

About this booklet

This booklet is one in a set of field guides prepared by the International Institute of Tropical Agriculture (IITA) to increase the technical knowledge of extension agents and enhance the integration of plant protection and plant production practices in farmers' efforts to grow a healthy crop of cassava. The booklet is based largely on the extension and farmer training experience of the regional project "Ecologically Sustainable Cassava Plant Protection" (ESCaPP), 1993–1997. ESCaPP was executed by IITA's Plant Health Management Division (PHMD), in collaboration with national agricultural research and extension systems in Benin, Cameroon, Ghana, and Nigeria, and funded by the Division of Global and Interregional Programmes of the United Nations Development Programme (UNDP).

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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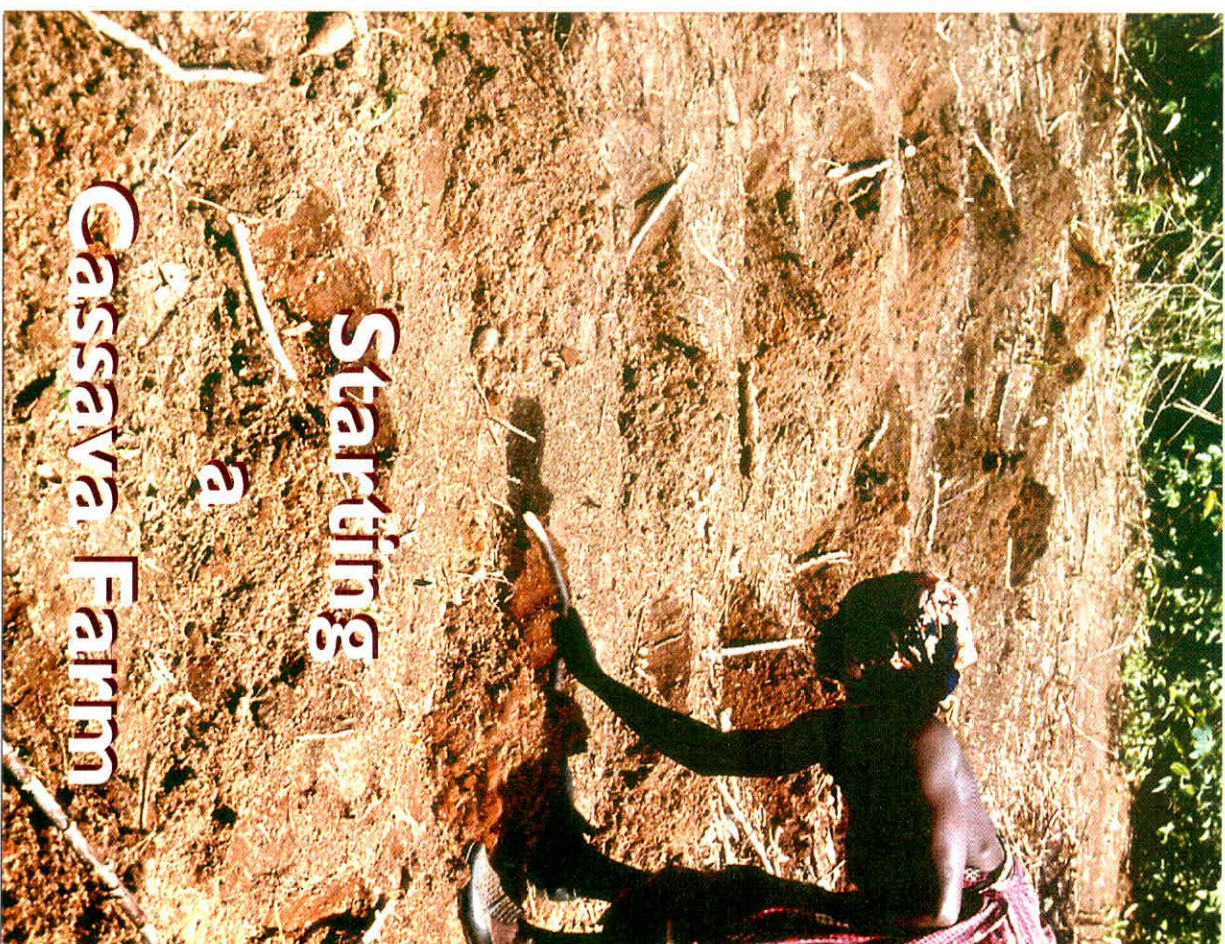
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Starting a Cassava Farm

