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Cassava Weed
Management
Project



THE **A** **B** **C**
OF WEED MANAGEMENT
IN CASSAVA PRODUCTION
IN NIGERIA

A training manual

The ABC of WEED MANAGEMENT IN Cassava Production in Nigeria

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PREFACE

This guide is in response to demands from cassava stakeholders on the Cassava Matters WhatsApp group and the Knowledge Attitude and Practices study (KAPs) that was conducted by the IITA-led Cassava Weed Management Project. This easy-to-read reference manual for farmers will help them to cultivate cassava better and increase their productivity. The three dimensions of weed control: cultural, mechanical, and chemical are captured and illustrated in a logical and simplified manner.

Our aim is that farmers and other extension service actors reading this guide will be properly informed about critical aspects of cassava cultivation, and will be able to pass on this information to others. This material primarily belongs to the IITA Cassava Weed Management Project that is funded by the Bill & Melinda Gates Foundation.

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INTRODUCTION

Cassava is widely grown in Nigeria and other tropical and subtropical areas of the world. It is rich in carbohydrates, calcium, vitamins B and C, and essential minerals. However, nutrient composition differs according to variety and age of the harvested crop, soil conditions, climate, and other environmental factors during cultivation. Every part of cassava is useful, the leaves are used as a vegetable for humans or fodder for animals, while the roots are major sources of carbohydrates. Yield of cassava in Africa and Nigeria in particular is being stymied by several factors including poor weed control.

Weeding takes 50-80 percent of total farm budget. In most communities women are the main actors that hand weed cassava, an activity that is tortuous and results to back-ache. Yield losses of cassava under weed infestation is estimated at between 50 and 90 percent. Poor weed control and other agronomic constraints impedes cassava production and put yield of cassava in Nigeria at about 8 tons per ha (t/ha) (FAO, 2013).



On the flip side, yield potential of cassava is high under good weed control conditions providing 25-40 t/ha of fresh root yield and 500-750 bundles/ha of stems. To bridge the yield gap, farmers need to:

- ✎ Have a weed control plan.
- ✎ Reflect on the purpose for which they want to go into cassava production:
 - Root production for localized market or targeted industry.
 - Seed/stem production as a certified seed entrepreneur.
 - Root and stem production.
- ✎ Reflect on the technical competence of personnel on weed management, agronomy, mechanization, processing and marketing.
- ✎ Ensure timeliness of operation: an activity calendar can be of help.
- ✎ Understand the cost implications and associated risks.

Uses of cassava

Cassava roots are consumed either boiled or processed into products such as flour, *gari*, *fufu*, *akpu*, chips, *attieke* (cassava couscous), tapioca, and *abacha*. Cassava can also be processed into industrial products such as ethanol and starch.















Cassava/Wheat Bread



Steps in setting up a cassava farm

The basic steps required for cassava production are:

-  Site selection
-  Land clearing
-  Pre-planting herbicides application
-  Sourcing of good planting materials
-  Tillage
-  Planting
-  Application of pre-emergence herbicide
-  Replacement of dead or non-sprouted cuttings
-  Fertilizer application
-  Application of post-emergence herbicide
-  Harvesting
-  Selling or processing

Setting up calendar for cassava farm

Depending on location, prospective farmers are encouraged to draw up a calendar of operation (Fig. 1). This helps in planning and better implementation of activities. Please contact the nearest Agricultural Development Program (ADP) office to draw a calendar of operations.

		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	
1.	Site selection	■	■														
2.	Land clearing		■	■													
3.	Pre-planting herbicides application			■	■												
4.	Sourcing of good planting materials			■	■	■											
4.	Tillage			■	■	■											
5.	Planting			■	■	■											
6.	Apply pre-emergence herbicide			■	■	■											
7.	Replace dead or Non-sprouted cuttings			■	■	■											
8.	Fertilizer application				■	■	■	■									
9.	Apply post-emergence herbicide				■	■	■	■									
10	Harvest														■	■	■

Figure 1. A typical calendar for cassava production in Oyo State, South West, Nigeria.

Site selection

Site selection is among the most important steps in cassava production. A good site for cassava production should have the following characteristics:

- ✎ Soils should be well-drained loamy soil, and not sandy, clayey, stony or salt-affected.

- ✎ The site should be located in an area where the annual rainfall is 1000 mm or more. A minimum of six months of rain a year with at least 50 mm rainfall per month is needed.
- ✎ Waterlogged areas should be avoided.
- ✎ The site selected should be on flat terrain or a gentle slope. Steep slopes should be avoided as they could cause erosion.
- ✎ Avoid sites that are continuously cropped with cassava.
- ✎ Look out for soils with worm cast. It is an indicator of fertility.
- ✎ Carry out a soil test. You can contact the Agricultural Development Programs (ADPs) in your state for help.

