Phosphate), and % K<sub>2</sub>O (Soluble Potash), respectively on a percentage basis. All are needed for healthy, productive mango trees. For example, a 30 pounds (lbs) bag of a 10-20-20 complete fertilizer contains 3 lbs N (10% x 30 lbs), 6 lbs P<sub>2</sub>O<sub>5</sub> (20% x 30 lbs), and 6 lbs K<sub>2</sub>O (20% x 30 lbs). The remaining contents are generally inert materials and sometimes include other secondary and trace elements used by plants.

Do not use a complete fertilizer that has a higher percentage of nitrogen than phosphorus and potassium for fruit trees because nitrogen encourages leaf growth at the expense of fruit and root production. Fertilizers high in N are generally recommended for use on leafy crops, such as leafy greens and green herbs.

## Fertilizer Application

Table 1 shows how much complete fertilizer to apply to young, non-bearing mango trees and Table 2 shows how much complete fertilizer to apply to mango trees that are bearing fruit.

**Table 1. Fertilizer program for young non-bearing mango tree.**

Year	Times/Year	Amount per Tree Application (lbs) 10-20-20 <sup>1</sup>	Amount per Tree Application (lbs) 16-16-16 <sup>1</sup>
1	6	0.5 lbs 3 lbs/year	0.25 lbs 1.5 lbs/year
2	6	1 lbs 6 lbs/year	0.5 lbs 3 lbs/year
3	6	2 lbs 12 lbs/year	1 lbs 6 lbs/year
4	4	3 lbs 12 lbs/year	1.5 lbs 6 lbs/year
5	4	4 lbs 16 lbs/year	2 lbs 8 lbs/year
6	4	5 lbs 20 lbs/year	2.5 lbs 10 lbs/year

<sup>1</sup>Total amount of a complete fertilizer to be applied for the year.



**Table 2. Fertilizer program for bearing mango trees. Apply 1/2 pound of (10-20-20) or 1/4 pound of (16-16-16) complete fertilizer per foot of tree canopy diameter per year.**

Time of Application	Amount per 30' Tree	Amount per 30' Tree	Amount per 40' Tree	Amount per 40' Tree
	Canopy 10-20-20	Canopy 16-16-16	Canopy 10-20-20	Canopy 16-16-16
After harvesting all fruit apply 1/2 the amount of fertilizer for the year	7.5 lbs	3.8 lbs	10 lbs	5 lbs
Apply 1/4 of the amount of fertilizer two months later	3.8 lbs	1.9 lbs	5 lbs	2.5 lbs
Apply 1/4 of the amount of fertilizer two months later	3.8 lbs	1.9 lbs	5 lbs	2.5 lbs
<b>Total</b>	15 lbs yearly	7.5 lbs yearly	20 lbs yearly	10 lbs yearly

Application of fertilizer for existing mango trees may be done either topically or as in-ground spot applications. Topical applications involve the even distribution of fertilizer on the soil surface under the tree and away from the main tree trunk. Preferably, concentrate the application of fertilizer within the circumference of the edge of the leaf canopy or “dripline” (Figure 11). It is advisable to water fertilizer in thoroughly after it is applied to get the nutrients into the soil as soon as possible so they are not lost into the atmosphere. For medium to large size mango trees apply the fertilizer 1 ft. toward the tree trunk from the dripline in a circular (band) fashion.

In-ground spot application of fertilizer involves digging numerous holes 2-3 ft. apart along the dripline. Deposit fertilizer, about 1-2 tablespoons per hole, cover with soil and water moderately. Spot application, while it requires more work, makes more efficient use of the fertilizer. In-ground spot applications have less chance of

