THE REPUBLIC OF UGANDA

BANANA PRODUCTION MANUAL



NATIONAL AGRICULTURAL RESEARCH ORGANIZATION

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1.0 INTRODUCTION

Banana/plantain is one of the most important food crops in Uganda. About 75% of the farmers grow the crop on 1.3 million hectares.

Most of this production is for local consumption., In addition, banana insures income to the farmer throughout the year, provides soil surface cover, reduces soil erosion on steep slopes and a principal source of mulch for maintaining and improving soil fertility. Banana also provides feeds for animals.

2.0 HOW TO ESTABLISH A BANANA PLANTATION

2.1 Selecting the Site

Bananas require a deep, well-drained loam soil with high humus content, often of volcanic or alluvial origin. Very acidic soils are not suitable. Bananas require considerable amounts of nutrients to maintain high yields.

2.2 Preparing the Field

Bananas can be planted on fallowed land or newly established fieIds. In case of the latter trees must be cut and some of the debris or obstacles from the forest burnt. If there are not much obstacles, planting can be done through the mulch.

If the plantation is to be established on fallowed land, (3 to 5 years) the field should be simply slashed and left without

burning. Burning is not usually recornmended because useful organic matter is destroyed.

A few days after slashing, the grass may be sprayed with a herbicide to speed up organic matter breakdown. A pre-cultivation weed spray can reduce later weed control costs. If Grarnmoxone is used ploughing can take place two days after spraying. Roundup requires two weeks before ploughing is done.

Generally two ploughings are sufficient to provide a good seedbed for the banana plantation. A couple of weeks should be left between each cultivation to allow gernimation of weed seeds which are then killed by the following cultivation.

2.3 Spacing and Digging Holes

The recommended spacing is 3m between the planting rows and 3m within the row (3m x 3m) or wider depending on soil fertility. Rows should be straight in flat fields to give plants the maximum amount of sunlight. Rows should follow the contour lines on sloping land in order to decrease soil erosion.

Planting holes are prepared with minimum size of about 30cm x 30cm x 30cm, and most commonly 45cm x 45cm x 45cm, to as big and deep as 60cm x 60cm x 60cm. Large and deep

planting holes ensure that the roots of future plants exploit the greatest volume of soil and also plants withstand toppling by wind.

2.4 Source and Selection of Planting Material

The planting material must come from a healthy, disease and pest free plantation. Planting material (in-vitro plants) may be obtained from the Tissue Culture Laboratory at Kawanda.

The most commonly used planting material are sword suckers, maiden suckers or corms. Sword suckers are preferred to other planting material. Suckers 1.8 - 2.1 metres high and about 45cm in girth should be selected for planting. Small sword suckers may also be used. The sword suckers have the advantage of being less infected with nematodes and weevils than larger planting material.

2.5 Preparation of Planting Material

The bulb should be pared/peeled to remove all the roots and parts with damage (tunnels formed by weevil larvae or necrosis due to nematodes). Remove the last leaf sheaths as they may house weevil eggs or adult weevils.

The brown and black spots that may appear on the corms due to infestation by weevils and nematodes should be removed until only white tissue remains. If the infestation is severe, with many brown and black spots, the sucker should be destroyed.

Sucker preparation should be carried out in the field where the planting material is collected or far away from the new field, to avoid contamination of the field with pests.

It is recommended to treat banana planting material with the water. A treatment for 20 minutes in water of a temperature between 53°C and 55°C kills the nematodes in the outer layers of the planting material.

It is advisable to plant the suckers within a week.

2.6 Planting

Bananas can be planted throughout the rainy season. However, they should grow vigorously and without stress during the 4 to 6 months after planting, and therefore should not be planted during the last months of the rainy season. 25mm of rain water per week is the minimal requirement for satisfactory growth. Well distributed annual rainfall of 2000 - 2500mm is satisfactory.

The sucker is placed in the hole and its corm is covered, first with the top soil and then the bottom soil. In the planting hole, the sucker is tilted towards the edges of the hole. If the land is sloping, the sucker should be so oriented that the future ratoons emerge against the slope. This will delay the ratoon crop from growing out of the soil exposing the corm, a condition called high mat.

If no hot-water treatment was usea on me planting material you may apply insecticides or nematicides in the hole and on top of the soil after planting at recommended manufacturer's rates.