IPM Field Guide for Extension Agents

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Summary

- To select a good site for a cassava farm, look for an area with dense vegetation cover, good soil texture, fertile soils, and flat or gently sloping land; also examine the field history to plan for plant protection measures.
- Improve the soil by manuring, mulching, and intercropping to encourage cassava plants to grow vigorously and offset damage by cassava diseases.
- To select good cassava varieties for planting, look for varieties with high dry matter, good mealiness, good ground storability and which are well adapted to your area; the variety should also bulk early and be easy to process.
- To select healthy cassava stem cuttings, choose healthy cassava plants as sources of planting materials; use stem cuttings taken from the middle, brown portions of the stem and free of stem-borne pests and diseases.
- To prepare cassava stem cuttings for planting, cut each stem cutting to a length of at least 20–25 cm; use stem cuttings with about 5–8 nodes; treat stem cuttings slightly infested with stem-borne pests by immersing them in heated water for 5–10 minutes, dipping them into a dilute pesticide solution, or by planting them horizontally.
- To plant cassava stem cuttings properly consider the type of soil; prepare ridges and mounds in areas where soil gets waterlogged; use minimum tillage in sandy soil; plant cassava stem cuttings vertically in sandy soil; plant cassava stem cuttings at an angle in loamy soil; plant cassava stem cuttings 1 meter apart from each other in sole cropping; and in cassava intercrops make sure there is enough space for the plants.

stem-borne fungal diseases if a solution of pesticide (for example, Décis) and fungicide (for example, Benlate) is used. If pesticides are 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.

Adopt suitable planting mode: In order to get the best sprouting and growth from cassava stem cuttings, it is important to plant them properly. Cassava stem cuttings may be planted vertically, at an angle, or horizontally. When planted vertically, the storage roots develop deeper in the soil, more closely together, and are more difficult to harvest by pulling. Vertical planting is best in sandy soils. In such soils, plant stem cuttings vertically with 2/3 of the length of the cutting below the soil. When planted horizontally, the storage roots develop more closely to the surface and are more likely to be exposed and attacked by rodent and birds. Also, in horizontal planting several weak stems develop from the stem cutting. Horizontal planting, however, has the advantage of killing insect and mite pests which occur on the surface of stem cuttings. In loamy soil it is probably best to plant at an angle.

The spacing between plants will depend on whether you are growing cassava alone (sole crop) or with other crops (intercropping). If cassava is being grown alone, plant 1 meter apart from each other. If cassava is being grown as an intercrop, consider the branching habit of both the cassava and the other crops and make sure there is enough space for the plants. You should also make sure there is enough space for you to work between the plants during weeding and other activities.

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What are the objectives of this guide?

This field guide has been prepared to help you to:

- select good sites for cassava farms,
- improve soils for good cassava growth,
- select suitable cassava varieties for planting, and
- select, prepare, and plant healthy cassava stem cuttings.

Introduction

Cassava is one of the most common food crops grown and consumed in many parts of Africa. The crop grows well in various soil types and ecologies. It can be planted alone or in association with many other crops, like maize, groundnuts, vegetables, and rice. Growing cassava is not very labor intensive and usually requires 75–125 person-days per hectare from land preparation to harvesting. The storage roots can be harvested 9–18 months after planting. Under traditional farming practices, one can expect between 8 and 15 tonnes of storage roots per hectare of land planted only with cassava. Even under harsh environmental conditions cassava will provide some food when other crops fail. In most places there is a good market for cassava. The storage roots can be processed into various food products (Figures 1 and 2), and starch for domestic consumption, local, and/or export markets. Cassava leaves are nutritious vegetables (Figure 3). The leaves and storage roots can also be used as animal feed. The stems can be sold as planting material.

