



Disease Control in Cassava Farms

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IPM Field Guide for Extension Agents

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What are the objectives of this guide?

This field guide has been prepared to help you to:

- recognize common cassava diseases and specify their causes,
- specify how the diseases damage cassava plants,
- identify the sources of cassava diseases, and understand how cassava diseases spread, and
- combine appropriate practices to control cassava diseases and grow a healthy crop of cassava.

Introduction

Many diseases are caused by very tiny living things called pathogens. Pathogens are so tiny that you cannot see them even with the aid of hand lenses. Examples of pathogens are viruses, bacteria, and fungi. When a pathogen attacks a cassava plant, it multiplies and spreads inside or on the plant. As it spreads, it destroys the plant. The plant will show signs (symptoms) of attack. Damage symptoms of cassava diseases appear on the leaves (Figure 1), stems (Figure 2), and storage roots (Figure 3) of the plant. Cassava diseases are recognized by their symptoms, such as discoloration of leaves, "sores" on the stems, and discoloration of storage roots.

Some other diseases which you may notice in cassava are caused by nonliving things. Examples of such diseases are wilting due to drought and poor plant growth because of poor soils.



Figure 1: Cassava plant damaged by cassava mosaic disease



Figure 2: Cankers of cassava anthracnose disease on stem



Figure 3: Cassava storage roots damaged by cassava brown streak disease

What are the common cassava diseases?

The common diseases of cassava are cassava mosaic disease, cassava bacterial blight, cassava anthracnose disease, cassava bud necrosis, and root rots. Some of these diseases attack the leaves and stems of cassava plants while others attack the storage roots.

Leaf and stem diseases

Common leaf and stem diseases of cassava are cassava mosaic disease, cassava bacterial blight, cassava anthracnose disease, cassava bud necrosis, and brown streak disease.

Cassava mosaic disease

Cassava mosaic disease is caused by a virus which occurs inside cassava leaves and stems.

Damage symptoms: The leaves of cassava plants with the disease are discolored with patches of normal green color mixed with light green, yellow, and white areas (Figure 4). This discoloration is known as chlorosis. The chlorotic patches can be confused with cassava green mite feeding damage (Figure 5). When cassava mosaic attack is severe, the leaves are very small and distorted and the plants are stunted. The disease symptoms are more pronounced on younger plants (Figure 1), usually under 6 months, than on older plants.

Method of spread: The main sources of the virus which causes cassava mosaic disease are cassava plants with the disease and the whitefly *Bemisia tabaci* (Figure 6). The virus occurs in the saliva of the whitefly. During feeding, the insect injects saliva containing the virus into

cassava leaves. The virus multiplies and occurs in large numbers in the leaves and stems. Cassava mosaic disease is also spread by planting stem cuttings from plants infected with the disease.

Other crops attacked: Cassava mosaic disease attacks only cassava.



Figure 4:
Cassava leaves with chlorotic (pale) patches of cassava mosaic disease



Figure 5:
Cassava leaf with chlorotic (pale) spots caused by cassava green mite



Figure 6:
Adults of *Bemisia* whitefly (as seen enlarged under the microscope)

Cassava bacterial blight

Cassava bacterial blight is caused by a bacterium which occurs inside cassava leaves and stems.

Damage symptoms: Initially, damage by cassava bacterial blight appears as water-soaked dead spots (lesions). The lesions occur between leaf veins and are most evident on the lower surfaces of the leaves (Figure 7). The lesions are small, not completely round in shape, and have a few angles at their edges. These angular lesions later join together into larger patches killing the leaf blade as they enlarge. The leaf blade turns brown with the water-soaked area at the leading edge of the brown patch. This damage symptom is known as leaf blighting (Figure 8). Severely blighted leaves wilt (Figure 9), die, and fall causing defoliation and shoot tip die-back (Figure 10) or complete death of the shoot. Leaf blighting starts from the leaf blade and moves towards the petiole. The petiole retains a horizontal position before leaf fall (Figure 9). This is unlike cassava anthracnose-damaged leaves whose petioles droop before leaf fall (Figure 12). Drops of brownish gum may occur on the leaves, petioles, and stems of plants infected with cassava bacteria blight.

