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Rapid multiplication of cassava

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Rapid multiplication of cassava

Objectives. This guide is intended to enable you to:

- explain the principles of rapid multiplication;
- prepare *ministem cuttings*;
- sprout ministem cuttings in nursery beds;
- sprout ministem cuttings in polythene bags;
- transplant, maintain, and harvest ministem cuttings
- store and distribute stem cuttings.

Study materials

- Cassava plants.
- Tools and materials to prepare ministem cuttings.
- Color slides of plants, cuttings, tools, fields,
- Nursery beds.
- Fields for transplanting.

Practicals

- Prepare different types of ministem cuttings.
- Prepare nursery beds and plant ministem cuttings.
- Practice the polythene-bag method.
- Transplant ministem cuttings, harvest and prepare them for storage and distribution.

Questionnaire

- 1 What is the definition of multiplication ratio?
- 2 What is the multiplication ratio of cassava? of maize?
- 3 What is the benefit of rapid multiplication in variety release?
- 4 Why is rapid multiplication useful in germplasm distribution?
- 5 What are three types of ministem cuttings?
- 6 How many ministem cuttings can be produced from a cassava plant?
- 7 Why should cutting tools be sharp?
- 8 How should you select the width of a nursery bed?
- 9 Why should you plant hardwood cuttings not too shallow?
- 10 How should you orient nodes when planting hardwood cuttings?
- 11 What do you do with tip shoots cut from the nursery 8-12 weeks after planting?
- 12 After what time can you transplant ministem cuttings from the nursery to the field?
- 13 What are the disadvantages of sprouting in nursery beds when compared to sprouting in polythene bags without soil?
- 14 Where is sprouting in polythene bags without soil suitable?
- 15 After what time can you transplant ministem cuttings from polythene bags without soil to the field?
- 16 What are the advantages and disadvantages of plastic mulch?
- 17 After what time can you harvest planting material from the field?
- 18 How can you store cassava stems?
- 19 Through what channels can you distribute cassava stems?

Rapid multiplication of cassava

- 1 Principles of rapid multiplication**
- 2 Preparing ministem cuttings**
- 3 Sprouting in nursery beds**
- 4 Sprouting in polythene bags without soil**
- 5 Transplanting, field maintenance, harvesting**
- 6 Storage, distribution**
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Abstract. Cassava has a low multiplication ratio compared with other crops, especially seed-propagated crops. Rapid multiplication techniques are available to increase the multiplication ratio. Three types of ministem cuttings can be produced from a cassava stem. After sprouting in nursery beds, or polythene bags without soil, the ministems can be planted into the field to produce normal cassava plants from which cassava cuttings can be prepared for distribution to farmers.

1 Principles of rapid multiplication

The term rapid multiplication, describes a technique developed to overcome the problem of low multiplication ratios in vegetatively propagated crops like cassava. The multiplication ratio is the increase in planting material over what has been planted. For example, a cassava stem cutting (25-30 cm long) when planted, yields about 10 stem cuttings 12 months later. The multiplication ratio is 1:10. In contrast, a maize plant which yields a cob with about 300 seeds has a multiplication ratio of 1:300. Thus, cassava has a low multiplication ratio compared with maize.

Rapid multiplication techniques help to overcome the low multiplication ratio for the benefit of:

- germplasm evaluation,
- germplasm distribution,
- seed multiplication for variety release.

Germplasm evaluation. During the breeding process, it is necessary to evaluate the materials in multilocal or on-farm trials in several locations. Rapid multiplication techniques are used to produce enough materials for such trials.

Germplasm distribution. Vegetatively propagated crops, such as cassava cannot be distributed internationally unless germplasm material has been certified by plant health services. Rapid multiplication techniques applied to the few healthy plants distributed to national programs can generate enough material for local evaluation.

Seed multiplication for variety release. Rapid multiplication techniques can be used to multiply resistant varieties in areas where diseases and pests such as

cassava bacterial blight (CBB) and cassava mealybug (CM), have wiped out susceptible varieties.

