A Guide to Growing Bananas on Guam

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Contents

Foreword

The original version of this publication was made available to the general public 35 years ago. Much of the information it provided still applies today for successful production of bananas on Guam. The updated information was input by Joseph E. Tuquero and Jesse P. Bamba. The formatting and printing of this second version was performed by Emily Shipp. 2015

Foreword to the Original

Bananas (*Musa spp.*) have been a traditionally important crop on Guam. In recent years, production has fallen primarily due to the introduction of serious pests from overseas. Bunchy top disease in particular is a threat to the island's plantings. The goal of this publication is to provide the technical information for reviving production. The publication stresses the importance of pest prevention and good field management. The information has been drawn from other areas of the Pacific and Asia, and has been adapted to meet the growing conditions of Guam. The preparation of this publication was a joint effort by the College of Agriculture and Life Sciences and the Department of Agriculture. The authors are indebted to the Dean of the College, Wilfred P. Leon Guerrero and his staff members: Gary Beaver, Frank Cruz, Lee Soliwoda, Lew Watson, Ed Pickop, Patsy Castro, and Marie Reyes. The authors are equally indebted to Director of Agriculture Antonio S. Quitugua, and his staff members: Victor Artero, Gonzalo Cruz, Segundo Bias, Betty Baza, and Barbara M. DeLaRosa. 1981.

Site Selection

The banana is a large tree herb native to the tropical regions of Asia and Africa, but is now grown throughout the tropics. Its commercial cultivation is confined to areas where a continuously warm, moist climate prevails. Temperatures on Guam are ideal for banana production, however, moisture deficiencies may exist. From November to April extended periods of dry weather may necessitate the need for irrigation. Between 1" - 2" of rain per week is considered optimum.

The best soils for production are the well-drained, deep, loamy soils of the flat lands. Because bananas are very sensitive to waterlogged soil conditions, it is important that a production site with well-drained soil be selected. However, poorly drained soils can be made suitable for production through proper management and cultivation. A wide range of pH values are acceptable for production, but 6.0-7.0 is preferred.

Another consideration when selecting a planting site is that of windbreaks. Winds of 60 mph can knock banana plants over, and sustained winds of 25-30 mph can cause severe leaf tearing. It is essential that shelter be provided if it does not exist (Figure 1.). The following tree species provide banana plantations adequate protection from prevailing winds:

1. *Casurina equisetifolia* - iron wood, gagu
2. *Thespesia populnea* - rosewood, binalo
3. *Artocarpus mariennensis* - seeded breadfruit, dokduk
4. *Calophyllum inophyllum* - palomaria, da'ok
5. *Persea americana* - avocado, alageta
6. *Mangifera indica* - mango, mangga

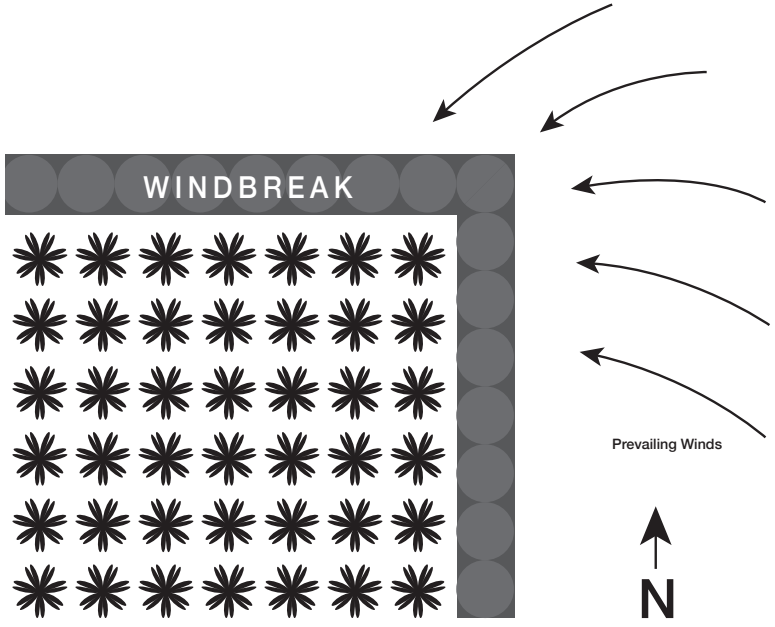

Fig. 1. Guam's prevailing winds blow from the East-Northeast. However, strong winds do come from all around in certain times of the year, and storm winds hit in circular motion from all angles depending on how a strom passes through the island. It is advisable that wind-breaks (shelters) are planted around entire fields, even in multiple rows, but at a minimum, shelters should be established on the North and Eastern exposures of the field to address potential wind damage from prevailing winds. A rule of thumb for wind breaks is: for every 10' of windbreak height, 100' of field is protected.

Land Preparation

Land preparation includes land clearing, site preparation, and soil preparation. If new land or land that has become overgrown with vegetation is to be planted, then the first task of the grower is to remove the unwanted vegetation. A bulldozer is the easiest method for clearing away tall, dense brush. However, growers should insure that the topsoil is not dozed away with the vegetation. Steeply sloping land with clay soils should not be cleared because it is very susceptible to erosion, and bulldozers should not be allowed to operate on a soil that is wet because this compacts the soil and may reduce yields. Although brush removal by hand is labor intensive, it is the most environmentally-friendly method to clear land for cultivation.