Farmers are advised to use Farm Yard Manure, which is put in the planting holes several days prior to planting. Use of artificial fertilizers should be minimised as much as possible because of the high cost and inability of farmers to apply recommended quantities.

2.7 Intercropping

Before the banana canopy closes, a fair amount of inter row space remains unexploited during the first months. This space can be used for plants which have a short life cycle or which do not compete with bananas.

The intercrop should be planted before (e.g. coffee or cocoa) or at the same time (e.g. legumes such as groundnuts, vegetables, maize: as banana do not plant too close to the banana plant.

Advantages of Intercropping

- Land gives a return before the banana crop is ready to be harvested
- Weed control is easier
- Soil is protected against erosion
- Soil moisture is conserved
- Organic matter is added to the soil.

Disadvantages of Intercropping

If the intercrops are not wisely chosen, intercropping bananas may lead to:

- Soil exhaustion
- Plant health problems
- Competition with bananas for nutrients, water and sunlight

3.0 PLANTATION CARE AND MAINTENANCE

3.1 Weed Control

Weed control in the first year of life is very important. Keep the new plantation weed free to let the banana plants get well established. Once the plants get big enough for the leaves to completely shade the ground, weeds become less of a problem and mulching can keep the weeds down.

3.1.1 Hoe and/or Hand Weeding

Weeds can be hand-pulled or weeded with a noe. Hand or hoe weeding can either be carried out on its own or combined with chemical weed control. For example, ring or row weeding of the banana plants can be followed by a herbicide application on the remaining weeds.

3.1.2 Chemical Weed Control

Chemical w ntrol is less labourious, provides longer control and is faster than hand or hoe weeding.

Chemical weed killers are applied using a knapsack sprayer. If a contact herbicide is used, precautions must be taken to avoid it to drift on to the bananas. Spraying should be done on a day with no or little wind. Herbicides commonly used include Grammaxor Roundup.

It is recommended that the operator follows the dosage instructions, do not smoke or eat during treatment, avoid contaminating human/animal water with the herbicide residues, or reusing herbicide containers for domestic purposes.

Other cultural practices may restrict weed growth as well.

3.2 Mulching

Mulching has a number of roles:

- Restricts weed growth
- Protects the soil against heavy rainfall and intensive sunshine
- Prevents erosion in plantations on steep slopes
- Provides organic matter
- Stimulates root development
- Improves soil drainage
- Decreases soil temperature

- Increases soil porosity and biological life

It is therefore highly desirable for a farmer to mulch as often as possible on his plantation. Due to the difficulty of obtaining mulch, the cost of harvesting and transporting it in terms of labour, it is imperative to:

- Use the mulch obtained from cleaning the bush when setting up a plantation
- Use vegetable obtained from the plantation themselves; leaves, trash, pseudostem, stalks
- Use organic matter available near the plantation e.g. poultry, pig and cow manures
- grow one's own mulch close to the plantation.

The mulching plants which are easier to grow and which produce a substantial amount of vegetable matter are: Pennisetum purpureum (Elephant grass), Tripsacum laxum (Guatemala grass) and Panicum maximum (Guinea grass).

Mulching is known to increase pest attack and toppling. Mulching therefore should be done off the mat. Mulching should also be done when the crop has established in order to encourage a deeper rooting system. Negative geotropism of the roots starts when a thick mulch is introduced early in the plantation, hence the phenomenon of high mats. This increases toppling of banana plants during windy storms.

3.3 Pruning/Desuckering

Pruning or desuckering is carried out to ensure that the number of bunch bearing plants is maintained at a level which stops competition (for water, light, nutrients) and sustains substantial yield. Farmers are advised to desucker the banana mat to 3 plants at various growth ages (mother, daughter and grand daughter) in order to get big bunches.

A special desuckering spade or knife or panga is used. The sucker pseudostem is cut off near its corm and the sharp point of the knife or panga is twisted in the growing point, thus killing it. During these operations care must be taken not to harm the daughter plants.

Generally, up to 6 months old suckers must be removed, at flowering up to harvest time. 1 or
2 suckers must be maintained. Always choose suckers which are coming from well down on the
corm because the banana plant has a tendency to grow out of the ground. The suckers should be on the opposite side of the bunch of the mother plant.

3.4 Fertilization

Extra nutrients can be applied in the form of either organic (mulch, manure or ash) or inorganic fertilizers.

