African Organic Agriculture Training Manual

A Resource Manual for Trainers

9-19 BANANA

Draft Version 1.0
June 2011

Ready for field testing

FiBL

IMPRINT

Publisher:
FiBL, Research Institute of Organic Agriculture, Switzerland,
www.fibl.org

Collaboration:
› IFOAM, International Federation of Organic Agriculture Movements, Germany, www.ifoam.org
› NOGAMU, National Organic Agricultural Movement of Uganda, www.nogamu.org.ug
› FENAB, Senegal
› OPPAZ, Organic Producers and Processors Association of Zambia, www.oppaz.org.zm

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Draft version 1.0, June 2011.

This is an interim version. Comments and recommendations for improvement are welcome.

All materials resulting from the Africa Organic Agriculture Training Manual project are available free of charge in the internet under
www.organic-africa.net

The production of this manual was funded by the Bill and Melinda Gates Foundation (BMGF) and the Syngenta Foundation for Sustainable Agriculture (SFSA) with the goal to promote organic farming in Africa.

CONTENTS

9-19 BANANA

FACTSHEET 19: BANANA

Learning targets for farmers:

- Understand good management practices of bananas
- Understand how to better manage banana pests and diseases
- Acquire knowledge on improving productivity of banana plantations
- Receive guidance on marketing and organic certification of banana production

1 Introduction

Banana (*Musa* species) is a very important crop in sub-Saharan Africa, especially Eastern Africa, where besides consumption as food, bananas have cultural and medicinal values. There are many types of bananas grown in Africa, but depending on how bananas are utilised, they can be broadly grouped as follows:

- **Dessert bananas –** They include Cavendish, Red Bananas, Apple bananas and Gros Michel. These are consumed as ripe fruits (table bananas). Most cultivars are susceptible to nematodes, Sigatoka leaf spots and Fusarium wilt although they are generally tolerant to weevil attack. Cavendish cultivars are the most popular and valuable of the dessert bananas and are traded worldwide.
- **Cooking bananas –** They include the East African highland bananas (EAHB) and many other types of plantains consumed as cooked or roasted bananas. The EAHB are said to be endemic to the East African region and grow comfortably at higher altitudes (above 1000 m). On the other hand, most plantains are lowland varieties and are very susceptible to weevil attack.
- **Beer bananas –** These cultivars can perform well even in suboptimal conditions and are used mostly for production of banana juice which is directly consumed or used for making banana beer, wine or spirits.
- **Multipurpose bananas –** They include a number of improved cultivars such as the FHIA hybrids. These have multiple uses from being used as dessert bananas to juice production. They are relatively tolerant to nematodes.

POOR BANANA PRODUCTION PRACTICES

Bananas are a perennial tropical and subtropical crop, which grow in a wide range of environments. However, the banana production systems can be divided into three broad categories depending on the number of cultivars grown and the intensity of management.

a. Backyard garden systems

Here banana is grown in a highly integrated system especially in peri-urban areas where land is limited. Bananas are grown mainly for food in combination with other enterprises like zero grazed animals or vegetable gardens to supplement nutritional or peri-urban market needs. This is a low input system and normally no proper pest and disease management is done.

b. Perennial agroforestry systems

In this system, bananas are intercropped with mainly perennial crops like coffee, vanilla, cocoa or fruit trees. In this system, bananas serve as a middle storey shade crop, but also provide food for household needs. Any excess is sold to the market. Different cultivars are normally grown together depending on the location and the intended use of the bananas. The plants are not replaced until they die of senescence or pests and diseases. This is also a low input system and many pests and diseases are either partially controlled or not controlled at all, making banana production highly vulnerable. However, it is the most common production system in most banana producing areas in Africa.

c. Commercial plantations

These are normally 'single cultivar' monoculture systems, comprising mostly dessert banana cultivars which have good export potential. Management of these plantations characterised by careful selection of cultivars/varieties and intensive use of synthetic fertilizers and pesticides. In this system, well-defined crop cycles are also observed, usually lasting 2 to 5 years after which all plants are uprooted and replaced.

Challenges to banana production in Africa

Production of bananas in Africa is, however, threatened by many challenges, including:

› **Several important pests and diseases** – Pests and diseases are the main threat to banana production. Traditional banana cultivars have been severe-

IMPROVED BANANA PRODUCTION PRACTICES

ly damaged by a wide range of pests and diseases, resulting in heavy yield losses. For example, bacterial wilt and Fusarium wilt are serious threats in many sub-Saharan African countries leading to 100 % losses. Nematodes, banana weevils, Sigatoka leaf spots and banana bunchy top virus disease have also caused immense damage to plantations. Most farmers lack information on proper management of these infections so they continue to spread them unknowingly.