In order to grow a healthy crop of cassava you will need to combine plant production and plant protection practices. These include site selection, soil improvement, variety and planting material selection, and planting and post-planting measures against weeds, pests, and diseases. The companion field guides on “Weed Control in Cassava Farms”, “Pest Control in Cassava Farms”, and “Disease Control in Cassava Farms” cover specific details of weeds, pests and diseases.



Figure 17:
Planting
cassava on
the flat



Figure 18:
Cassava growing
on mounds



Figure 19:
Cassava growing
on ridges

How do I best plant cassava?

The important factors to consider when planting cassava are time of year, land tillage methods, seedbed type and preparation, and preparation, handling, and planting mode of stem cuttings.

Select suitable planting dates: You should try to plant cassava early, at the beginning of the rainy season. This ensures healthy sprouting and good crop establishment which helps the plant to better withstand damage by dry season pests like the cassava green mite, cassava mealybug, and termites. Late planting at the end of wet season exposes the crop to severe damage by these pests as the dry season progresses. However, planting date recommendations should fit within local farming calendars and farmers' choice of crops to enhance their adoption.

Use suitable land and seedbed preparation methods: In cassava cultivation, land is usually tilled to loosen up the soil, improve soil drainage, make it easy for roots to develop, and promote healthier storage root development. Mounds and ridges are commonly made to gather top soil material for cassava root development, limit prolonged contact between the storage roots and stagnant water, and protect storage roots from rodent and bird pests.

The soil texture at the site you select for cassava cultivation will be an important factor in determining the level of tillage and type of seedbeds required for your cassava farm. In deep loamy soils, tillage may be essential but it does not matter which seedbed type is adopted and cassava can be planted on the flat

(Figure 17), mounds (Figure 18), or ridges (Figure 19).

However, if the loamy soil is shallow and cassava is planted on the flat, the storage roots will quickly reach hard ground or rocks giving poor yields. In sandy soils, minimum tillage and planting cassava on the flat are appropriate because the soil is sufficiently loose to allow for faster drainage and normal storage root development. At sites where the sandy soil gets waterlogged, it is however better to make ridges or mounds than to plant on the flat. In clayey and poorly drained soils, tillage and planting of cassava on mounds or ridges are also essential to limit the effects of waterlogging.

Prepare and handle stem cuttings properly: When cutting up cassava stems into stem cuttings for planting, make sure each cutting is at least 20–25 cm long and has about 5–8 nodes. You should handle cuttings carefully during transportation to prevent bruises and damage to the nodes. This can be done by packing them on cushions of dry leaves.

Sometimes, when planting material is slightly infested with cassava green mites, cassava mealybugs, and other stem-borne pests, the stem cuttings can be treated by immersing them in heated water for 5–10 minutes just before planting. This treatment will kill pests on the surface of the cuttings. You can prepare the heated water by mixing equal volumes of boiling and cold water. Alternatively, you can dip the stem cuttings into a dilute pesticide solution (for example, 1% Rogor solution) to kill stem-borne pests. You can also reduce the incidence of cassava anthracnose and other

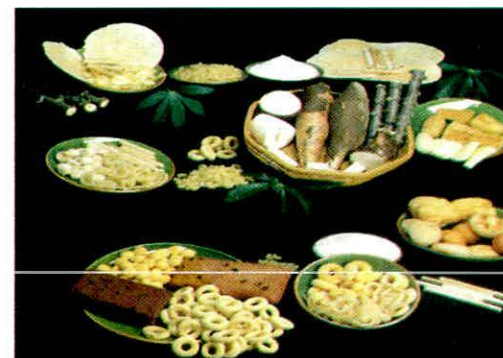


Figure 1:
Assorted
cassava products



Figure 2:
Gari preparation



Figure 3:
Good cassava leaf
harvest

How do I select a good site for planting cassava?

Cassava grows best in areas with deep and well-drained loamy soils, adequate rainfall, and warm and moist climatic conditions. The factors which guide you to determine if an area will be suitable for growing cassava include vegetation cover, soil texture and fertility, topography of land, and the field history of the area.

Look for an area with thick vegetation cover:

Sites with dense vegetation cover are likely to have fertile soils. The dense vegetation shades the soil from direct sunlight, reduces the amount of moisture that is lost from the soil through evaporation, and minimizes run-off water which may otherwise cause soil erosion. The dense vegetation also drops a lot of leaves which rot and add nutrients to the soil. In addition, decaying leaves encourage an increase in the number of earthworms and other small invertebrates in the soil, which in turn help to increase the air in the soil and make it better for growing cassava.