Site preparation and soil preparation activities usually occur simultaneously and normally follow land clearing activities, but this depends on each individual's management program. An example of an activities schedule is provided in Appendix 1.

Site preparation is the improvement of the land with fences, sheds, irrigation systems, and roads. The purpose of site preparation is to insure that all support systems for the plantation are close at hand and easily accessible. This is especially true with access roads and the water systems which are crucial to a successful plantation.

Soil preparation is very important during the planning and establishment phase of plantation development. The particular soil treatments and kinds of plowings selected are dependent on the previous history of the land. Newly cleared land may be prepared with one deep plowing, two discings, and one harrowing. Soils that have been compacted, or have impeded drainage should be ripped to break up hard pans or plow pans, thus allowing better water infiltration. If a field has been previously planted with bananas, it may be worthwhile to have the soil checked for nematodes and Panama wilt. If nematodes are a serious problem, preplant application of legally registered nematicides should prove effective, and may easily be applied prior to one of the discings. After the soil is ready for planting, tags should be placed where plants are to be set.

Propagation Material

Most types of bananas grown on Guam do not produce seed, therefore, the young plants which develop from the corm of the parent plant are used as propagation material. The corm is the underground portion of the stem of the plant. There are two different kinds of young plants: “sword suckers” and “broad-leaf suckers” which develop in established banana mats. A mat is a clump of plants.

The sword suckers are considered the best type of planting material because they bear earlier and tend to carry a heavier crop. They may be recognized by the long, narrow, bladed laves which have the appearance of a sword. When selecting sword suckers for planting it is advisable that they meet the following criteria:

A. The stem should be 5" wide at the base.
B. The suckers should not be older than six months.
C. Suckers should arise deep on the parent corm.
D. Sword suckers are best if the tapered leaves persist till the plant is 2' or more tall.
E. Suckers should be selected from disease free mats; particularly free of bunchy top.

Suckers that are larger than mentioned above will tend to give lower yields. Broad-leaf suckers, water suckers, or peepers, as they are sometimes called, usually lack vigor and are slower to bear. Other planting materials include: maidens, which are large, young plants older than six months that have not produced a bunch; and bullheads which are plants that have already flowered. With maidens and bullheads, usually only the trimmed corm is planted; the bullheads may be divided to obtain more planting material. There should be at least one good bud on each corm or on the section of corm being planted. When collecting planting material, only those shoots arising from mature vigorous mats that are apparently free from diseases and pests should be selected, and in accordance with the criteria set for sword suckers. Also, suckers should be selected away from the plant that is carrying fruit so as not to damage roots and hinder bunch development. (Figure 2.)

When digging the sword suckers, a mattock and shovel are useful tools. The roots of the sucker should be cut and the soil loosened around the corm; this allows for removal of the corm with minimum damage to the mat and the desired sucker. The separating cut should be made where the sucker corm joins the mother corm. The sucker is freed by gently pulling the banana seedling while lifting with the mattock. It is important to take all the corm that has developed on the sucker as this will provide needed food for the new plant. All tools should be cleaned with kerosene or diesel oil after lifting each sucker; this prevents the spread of diseases.

After the planting material has been dug it should be removed from the plantation for trimming. The roots and soil should be trimmed off until the white portion of the corm is visible. All red or discolored spots should be gouged out because these are sites where weevils and nematodes may be feeding. Seriously discolored or rotten corms should be discarded. The stem is then cut 2-3" above the corm and 2 layers of outer leaf sheaths are removed (Figure 2.). The seed corms are then allowed to air dry a few days. The finished corm should weigh 2-3 lbs.

This process of trimming is not traditionally performed on Guam, but if followed will result in a more uniform plantation with reduced disease and pest problems.

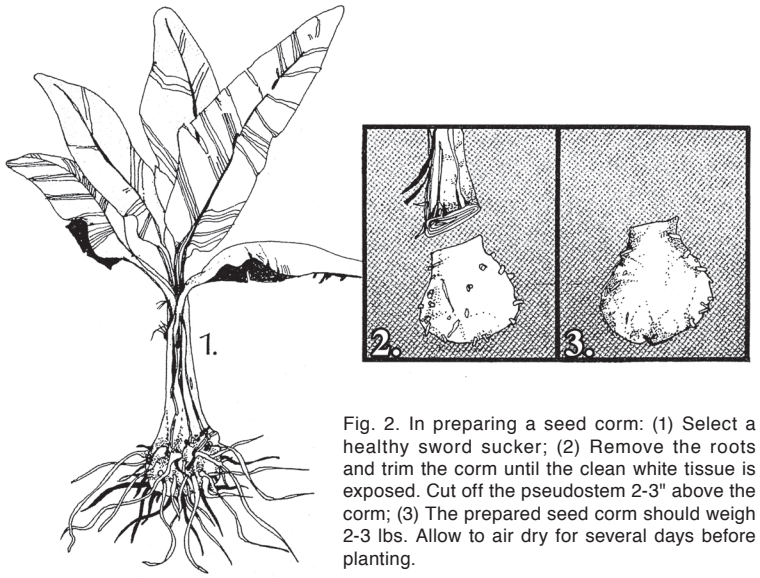

Fig. 2. In preparing a seed corm: (1) Select a healthy sword sucker; (2) Remove the roots and trim the corm until the clean white tissue is exposed. Cut off the pseudostem 2-3" above the corm; (3) The prepared seed corm should weigh 2-3 lbs. Allow to air dry for several days before planting.