- **Low productivity of banana plantations** – Low productivity is mainly due to poor soil fertility management, water conservation and husbandry practices. In highland areas, banana plantations are not terraced and yet many trees are cut out of the garden. Running water from uphill washes down the topsoil and mulch. The soil remains exposed and its water storage capacity is gradually reduced, and yet bananas require good soil moisture for proper growth. Many suckers are left per banana stool, pruning and removal of male buds is either done late or not at all. Crop cycles are not regulated whereby the same garden of bananas is left for a long time without rotation or replanting. Suckers for establishing new gardens are carried with all their roots from one village to another, thereby spreading pests and diseases.
- **Hailstorm and wind damage** – Bananas have shallow spreading roots, weak stems and leaves. This makes them very susceptible to strong winds and hailstorms especially during the fruit bearing stage. This is a common problem in monoculture banana plantations where trees are cut for other purposes and in highland areas.

Bananas, especially the cooking and dessert bananas are widely consumed in Africa and are a source of livelihood for many people. The challenges mentioned above facing banana production need to be addressed to ensure sustainable and profitable banana production and utilization. This chapter therefore introduces organic approaches to banana production challenges, which can be adapted to local conditions.

Discussion: Assessment of the local situation

Inquire about the local practices in banana production and especially about the common challenges faced in banana production asking the farmers the following questions:

- Do you experience any of the above or other challenges?
- How have they tried to address them?

PREPARING SUCKERS FOR PLANTING (CORM PAIRING)

2 Improving management of banana pests and diseases

Bananas are susceptible to a wide range of pests and diseases. Some of these pests and diseases are highly destructive and very contagious (easily spread), and once introduced they are persistent and difficult to eradicate. In general, the severity and occurrence of pest outbreaks and plant damage depends on the prevailing environmental conditions, specific banana cultivars, and the specific disease or pest. However, most of these can be managed and controlled by implementing organic production practices.

The main approach in organic pest and disease management in banana production is prevention and proper management of infections to restrict spread and multiplication. With proper implementation of cultural practices (e.g. soil fertility improvement, crop rotation, use of resistant varieties and clean planting materials, proper sanitation in the field and rouging of infected plants) many of these pests and diseases can be effectively managed. This is also necessary because most the destructive diseases cannot be eradicated by direct control methods.

2.1 Establishing a new banana garden

A site with deep, well-drained and fertile soils, preferably rich in organic matter is good for banana production. It will encourage the development of strong plants that can tolerate infections. A newly opened land without signs or history of nematodes or the devastating Fusarium wilt and bacterial wilt diseases is preferred.

If the site has been used for production of bananas in the last two years, it is highly recommended to remove all remaining banana plants and corms. Normally such remnants harbour a lot of pests and diseases. The remnants should be transferred into another field (not of bananas), chopped and spread to dry or composted. The land should then be planted with a legume crop (like beans) or left to fallow with a legume green manure cover crop for 1 to 2 years. This will ensure that any remaining pest or disease infections are completely removed before introducing new banana plants.

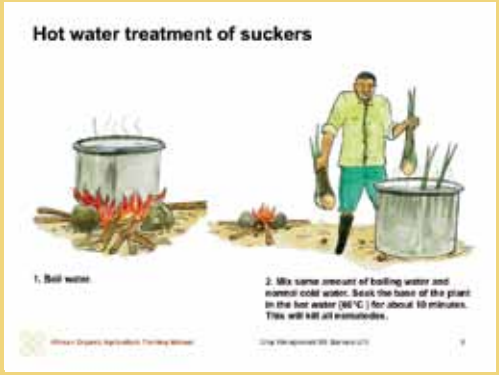
All perennial weeds should also be removed and destroyed before planting because bananas are very susceptible to weed competition. Some of the existing

Discussion on local management of common banana pests and diseases

Try to find out the most problematic pests and diseases in the area asking the following questions:

- Which banana pests and diseases are common in the area?
- How do you prevent the introduction or spread of these pests or diseases?
- What do you do when an infection is identified in the banana plantation?

HOT WATER TREATMENT OF SUCKERS



trees at the selected site should be left during land clearing in order to protect the young banana plants from wind and strong direct sunshine.

2.2 Selection and preparation of planting material

Proper management of banana pests and diseases starts with the careful selection and handling of pest and disease free and, where possible, resistant planting materials. The right cultivars and varieties should be selected with respect to the disease problems prevalent in a given location. Some cultivars are resistant to certain diseases like Cavendish and highland cooking bananas, and varieties like FHIA 17 (Cavendish variety), FHIA 23 (Gros Michel variety) are resistant to the devastating Fusarium wilt (Panama) disease. Clean planting materials of superior banana cultivars that are resistant to diseases exist, and can be obtained through local extension officers, research stations or nursery operators (banana tissue culture hardening nurseries). It is highly advisable to plant different cultivars and/or varieties in the banana plantation. In case a variety or cultivar is attacked by certain pests or diseases, then the whole field will not be wiped out. Bananas are propagated using suckers or corms from the mother plant. Generally, well treated suckers/corms or tissue culture banana plantlets are highly recommended because they are free of pests and diseases. Suckers for planting should be carefully selected and prepared to minimise spread of pests and diseases. They must be obtained from pest and disease free plantations. Sword suckers are preferred because they are usually less infected with nematodes and weevils than bigger suckers.