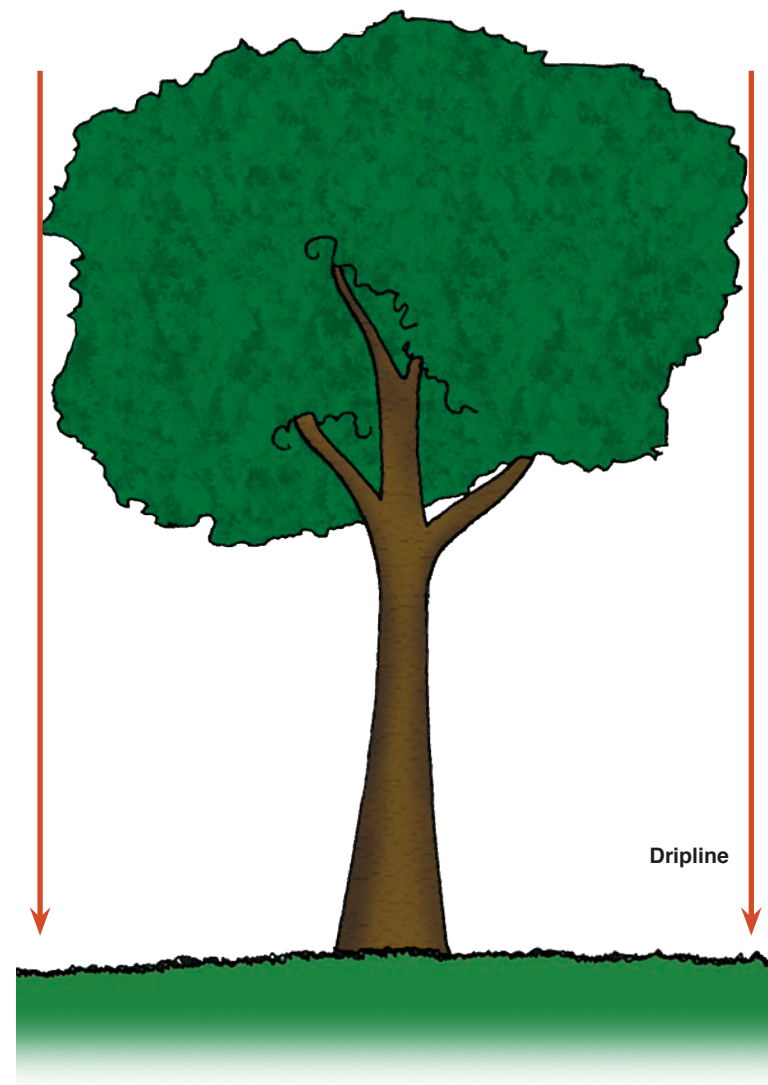


Figure 11. Tree dripline.

fertilizer loss, especially nitrogen. The fertilizer should be covered up with soil promptly and watered in.

## Flower and Fruit Problems

The production of flowers on a mango tree is necessary for consistent fruit production and is the main objective for homeowners and commercial producers.

### Reasons for Poor Flowering\*

1. The tree may be too young to flower. Trees grown from seed may take 10-12 years before they have the ability to flower whereas grafted trees usually take 3-5 years.
2. The tree may be out of season. Sometimes mango trees flower sporadically in response to sporadic climate and weather changes. When this happens, it will usually not flower as well during the regular flowering season.
3. The variety may be poorly adapted to Guam. Many mango varieties have specific requirements for inducing flowering naturally. Consistent flowering of mango trees on Guam with its humid, wet climate is dependent on planting varieties that flower well. Mango trees flower best where a prolonged, severe dry season is common every year.
4. The tree may have had excessive vegetative growth prior to the flowering season. This can be caused by too much nitrogen from fertilizing or new organic matter that was added to the soil.

\*Information provided by Marler, T. E. 1993. Mango Production on Guam.

### Reasons for Poor Fruit Production\*

1. Poor flowering.
2. Poor fruit set from poor pollination or other reasons.
3. Anthracnose disease.
4. Poor nutrition of the tree.
5. Insect damage.

6. Unfavorable weather such as heavy rain, high winds or a typhoon at the time of flowering and when the fruits are small, will cause poor fruit production.
7. Biennial (every other year) or erratic bearing. Many seedling mango trees are prone to erratic or biennial bearing.
8. Too much shade. Mango trees require full sun for optimum fruit production.

\*Information provided by Marler, T. E. 1993. Mango Production on Guam.

## Forcing Mango Trees to Flower

Some well established non-bearing mango trees can be forced to flower by treating the mature branch buds on the tree with a weak spray solution of fertilizer. The two types of fertilizers that can be used are potassium nitrate and sodium nitrate. The fertilizer inducers cause the mango tree to release ethylene which is a plant hormone that directs growth and development. Hence, the production of ethylene forces the buds to produce flowers. The effectiveness of inducement depends on several factors such as:

1. Health - trees must exhibit vigor and good growth. If a tree appears weak and needing nutrients for overall growth, assist the tree by applying complete fertilizer at least 6-8 weeks prior to actual inducement (refer to the section above on Fertilizers).
2. Old enough - grafted trees originated from seedlings must be at least 3 years old from date of grafting or 5 years old if tree is planted from seed.
3. Physical Characteristics - trees should not be in the flush stage; that is, trees should not exhibit predominance of new, young, and tender leaves, but rather mature and hardened leaves (crisp condition). Additionally, the buds on the branches must have a hardened appearance and exhibit growing or protruding points.

4. Weather conditions.
5. Proper application of fertilizer flower inducer.

### Application of Fertilizer Inducer

After thoroughly checking for proper tree conditions, the following fertilizer flower inducer application and precautionary steps are highly recommended. First, the weather should be ideal for spraying, such as a dry day with little wind. Avoid inducement during the rainy season as disease and insect problems will be prolific during this time thus greatly reducing flower retention. Second, identify locations of hardened buds on the tree. Third, select no more than two-thirds of the identified hardened buds for fertilizer application (less for Haden because of the heaviness of the fruit). Fourth, for proper application, direct the spray mixture of fertilizer to the selected hardened scions and immediate leaf area. Refer to Table 3 for suggested inducers and rates. One must adhere to suggested precautionary measures to assure greater flower inducement success and prevention of tree injury.

**Table 3. Suggested Fertilizer Inducers and Rates**

Type of Mango Tree	Fertilizer grade
Haden	71 g sodium nitrate, plus 56 g potassium nitrate per gallon of water
Carabao and others	56 g potassium nitrate per gallon of water

### Caution

Injury and/or destruction to the tree may result if: (1) the fertilizer flower inducer is applied throughout the tree, and (2) the recommended rate is exceeded.

### For Further Information

For more information regarding mangos contact the College of Natural & Applied Sciences, Cooperative Extension & Outreach at the University of Guam at 735-2080.

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