Look for an area with good soil texture:

The best soil for growing cassava is deep, loamy soil. Such soils are rich in nutrients, low in gravel, hold water well, and are easy to work or till. The way to tell if the soil is loamy is to moisten a small amount of it and try to shape it into a ball (Figure 4). If you press the ball and it falls apart, then your soil is loamy. If it feels gritty and you are not able to shape the moistened soil into a ball, then the soil is sandy. If you shape the soil into a ball, and the soil does not fall apart when pressed, then the soil contains a lot of clay and is a clayey soil. Sandy and clayey soils are not the most suitable soils for growing cassava.

Look for an area with fertile soil: Fertile soils usually have a dark color, for example, dark red or dark brown. The dark color shows that the soil has a lot of organic matter. If the soil looks gray and sometimes contains green or blue spots, it means that there is poor drainage and waterlogging. Do not grow cassava on soils that get waterlogged.

Look for an area with flat or gently sloping land:

The best farmland for cassava is flat or gently sloping. Steep slopes are easily eroded and are therefore not very good areas for growing cassava. Valleys and depression areas are also not very suitable because they usually get waterlogged and do not allow cassava roots to develop well. You may, however, plant early maturing cassava varieties on mounds or ridges in inland valleys during the dry season.

Know the history of the site: Information such as how the land was previously used, and the types of weeds, diseases, and pests in the area, can help you in selecting a site for your cassava farm. Such information can help you to avoid a site with problems or make good plans for plant protection. Table I can be used to summarize the agronomic and cassava plant protection history of a site.



Figure 4: Testing soil texture by the “feel” method

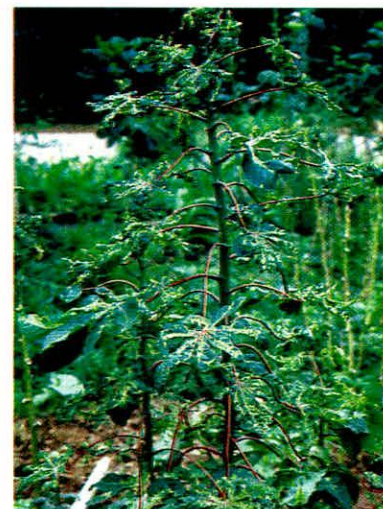


Figure 13: Cassava plant with cassava mosaic disease



Figure 14: Leaf blighting and wilting caused by cassava bacterial blight



Figure 15: Cankers of cassava anthracnose disease on stem

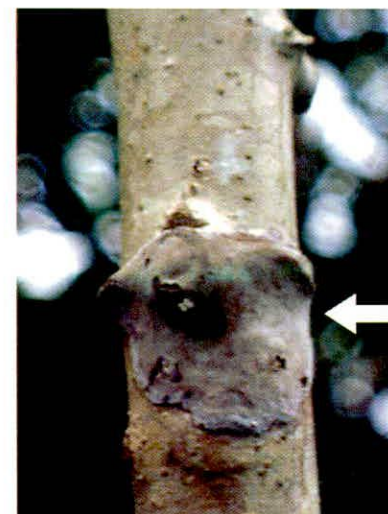


Figure 16: Fungal patch (arrow) of bud necrosis disease

The white scale, *Aonidomytilus albus*, covers cassava stem surfaces with conspicuous white waxy secretions (Figure 12). The insect sucks sap from the stem and dehydrates it. Stem cuttings derived from affected stem portions normally do not sprout. The insects survive on cassava stems and leaf petioles and are easily carried to new fields in this way.

Cassava mosaic disease is caused by a virus which occurs inside cassava stems. Symptoms of cassava mosaic disease damage are patches of normal green leaf color mixed with light green and yellow chlorotic areas in a mosaic pattern (Figure 13). Generally, plants with these symptoms should be avoided as sources of stem planting material. However, the disease is very common in Africa and it is sometimes difficult to find cassava plants that are completely free from the disease. You can, however, reduce cassava mosaic disease problems by selecting stem cuttings from cassava stem branches and not from the main stems. Stem cuttings from the branches are more likely to sprout into disease-free plants than stem cuttings from the main stems.