Planting

Prior to planting it is important to thoroughly disinfect the planting material. This is done to prevent the introduction of parasites into the field. This disinfection process can be accomplished by a number of methods, including dipping the planting material in hot water at 122˚F-130˚F or a 10% bleach solution for 20 minutes.

After the seed corms have been treated they should be set out to dry. If this procedure of seed treatment cannot be performed it is suggested that growers pare and trim the corms, being sure to remove all dead or discolored tissue, then allow the material to air dry before planting. After treatment, the disinfected corms should be sorted into categories of equal size for planting. Disinfected corms should be kept well away from those not yet treated. By following this procedure growers will prevent the introduction of diseases and pests into their planting stock and plantations.

The hole where the seed corm is to be planted should be 18" deep and 18" wide. This is as deep as the length of an arm from elbow to fingertip. The bottom portion should be filled with a mixture of compost, chicken manure, one pound of 10-20-20 fertilizer and soil. The seed corm is placed in the hole and soil is packed tightly around the corm. Be sure the bud or sucker is pointing upward. The corm should be completely covered with

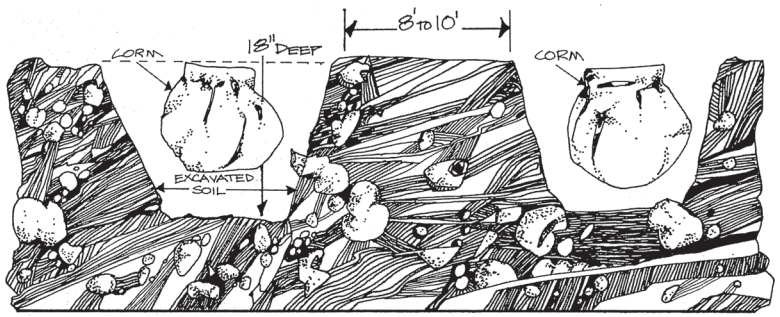

Fig. 3. The prepared corm is planted in an 18" deep hole. One pound of commercial fertilizer, such as 10-20-20, and ten pounds of dried chicked manure should be mixed into the excavated soil.

soil to prevent weevils from laying eggs in it. Insure that the soil is replaced to the original level. Figure 3 depicts a diagram of proper planting of corms. Within a month shoots should begin to emerge (Figure 4.). If more than one emerged, only the stronger should be allowed to continue; the rest removed with a mattock or shovel. Replanting may take place in 6-7 weeks after planting.

Fig. 4. Shoots should emerge from the planted corms within a month.

Various spacing are used in banana plantings. Variety, location, and machinery all affect the spacing selected. 8'x10', 8'x12', 10'x10' and 10'x12' are the more common spacing used and result in about 400-600 mats per acre. More than 700 mats per acre will result in lower bunch weight and a longer fruit maturation period.

Bananas may be planted at any time during the year. They generally flower in 10-15 months after planting. It is recommended that bananas are harvested between 3-4 months after full flowering. Experienced growers can predict the harvest date of their plantings to accommodate particular markets. This is an important consideration when market prices are fluctuating greatly. The plantation site, management and the variety grown will also affect the time needed for the crop to mature.

Plantation Management

After the crop has been planted a variety of activities must be performed in order to insure a successful plantation. Activities such as irrigation, weed control, fertilization, pruning, crop protection and pre-harvest bunch care are all important aspects to be considered (Figure 5.). Growers should attempt to prepare a schedule of activities that will be conducted over the production period. Although it is sometimes difficult to precisely schedule work activities, a general format should be outlined and adhered to. An example schedule is found in Appendix 1.

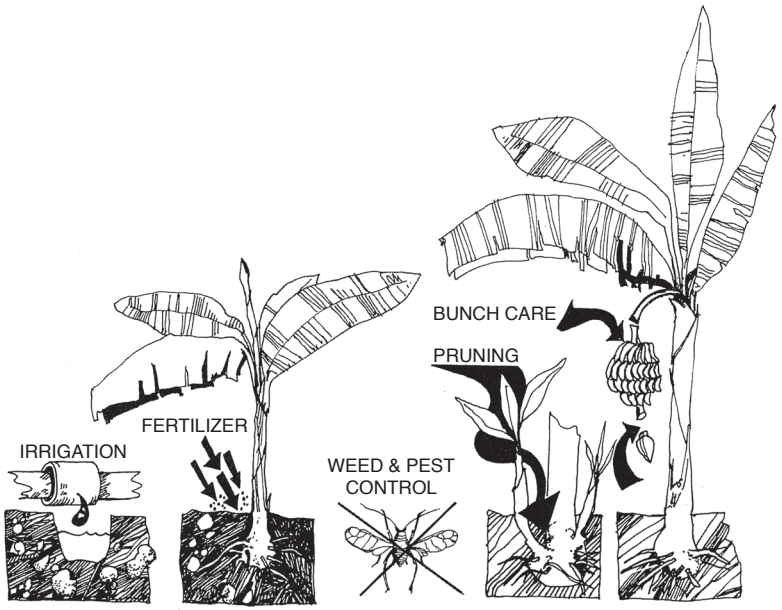

Fig. 5. Plantation Management

Irrigation

With dry season lasting up to six months it is essential that irrigation be provided for that part of the year. The system should be designed, constructed, installed and functional prior to planting. No particular system is best; what is satisfactory for one grower may not be for another. It is important that a system be designed in response to the various factors affecting production. These include soil type, shape of the land, water quality, water avail-

ability, labor, and budget. Drip irrigation, drag lines, travelling sprinklers, basin and furrow irrigation techniques all have their merits and disadvantages (Appendix 2).