2 Preparing ministem cuttings

Ministem cuttings are small stem pieces, each with one or more nodes, depending on the stem portion from which the cuttings are taken. Three types of ministem cuttings can be produced from a cassava stem (Figure 1):

- cuttings from the hardwood portion may have one or two nodes (hardwood ministem cuttings);
- cuttings from the semi-mature portion may have four to six nodes (semi-mature ministem cuttings);
- cuttings from the tip portion may have six to ten nodes (tip shoots or tip-shoot ministem cuttings).

The number of nodes on a cutting is not fixed and depends on factors such as internode length, stem diameter, plant age, and weather conditions during and after planting. About 60-100 ministem cuttings can be produced from a cassava plant.

Prepare hardwood and semi-mature ministem cuttings using shears, secateur, hand saws or machetes (Figure 2). Tools must be sharp to ensure that cut ends are clean.

Prepare tip shoots using secateurs or sharp knives. Strip off all leaves carefully from tip shoots leaving the youngest leaves. Take care not to damage the axillary buds. Place each tip shoot in water immediately to prevent dehydration.

Sprout ministem cuttings in well-drained nursery beds near a water source, or in perforated black polythene bags filled with garden soil (Section 3). You can also sprout ministem cuttings in polythene bags without soil (Section 4).

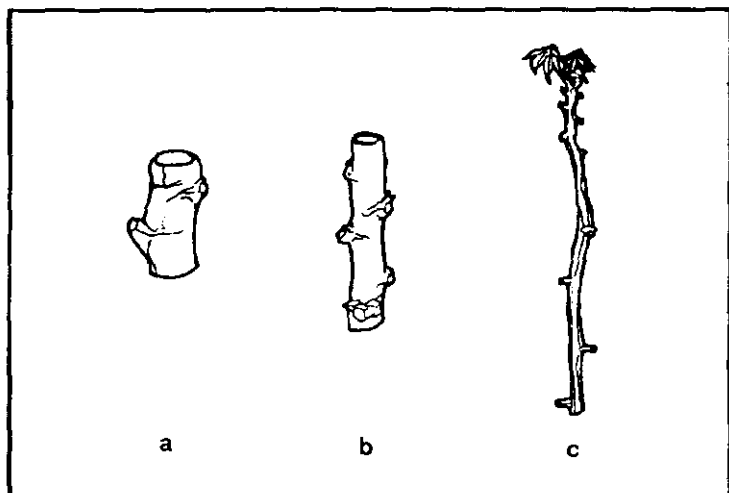
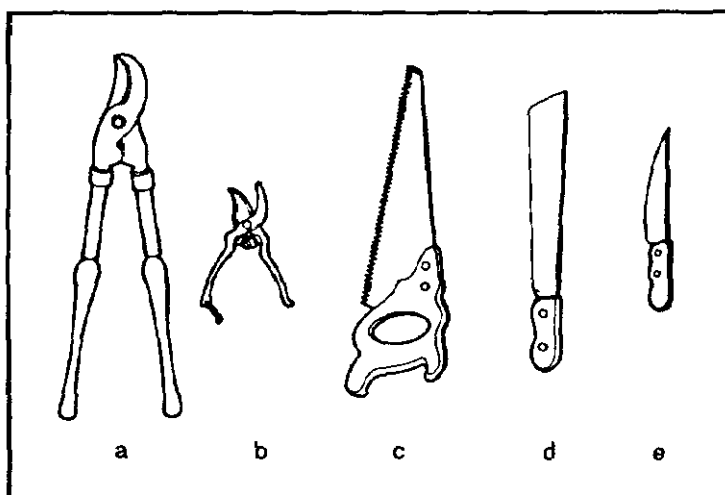


Figure 1. Ministem cuttings: hardwood (a), semi-mature (b), tip shoot (c).

Figure 2. Shear (a), secateur (b), hand saw (c), machete (d), knife (e).



3 Sprouting in nursery beds

Select a well-drained, flat site for the nursery bed preferably near a source of water. Mark out the length and width of each bed, ensuring a neat arrangement.

Select the width of the nursery bed so that from either side, you can reach the central portion of the bed. Dig up the soil with a mattock, pick-axe, or hoe.

With a spade or hoe, remove the soil from the area between two beds to fill or raise the beds (Figure 3). Flatten the top with a garden fork or rake. The height of the beds may be up to 30 cm. The area between adjacent beds may be 50 cm wide.