Measurement of selected site

After selection of a suitable site, it is highly recommended to measure the site with an appropriate measuring instrument; a tape or a Global Positioning System (GPS) device. For rough estimate, measure the length and breadth in meters and multiply the length by the breadth to get the area.



Benefits of site measurement

- ✎ It tells you the amount of money you need to pay for other operations such as land clearing, ploughing, harrowing etc.
- ✎ It reveals the exact amount of inputs to be applied such as herbicides and fertilizers.
- ✎ In summary, all other good agronomic practices are based on proper site measurement.

Land preparation and tillage

- ✎ Slash the vegetation and remove tree stumps (where applicable).
- ✎ Apply glyphosate at the label rate on perennial weeds such as *Imperata cylindrica*, *Panicum maximum*, and *Cyperus rotundus* and other sedges.



- ✎ Wait for 14 days and then plough once.
- ✎ Harrow once 14 days after ploughing.
- ✎ Ridge (1 m × 1 m) with a tractor mounted ridger but where not possible ridge manually. In case of manual ridging, mark out the points for ridging with pegs 1 m apart at both ends of the field.
- ✎ Join two pegs at opposite ends to guide ridging.

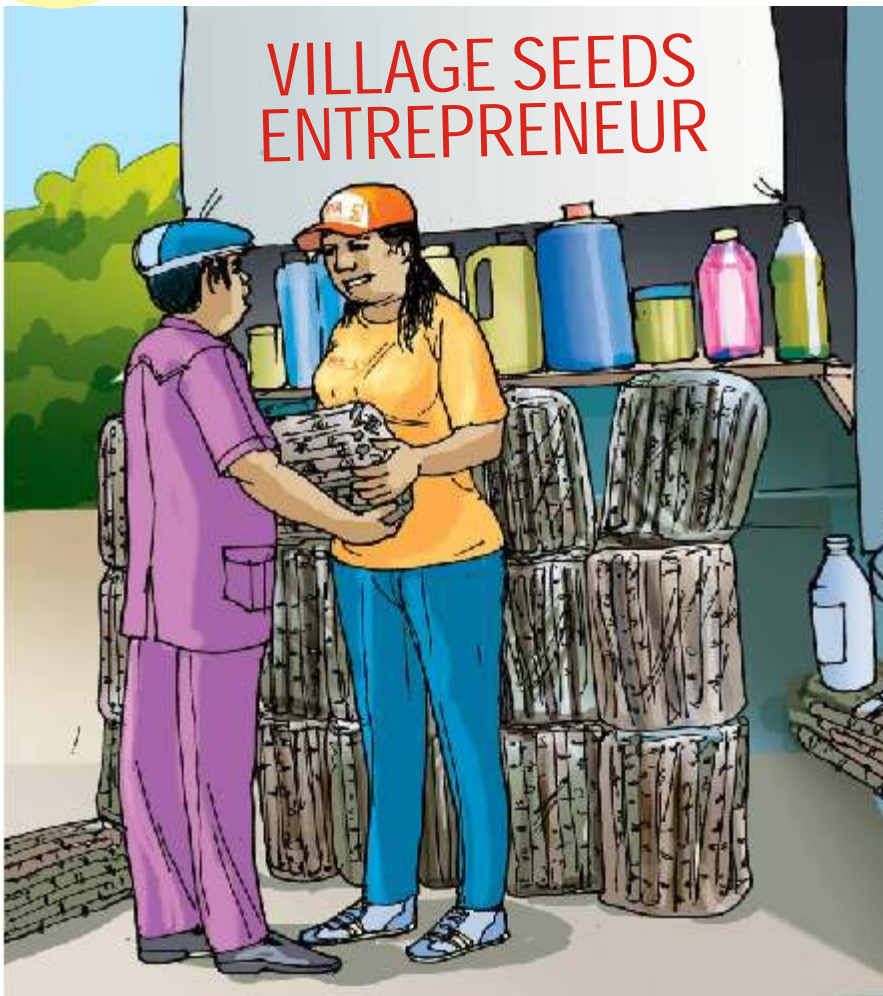


Planting materials

Cassava stems are used for the propagation of cassava. The choice of variety is usually driven by the end use. For instance, a farmer who is targeting the starch industry might go for varieties that have high starch content while those considering the gari industry may go for the yellow varieties because of the nutritional benefits and so on. The yellow varieties are biofortified through conventional breeding to have increased carotenoid content to supply vitamin A— an essential nutrient needed by the body.