The determination of when to water and how much water to apply is important. The age of the crop, the irrigation system used, the permeability of the soil and the prevailing weather conditions all affect irrigation timing. Usually when the rainfall is below 1"-2" per week irrigation is needed. Currently available on the market are instruments which can be placed in the soil to determine the quantity of available moisture. Tensiometers, soil moisture blocks, and portable field meters are just a few such instruments that can assist the grower in determining the irrigation needs of a particular crop.

Fertilizers

Bananas are fast growing plants which yield a heavy crop and because of this, requires repeated applications of fertilizers. Fertilizer rates should be based on soil or tissue analysis. If this information is not available then a general rule of thumb is: 2 pounds of complete fertilizer per mat applied every 2 or 3 months; for an acre containing 400 mats, apply 800 lbs. of complete fertilizer every 2 or 3 months. Because bananas require large quantities of potassium, fertilizers such as 10-5-22 or 10-20-20 which are high in potassium are best.

The fertilization of new plantings has been outlined in the previous section. The first application of fertilizers using the above scheme may be initiated 2 or 3 months after planting and should continue through flowering and throughout all ratoons. Ratoons are subsequent crops from the same mat.

The merits of an organic fertilizer program should not be overlooked. On Guam chicken manure is widely used and is presently the only organic fertilizer available in quantity. Organic fertilizers improve soil structure and water holding capacity in addition to supplying needed nutrients. Organic fertilizers are an excellent source of nearly all the essential elements for plant growth, but sometimes the quantity of a nutrient is insufficient. In order to compensate for the inadequate levels of nutrients in manure, large quantities must be applied. A pre-plant rate of 5-10 tons per acre is not uncommon for a banana crop. When applying large amounts of any type of fertilizer, potential leaching and run-off of nutrients must be mitigated. Timing and methods of applying fertilizer must be considered to optimize crop use and reduce potential leaching and runoff of nutrients. Other mitigation considerations include topography, proximity to water sources, and weather condition. Conservation practices such as conservation tilling, filter strips, and vegetative barriers will further reduce chances of potential leaching and runoff of nutrients.

Weed Control

Weeds inhibit crop production by competing for nutrients and irrigation water, as well as harboring diseases and pest. It is important to establish a good weed control program from the outset. Weed control is best accomplished by hand hoeing, mowing, mulching, or through the use of herbicides labelled for use on bananas. A good weed control program uses all of these practices. When removing weeds with a hoe or fusiños (a whaling tool modified by Chamorros to a common farm tool), growers should be careful not to injure the feeder roots around the base of the plant. After the weeds have been eliminated, they may be left between the rows as a mulch. Mulches help retain ground moisture, add nutrients to the soil and form a layer over the soil which inhibits weed growth. In addition to the mulching of weeds, the easiest mulch to use is the old banana plants. Mulches have been shown to be very helpful in banana plantings and growers are encouraged to make use of this resource. Registered herbicides like can also be used to control weeds.

A weed control program should integrate all available methods to the maximum efficiency of the grower. Immediately around the base of the plant hand hoeing or a fusiños may be used. Around the mat there should be a 5' weed-free zone which may be accomplished by mowing or with the use of herbicides may be employed depending on individual preference. On sloping sites

susceptible to erosion some vegetation should be left to bind the soil; this type of situation is best suited to mowing. If diseases and pests are a major problem then mulches are not recommended. No matter what situation exists, weed control is a constant activity until the plants have enough foliage to shade out the weeds.

Pruning

The pruning of unnecessary suckers is often the most neglected activity in banana plantation management. Failure to de-sucker results in a greater incidence of disease and decreased fruit production. Only three or four plants should exist in a mat at any one time (Figure 6). One sucker should be allowed to develop every four or six months.

Pruning should result in a mother plant, a maiden, and one or two followers at harvest time (Figure 7). The first pruning activities start soon after germination where more than one sucker arises from the seed corm.