Hardwood ministem cuttings. Plant hardwood cuttings horizontally, at a spacing of 10 cm x 10 cm and a depth of 4 cm to 5 cm. Do not plant cuttings too shallow otherwise they become exposed and dehydrated.

Place cuttings so that two adjacent nodes are on the right and left sides (Figure 4). Avoid orientating one node on top and one node below. Shoots developing from below struggle to emerge, are weak, and may break when transplanted. Shoots developing from a node closer to the soil surface emerge quickly and are strong.

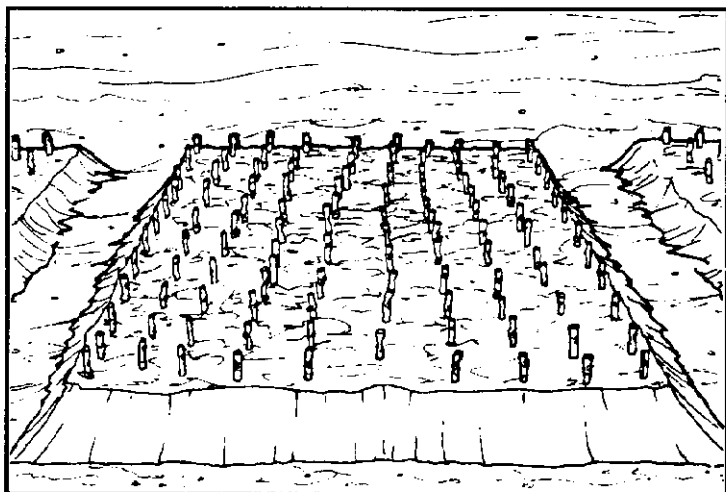
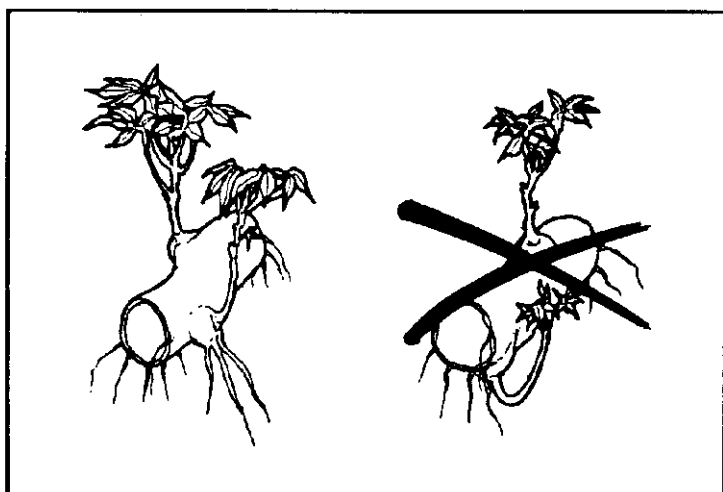


Figure 3. Nursery bed with semi-mature ministem cuttings planted vertically.

Figure 4. Correct placement of hardwood ministem cuttings.



Semi-mature ministem cuttings. Plant semi-mature cuttings vertically at a spacing of 10 cm x 10 cm with two-thirds of the cuttings and the old ends buried in the soil.

Tip-shoot ministem cuttings. Plant tip-shoot cuttings in the same manner as semi-mature cuttings, at a spacing of 10 cm x 10 cm. Bury two-thirds of the cuttings in the soil. Tip shoots are sensitive to low humidity. Water the tip shoots lightly 3 times daily.

Alternative. Alternatively, you can plant ministem cuttings in strong, black, polythene bags. Perforate bags at the sides and bottom to allow drainage, and fill with good quality garden soil. The planting procedure is similar to nursery beds.

Nursery maintenance. Apply the following steps for nursery maintenance:

- Water the cuttings immediately after planting.
- Water twice a day, once in the morning and once in the evening. After rain, it may not be necessary to apply water as too much causes rotting.
- Label the beds, indicating variety and planting date.
- Weed regularly and keep the nursery clean.
- Cover cuttings that become exposed during watering with soil.