Recommendations to farmers for preparing planting seedlings:
Planting materials should be prepared in the field from where they are being obtained to limit the transfer of infections into new fields.

- Remove all leaves, outer leaf sheaths, roots, dead parts of the plant and pare the corm (trim off part of the corm) to eliminate weevils, weevil eggs and nematodes. Any brown and black spots that may appear on the corms should also be removed until only white corm tissue remains.
- It is recommended to treat the suckers in order to clean them of any infections. This is done by soaking the suckers in soapy water over night to eliminate weevil eggs and nymphs. Alternatively, the suckers can be treated by

Discussion on preparation of planting materials

Inquire how farmers obtain planting materials for new gardens by asking the following questions:

- How do you prepare banana planting materials for establishing new banana plantations?
- How do you proceed to establish a new banana garden?

Discuss the approaches together while noting any shortcomings and then introduce the guidelines below.

ROUTINE MANAGEMENT PRACTICES

soaking the base of the plant in hot water (about 60 °C) for 10 minutes. This will kill all nematodes in the outer layers of the sucker. A 10 % household bleach solution (100 ml of solution in 1 litre of water) is also useful for disinfesting corms. Submerge the base of the suckers into the solution for about 20 minutes.

Treated suckers should be planted within one week to avoid being reinfected.

Recommendations to farmers for planting a banana garden:

- **Mark out rows** - with a spacing of 3 m by 3 m (10 f x 10 f) to get the proper plant population of 450 plants per acre. This helps to avoid competition between banana plants and limits spread of pests and diseases from one plant to another.
- **Dig out planting holes** - 60 cm by 60 cm by 60 cm (2 f x 2 f x 2 f) while placing the top soil and subsoil on separate sides of the planting hole. This ensures that during planting, the top soil mixed with manure/compost will be used for refilling the hole.
- **Plant bananas at the beginning of the rainy season** - so that newly planted plants receive enough water for quick establishment. When planting, do not completely fill the planting hole. Leave a shallow basin of about 1 foot to enhance harvesting water for the young plant. Later during growth, this also provides a conducive environment for producing new suckers away from the mother plant.

2.3 Routine management practices

Some management practices are helpful in both strengthening the growing banana plants and in minimising the spread of pests and diseases. However, these practices need to be routinely applied together as a package because, leaving one practice may undermine the benefits achieved from the others.

a. De-suckering

Competition between suckers depletes soil fertility very fast and results in weak plants which are very susceptible to infections. About 3 to 4 suckers should be maintained per stool in order to ensure strong plants and good yields. Any ex-

tra suckers should be removed when they are still young. Suckers at different growth stages (mother, daughter and granddaughter) on the opposite side of the mother plant, should be chosen, also to avoid competition for light. De-suckering should be done well, so that pruned suckers do not grow up again. The sucker pseudostem should be cut off near its corm and the sharp point of the knife twisted into the growing point to kill off the sucker permanently. During this operation, care must be taken not to harm other daughter plants.

In the course of time, the banana plants tend to grow away from the original space whereby the gaps between the plants become smaller. At this point, it is necessary to remove the plants that stand close to each other. If the original pattern of the banana plantation becomes completely distorted, then the plantation should be cleared and newly planted.

b. Deleafing

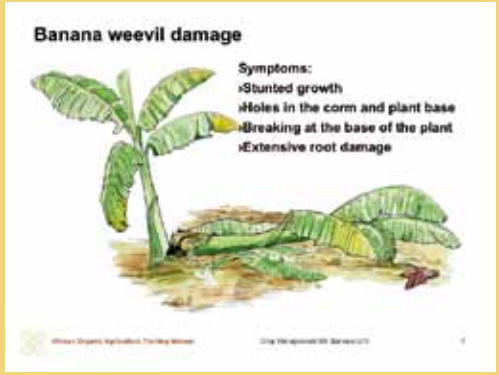
Old leaves and sheaths are susceptible to infections and can host infections if not removed in time. Removal of old leaves helps in management of the Sigatoka leaf spots, limiting its spread to young leaves and plants, while the removal of old sheaths eliminates hiding places for adult banana weevils. In addition, old leaves that hang downwards shield the young plants from sunlight. It is therefore recommended to remove all old leaves and sheaths that have attained natural senescence and use them as mulch.