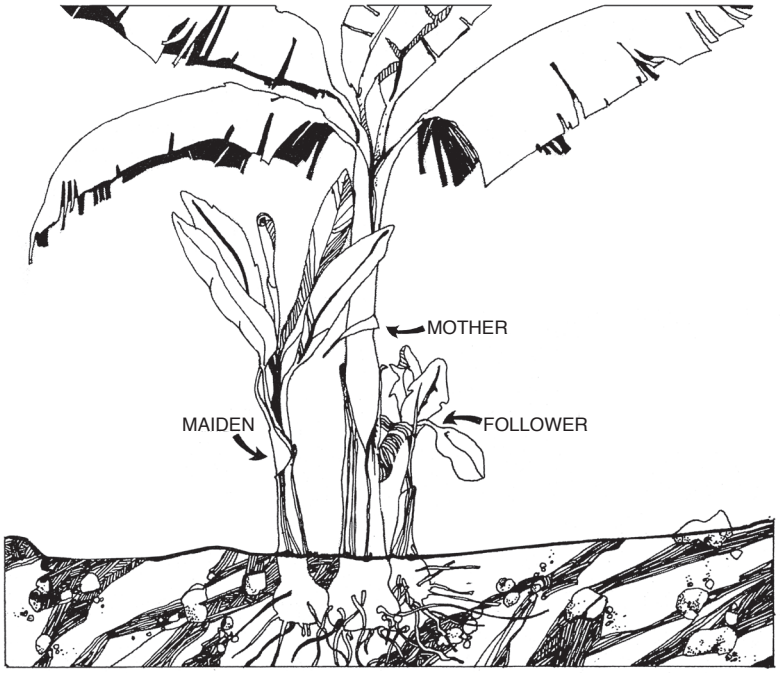

Fig. 6. An ideal mat usually has only three or sometimes four plants: A mother, a maiden, and one or possibly two followers (suckers).

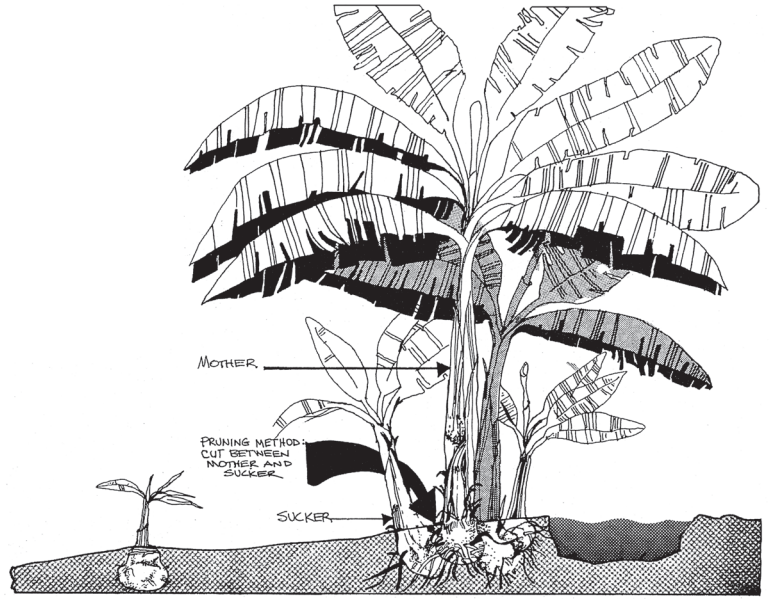

Fig. 7. Pruning

Pre-Harvest Bunch Care

The bunches will begin to emerge in seven to nine months. At this time there should be ten or more healthy leaves in the plant; they help insure good fruit size and quality. After the flowers have emerged and set fruit, the male inflorescence or fafalo, and extra female flowers should be removed. This increases the finger length and reduces the fruit maturation period. After the bunches have been trimmed a blue plastic bag is placed over the fruit. This process is known as sleeving. Sleeving prevents sunburn, controls fruit scarring and can increase bunch weight. The sleeves produces an environment where temperature, humidity, and light intensity are moderated. Additionally, old leaves should be removed to prevent scaring caused by their rubbing against the fruit. As the bunched begin to mature they become heavy and need propping. If the bunches are not propped shortly after flower trimming they may become too heavy and cause the plant to topple over. Usually a forked stick made of tangantangan is used for this purpose. A properly managed plantation may produce 80-lb bunches with 8 hands per bunch.

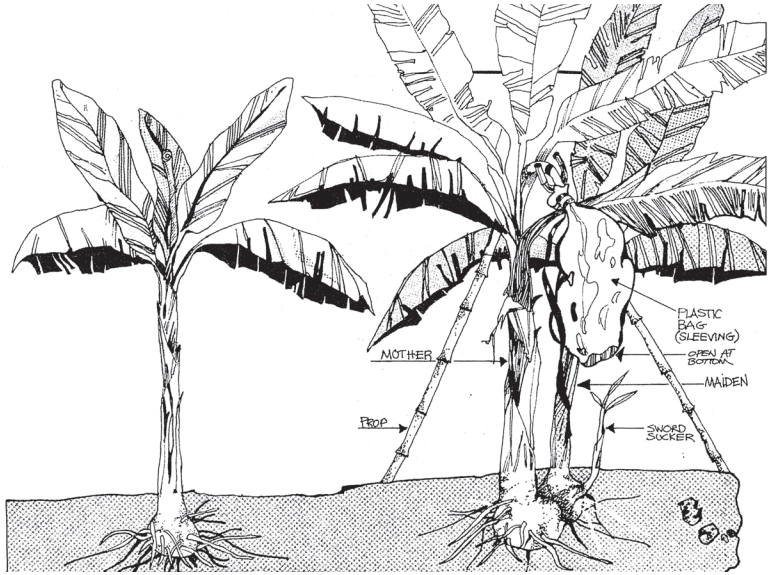

Fig. 8. Pre-Harvest Bunch Care.

Diseases and Pests

The simplest method of controlling banana disorders is prevention. By taking precautionary measures such as treating and using only disease-free planting material, disinfecting tools and controlling the movement of soil, a number of diseases and pests will not gain entry into a plantation. Additional methods include eradication, chemical and other management practices. The eradication of an established disease is simply the removal of diseased plants or plant parts and their destruction. Chemical control is the use of pesticides to control problems that may arise during the course of production. When applying pesticides proper personal protection equipment (P.P.E.) and apparatus should be used and label recommendations should always be followed. Other practices that may be utilized to decrease the incidence or eliminate problems are: field fallowing, using resistant varieties, biocontrol agents, and weed suppression.