Cassava bacterial blight is caused by a bacterium which occurs inside cassava stems. The disease damage symptoms are angular leaf spots on the under leaf surfaces, leaf blighting and wilting (Figure 14), gum exudate on the stems, and shoot tip die-back. Avoid selecting stem cuttings from plants with these symptoms.

Cassava anthracnose disease is caused by a fungus which occurs on the surface of cassava stems. The disease damage symptoms are cankers ("sores") on the stem and bases of leaf petioles (Figure 15). The disease reduces the sprouting ability of stem cuttings.

Cassava bud necrosis is caused by a fungus which grows on the surface of cassava stems covering the axillary buds or the "eyes" of stem cuttings (Figure 16). The affected buds die, and the sprouting ability of stem cuttings is reduced.

Table 1: Site description and history

Site description	Pests, diseases, and weeds
Vegetation cover ☐ Scanty ☐ Dense natural fallow ☐ Dense improved fallow	Cassava pests in the locality ☐ Cassava green mite ☐ Cassava mealybug ☐ Variegated grasshopper ☐ Spiraling whitefly ☐ Cassava root scale ☐ Termites ☐ White scale insects ☐ Vertebrates ☐ Other (specify)
Soil texture ☐ Sandy ☐ Loamy ☐ Clayey	Cassava diseases in the locality ☐ Cassava mosaic disease ☐ Cassava bacterial blight ☐ Cassava anthracnose disease ☐ Cassava bud necrosis ☐ Root rots ☐ Leaf spots ☐ Other (specify)
Soil fertility ☐ Poor ☐ Good	Common weeds in the locality ☐ Spear grass ☐ Bermuda grass ☐ Guinea grass ☐ Feathery pennisetum ☐ Sedges ☐ Siam weed ☐ Giant sensitive weed ☐ Wild poinsettia ☐ Tridax ☐ Goat weed ☐ Parasitic weeds ☐ Other (specify)
Topography ☐ Flat ☐ Hilly/steep slopes ☐ Depression area	
Previous crop ☐ Cassava ☐ Yam ☐ Sweetpotato ☐ Rice ☐ Maize ☐ Sorghum ☐ Cowpea/legumes ☐ Other (specify)	

For site description, tick (+) appropriate boxes.

For pests, diseases and weeds, indicate importance of the problem as:

+ = not serious

++ = serious

+++ = very serious

How do I improve the soil for planting cassava?

If you do not select a good site for growing cassava you may have to spend a lot of time and materials to improve the soil. Cassava plants on good soils grow vigorously and are able to withstand some damage by pests and diseases. The following are examples of cultural practices you can use to improve soil properties.

Manure your farm: At land preparation, you can add organic manure to the soil to increase soil nutrients, improve soil structure, and improve the ability of the soil to hold water. Organic manure can be in the form of green manure or other dead plant or animal manure. In green manuring, plant foliage (fresh leaves and young green stems) is ploughed into the soil. Green manure improves soil properties as the foliage rots. *Egusi* melon and leguminous crops, for example, groundnuts and beans, make good green manure. Inorganic fertilizers can also be applied to increase soil fertility. For example, in southeast Nigeria, the recommended rate for NPK application is 400 kg. per hectare of land.

Prepare suitable seedbeds: Cassava fields on hilly sites with steep slopes are frequently eroded. The erosion will be severe if the leaf canopy of cassava plants is not thick enough to cover the ground against rain splashes. This happens in young cassava farms and if the varieties have a tall and less branching habit (Figure 5). If you cannot avoid growing cassava on steep slopes you can grow cassava varieties with early, low, and much branching habit (Figure 6) to cover the ground quickly and properly against rain erosion. You can also make ridges across the slopes and mulch the ridges to reduce erosion.

Mulch cassava seedbeds: Mulching involves covering the soil surface with plant materials. Mulching improves the fertility of the soil, increases the ability of the soil to hold sufficient water for plant growth, and reduces erosion and weed problems. Mulching cassava seedbeds is especially valuable when growing cassava in dry areas and on slopes.