It is, however, important that enough leaves are left on the plant to produce a good quality bunch. The average number of leaves per banana plant should be 8 to 10 leaves at flowering and 4 at harvest. Complete deleafing of the plant prior to harvesting is not recommended as this starts the ripening process, before the plant is actually ready.

c. Cutting off male buds

Removing the male buds early also helps reduce the spread of diseases like the banana bacterial wilt, which can be transmitted by bees collecting nectar from the banana male buds. Care should be taken not to damage the hands of the bunch while removing the male buds. Male bud removal also encourages quicker development of the young bunch.

BANANA WEEVIL DAMAGE



2.4 Management of specific pests and diseases

Banana weevils and nematodes are the most important pests of bananas, attacking nearly all banana cultivars. On the other hand, banana has a multitude of diseases which can cause significant yield losses if not well managed. For example, the black sigatoka, bunchy top disease, streak virus disease, and the highly devastative bacterial wilt and Fusarium wilt (panama) diseases.

Pest management

a. Banana weevil *(Cosmopolites sordidus)*

The Banana weevil is a very damaging banana root borer. The larvae bore into corms, suckers, and roots and lead to extensive root destruction. This leads to stunted plant growth and eventually premature toppling of the plants and plant death.

Recommendations to farmers for management of the banana weevil:

- **Use clean planting materials -** As mentioned earlier, use tissue culture plantlets or treated suckers for planting new banana plantations.
- **Crop rotation -** In heavily infested gardens, it is highly recommended to progressively destroy the entire garden and remove all banana plants and their corms. Chop them to dry or compost them and plant other crops in the field for 1 to 2 years. Make sure that all corms and roots are destroyed during that time.
- **Ensure field hygiene -** It is a common practice to split the pseudostem after every harvest. The stem is split open and the sheaths are spread out to dry so that weevil eggs and larvae are destroyed. The sheaths should, however, be laid about 2 feet away from the banana stool, like any other mulching material in a banana plantation. Do not move banana residue material (pseudostems, corms, sheaths) from one field to another in order to limit transmission of weevils.
- **Trap the weevils -** Laying traps to catch banana weevils and killing the weevils collected from traps can be an effective method of controlling weevils especially in small gardens. The weevils are mobile at night and can be trapped by baiting the field with slices of banana pseudostems. Traps should be cleared every 3 days so that they do not become a breeding ground for the weevils. All trapped weevils should be picked from the baits and destroyed or fed to poultry.

Discussion: Working groups on field identification of banana pests and diseases

Organise a field visit with the participants to different banana fields and identify any observable signs of pest or disease problems. Ask the farmers to analyze the signs of infection and identify the pests or diseases.

NEMATODE DAMAGE

HOW TO MANAGE NEMATODE AND WEEVIL DAMAGE

› **Keep the banana stool clean -** Mulching materials or any debris should not be put close or within the stool in order to deny weevils a hiding place. Also, any banana plant remains from infected gardens should not be used as mulch in clean banana gardens.

› **Use natural pesticides -** Such as wood ash, tephrosia leaf dust, chilli preparations with animal urine, tithonia leaf extract, and neem oil. These materials should be applied at the base of the plants around the stool and around infected pseudostems. However, it is important for certified organic farmers to check with their certification body before using any factory-made products for weevil control.

b. Nematodes

Radopholus similis and *Pratylenchus goodeyi* are the most damaging nematode species on bananas. Nematodes are microscopic (not visible with the naked eye) pests, which feed on banana roots. They destroy the roots and reduce uptake of water and nutrients. With damage to the roots, plants will lose stability and topple down. It is, however, hard for farmers to distinguish between damage caused by the nematodes and the banana weevils. Nematode attack will cause the plant to topple down with all the roots exposed (the whole plant is uprooted) while weevils will cause the plant to break from the base at the soil level. New fields become infested with nematodes when suckers from infected fields are used; nearly all suckers will be infected with nematodes in an infected field. Cooking bananas and plantains are particularly susceptible to nematodes.

Recommendations to farmers for management of the banana nematodes:

› **Use clean planting materials -** Use tissue materials or treat banana suckers to ensure that no infections are introduced into the new fields.

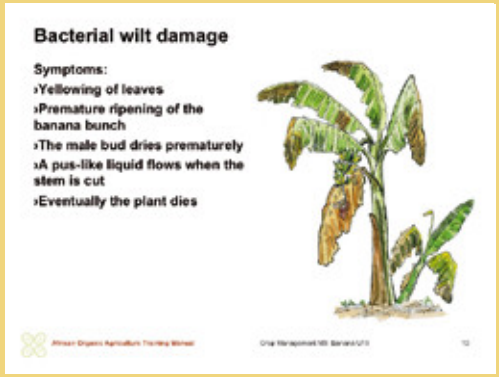
› **Crop rotation -** In heavily infested plantations, it is highly recommended to destroy the garden and remove all banana plants and their corms. Chop them to dry or compost them. Nematodes will survive in the soil for about one year if deprived of host materials. Therefore, after uprooting all banana material from the infected plot; grow other crops for a period for 1.5 to 2 years, followed by recultivation with clean banana planting materials.