The following pages include information about common diseases and pests of bananas found on Guam and how the grower may best manage the problem.

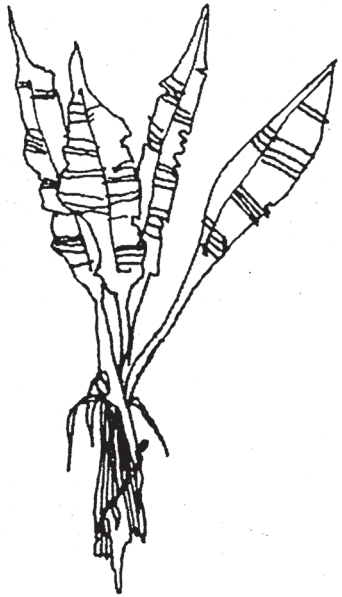
Fig. 9. Bunchy Top

Banana Bunchy Top Virus (genus *Bavuvirus*)

Banana bunchy top virus (BBTV) is the most serious disease of bananas on Guam. The most alarming symptom is that infected mats do not produce any fruit. Other symptoms include leaves that are erect, narrow, stunted and often

have yellow leaf margins. As the disease progresses, the leaves become smaller and eventually the crown of the plant becomes composed of only stunted leaves, and develops a "bunchy top" which gives the disease its name.

This disease is caused by a virus and is spread by the brown banana aphid (Pentalonia nigornevosa). Wild bananas (Musa spp.), bird of paradise (Strelizia spp.), and gingers (Zingiber spp.) can harbor the disease and should be removed from the area surrounding the plantation.

There is no cure for BBTV. The disease can be avoided by using disease-free plating material, controlling the aphid vectors with insecticide sprays, and removing and destroying infected mats.

Panama Wilt *(Fasariem oxysporum f. cubense)*

Yellowing, wilting and drying of leaves are early symptoms of Panama wilt. Eventually all the leaves will collapse, die, and then dangle from the pseudostem.

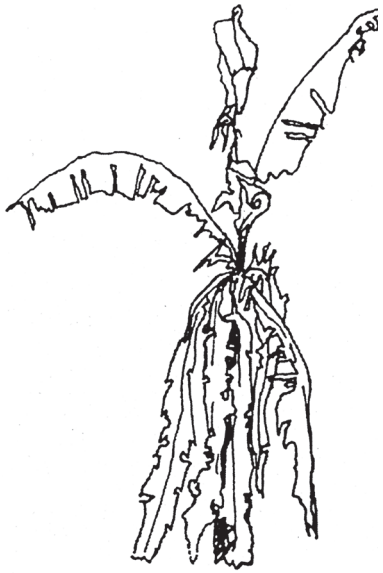

Fig. 10. Panama Wilt

The most reliable way of identifying the disease is to slice open the stem. Normally it will have a clean white interior, but Panama wilt produces characteristic reddish-brown to black discolorations and sometimes a rotten or fishy smell.

The disease is caused by a fungus that lives in the soil for many years. It is spread with infected planting material and transported soil. Panama wilt has been recently identified on the island and has been a serious problem where observed. Growers should take care to obtain

disease-free suckers, thus avoiding contaminating their fields.

The best management techniques are to destroy infected mats and replant with resistant varieties such as Taiwan, Williams Hybrid, and Dwarf Cavendish (Guahu).

Black Leaf Streak *(Mycosphaerella fijiensis)*

Black leaf streak is a fungal disease caused by the airborne fungus, M. fijiensis. This disease results in reddish brown specks occurring on the lower leaf surfaces. These specks develop into dark brown or black streaks as the infection becomes more severe. Hot humid conditions favor its development. The pruning and burning or burying of infected leaves will reduce the incidence of this disease.

Fig. 11. Black Leaf Streak

Sigatoka Disease *(Mycosphaerella musicola)*

Sigatoka disease is very similar to black leaf streak except less virulent. Sigatoka disease does not cause black streaks but rather yellow streaks which later give way to dead tissue. The control for Sigatoka disease is the same as for black leaf streak.

Banana Aphid *(Pentalonia nigronevosa)*

The importance of this insect is due to its ability to transmit bunchy top disease, rather than any direct injury caused by feeding. The aphid is usually found on the base of the plant, in the throat and on the small suckers. They pierce the tissue and suck fluid from the plant. Bunchy top disease is passed to the banana while the insect is feeding. Usually ants may be seen tending aphids on infested plants. The aphid is a very small ($^{1}/_{16}$") brown or black bug which is either winged or wingless.

No pesticide application program can effectively prevent this

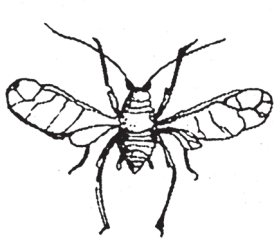

Fig. 12. Banana Aphid

insect from entering and infecting plants with bunchy top. However, the spread of this insect throughout a plantation can be retarded by the use of labelled-for-banana insecticides. Plants infested with aphids should be sprayed promptly and those mats exhibiting bunchy top symptoms should also be sprayed and immediately removed from the field.