The damage symptoms of cassava bacteria blight are more evident in the wet than in the dry season. The disease is more severe in young plants than in older ones.

Method of spread: The main sources of the bacterium which causes cassava bacterial blight are cassava plants with the disease. The bacterium enters cassava plants through wounds and scratches on the stems and

leaves. It multiplies and occurs in large numbers in the leaves and stems. Cassava bacterial blight is therefore spread by planting stem cuttings from plants with the disease symptoms. Dead cassava stems and leaves with the bacterium also serve as sources of the disease if they are not destroyed after root harvest.

The disease is spread naturally by raindrops which splash the bacterium from infected plants to healthy plants. Insects, for example, grasshoppers become contaminated with the bacterium and spread it to healthy cassava plants. Farm tools that are used to cut infected cassava plants should be cleaned after use to prevent the bacterium on them from spreading to other plants.

Other crops attacked: Cassava bacterial blight attacks only cassava.



Figure 7: Cassava leaf with angular leaf spots of cassava bacterial blight



Figure 8: Cassava leaf blighting caused by cassava bacterial blight



Figure 9: Leaf blighting and wilting caused by cassava bacterial blight



Figure 10: Cassava shoot tip die-back caused by cassava bacterial blight

Cassava anthracnose disease

Cassava anthracnose disease is caused by a fungus which occurs on the surface of cassava stems and leaves.

Damage symptoms: Cassava anthracnose disease appears as cankers ("sores") on the stems and bases of leaf petioles (Figure 11). Cankers weaken the petioles so that the leaf droops downwards (Figure 12) and wilts. The wilted leaves die and fall causing defoliation and shoot tip die-back or complete death of the shoot. Soft parts of cassava stems become twisted under severe attack by the disease. The disease usually starts at the beginning of the rains and worsens as the wet season progresses.

Method of spread: The main sources of the fungus that causes cassava anthracnose disease are cassava plants with the disease. The fungus spreads by wind carrying spores from cankers on the stems, or by planting stem cuttings with cankers. The fungus enters cassava plants through wounds and feeding punctures made by the bug *Pseudotheraptus devastans* (Figure 13). Dead cassava stems and leaves with the fungus also serve as sources of the disease if they are not destroyed after root harvest.

Other crops attacked: The fungus that causes cassava anthracnose disease affects other crops as well as cassava, for example, coffee, pepper, and pawpaw.

Cassava bud necrosis

Cassava bud necrosis is caused by a fungus which occurs on the surface of cassava stems and leaves.

Damage symptoms: The disease appears as patches of brown or grey fungal matter covering the stem. The fungal matter sometimes covers buds ("eyes") on cassava stem cuttings (Figure 14). The affected buds die, which reduces the sprouting ability of stem cuttings.

Method of spread: The main sources of the fungus that causes bud necrosis are cassava plants with the disease. Dead cassava stems and leaves with the fungus also serve as sources of the disease if they are not destroyed after root harvest. The fungus spreads by wind, however, planting of infected stem cuttings is the main method by which the disease spreads.

Other crops attacked: The fungus that causes bud necrosis causes leaf spots on a variety of plants including grasses, cereal crops, banana, and mango.



Figure 11: Cankers of cassava anthracnose disease at the bases of cassava leaf petioles



Figure 12: Cassava shoot with wilted leaves caused by cassava anthracnose disease



Figure 13: The bug *Pseudotheraptus devastans* on cassava leaf



Figure 14: Cassava stem with fungal patch (arrow) of bud necrosis disease

Leaf spot diseases

Cassava leaf spot diseases are caused by fungi. There are three different types, namely white leaf spot, brown leaf spot, and leaf blight.

Damage symptoms: Cassava white leaf spot disease appears as circular white or brownish-yellow spots on the upper leaf surfaces (Figure 15). The spots sometimes have purplish borders around them.