› **Increase soil fertility -** Addition of compost in planting holes, top-dressing with organic manures and mulching with organic materials increases soil life activity and has a negative effect on soil pests like nematodes. It encourages

establishment of stronger plants that are less susceptible to toppling as a result of nematode infestation.

› **Field hygiene -** Besides planting materials, nematodes can also be spread through soil carried on farm tools, farmers shoes/feet and banana residues, mainly corms. Therefore, ensure that proper cleaning is done of all tools and farmers shoes/feet before entering a healthy garden. Banana corms should not be shared between gardens to limit the spread of nematode infections.

BACTERIAL WILT DAMAGE



Disease management

a. Bacterial wilt

Bacterial wilt is the most destructive banana disease, attacking all types of bananas. It is caused by *Xanthomonas campestris* pv. *Musacearum*. Infected plants show premature ripening and staining of fruits, yellowing of leaves, the male bud dries prematurely and a pus-like liquid flows when the stem is cut. The infection is spread when farm tools and infected plant parts are moved from infected to healthy gardens. It is also spread by pollinating bees visiting male buds of infected plants and passing the infection to male buds of healthy plants.

In order to effectively manage the bacterial wilt disease, participatory and community action is normally necessary. Local leaders, NGOs, extension and research staff can be very helpful in mobilising communities to implement strict quarantine practices. For example, restricting movement of planting materials and removal of male buds as soon as the bunch is formed.

Recommendations to farmers for management of the banana bacterial wilt:

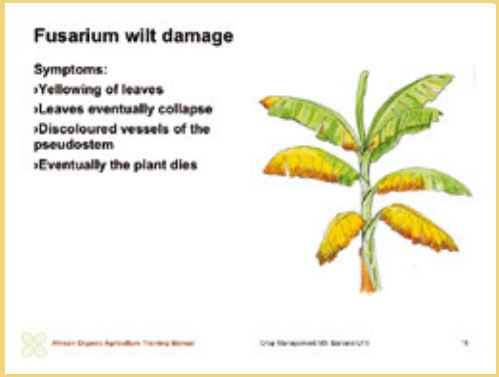
The disease can also be managed by employing the following measures:

› **Destroy all plants showing symptoms of bacterial wilt -** at the very first show of any signs. Cut the entire plant and heap to rot or bury, to limit the spread of the disease. All tools must be disinfected by flaming them over fire or by cleaning them with Sodium hypochlorite or any other bleach solution.

› **Use clean planting materials -** Use tissue materials or treat banana suckers to ensure that no infections are introduced into the new fields.

› **Crop rotation -** After uprooting all banana material from the infected plot; grow other crops for a period of at least 2 years, followed by recultivation with pest-free banana planting materials.

FUSARIUM WILT DAMAGE



MANAGEMENT OF BACTERIAL & FUSARIUM WILT DISEASES

b. Fusarium wilt

Fusarium wilt is caused by the soil borne fungus, *Fusarium oxysporum f.sp cubense (Foc)*. It spreads mostly through infected suckers, soil attached to plants, tools and shoes/feet. As the disease disrupts the plant's water vessels, leaves become yellow progressing from old to young leaves. The leaves then collapse at the petiole forming a skirt around the plant. Vascular tissues (pseudostems, corm leaf stalks), will also show discoloration to yellow, pale and dark red lines (i.e. infected vessels). Gros Michel and apple bananas are highly susceptible to Fusarium wilt. The fungus can survive in the soil for many years (up to 30 years) and is thus very difficult to control. Fusarium wilt can be distinguished from Bacterial wilt by the absence of symptoms in young suckers of less than 4 to 5 months of age.

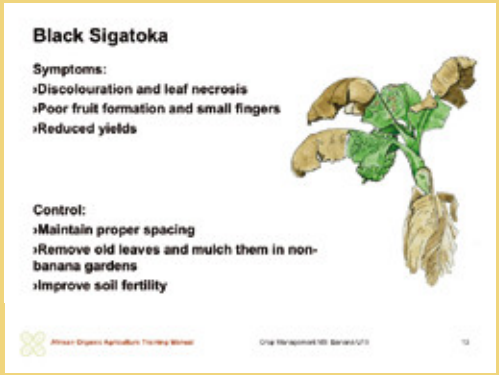
Recommendations to farmers on management of the banana Fusarium wilt:

- **Use resistant cultivars or varieties -** This is the most cost-effective and sustainable method of controlling the Fusarium wilt in the field. Resistant varieties include: Cavendish, FHIA 17, FHIA 23 and other hybrids.
- **Field hygiene -** It is highly recommended to destroy infected gardens; remove all banana plants and their corms. Chop them to dry or compost them to limit the spread of infection. Plant the field with other non-susceptible banana cultivars (cooking bananas, Cavendish, or other hybrids). Select new clean fields for replanting with clean banana planting materials. Ensure that proper cleaning is done of all tools and farmers shoes/feet (dipping in a 10 % Sodium hypochlorite solution) before entering a healthy garden. Banana corms should not be shared between gardens to limit the spread of nematode infections.