Banana Corm Weevil *(Cosmopolites sordidus)*

This black weevil, 1/2"-3/4" long, lays its eggs in exposed portions of the corm. The eggs develop into white larvae which can riddle the corm with tunnels. These burrows reduce the plant's vigor which results in smaller bunches. The plants are also more susceptible to toppling over from the wind and contracting Panama wilt. The control of this weevil is primarily preventative. Planting material should be cleaned and dipped in hot water 122˚F-130˚F or 10% bleach solution for 20 minutes. When planting, the corms should be completely covered with soil to prevent egg laying.

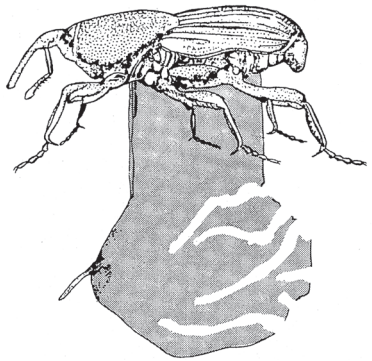

Fig. 13. Banana Corm Weevil

Chinese Rose Beetle *(Adoretus sinicus)*

This insect is a light to dark brown beetle, 3/8" long, with a fairly narrow body. The adult beetle damages the leaves by chewing from the leaf margin to the midrib, usually starting at the leaf tip. The larvae live in the soil and feed on plant roots.

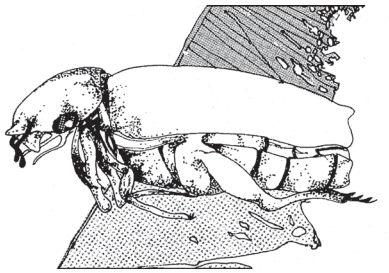

Fig. 14. Chinese Rose Beetle

The Chinese rose beetle is also a pest of many other commercial crops and local flora that grow on Guam. It is a difficult pest to control with insecticides. Maintaining a clean, weed-free plantation and buffer zone is an important step in keeping populations low. It is also advisable to tolerate minor damage.

Burrowing Nematode *(Radopholus similis)*

This microscopic worm attacks the corm of the banana plant causing a reddened tissue around the feeding sites. Severe infestations result in weak plants, poor growth, depressed yields, and the plants being more susceptible to Panama wilt. Because this pest is found both in the soil and in plant roots it is important to insure that planting materials and planting site are pest-free. By trimming the corm, gouging out discolored spots and dipping the corms in hot water, the nematodes can be eliminated from the planting material.

Virgin or fallowed lands may be relatively free of plant parasitic nematodes and make good planting sites. When fallowing a field no bananas should be grown on it for two years.

Moko Disease *(Pseudomonas solanacearum)*

Moko disease is a bacterial disorder which is most prevalent on younger plants, but may also cause problems with older plants. The disease attacks the younger leaves which become yellowish-green and then collapse. The older leaves are subsequently infected and collapse, resulting in a leafless plant that soon dies. At present this disease is a minor problem on Guam, but could become more serious. Basic plantation sanitation and weed suppression will help restrain this disease. If an infection overtakes the crop a minimum two-year fallow period may be an effective method of control.

Banana Leaf Roller *(Erionata thrax)*

This brown moth (or skipper) with yellow spots on its forewings lays batches of eggs on the leaves. The eggs hatch into larvae or

caterpillars which cut a strip of leaf and roll it into a distinctive leaf roll. The larva, covered in a whitish powder, will evolve into a pupa or cocoon inside the roll.

On Guam there are three natural parasites of this leaf roller. *Oo-encyrtus erionotae* and *Trichogramma sp*., both parasitoid wasps, attack the eggs and *Apanteles erionotae*, another parasitoid wasp feeds on the larvae. It is more economical to let these parasites control the pest then to spray insecticides. Only in severe cases should a grower consider applying a registered pesticide for banana leaf roller on bananas.

For smaller plantings, the leaf rolls can simply be squeezed by hand to crush the larvae.

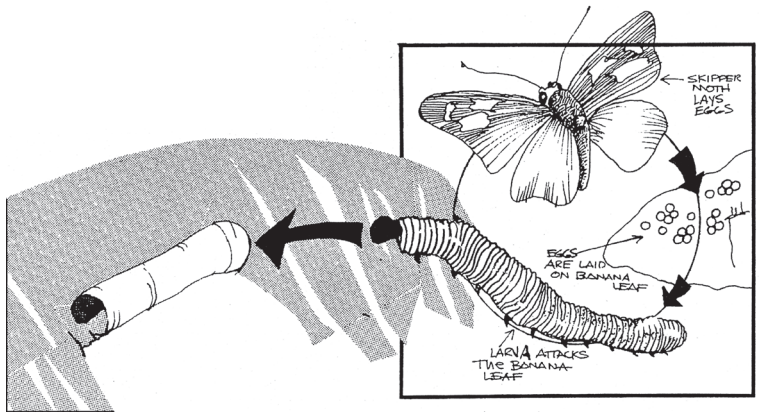

Fig. 15. Life Cycle Of The Banana Leaf Roller

Table 1. Non-Chemical Pest Control Guide For Bananas

Disease	Type	Threat	Control Steps
Bunchy Top	Virus	Major	1. Use disease-free planting material. 2. Remove and destroy infected mats.
Panama Wilt	Fungus	Major	1. Remove and destroy infected mats. 2. Plant resistant varieties. 3. Avoid soil movement. 4. Disinfect tools.
Black Leaf Streak	Fungus	Minor	1. Prune and burn or bury diseased leaves
Sigatoka	Fungus	Minor	1. Prune and burn or bury diseased leaves.
Moko	Bacteria	Minor	1. Allow at least two year fallow period before replanting. 2. Use disease-free planting materials. 3. Avoid soil movement.