Mulching requires very large amounts of plant foliage. Dead plant foliage can be used as "dead mulch". Sources of good dead mulch are foliage from alley crops, leguminous plants, rice husk, coffee hull and general crop and weed residues. Avoid using weed residues containing weed seeds, rhizomes, stolons, or tubers as mulch because these can increase weed problems on your farm. Straws of maize and guinea grass (Figure 7) are bad mulch materials because they take too long to rot and use up soil nitrogen as they do so.

You can grow plants as "live mulches". For example, *egusi* melon (a food crop) planted at very close spacing on cassava seedbeds is a good live mulch. Nonfood crops can also be used as live mulches, but these are normally grown as improved fallow plants. For example, during fallow periods you can grow *Mucuna pruriens* var. *utilis* on land you have selected for growing cassava in the next season (Figure 8). *Mucuna pruriens* var. *utilis* is, however, a fire hazard in the dry season when its foliage dries.

Plant cassava in association with other crops: Appropriate intercrops improve soil properties in a manner similar to live mulches. Crops that are commonly intercropped with cassava are maize, rice, legumes, and vegetables. Legumes, for example, cowpea and groundnuts, are a particularly good intercrop because these plants make and release nutrients into the soil.



Figure 9: Cassava shoot tip with "bunchy top" caused by cassava mealybug



Figure 10: Cassava shoot tip with small and narrow leaves caused by cassava green mite



Figure 11: Cassava stem and leaves blackened under attack by spiraling whitefly



Figure 12: Cassava white scale on cassava stem

How do I select healthy cassava stem cuttings?

The most common sources of cassava stem planting material are farmers' own farms. Occasionally, cassava stem cuttings are sold at village and town markets. Researchers and extension agents sometimes provide their contact farmers with cassava stem cuttings. Many cassava pests and diseases are stem-borne and spread by distribution, sale, and planting of infested or diseased stem cuttings. By planting healthy stem cuttings, you can greatly reduce the spread and damage caused by these cassava pests and diseases. The following guidelines will assist you to avoid unhealthy stem cuttings and to select healthy planting material for a healthy crop of cassava.

Look for healthy cassava plants: Select healthy cassava plants in the farm. Healthy cassava plants have robust stems and branches, lush foliage, and minimal stem and leaf damage by pests and diseases. From each plant select the middle brown-skinned portions of stems as stem cuttings. These parts sprout and ensure plant vigor better than the top green stem portions. Stem cuttings taken from the top green portions of stems or extreme top and bottom of stored stems are unsuitable. They will dehydrate quickly, produce unhealthy sprouts, and are easily damaged by pests and diseases.

Avoid plants with pests and diseases: In selecting cassava plants as sources of stem cuttings, you should avoid those infected with these pests and diseases. The common stem-borne cassava pests and diseases are cassava mealybug, cassava green mite, spiraling whitefly, white scale insect, cassava mosaic disease,

cassava bacterial blight, cassava anthracnose disease, and cassava bud necrosis.

The cassava mealybug, *Phenacoccus manihoti*, occurs on cassava leaves, shoot tips, petioles, and stems. The mealybugs are covered with white waxy secretions. Cassava mealybug damage symptoms include shortened internode lengths, compression of terminal leaves together into "bunchy tops" (Figure 9), distortion of stem portions, defoliation, and "candlestick" appearance of shoot tip. The insects survive on cassava stems and leaves and are easily carried to new fields in this way.

The cassava green mite, *Mononychellus tanajoa*, occurs on the undersurfaces of young leaves, green stems, and axillary buds of cassava. The mites appear as yellowish green specks to the naked eye. Mites survive on cassava stems and leaves and are easily carried to new fields in this way. Cassava green mite damage symptoms include yellow chlorotic leaf spots (like pin pricks) on the upper leaf surfaces, narrowed and smaller leaves (Figure 10), "candlestick" appearance of the shoot tip, and stunted cassava plants.