Cassava brown leaf spot disease appears as small brown spots with dark borders on the upper leaf surfaces (Figure 16). The brown spots occur between leaf veins, and their sizes and shapes are limited by the distance between these veins. The dead tissue in the center of brown spots may fall to give the leaf surface a "shot hole" appearance. Under severe attack the infected leaves become yellow, dry, and die prematurely.

Cassava leaf blight disease appears as light brown lesions on the upper surfaces of the leaves. The lesions are not limited by veins, therefore they are usually larger than brown leaf spots. The lesions may enlarge to cover most of the leaf surface and cause leaf blighting (Figure 17). The blighted leaves lack water-soaked areas, which are typical of leaf damage by cassava bacterial blight (Figure 8). Leaf blight lesions also lack the dark borders of brown leaf spots and they do not develop into "shot holes" on the leaf surface.

Method of spread: The main sources of the fungi that cause leaf spot diseases are infected cassava leaves on the plant or those fallen on the ground. The fungi spread to new plants from these sources by wind or rain splashes. Leaf spot fungi can occur on weeds which

then serve as sources for spread of the diseases.

Other crops attacked. Not much is known about the host crop range of cassava leaf spot diseases.



Figure 15: Cassava leaf with white leaf spot disease



Figure 16: Cassava leaf with brown leaf spot disease



Figure 17: Cassava leaf with leaf blight disease

Stem and root diseases

Cassava brown streak disease

Cassava brown streak disease is caused by a virus. Presently the disease is reported only from cassava-growing regions in East and Southern Africa.

Damage symptoms: Damage symptoms of cassava brown streak disease appear on the leaves, stems, and storage roots of cassava plants. On the leaves, the disease appears as patches of yellow areas mixed with normal green color (Figure 18). The yellow patches are more prominent on mature leaves than on young leaves. The damaged leaves do not become distorted in shape as occurs with leaves damaged by cassava mosaic disease (Figure 1). On the stems, the disease appears as dark brown "streaks" (Figure 19) with dead spots on leaf scars. These streaks are most prominent on upper, green portions of the stems. The diseased plants may show shoot tip die-back. Cassava brown streak disease distorts the shape of the storage roots and may cause cracks and discoloration in the storage roots (Figure 20).

Method of spread: The main sources of the virus that causes cassava brown streak are cassava plants with the disease. The disease is spread through the planting of stem cuttings from diseased plants. The virus is also believed to be spread from plant to plant by insects.

Other crops attacked: Cassava brown streak disease is not known to attack other crops.



Figure 18: Cassava leaves with chlorotic (pale) patches of cassava brown streak disease



Figure 19: Cassava stem with "streaks" of cassava brown streak disease



Figure 20: Cassava storage roots discolored by cassava brown streak disease

Cassava root rot diseases

Cassava root rot diseases are caused by various kinds of fungi living on or in the soil. The fungi occur mainly in soils that do not drain properly and in forest fallow land that has been recently cleared.

Damage symptoms: The leaves on cassava plants affected by root rot disease turn brown, wilt, and the plant appears scorched. The leaves may or may not remain attached to the plant, but the plant loses a lot of water and dies. If you suspect a cassava plant as having root rot disease, you should confirm this by uprooting it and examining the roots for the damage symptoms. Root rot diseases kill both feeder and storage roots of cassava. The storage roots may swell unusually and develop light brown coloration which you can see if the roots crack in the soil or if you cut them open (Figure 21). The roots may give out a bad smell as they rot.

Method of spread: The important sources of cassava root rot fungi are soils, and cassava root and stem debris contaminated with the fungi. The fungi enter cassava plants through wounds caused by pests or farming tools or by piercing the roots by themselves. Farm tillage tools used in cassava farms with the disease should be cleaned after use to prevent the fungi on them from spreading to other areas. Similarly, cassava plant debris in farms with the disease serve as sources of root rot fungi and should be destroyed by burning.

Other crops attacked: Cassava root rot fungi attack a wide range of other crops including maize, soybean, sunflower, and coffee.



Figure 21: Cassava storage root destroyed by root rot disease

Why are cassava diseases important?