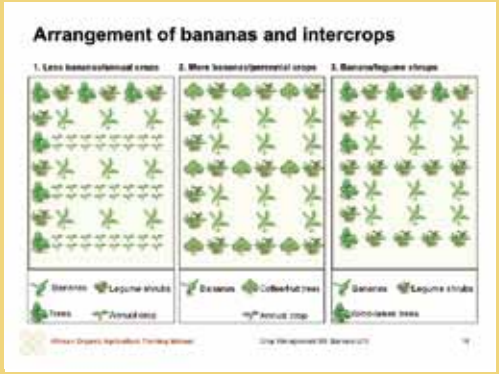
c. Black sigatoka

Black sigatoka is also called Black leaf streak (caused by fungus *Mycosphaerella fijiensis*). It is the most important leaf disease that reduces yields. The disease causes severe discolouration and leaf necrosis, reducing the effective photosynthetic area dramatically and leading to poor fruit formation and small fingers. As the pathogen can be spread by wind or water, it becomes difficult to control.

BLACK SIGATOKA



ARRANGEMENT OF BANANAS AND INTERCROPS



Recommendations to farmers for management of the Sigatoka leaf spots:
Sigatoka leaf spots can be managed by applying the following cultural practices in order to improve host resistance and minimize the spread of infection:

- **Improve soil fertility -** Enhancing plant nutrition has been found to reduce leaf spot impact. A fertile soil encourages quick growth of the banana plant before significant leaf tissue is destroyed by the pathogen.
- **Maintain proper spacing -** As banana trees grow and produce suckers, there is a possibility of the space between neighbouring plants to reduce. It is important for the farmer to regulate the space between plants such that plant leaves from adjacent plants do not touch and rub against each other. This will limit the spread of sigatoka leaf spots.
- **Ensure field hygiene -** Remove old leaves and mulch them in non-banana gardens to limit infecting young leaves and plants and banana leaves and stalks should not be shared between gardens to limit spread of infections.

3 Improving the productivity of the banana plantation

3.1 Intercropping

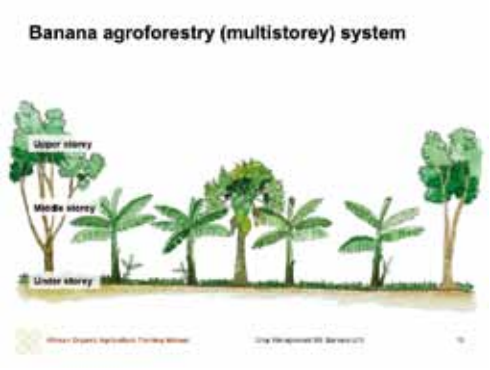
During the first two years of banana establishment, a good amount of space exists between the rows of bananas. This space should be planted with seasonal crops that do not compete with bananas in order to protect the soil from erosion, but also to provide extra harvest for the farmer. Using leguminous intercrops also contributes to soil fertility improvement directly by fixing nitrogen or indirectly by providing mulching material. Common intercrops include legumes like beans, groundnuts and soybean or vegetables like cabbage and tomatoes. Bananas can also be intercropped with coffee, vanilla, cocoa, avocado, passion fruits, pineapples, or pawpaws. A minimum distance of 60 cm should be maintained between the banana plants and the intercrops.

Trees are also needed in a banana plantation for providing shade and for protection from strong winds. Strong winds shred banana leaves and can lead to serious toppling, especially in tall cultivars. In areas with strong winds, it is important to establish windbreaks long before planting bananas. Such trees will need regular pruning to avoid too much shading during early growth. New planting of shade trees can also be done at the same time as planting of bananas. In either

Discussion: Improving productivity of banana plantations

Ask the farmers to give examples of local species of trees that can be grown with bananas. What other benefits do these trees provide and how should these trees be managed within a banana plantation?

BANANA AGROFORESTRY (MULTISTOREY) SYSTEM



case, trees should combine well with other crops to form a banana agroforestry (multistorey) system.

However, shade in the banana plantation needs to be regulated; too much shade causes elongation of the plants and results in small bunches. Shade trees should be pruned regularly, especially at the beginning of the rainy season to reduce overhead shading.