Whatever the reason for cultivating cassava, we encourage farmers to go for improved varieties that are high yielding and disease and pest resistant. A total of 46 improved cassava varieties have been released in Nigeria out of which 6 are biofortified yellow varieties. Please contact IITA, National Root Crops Research Institute, Umudike, or the nearest ADP office in your area for improved varieties.

VILLAGE SEEDS ENTREPRENEUR



Stem cutting handling

- ✎ Stems for planting should be obtained from plants that are between 10 and 12 months old.
- ✎ Cuttings should be disease free and without evidence of scars on the stem.

- ✎ Cassava stems can be planted the same day, but should not be stored for more than 5 days under shade.
- ✎ For longer storage (not exceeding 60 days), cassava stems should be stored vertically in the soil under shade.
- ✎ The base of the stems should touch the soil and moistened regularly, with the surroundings kept free from weeds.
- ✎ The stems should be cut with sharp tools, preferably secateurs, cutlasses or a chainsaw into 20–25 cm lengths with 5–7 nodes.
- ✎ Depending on location and history of insect pests, treat cassava stems with insecticide before planting to prevent termite and millipede attack by dipping stems in a solution of termiticide (Pyrinex 48 EC at 200 ml/100 liter of water) or any other termiticide.



Released cassava varieties in Nigeria

S/N	Official clone name	Original Name	Variety Name	Year of Release	Featured traits
1	ITA-TMS-IBA30555	ITA TMS 130555	NICA5S 10	1976	High dry matter (25%), moderate CMD resistance, early bulking, high starch and high yielding (> 25 t/ha)
2	ITA-TMS-IBA30572	ITA TMS 130572 (Id-Oche)	NICA5S 1	1984	High dry matter (25%), moderate CMD resistance, early bulking, high starch and high yielding (> 25 t/ha)
3	ITA-TMS-IBA4(2)1425	ITA TMS 14(2)1425	NICA5S 2	1986	High dry matter (25%), moderate CMD resistance, early bulking, high starch and high yielding (> 25 t/ha)
4	ITA-TMS-IBA90257	ITA TMS 180257	NICA5S 3	1986	High dry matter (25%), moderate CMD resistance, early bulking, high starch and high yielding (> 25 t/ha)
5	ITA-TMS-IBA84537	ITA TMS 184537	NICA5S 4	1986	High dry matter (25%), moderate CMD resistance, early bulking, high starch and high yielding (> 25 t/ha)
6	ITA-TMS-IBA8200358	ITA TMS 18200358	NICA5S 5	1986	High dry matter (25%), moderate CMD resistance, early bulking, high starch and high yielding (> 25 t/ha)
7	ITA-TMS-IBA8200981	ITA TMS 18200981	NICA5S 6	1986	High dry matter (25%), moderate CMD resistance, early bulking, high starch and high yield (> 25 t/ha)
8	ITA-TMS-IBA8100110	ITA TMS 18100110	NICA5S 7	1986	High dry matter (25%), moderate CMD resistance, early bulking, high starch and high yielding (> 25 t/ha)
9	MS-6	MS 6 (Amiola)	NICA5S 8	1986	Local landrace that has been released as a variety
10	MS-3	MS 3 (Odogbo)	NICA5S 9	1986	Local landrace that has been released as a variety
11	NR6083	NR 8083	NICA5S 12	1986	High yielding (> 25 t/ha) - NRCRI, Umudike
12	NR83107	NR 83107	NICA5S 13	1989	High yielding (> 25 t/ha) - NRCRI, Umudike
13	NR6082	NR 8082	NICA5S 14	1986	High yielding (> 25 t/ha) - NRCRI, Umudike
14	ITA-TMS-IBA50395	ITA TMS 150395	NICA5S 15	1986	Moderate CMD resistance, early bulking and high yielding (> 25 t/ha)
15	NR8212	NR 8212	NICA5S 16	1986	High yielding (> 25 t/ha) - NRCRI, Umudike
16	NR41044	NR 41044	NICA5S 17	1986	High yielding (> 25 t/ha) - NRCRI, Umudike
17	ITA-TMS-IBA30001	ITA TMS 130001	NICA5S 18	1986	High dry matter (25%), poundable, CMD and CSSB resistance
18	ITA-TMS-IBA81934	ITA TMS 181934	NICA5S 19	1986	High dry matter (25%), early bulking, stay green and high yielding (> 25 t/ha)
19	NR8208	NR 8208	NICA5S 11	1988	High starch and high yielding (> 25 t/ha) - NRCRI, Umudike
20	TMEB-419	TME 419	NICA5S 20	2005	High dry matter (25%), high CMD resistance, high yielding (> 25 t/ha), poundable and high starch
21	ITA-TMS-IBA872205	ITA TMS 1872205	NICA5S 21	2005	High dry matter (25%), high CMD resistance and high yielding (> 25 t/ha)
22	ITA-TMS-IBA860505	ITA TMS 1860505	NICA5S 22	2005	High CMD resistance, high starch, high yielding, early bulking
23	ITA-TMS-IBA860510	ITA TMS 1860510	NICA5S 23	2005	High dry matter (25%), high CMD resistance and high yielding (> 25 t/ha)
24	ITA-TMS-IBA860581	ITA TMS 1860581	NICA5S 24	2005	High dry matter (25%), high CMD resistance, high yielding (> 25 t/ha), stay green and drought tolerant
25	NR67184	NR 87184	NICA5S 25	2006	High yielding (> 25 t/ha) - NRCRI, Umudike