Sprouting and establishment. Ministem cuttings (especially hardwood and semi-mature cuttings) sprout 7-10 days after planting. Fibrous roots develop at the buried nodes and at the oldest ends of the cuttings. Later, shoots emerge and develop leaves.

Hardwood cuttings give the highest establishment, tip-shoot cuttings the lowest. Tip shoots prepared from field-growing plants usually perform poorly because they are tender, and dehydrate or rot easily. Tip shoots taken from ministem cuttings 8-12 weeks after planting in the nursery are less sensitive, because they are woody and can withstand environmental stress.

Multiplication in the nursery. Cut back young stems 8-12 weeks after planting of cuttings in the nursery and use the resulting tip shoots for further multiplication. Cutting back is called ratooning. You can cut tip shoots as many as three times in a year, when you manage the nursery carefully.

Transplanting. Keep ministem cuttings in the nursery for 4-6 weeks before transplanting onto the field (Section 5).

4 Sprouting in polythene bags without soil

Sprouting in nursery beds (Section 3) is effective and widely used. However it has several disadvantages:

- Ministem cuttings require 4-6 weeks in nursery beds before they can be transplanted onto the field.
- When planted in polythene bags, considerable amount of soil - usually transported from another site to the nursery - and labor are required to fill the bags.
- Labor is also required to plant and maintain the cuttings.
- At low temperature, ministem cuttings sprout slowly, leading to high losses.
- Nursery soil may carry disease-causing organisms such as nematodes, fungi and bacteria. Soil sterilization to reduce diseases is expensive and may not be possible.

These disadvantages can be avoided by sprouting ministem cuttings in polythene bags without soil. The method is quick, inexpensive, and convenient. However, the method is only suitable for hardwood and semi-mature ministem cuttings. Tip shoots, which are tender do not usually survive the high temperatures in the bags.

Dip ministem cuttings into a fungicide suspension. Benlate and Demosan are suitable broad spectrum fungicides. Place ministems directly into perforated polythene bags. Tie bags with pieces of string, leaving about one-third of the total space empty for aeration. You can use various sizes of bags as long as there is space for aeration. Keep bags in a shaded area or under a roof.

High humidity and temperature in the polythene bags promote rapid and uniform sprouting. Cuttings sprout in 3-5 days. Some varieties may require a few more days. Sprouted ministem cuttings establish well in the field.

Sprouting in bags without soil has additional advantages:

- cuttings can be stored for a few days before planting;
- bags can easily be carried by hand. Little space is required to transport large quantities over long distances;
- cuttings can be used for mechanical planting.

Ministem cuttings sprouted in bags without soil can be planted directly onto the field after 7-10 days.

5 Transplanting, field maintenance, harvesting

Transplanting. Transplanting in the dry season requires irrigation; in the rainy season irrigation is usually not necessary. Avoid waterlogged fields to prevent low establishment due to poor aeration and poor root development.

Transplant cuttings in a well-prepared field at a spacing of either 100 cm x 50 cm or 50 cm x 50 cm. Firm the soil around each plant. Label the plots indicating variety, date of planting, and other data.

Before transplanting, you can cover the soil with "plastic mulch" if available. During the dry season, irrigate the field before laying the plastic. Plant cuttings through small holes cut into the plastic.

Plastic mulch has several advantages; it:

- reduces labor requirement for weeding so you can manage larger areas of land for multiplication;
- reduces soil erosion;
- improves soil moisture conservation;
- enhances light distribution;
- promotes plant establishment and growth, particularly in the initial growth stages, leading to higher yield of cassava stems and storage roots.

However, plastic mulch has some disadvantages. It is:

- expensive and not easily available,
- difficult to dispose of.

Field maintenance. After transplanting, proper field maintenance is essential for production of strong, healthy plants. During the first 10 weeks, hoe or apply herbicides to control weeds.

With plastic mulch, weeding requirement is minimal. Remove any weeds that develop near the plants in the small holes. Plastic mulch prevents heavy weed growth.

Fill any gaps caused by loss of plants to ensure good plant stand and good canopy cover, which in turn help suppress weed growth. Apply fertilizer where necessary.