Organic Fertilizers

Crop residues should be returned to the farm to compensate for the continual loss of nutrients at harvest. Many farmers who have banana plantations near their homesteads use some organic inputs by coincidence, through the traditional residue disposal system. This maintains good stands of banana where banana production has declined.

Mulching banana farms with off farm residues sustains bananas for a long time.

Well rotten farm yard or compost manure may be placed in the planting holes or after planting usually in the rains. The manure is ploughed in to a depth of 30-40cm over the soil surface or placed in the furrows between the rows or along the rows.

Inorganic Fertilizers

The application of adequate fertilizers increases production, improves the grade of the fruit and reduces crop duration to maturity appreciably. Bananas have a high demand for nitrogen and potash and therefore, respond very well to nitrogen and potash application. Phosphorus is vital but it is required in smaller quantities.

Application of inorganic fertilizers at an early stage is critical since this stage will affect the later phases in development. Therefore, mineral nutrients must be available at the time of

planting or at the initiation of the ratoons. Some phosphates and potash should be applied in the planting holes and thereafter twice yearly, while nitrogen should be applied regularly at shorter intervals.

The fertilizer requirements may vary from farm to farm and year to year. Before applying any type of fertilizer advice should be sought from soil scientists or agricultural staff.

3.5 Deleafing

Deleafing is carried out on a regular basis because of plantation hygiene and appearance. The dead hanging leaves cover young suckers and the old sheaths on the base of pseudostem provide an ideal refuge for adult banana weevils.

Always remove these leaves and sheaths and use them as mulch. Leave enough leaves to produce a good quality bunch, at least 9-12 leaves at flowering and 4 at harvest.

Complete deleafing of the plant prior to harvesting is not recommended as this starts the ripening process.

3.6 Cutting off Male Buds

Male buds are removed to encourage development of the young bunch. Care should be taken not to damage the hands of the bunch.

3.7 Propping

Propping up of banana is done in order to prevent the plants with maturing bunches from falling down. The heavy weight of the banana bunch bends the bearing plant and can cause doubling (pseudostem breaks), snap-off (corm breaks, leaving a part in the ground) or uprooting, also called toppling (the entire corm with roots comes out of the ground).

Plants are generally weak during the dry season, strong winds, and nematodes and weevils also increase the rate of loss, For these reasons, bearing plants always need support from 1 or 2 wooded props, usually made of bamboo. A lateral branch usually with a natural fork can be used. Depending on the weight of the bunch the branch(es) can be placed underneath the bunch or along the pseudostem.

3.8 Harvesting

The time taken from flowering to harvest vary with cultivar, climatic conditions and sometimes management practices. Generally bunches take 3-4 months to mature.

The methods of harvesting will be determined by the purpose of the bunch, either for home consumption, sale or brewing. The pseudostem and foliage of the harvested plant should be chopped and spread over the soil as a mulch for the ratoon crop. This practice eliminates the breeding sites for the banana weevils.

4.0 BANANA ZESTS AND THEIR CONTROL

The banana weevil, Cosmopolites sordidus and plant parasitic nematodes are the most destructive pests of bananas in Uganda. These may result in severe yield loss if unconlrolled.

4.1 Banana Weevil

4.1.1 Damage and Symptoms

Weevil damage results from larvae feeding and tunnelling into banana corms and pseudostems. The adult weevil lay its eggs near the corm and on hatching the larva attack the underground part, boring tunnels in it. As weevil larvae grow in size., they make large tunnels 15 cm in diameter and may extend to 60-100 cm up the pseudostem. The damage weakens the plant and interferes with uptake of nutrients and water

Weevil infestation of young plants causes stunting, disruption and delay of fruiting and sometimes leads to plant death. Heavily infested plants produce small bunches and have reduced resistance to drought and strong winds, leading to snapping and toppling of large or mature flowered plants.

The banana weevil causes more damage to the cooking types than the beer cultivars. Weevils damage may increase when plants of reduced vigour are attacked. Low vigour usually results from plants being grown in soils with low moisture and fertility levels, weeds or intercrop competition, lack of desuckering which encourages competition for nutrients

between suckers of the same plant and attack of plants by other pests and diseases.

Weevil damage is most severe between altitudes 1000 - 1200 m.a.s.l and decreases at higher altitudes; little or no weevil damage is recorded in places like Kabale (17660 m.a.s.l) and Kapchorwa (1830 m.a.s.l). Absence of banana weevil from higher elevations suggests that the weevil has a lower temperature threshold for larval development or adult survival.