Banana agroforestry (multistorey) system

The banana garden should be established in a mixture of tall and short crops to form a multistorey system. Multistorey means that there are different layers of plants growing to different heights in the system. Three levels (storeys) are important in a banana agroforestry plantation:

a. Crops of the upper storey (shade)

› Shade trees protect the plants against strong winds and hailstorms. Common tree species that can be used as shade trees include Grevelia robusta, Ficus natalensis, Albizia coriaria, Mesiopsis eminii, Cordial africana, Acacia or Erythrina spp. Fruit trees such as mango, avocado or jackfruit can also be included at intervals.

b. Crops of the middle storey

› Depending on the needs of the farmer, fruit trees (e.g. citrus, paw paws), coffee, cocoa or vanilla can be integrated as middle storey crops. However, these should be included at a much wider spacing since bananas themselves feed at this level. Multipurpose leguminous trees can also be planted within the garden or along the boundaries (e.g. Leucaena diversifola, Calliandra calothyrsus, Sesbania sesban, Gliricidia sepium). They fix nitrogen into the soil and also provide mulch for the field when pruned. Trees like (e.g. Glyricidia sepium and Leucaena leucocephala), should always be cut back at the banana plant's height once a year, so that around 15 % of their leaves remain.

c. Crops of the understorey

› The understorey will comprise the annual crops that will be intercropped with bananas during early growth. As the plants grow bigger, the ground cover will then be replaced with green manure legumes. Legume ground covers are preferred as understorey crops, for example, jack bean *(Canavalia ensi-*

WATER CONSERVATION TRENCHES IN A BANANA PLANTATION

formis), or Lablab *(Lablab purpureus)*. Any other perennial non-climbing species can also be used but they should be regularly pruned.

3.2 Improving soil fertility

A healthy soil provides the foundation for a healthy banana crop and sustainable production. There are two approaches to building a fertile soil in a banana garden. First is to prevent soil, organic matter and water loss. Second is to grow crops that feed the soil or directly add organic manures, compost and other organic amendments to improve the soil organic matter content and nutrients.

Soil and water conservation measures

Water stress affects banana yields by influencing the size of the bunch and the fingers. It is, therefore, important that banana farmers make all possible efforts to conserve as much water as possible in the banana fields. Making soil bunds or terraces depending on sloping terrain is needed in order to trap runoff water. The terraces should further be stabilized with grass and legume shrubs. Shade trees also assist in conserving moisture within the plantation.

Mulching is very important in a banana plantation. It conserves soil moisture, improves soil structure, limits weed growth and controls soil erosion. When mulching, lay mulch across the slope and place it about 2 feet away from the banana stool. Mulching too close to the stool provides hiding places for weevils and encourages bananas to produce suckers too close to the mother plant. The mulch should be maintained because banana roots develop just below the mulch where there is good moisture. Such roots will dry off under strong sunshine when there is less mulch. It is highly recommended for banana farmers to grow their own mulch close to the banana plantation or along soil bunds and partitions within the banana plantation. This is the best way to ensure a constant cheap supply of mulching materials. Common sources of mulch used in bananas include Elephant grass *(Pennisetum purpureum),* Guatemala grass *(Tripsacum laxurn)* and wild sunflower *(Tithonia spp)*. Crop residues such as coffee husks, bean husks, maize stover and sorghum stover can also be used for mulching bananas.

As already mentioned, leguminous cover crops such as jack beans *(Canavalia ensiformis)*, velvet beans *(Mucuna pruriens)* or Lablab *(Lablab purpureus)* also provide a source of mulching in the understorey. They suppress weeds, fix nitro-

Group work on soil fertility management in banana plantations

Organise a field visit to selected banana plantations. Let the farmers examine the soil and make recommendations on how soil fertility can be improved in the different plantations.

HOW TO IMPROVE SOIL FERTILITY

gen and control soil erosion. However, cover crops should be pruned regularly so that they do not compete with the banana plants.

Organic manures and compost

In addition to the above organic materials, compost and animal manures should also be applied. Compost is best applied in the planting holes of young banana seedlings while animal manures should be added, whenever available, as a top-dressing but most importantly close to the flowering stage to improve growth and productivity. Poultry manure is preferred because it is particularly rich in nitrogen (N).

There are also a variety of other local amendments that have been used to improve banana yields:

- Wood ash from the kitchen is also a good source of potassium (K).
- Animal urine (including human urine), is a good nitrogen source and if mixed with hot chilli, has also proved effective in weevil control.

3.3 Proper weed management

Banana trees are highly susceptible to weed competition especially during the first year of establishment. Therefore, timely weeding is necessary in order to achieve good yields. Weed management can be achieved by mulching, cover cropping or mechanical means.

During early growth (up to one year), when annual crops are still intercropped within the young banana plants, mechanical weeding is feasible. After 1 to 2 years, usually no weeding activities are necessary. At this stage, digging/tillage in the banana plantation is not recommended to avoid damaging banana roots. Usually, most banana roots do not go deep (less than 30 cm depth), but they spread out widely forming a mat of up to 1.5 m in width. Damaging the roots through tillage reduces their capacity to take up nutrients and water. Mulching and zero tillage are highly recommended practices in a banana plantation. Mulching limits weed growth while zero tillage improves soil structure and minimizes damage to banana roots.