Harvesting of stems. The objective of rapid multiplication of cassava is to produce planting materials (stems). If the field is properly maintained, stems can be cut and supplied to farmers 6-7 months after transplanting. Do not uproot plants to harvest storage roots.

Cut stems at a height of 20-25 cm above the ground, after ensuring that stems are physiologically mature and free of diseases and pests.

The practice of leaving stumps standing after cutting the stems is known as 'ratooning'. Several shoots sprout from each stump, but leave only two or three. Apply herbicide and fertilizer to the ratooned fields. Cut another set of stems again 6 months later. At IITA, as many as three sets of stems have been harvested from ratooned fields. The number of sets is influenced by several factors, including variety, soil type and fertility, weed control, and field maintenance.

After harvest, tie the stems together in bundles. In Nigeria, cassava stems are sold in bundles of 50 and each stem is 1 m long. Handle stems with care when harvesting, loading, transporting and unloading to avoid bruising. Bruised buds may never develop into shoots.

6 Storage, distribution

Storage. Long-term storage of cassava stems is not possible because stems dehydrate. Stems are also attacked by insects and diseases. Cassava stems can be stored for up to 8 weeks in three ways:

- Tie stems into bundles and store upright in a well-ventilated shed, or under a tree providing good shade. Insert the base of the stems in the soil, and apply water.
- Insert cassava stems upright into the soil in a cool, well-shaded area. The bases of the stems should touch each other. Insert the stems so that they lean on a strong support which has been tied horizontally between two trees.
- Store stems horizontally under a well-developed tree.

When storing cassava stems:

- avoid direct sunlight and hot or cold winds;
- ensure that buds face upwards when stems are stored vertically;
- use mature stems from healthy cassava plants.

Distribution. Distribution of cassava stems deserves special effort. Some farmers may be able to collect stems at the sources of supply. Many farmers, however, lack transport or are not aware of the existence of superior varieties.

Planting material can be distributed through the following channels:

- government or donor-assisted agricultural projects;

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- strategically located multiplication centers;
 - private and mission agricultural projects;
 - school farming projects;
 - agricultural meetings, training courses, farmers' field days, and agricultural shows;
 - demonstration plots;
 - multilocal or on-farm trials where the varieties are supplied to farmers for testing;
 - farmer-to-farmer distribution of planting materials.

7 Bibliography

International Institute of Tropical Agriculture. 1990. Cassava in tropical Africa. A reference manual. International Institute of Tropical Agriculture, Ibadan, Nigeria. 176 + p. (This IITA Production Guide is based on Unit 4 of the reference manual).

Cock, J.H. 1985. Rapid propagation techniques for cassava. p. 165-171. In: Cock, J.H.; Reyes, J.A. (eds.). Cassava: Research, production and utilization. Centro Internacional de Agricultura Tropical, Cali, Colombia. 745 p.

8 Suggestions for trainers

If you use this Research Guide in training ...

generally:

- Distribute handouts (including this Research Guide) to trainees one or several days before your training activity, or distribute them at the end of your presentation.
- Do not distribute handouts at the beginning of a presentation, otherwise trainees will read instead of listening to you.
- Ask trainees not to take notes, but to pay full attention to the training activity. Assure them that your handouts (or this Research Guide) contain all relevant information.
- Keep your training activities practical. Reduce theory to the minimum that is necessary to follow the practical exercises.
- Use the questionnaire on page 4 (or a selection of questions) for examinations (quizzes, periodical tests, etc.). Allow consultation of handouts and books during examinations.
- Promote interaction of trainees. Allow questions, but do not deviate from the subject.
- Control your time.

specifically:

- Discuss with trainees experiences in cassava multiplication (10 minutes).

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- **Present the content of this Research Guide, using the study materials listed on page 3 (45 minutes). You may photocopy the illustrations of this Research Guide onto transparencies for projection with an overhead projector.**
 - **During your presentation, you can demonstrate some aspects of rapid multiplication. Have tools and materials available so that each trainee can practise.**
 - **In the field, conduct the practicals suggested on page 3 (2 hours). Divide your trainees into groups. Make sure that each trainee has opportunity to practice. Have resource persons available for each group and each exercise.**
 - **A few days later - towards the end of the course - evaluate the result of the practical exercises in the field.**



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