Cassava pests are important because they reduce the yield from the crop. They cause food and income losses from cassava in the following ways.

Loss of roots: Root rot and cassava brown streak diseases attack storage roots and cause immediate and direct losses. By damaging leaves and stems, cassava diseases generally interfere with the way by which the plant makes food for storage in the roots. This will reduce the growth of the plants, the number of storage roots they can form, and the ability of the storage roots to swell with food and mature for harvest (Figures 22 and 23). However, most cassava varieties can lose a lot of leaves before the root yield is reduced. Farmers should be discouraged from rushing to tackle control measures at the first signs of damage.

Loss of planting material: Many cassava diseases contaminate cassava stems with viruses, bacteria, and fungi. This makes stem cuttings unhealthy and unsuitable for planting. Certain cassava diseases, for example, cassava bacterial blight, cassava anthracnose, and cassava brown streak diseases, reduce the quantity and quality of planting material by causing shoot tip die-back. Cankers of cassava anthracnose disease (Figure 11) cause cassava stems to break easily. Fungal matter of cassava bud necrosis (Figure 14) kills the buds ("eyes") on stems and reduces the ability of stem cuttings to sprout.

Loss of leaves: In areas where cassava leaves are used as food, leaf diseases "rob" farmers and other consumers directly of the leafy vegetables (Figure 24). For example, cassava bacterial blight and cassava anthracnose disease defoliate cassava plants; cassava mosaic disease and cassava brown streak discolor the leaves, and cassava mosaic disease distorts the leaf shape and size. These kinds of damage will also reduce the ability of cassava plants to make sufficient food for storage in the roots.

Increase in weeds and erosion: Diseases that defoliate and kill cassava shoot tips encourage weed growth in farms because the cassava plants are no longer able to block sunlight from reaching the weeds growing underneath. In loose soils, defoliation of cassava plants will expose the soil to erosion.

Damage to other crops: In addition to cassava, the diseases can damage other crops. Examples of cassava diseases that attack other crops are cassava anthracnose, cassava bud necrosis, and cassava root rot diseases.



Figure 22:
Poor cassava
storage root
yield



Figure 23:
Good cassava
storage root
yield



Figure 24:
Good cassava
leaf harvest

When are cassava diseases likely to cause severe losses?

The presence of diseases in cassava farms does not always mean that they will cause severe losses in food and income. The appearance of disease damage can be misleading. For example, leaf spot diseases are unlikely to cause severe losses in root yield because they usually attack plants close to maturity. It is therefore very important to know the conditions under which diseases can be serious problems. The following pointers will help you to know when the diseases are likely to cause severe losses in cassava farms.

The cassava varieties you grow: Losses caused by diseases are less severe on some cassava varieties than on others. Table 1 lists some varieties with different levels of tolerance against cassava mosaic disease and cassava bacterial blight.

The stage of plant growth at attack: Generally, yield loss is greater if stem cuttings sprout with the diseases than in disease-free sprouts. Disease-free sprouts can, however, be infected with pathogens later on. If this happens, young cassava plants suffer more from disease attack than older plants. At 3–4 months after planting, the storage roots of most cassava varieties start to swell with food. At about 7 months after planting, the plants have formed the number of storage roots they will carry during their growing period. This number will not increase much after this time, but the storage roots will continue to swell with food until they are harvested. Therefore, if diseases attack cassava farms aged 7 months or less, the plants will provide

fewer and smaller storage roots than if attacked later. For example, under cassava mosaic disease attack, yield losses will be higher if disease-free plants became diseased within 4 months after planting than if they became diseased later on. Also, leaf spot diseases occur mainly on mature and older cassava leaves, and normally on older cassava plants, usually more than 5–9 months old. Leaf spot diseases are therefore unlikely to cause severe losses in root yield.

The plant parts attacked: Diseases which damage the plant parts that you harvest “rob” you directly of food and income. For example, when cassava storage roots are damaged, the plants do not replace them with more roots nor do the roots become bigger to compensate for the damage. Diseases which cause this kind of damage are mainly cassava root rots and cassava brown streak disease. However, when diseases attack cassava leaves the plants may produce new leaves and later produce a good root yield.