4.1.2 Control Measures

4.1.2.1 Cultural Methods

Cultural control based on manipulation of weevil habitat and oviposition site provides the first line of defence against the banana weevils. It is cheap and does not entail extra inputs. Various cultural practices are used and they include:

Use of Clean Planting Material

This minimizes the spread of the weevils which are mainly carried to new sites with infested suckers. Clean suckers may be obtained from non-infested fields, by paring the corm to remove eggs and larvae or by use of tissue cultured plants. Hot water treatment (52°C for 20 minutes) was advocated for but this practice may not be very effective for weevil control especially when there are larvae in the planting material.

Good Husbandry

This involves clean weeding, desuckering, pruning, manuring and mulching, which produce vigorous plants that are more tolerant to weevil damage.

Destruction of Post Harvest Residues

Removal and splitting of harvested stems into small strips and spreading them out to dry quickly reduces hiding and breeding sites for the weevil. It also exposes weevil eggs and larvae to desiccation.

Trapping

Two types of traps, pseudostem and disc-on-stump are used. The pseudostem trap is made from pseudostem pieces split longitudinally into halves, and placed against a banana plant with split surface on the ground. The disc-on-stump traps, on the other hand, are made by cutting harvested stump, 15-25 cm above ground level and then placing a pseudostem sheath or banana leaves on top of the stump. The weevils attracted to these traps are collected and destroyed. Traps remain effective for about 1 or 2 weeks and are renewed whenever ample supply of pseudostem pieces are available.

Use of Mixtures of Ash, Urine and Insecticidal Plants

Traditionally farmers have used ash in banana fields for soil nutrient enhancement and weevil control. Farmers are now

using mixtures prepared by adding various levels of ash, urine, tobacco, capsicum, phytolacca, and other weed species. The method and rates of application vary from farmer to farmer. But the most common one is use of a 14 day fermented mixture at 1-2 cups (500 ml - 1000 ml) per banana stool. While the practice is being recommended and encouraged, it's field efficacy is still unclear and work is under way to validate the practice.

4.1.2.2 Chemical Control

At planting a certain amount of insecticide such as Furaaan, Pimicid, Mocap and Dursban should be systematically applied around the sucker in the plating hole.

In the case of established plantation, the insecticides should be applied to the soil around on the base of the banana stool.

The chemicals can also be applied with pseudostem or disc-on-stump traps in mature banana plantations to kill weevils that get attracted to the traps.

It is extremely important for a farmer to seek advice from the relevant services, to assess the level of damage and whether it is economical to apply, and which chemical to be used. Monitoring of the weevils is required before chemical application (more than 2 weevils per trap might require chemical control).

As in the case with herbicides, utmost care should be taken when using insecticides.

4.1.2.3 Biological Control

Research is on-going to develop a biological control strategy for the banana weevil using entomopathogenic fungi. Beauveria bassiana seems more promising and is being tested to be integrated with other methods for weevil control.

4.2 Nematodes

4.2.1 Damage and Symptoms

Nematodes are minute worms which live in the soil and infest plant roots. During their process of feeding, nematodes tunnel through the root cortex, leading to expansion of the lesions caused. The lesions coalesce into large necrotic patches reddish purple in colour, a symptom known as root necrosis. Root necrosis results in premature root death or root fracture at points where the necrosis girdles across. The necrosis interferes with the water and nutrient exchange passage.

The most obvious symptom of nematode damage is the toppling over of the entire plant, particularly fruiting ones. In general, damage to the banana root system results in: stunted growth, premature leaf drop, reduced vigour and delayed ratooning, small and poorly filled bunches, and increased susceptibility to water deficiency.

4.2.2 Management Strategies

The perennial nature of the banana crop and the subterranean and endoparasitic nature of nematodes makes control of the pest difficult. However, a number of control measures have been developed but their success against nematodes is influenced by various environmental and plant based conditions.

4.2.2.1 Cultural Control

Use of clean Planting Material

The spread of nematodes across and within regions is attributed to transfer of infested planting material and can be avoided by using nematode free or micro propagated suckers.

Field suckers can be cleaned by corm paring, followed by either exposing them to sunlight for some days or hot water treatment or dipping them in nematicide.