Please consult Cooperative Extension Service if pesticides are to be used.

Harvesting and Handling

Bananas intended for fresh market should be harvested when the fingers are plump, but still a light green. The corners of the fingers should be rounded rather than angular. Harvesting at this stage reduces potential damage and quality loss during transport. The harvesting of bunches with yellow fingers, even if it is only the top fingers, is not recommended. The bunch will ripen with unexpected speed. The fingers will quickly blacken, split, fall off and attract insects. This results in many wasted fruit.

Harvesting bananas generally requires two strong people. The first stands beneath the bunch; the second, using a machete, makes two cuts in the shape of a "Y" on the top half of the pseudostem or trunk. This allows the bunch to slowly descend on the first person's shoulders. The bunch is then cut free. It is best to leave an 18" stalk on the bunch. Place the bunch on a layer of banana leaves or foam rubber to prevent bruising. Also, cover it with banana leaves for transporting to prevent sun damage and reduces moisture loss.

A banana pseudostem produces fruit only once. Cut it back to the point where it buckled and cut the leaves into pieces where they will serve as mulch. The pseudostem is then left to deteriorate in place.

If the bunches are temporarily stored on the farm they should be hung or set in a cool, shaded area. After harvesting, the bunches are usually cut into individual hands and dipped and washed with dishsoap and water to remove sticky sap and pests. Damaged hands are discarded. When possible the hands should be carefully packed in crates or boxes. In rder to obtain a good price, it is important that the fruit be presented in an attractive manner at the market.

The greatest challenge in banana growing is delivering unbruised fruit to the market. Every effort should be made to avoid these profit-reducing blemishes. The use of plastic sleeves, padding, and handling as little as possible will reduce avoiding bruising.

Appendix 1
Activities Schedule for Banana Production

Pre-plant activities

1. Select the site
2. Clear the land (Dry Season)
3. Build roads if needed (Dry Season)
4. Rip the soil if needed (Dry Season)
5. Plant windbreaks if needed
6. Build fences, sheds, etc.
7. Install water pipes, irrigation system, and electricity if desired

Items 1-7 should be done 3-5 months prior to the time of planting. Some activities are best done in the Dry Season, these have been indicated.

8. Disc and harrow field, and control nematodes if necessary, 4-6 weeks before planting
9. Mark planting holes: 3-4 weeks before planting
10. Dig planting holes: 2-4 weeks before planting
11. Collect manure for planting: 3 weeks before planting
12. Spray for weed control: 4-8 days before planting

Post planting

1. Plant the field: Day 1- ALWAYS IRRIGATE AS NECESSARY AT ALL STAGES OF PLANT GROWTH - 1" and 2" of rain per week is sufficient; if rainfall is below 1"-2" per week supplemental irrigation is likely needed
2. Prune away extra plants: Weeks 4 and 6
3. Replant those corms not germinated with new corms: Weeks 6 and 7
4. Inspect crop for diseases and pests: Weekly
5. Irrigate as necessary
6. Control weeds: Every two weeks
7. Fertilize: Week l4

8. Prune unwanted suckers: Month 5
9. Allow l sucker at: Month 5 and Month 10
10. Fertilize: Month 7
11. Remove dead leaves: as necessary for disease control
12. Remove male flowers and unwanted female flowers full fruit set; fruit set usually occur between 10-15 months from planting
13. Bag bunches: After fruit set
14. Prop plant if necessary: After fruit set
15. Arrange handling and harvest activities before harvest
16. Fertilize: Month 11

Appendix 2
Comparison of Irrigation Systems

Drip or Trickle System

Advantages:
1. Conserves water
2. Low labor
3. Uses poor quality water
4. Confines irrigation to crop only

Disadvantages:
1. Initially expensive
2. Fairly sophisticated filtering system
3. Difficult to repair

Drag Lines

Advantages:
1. Portable
2. Easy to build and repair
3. Inexpensive

Disadvantages:
1. Labor intensive
2. Can use large quantities of water
3. Sprinkles water in un-needed areas

Traveling Sprinklers

Advantages:
1. Simple
2. Inexpensive
3. Portable

Disadvantages:
1. Can use large quantities of water
2. Sprinklers water un-necessary areas
3. Travelers sprinkling overhead may increase disease problems

Appendix 3
Bananas on Guam

Chamorro Name	English Name	Eating (E) or Cooking (C)
Dama		E
Guåhu	Dwarf Cavendish	E
	Williams Hybrid (Giant Cavendish)	E
Lakatån	Cavendish Group	E
Makåo		E
Manila		E
Taiwan	Cavendish Group	E
Gålayan		C
Halom Tano	A wild plant with seeds	C
Long		C
Pahong		C
Palau		C
Paladang		C
Tanduki		C
Bunita	An ornamental with purple fruit	

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