The spiraling whitefly, *Aleurodicus dispersus*, damages cassava by sucking sap from the leaves. Colonies of the insect occur on the undersurfaces of cassava leaves and are covered with white waxy secretions similar to those of the cassava mealybug. Spiraling whitefly eggs occur in spiral patterns of wax tracks, mostly on the undersurfaces of leaves. Symptoms of whitefly damage are black sooty mold on the upper leaf surfaces, petioles, and stems (Figure 11), and premature leaf fall of older leaves. The insects survive on cassava leaves and stems and are easily carried to new fields in this way.



Figure 5: Cassava variety with late, high, and less branching habit



Figure 6: Cassava variety with early, low, and much branching habit



Figure 7: Shoots of guinea grass, *Panicum maximum*



Figure 8: Live mulch of *Mucuna* on fallow land

How do I select the best cassava varieties to plant?

The best cassava varieties are those that are liked by consumers, grow fast, give good yields, store well in the soil and are tolerant to major pests, and diseases. The particular variety chosen by a farmer depends on her/his objectives for planting the crop, and the factors looked for in selecting cassava varieties usually include the following.

Look for varieties with high dry matter and good food quality: Cassava storage roots consist mainly of water and dry matter. The dry matter is mainly starch and a little bit of fiber. The percentage of dry matter in the roots determines the quantity and quality of the products obtained after the roots are processed. Cassava varieties whose storage roots have 30% or more dry matter are said to have high dry matter content. Such varieties produce good quality products and are profitable for growers and market women.

Look for varieties with good mealiness: Mealiness refers to the cooking ability of cassava storage roots without processing. Mealy varieties are commonly called "sweet" cassava whilst non-mealy varieties are called "bitter" cassava. Bitter cassava requires processing before consumption and this is related to the total cyanide content (referred to as cyanogenic potential, CNP) in the storage roots. The higher the CNP of a variety, the greater the need to process its storage roots for safe consumption. If cassava leaves will be eaten, you can also consider the cooking quality of the leaves.

Look for varieties that bulk early: Bulking refers to the swelling of the storage roots as they are filled with stored food. Varieties that bulk early are better able to offset losses in storage root yield caused by weed competition, leaf-feeding pests, and disease than late maturing varieties.

Look for varieties with good ground storability: Ground storability is the ability of the mature cassava storage roots to stay in the ground for a long time without getting spoiled. Good ground storability prolongs the period over which the crop can be harvested. This reduces the duration of postharvest storage problems of fresh roots.

Look for varieties that are tolerant to weeds, pests, and diseases: Some cassava varieties tolerate weeds, pests, and diseases better than others. In selecting a variety to grow, it is advisable to consider how well the variety can compete with weeds, and resist pests and diseases. For example, if weeds are a problem you can look for adapted varieties which branch early, low, and often (Figure 6). Such varieties are able to develop a lot of branches and leaves quickly to shade the ground and prevent weeds from growing vigorously and becoming a problem. You can also find out if the variety has other features you may want.

Table 2 lists some features of cassava varieties commonly grown in West and Central Africa. Scientists and extension agents can prepare a list similar to Table 2 for the cassava varieties growing in the locality.

Table 2: 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	Tolerance to CBB
ITA								
TMS 4(2)1425	High	High	Low	Good	Good	Moderate	Moderate	Good
TMS 30572	High	High	Moderate	Moderate	Good	Moderate	Good	Good
Benin								
BEN 86052	High	High	Low	Poor	Moderate	Good	Good	Poor
RB 89509	Moderate	Moderate	Low	Good	Poor	Poor	Good	Moderate
Cameroon								
8017	High	High	Moderate	Poor	Good	Moderate	Moderate	Moderate
8034	High	High	Moderate	Poor	Good	Moderate	Moderate	Moderate
Ghana								
"Afiati"	High	High	Moderate	Moderate	Good	Moderate	Good	Good
"Abasa flaa"	High	High	Low	Good	Good	Moderate	Moderate	Good
Nigeria								
MS 6	High	High	Low	Poor	Poor	Good	Good	Moderate
NR 8082	High	High	High	Moderate	Good	Good	Good	Good

CGM = Cassava green mite

CMD = Cassava mosaic disease

CBB = Cassava bacterial blight

Source: ITA, INRAB-Benin, MoFA-CSD Ghana, IRAD-Cameroon, and NRCRI-Nigeria