Use of in-vitro propagated plants can delay infection by nematodes.

Crop Rotation

Rotating bananas with non or less favouralble hosts lead to decline in nematode populations in a field. The next banana crop then is started with a low initial inoculum. This method together with flooding and fallowing are efficient where

bananas are replanted frequently. Root crops (cassava and sweet potato) have proved potential rotation crops against nematodes.

Soil Amendments and Mulching

Well managed (mulched, weed free, manured) plantations and backyard garden plants (constantly receiving household wastes) have a long period of good productivity. In addition to enhancing vigorous plant growth, mulches may affect soil nematode populations through the benefits of organic matter and by altering the micro environment.

4.2.2.2 Chemical Control

For quick and efficient impact on nematode pests, chemical nematicides offer the best alternative. The use of nematicides is only feasible in commercial (growing fcr export) plantations. Their use in the subsistence production systems is not economically justified as chemicals are hazardous to man and the environment, and may negatively affect natural enemies of many pests.

As with the banana weevil, the nematode population should be regularly monitored to justify the implementation of appropriate nematicide treatment.

Some chemicals act as insecticides as well as nematicides e.g. Furadan and Mocap so the application procedures for control of the banana weevil will also work for the namatodes.

4.3 Other Pests

Monkeys

These can be notorious and destructive especially to plantations near forests. Monkeys can be scared off by dogs, children or guards.

Ants

Black ants commonly known as Kaasa in Luganda, usually dig up soil and expose the banana corms thus rendering the plant to toppling.

Leaf Eaters/Miners

The leaf blades and lamina can be attacked by various lepidoptera caperpill they are not usually very serious pests.

5.0 BANANA DISEASES AND THEIR CONTROL

The major diseases found in Uganda are: Black sigatoka, Yellow sigatoka, Cladosporium speckle, Banana streak virus (BVS), Fusarium wilt and Matooke wilt. All other diseases are minor and include Cucumber mosaic virus, Corm rot (Armellaria) and Cigar end disease.

Leaf diseases may be difficult to differentiate in the field and farmers often confuse their symptoms for causes of other

constraints especially weevils and nutrient deficiencies. The diseases are worse where other stresses (weevils, nematodes, nutrient deficiency) are severe. The diseases cause premature death of large areas of the leaf surface, in some cases the entire leaf is affected.

5.1 Yellow Sigatoka

Yellow sigatoka disease is caused by **Mycosphaerella musicola.** It is characterised by appearance of small yellow specks (1-2mm long) on the leaf, parallel to the secondary veins of the blade. The Yellow specks develop into necrotic spots, which are more or less round and are surrounded by a yellow halo. The necrotic pathes may go up the leaf.

The lesions on most susceptible clones pass through six stages to maturity:

(i) Minute yellowish green specks

(ii) Specks grow into yellowish green to yellow streaks, visible on the upper side of the leaf

(iii) The streaks expand and gradually change to brown or rusty red spots with undefined margins

(iv) The spots obtain a definite outline with a brown centre and a yellow to light brown halo sometimes with a water soaked centre

(v) The dark centre sinks and the water halo turns darker brown

(vi) The sunken central area turns grey and is surrounded by a dark brown or black border with a yellow halo between the border and the normal green leaf.

5.2 Black Sigatoka

Black sigatoka is caused by **Mycosphaerella fijiensis**. The disease cycle also passes through six stages to maturity largely similar to those of Yellow sigatoka. The main difference is at streak stage where Black sigatoka streaks are brown while those of Yellow sigatoka are initially yellow. This similarity makes it difficult to distinguish the two diseases by symptoms alone.

The disease is characterised by early death of the banana leaves, the appearance of large brownish coloured streaks on the underside especially of the fourth leaf.

In the absence of control, these streaks which are numerous, coalesce, with black necrotic patches appearing on topside of the leaf.

The blackened (necrotic) areas dry out rapidly and turn brown

When soaked by rain they tend to become much darker and give the plantation such an unsighty appearance of black dead leaves.

The leaf blade edges, which are often the most affected areas, tend to fold on themselves. On dessert bananas the same leaf may be affected by both yellow sigatoka and black sigatoka.

Generally the affected plants have very few functional leaves (3-4) at flowering and some plants may be seen completely bare of leaves at harvest time.

Under these circumstances, the bunches cannot reach maturity.