The season of attack: The effect of season on the extent of damage caused by cassava diseases varies according to the disease. The damage symptoms of cassava brown streak disease are more serious in the dry than in the wet season. Root rot damage can be severe either in the wet or in the dry season, depending on the type of fungi that causes the disease. Damage symptoms of cassava bacterial blight and cassava anthracnose disease occur more in the wet than in the dry season. In the dry season you can notice plants with shoot tip die-back and defoliation caused by any or both of these diseases. However, these symptoms are carried over from the wet season attack.

Table 1: Some features of common cassava varieties in West and Central Africa

Variety	Expression of selected features						
	Yield potential	% dry matter	Cyanogenic potential	Ground storability	Weed suppression	Tolerance to CGM	Tolerance to CMD, CBB
IITA							
TMS 4(2)/1425	High	High	Low	Good	Good	Moderate	Good
TMS 30572	High	High	Moderate	Moderate	Good	Moderate	Good
Benin							
BEN 86052	High	High	Low	Poor	Moderate	Good	Poor
RB 89509	Moderate	Moderate	Low	Good	Poor	Poor	Moderate
Cameroon							
8017	High	High	Moderate	Poor	Good	Moderate	Moderate
8034	High	High	Moderate	Poor	Good	Moderate	Moderate
Ghana							
Aisiali	High	High	Moderate	Moderate	Good	Moderate	Good
Abasa fissa	High	High	Low	Good	Good	Moderate	Good
Nigeria							
MS 6	High	High	Low	Poor	Poor	Good	Moderate
NR 8082	High	High	High	Moderate	Good	Good	Good

CGM = Cassava green mite

CMD = Cassava mosaic disease

CBB = Cassava bacterial blight

Source: IITA, INRA-Benin, MoFA-CSD Ghana, IRAD-Cameroon, and NRCRI-Nigeria

How can I best control diseases in cassava farms?

The best way to control diseases is to grow a healthy crop of cassava. This is especially so because you do not see the viruses, bacteria and fungi which cause diseases. In order to grow a healthy crop you will need to combine plant production and plant protection practices in growing the crop.

IPM practices at planting

Many integrated pest management (IPM) practices for cassava diseases are applicable at planting. These include site selection, soil improvement practices, and selection of appropriate varieties and planting materials. These practices are covered in the companion field guide "Starting a Cassava Farm". Table 1 lists some cassava varieties that can withstand disease attack better than others. A similar table can be prepared by scientists and extension agents for other cassava varieties in particular localities. In selecting a variety to grow against diseases you should find out if the selected variety also has other features you may want.

Almost all cassava diseases are spread by planting infected stem cuttings. The viruses, bacteria and fungi which cause the various diseases survive on or inside cassava stems and are easily carried to new fields in this way. The companion field guide on "Starting a Cassava Farm" presents the general guidelines on how to select healthy stem cuttings. The guidelines will assist you to avoid unhealthy stem cuttings (Figure 25) as planting material and grow a healthy cassava crop. In selecting planting material, you should avoid cassava plants which show leaf discoloration or chlo-

rosis (Figures 4 and 18), leaf blighting and wilting (Figures 9 and 12), gum exudate, cankers, fungus patches and streaks on the stems (Figures 11, 14, and 19) and defoliation, shoot or shoot tip die-back (Figure 10). Stem cuttings from such plants can sprout into diseased seedlings or not sprout at all.

In the control of cassava mosaic disease, you can select good planting material and reduce the level of disease in the farm by following a number of other steps. Firstly, in cassava varieties that branch, choose the branches as sources of planting material. Most of the stem cuttings from these branches will sprout without the disease. On the other hand, most of the stem cuttings from the main stem will sprout with the disease (Figure 26). In cassava varieties that do not branch, avoid the basal stem portions as planting material for a similar reason. Secondly, after planting, closely observe the stem cuttings as they sprout. Normally, stem cuttings sprout 3–4 weeks after planting. Tag all the plants which sprout without the disease. At harvest time select these plants as your planting material to control cassava mosaic disease. Even if the plants sprouting without cassava mosaic disease are attacked by the disease later on, they will grow into healthier plants than those which grow from stem cuttings sprouting with the disease.