PROPER POST HARVEST HANDLING OF BANANA

4 Proper postharvest handling

Under the weight of a maturing banana bunch, stems are likely to break under the weight of heavy bunches. Although this may be more common among tall cultivars than shorter ones, it is important to provide support to banana stems when bearing fruits. As the weight of the bunch increases, the pseudostem should be supported with a wooden pole to prevent it from breaking under the weight of the fruit. Forked poles are normally used to keep the stems upright and support the weight of the bunch.

Bananas are harvested throughout the year. With a good desuckering plan, it is possible for a farmer to harvest 3 to 4 times a year from each stool, depending on the variety and cultivar of the banana. Whilst still green, the fruits have a distinctly edged appearance, which gradually becomes almost round as they ripen. The cooking bananas are harvested green and dessert bananas should also preferably be harvested while still green. Normally the duration of transport to the market determines in which stage of ripeness the fruit should be picked.

While harvesting, care should be taken to see that bunches do not fall to the ground. Hitting the ground causes bruises which reduce the quality and can be starting points for rotting. Harvested bunches should be kept under the shade and should not be heaped together without sufficient ventilation. Piling up bananas without good air flow quickens ripening.

5 Increasing returns from banana production

Although banana production in most areas in Africa targets household food security, banana production can also be made more commercially beneficial to the farmer. The farmer can achieve this through several ways:

- The first consideration is to increase output from existing banana plantations. As discussed in the previous sections, this can be done by improving the soil fertility, better husbandry practices in the banana plantation and by managing pests and diseases better. Together, these practices will allow for more yields to be obtained from the same piece of land.
- The farmer can further expand the acreage under banana production, coupled with good management; the yields will be higher and hence the farmer gets excess production for sale to get income.

› Organic banana production also emphasizes use of locally available and, as much as possible, on-farm inputs for planting materials, soil fertility and pest and disease management. This helps the farmer be more self-reliant and spend less on off-farm inputs and hence money is saved. Through diversification by growing different crops along with bananas, the farmer gets consistent extra income from the intercrops like coffee, cocoa or vanilla.

Depending on the location, climatic conditions and growth stage of the banana plantation, banana trees can be grown together with other crops which can benefit the farmer:

› **Intercropping -** In the first 2 years of banana production, short term crops (e.g. beans, maize or cassava) or long term crops such as bananas, cocoa, vanilla, can be grown in the space between the plants. Such crops will provide extra income to the farmer, and yet their management costs will be greatly reduced.
› **Fruit trees -** Fruit trees can be included in the banana as shade or wind break trees. Fruit trees such as mangoes, jackfruit and avocados are commonly used. Fruit harvests can be eaten by the household to diversify their nutritional needs and extra harvests sold to earn extra income.
› **Timber trees -** Some species of shade and windbreak trees can serve as sources of timber in the longer term. This is a long term investment for the farmer for future income needs. Tree species like *Grevelia robusta, Albizia coriaria, Mesiopsis eminii* and *Cordia africana* grow very well in the banana agroforestry system and provide good timber.

Discussion on improving returns from banana production

Evaluate the participants' perception of banana production in terms of returns by asking the following questions:

› Do you consider banana production a profitable venture?
› How do you estimate the returns from banana production?
› Try to estimate the costs and returns from banana, and discuss potentials for saving costs and increasing returns.

6 Marketing and organic certification of banana production

Most banana production in sub-Saharan Africa is consumed domestically within production locations and urban areas. Some bananas are exported as fresh, dried or frozen pulp and here banana products of organic quality are demanded.

However, organic certification comes with costs. So it will only be rewarding, if the cultivars of banana being grown can be marketed with an organic surplus to the regular price that pays off for the certification costs. To reduce certification costs an individual farmer may join an existing collective certification scheme or work with other farmers in the form of a farmer group. This will minimise the

certification cost per farmer as well as making it possible to mobilise enough volumes that may be required by the market.

General requirements on organic certification of banana production:

- During production of bananas, no use of synthetic pesticides including herbicides, and fertilizers or genetically modified planting materials is allowed. Any pesticide contamination from neighbouring conventional banana gardens through soil erosion or wind drift should also be avoided.
- During postharvest handling of bananas, use of fungicides in treatment of bananas to increase shelf life is not allowed.

Specific national or international organic standards may define additional requirements for production and postharvest handling of bananas. Farmers should therefore consult the national organic movement or organic certification body operating within the region or country.

Further reading:

Oluka et al, Agroforestry Handbook for the Banana-Coffee Zone of Uganda, farmers' practices and experiences. RELMA. Technical handbook No. 21.
www.infonet-biovision.org – Bananas

Discussion on assessment of local banana marketing and certification

Inquire among the farmers about their knowledge on potential for marketing and certification by asking the following questions:

- Who are the main buyers of bananas in the area?
- Are there any certified organic banana farmers?
- Are there any companies that require certified organic bananas?
- What are their requirements on production and quality?