5.3 Cladosporium Speckle

Cladosporium speckle is caused by Cladosporium musae. The disease starts as small brownish spots similar to pencil specks three to four weeks after leaf unfurling. The specks enlarge and the leaves become greenish black. As the leaf ages, the spots turn orange-yellow then brown and finally necrotic. Necrosis starts from the margin of old leaves.

5.4 Control of Yellow Sigatoka, Black Sigatoka and Cladosporium Speckle

Generally, the cheapest and most effective method of controlling plant diseases is by use of host plant resistance. Resistant highland bananas do not exist but they are being developed. Resistant hybrids developed from exotic banana have already been imported into the country. Some of them (e.g. HFIA 01, HFIA 17 and HFIA 23) have good cooking attributes.

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Research to develop cultural control based on good crop husbandry and sanitation is going on. Preliminary results suggest that enhancing nutrition of the banana plant considerably reduces the impact of leaf spot diseases.

5.5 Banana Streak Virus (BSV)

The importance of Banana Streak Virus (BSV) in Uganda was recognised recently although presence here seems to have been longer. BSV belongs to the badnavirus group. BSV causes a range of symptoms and causes damage ranging from mild to severe cases.

5.5.1 Symptoms of BSV

- Initial foliar symptoms of BSV are yellow striate mosaic similar to symptoms of cucumber mosaic. Necrotic streaks later develop in leaves of BSV infected plants unlike in cucumber mosaic infected ones.

- Infected plants have reduced growth vigour, failure to flower, fruit distortion, smaller bunches and poorly filled fingers.

- Internal pseudostem necrosis that leads to top die back has been associated to BSV infection

Periodicity of symptom expression is a characteristic of BSV infection. Plants may not show streaks on all leaves and for several months at a time. Emerging leaves may be symptomless or show slight symptoms.

5.5.2 Control of BSV

- Eliminate infected plants to restrict the spread of BSV. All BSV infected plants should be uprooted and chopped dry.
- Use of clean planting material in establishment of new plantations. Suckers should be obtained from uninfected fields.
- Control can also be effected through quarantine measures.

Use of resistant cultivars.

5.6 Fusarium Wilt Disease

Fusarium wilt is also known as Panama wilt and is caused by Fusarium oxysporum f.sp. Cubense. It is known to be the major destructive disease of bananas in Uganda leading to losses up to 100% in some farms.

Fusarium oxysporum f.sp cubense is only pathogenic to four exotic dessert cultivars grown in Uganda, namely; Gros

Michel, **Sukari/Ndizi,** Kisubi and **Kayinja** and does not infect highland bananas.

Fusarium oxysporum f.sp.cubense, infect bananas through the lateral roots. The pathogen has got to be in contact with the vascular system in order to incite the disease and is transported by the transpiration pull of the plant. Therefore, contaminated implements can only transmit the pathogen if they get in contact with roots, or corm vascular system, or adhering spores get established in the soil. It is unlikely that the pruning practices in Uganda which involve the above ground part of the plant transmit the disease. The major transmission avenue is through contaminated or infected suckers.

5.6.1 Symptoms of Fusarium Wilt

Symptoms include yellowing of leaves, or collapse of the petiole while the leaf is still green. All leaves eventually collapse where the petiole joins the pseudostem and die. Sometimes the leaf sheaths loosen and later the pseudostem may split. After this the pseudotem remains with the dead leaves hanging round it. Normally the attacked plant fail to flower, but if it does, the bunch fails to develop and fill up.

The disease is confirmed by cutting through the pseudostem and this reveals a characteristic discolouration of the vascular bundles, usually stained pink or purplish or black. Sometimes the infected portion is smelly.

5.6.2 Control of Fusarium Wilt

There are no means of controlling fusarium wilt once the plant is already attacked by the pathc Growing resistant varieties such as Cavendish, FHIA 17 and FHIA 23 is the most cost effective way of controllinn the disease.

Control can also be effected through quarantine, and planting non-infected suckers in non-infested soil. Implements and movement from infested to clean hould be carefully observed and restricted.

Once a mat is attacked, it should be completely destroyed by chopping up the plants and burning it. The banana stool or plantation should be replaced with resistant cultivar ops.