If it is difficult to get sufficient quantities of healthy stems for planting, you should treat the stem cuttings against certain diseases. For example, you can dip cassava stem cuttings with cankers in dilute solutions of Benlate (a fungicide) to clean them of the fungus that causes cassava anthracnose. If fungicides are

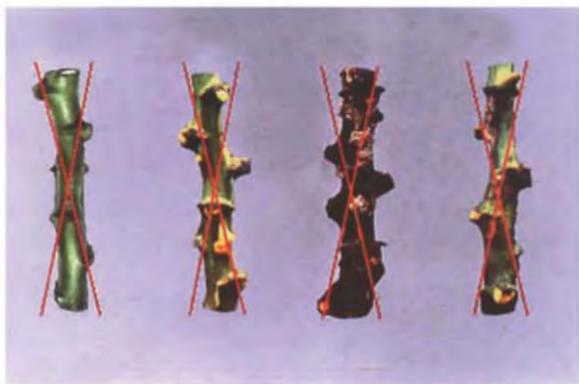


Figure 25: Unhealthy cassava stem cuttings



Figure 26: Cassava stem cutting sprouted with cassava mosaic disease

to be used, you should consult the label for guidelines on their application methods and how to avoid personal and environmental hazards associated with their use.

When cutting up cassava stems into stem cuttings for planting, you should select the middle brown-skinned portions of cassava stems. These parts sprout and ensure more vigorous plants than the top green stem portions. The top green stems dehydrate quickly and are easily damaged by disease.

It is advisable to plant cassava early, at the beginning of the rains. Early planting allows the crop to grow more vigorously and better withstand disease damage later in the dry season than late planting.

IPM practices after planting

Good farm sanitation helps to reduce the sources of the pathogens that cause cassava diseases in farms. For example, after root harvest you should destroy cassava stems with shoot tip die-back, cankers, fungus patches, streaks or any other disease damage symptom. Crop debris of storage roots, leaves, and stems with these symptoms harbor the pathogens and should be destroyed to reduce the sources of disease spread. Farm tools should be cleaned before and after tillage to reduce the spread of root rot fungi through tools contaminated with the pathogen.

If only a few stem cuttings sprout with disease it is advisable to remove them and replace

them with healthy stem cuttings. This is called roguing. Roguing of cassava plants is best done at 3–4 weeks after planting when controlling cassava mosaic disease.

Summary

To control diseases and grow a healthy crop of cassava:

- Identify the common cassava diseases, their damage symptoms, and know the conditions under which they will cause severe losses.
- Select sites with dense vegetation, deep loamy soils, and flat or gently sloping land to grow cassava.
- Improve the soils by manuring, mulching, and intercropping to encourage cassava plants to grow vigorously and offset damage by cassava diseases.
- Grow cassava varieties that tolerate the common cassava diseases in your area.
- Plant stem cuttings from healthy plants without leaf chlorosis, shoot tip die-back, cankers, fungus patches, or streaks on the stems.
- After root harvest destroy discarded cassava stems and storage roots showing any symptom of disease.
- In the control of cassava mosaic disease, select planting material mainly from stem branches; avoid the basal and main stem portions as sources of stem cuttings.
- Plant cassava mainly at the beginning of the wet season; try and avoid late planting.

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About this booklet

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IITA is one of 16 nonprofit international agricultural research and training centers supported by the Consultative Group on International Agricultural Research (CGIAR). Their shared mission is the alleviation of hunger and poverty in tropical developing countries by generating appropriate plant production and protection technologies which benefit the poor and enhance agricultural production while preserving the natural resource base. At IITA, PHMD is dedicated to sustainable plant protection of primary food crops in Africa. The division's research philosophy is to identify and correct the ecological imbalances in agricultural systems causing pest problems and to provide environmentally and economically appropriate options for integrated pest management. (IPM)

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