5.7 Matooke Wilt

Highland bananas have been found to succumb to another wilt syndrome (Matooke wilt) in Western Uganda highlands at altitudes above 1330 metres above sea level (m.a.s.l.). This wilt has since been erroneously diagonised as fusarium wilt. The disease has not been observed at lower elevations (bellow 1330 m.a.s.l.) even in Western Uganda.

Matooke wilt is virtually limited to areas around homesteads, garbage dumping sites and animal kraals.

Matooke wilt does not spread farther than 35 metres off the homesteads. It causes yield losses of up to 78% in bunch weight of Enyeru cultivars. Such losses are usually more severe closer to the homesteads where farmers expect higher yields because of higher organic matter content.

Suckers from seriously infected mats when transplanted from these sites to non-infested soils, outgrow the disease and produce healthy bunches and healthy suckers

Casual agent of this wilt syndrome is not yet known but investigation is in process by research.

The severity or this disease can be minimised by applying sanitary measures of removing infected plants and applying properly decomposed household refuse on fields.

5.8 Other Diseases

5.8.1 Corm Rot (Armillaria sp)

This usually occurs in plantations planted on cleared forest land as the pathogens (Amillaria sp) originate from the cleared trees and persist in stumps and roots. The pathogen invades the banana corms and roots.

Symptoms

Yellowing and death of leaves. The plant may be easily pushed over and break off at about ground leven in an event of advanced infection.

Control

Remove and burn infected plants. Replacing should be done a few meters from the infected site. All stumps and large roots should be removed from cleared forest soils before planting bananas as a preventive measure.

5.8.2 Cucumnber Mosaic Virus

This is transmitted by several aphid species and may occur in one form or the other where bananas are grown. The disease is rare and may not be so serious.

Symptoms

The most characteristic symptom is the loss of leaf colour in pathes, rendering leaves variegated in appearance. The variegations may be roughly parallel to the lateral veins, but not always, giving leaves a striped appearance. As the disease progresses, leaves emerge, having perhaps one or both sides of the lamina not fully developed so that the leaf margin instead of being smoothly curved is irregularly wavy, often with blotches of necrotic tissue and the lamina is reduced in width. Sometimes rotten areas are found throughout the leaf sheaths and the pseudostem.

In cooler areas, rotting of the heart leaf may develop to such an extent that a soft black rot extends right down to the corm (the 'heart rot' condition). The older leaves show black or purple streaks and may shed.

Fruits on infected plants may not show any symptoms or may be stunted with chlorotic streaks or may show necrosis.

Control

Planting material should be checked so as not to introduce the disease to a new plantation. Plants of the tomato and cucumber families, maize, **Panicum** sp. and **Digitalia** sp. are known to carry the virus. Intercropping bananas with such plants should be avoided. Non-host cover crops can be planted to suppress weeds.

The infected plants must be destroyed by digging them up. Eradicate all the suckers in the mat even if they appear healthy. Where possible the vegetation surrounding the diseased site can be destroyed to kill aphids using malathion or another suitable spray.

5.8.3 Anthracnose

This is a fruit disease caused by **Collectotrichum** musae. The disease is most common on cooking bananas. The anthracnose infection originates in the field on uninjured green fruit.

Symptoms

Infections appear as small black circular specks on the flowers, skin and distal ends of banana hands. The lesions increase in size and later become sunken and coalesce, forming large spots on the surface. As the fruit matures typical lesions develop

and this will continue on the mature fruit. In severe cases the fruit is entirely covered with dark blemishes.

Control

Normally the disease is not so serious and bunches affected by anthracnose produce good food. For domestic use, diseased bananas may not warrant expensive control.

5.8.4 Cigar End Disease

The air-borne fungi, Verticillium theobromae and Trachysphaera fructigena are consistently associated with cigar end disease.

Symptoms

The infection of the fruit takes place through the pistillate end. Necrosis spreads a short way up the finger and the necrotic tissue becomes corrugated and covered with greyish white fungal hyphae so that it looks like the ash at the end of a cigar. The occurrence of a dry rot of the pulp is very characteristic of infection with V.theobromae while that of T.fructigena gives rise to wet rotting.

There is a clear demarcation between the infected tip tissue and the rest of the finger. Occasionally when infection takes place early the whole finger becomes rotten.

Cigar end disease tends to be associated with high humidity areas (e.g. in Kabarole, Kabale). Old and badly maintained plantations suffer most damage.

Control

Hand removal of floral remains, i.e. pistils and perianth can give effective control.