26	ITA-TMS-IBA020087	ITA-TMS I920057	NICASS 26	2008	High dry matter (25%), high CMD resistance, high starch, poundable, high yielding (> 25 t/ha) and stay green
27	ITA-TMS-IBA020326	ITA-TMS I920326	NICASS 27	2008	High CMD resistance, high yielding, early bulking, stay green and drought tolerant
28	ITA-TMS-IBA061632	ITA-TMS I961632	NICASS 28	2008	High dry matter (25%), high CMD resistance, high yielding (> 25 t/ha), stay green and drought tolerant
29	ITA-TMS-IBA090002	ITA-TMS I990002	NICASS 29	2008	High CMD resistance, high yielding and high starch
30	NR0310199	NR 9310199	NICASS 30	2008	High yielding (> 25 t/ha) - NRCRI, Umudike
31	ITA-TMS-IBA061089A	ITA-TMS I961089A	NICASS 31	2008	Light yellow roots, moderate CMD resistance, high dry matter and high yielding (> 25 t/ha)
32	NR0110004	NR 0110004	UMUCASS 32	2010	High starch and high yielding (> 25 t/ha) - NRCRI, Umudike
33	CR41-10	CR 41-10	UMUCASS 33	2010	Early bulking, high starch and high yielding (> 25 t/ha) - NRCRI, Umudike
34	ITA-TMS-IBA010040	ITA-TMS I010040	UMUCASS 34	2010	High dry matter (25%), high CMD resistance, early bulking, high yielding (> 25 t/ha), pink skin and high starch
35	ITA-TMS-IBA000203	ITA-TMS I000203	UMUCASS 35	2010	High dry matter (25%), high CMD resistance, early bulking, high yielding and high starch
36	ITA-TMS-IBA011368	ITA-TMS I011368	UMUCASS 36	2011	Vitamin A cassava, yellow roots, moderate CMD resistance and high yielding (> 25 t/ha)
37	ITA-TMS-IBA011412	ITA-TMS I011412	UMUCASS 37	2011	Vitamin A cassava, yellow roots, high CMD resistance, early bulking and high yielding (> 25 t/ha)
38	ITA-TMS-IBA011371	ITA-TMS I011371	UMUCASS 38	2011	Vitamin A cassava, yellow roots, moderate CMD resistance and high yielding (> 25 t/ha)
39	NR0310211	NR 0310211	UMUCASS 39	2011	Early bulking, high starch and high yielding (> 25 t/ha), high flour - NRCRI, Umudike
40	NR0310155	NR 0310155	UMUCASS 40	2011	Early bulking, high starch and high yielding (> 25 t/ha), drought tolerant - NRCRI, Umudike
41	CR36-5	CR 36-5	UMUCASS 41	2012	High starch and high yielding (> 25 t/ha), high dry matter (25%), high CMD resistance
42	ITA-TMS-IBA092132	ITA-TMS I992132	UMUCASS 42	2012	Light yellow roots, moderate CMD resistance, high yielding (> 25 t/ha), early bulking and drought tolerant
43	ITA-TMS-IBA011206	ITA-TMS I011206	UMUCASS 43	2012	Light yellow roots, moderate CMD resistance, pink skin and high yielding (> 25 t/ha)
44	NR0710220	NR 0710220	UMUCASS 44	2014	Vitamin A cassava, yellow roots, moderate CMD resistance, high yielding (> 25 t/ha), early bulking, stay green and drought tolerant
45	ITA-TMS-IBA070563	ITA-TMS I070563	UMUCASS 45	2014	Vitamin A cassava, yellow roots, high CMD resistance, high yielding (> 25 t/ha), early bulking and stay green
46	ITA-TMS-IBA070539	ITA-TMS I070539	UMUCASS 46	2014	Vitamin A cassava, yellow roots, high CMD resistance, high yielding (> 25 t/ha), early bulking, stay green and drought tolerant

Improved Cassava varieties bred by ITA in collaboration with the National Root Crops Research Institute (NRCRI), Umudike, and HarvestPlus

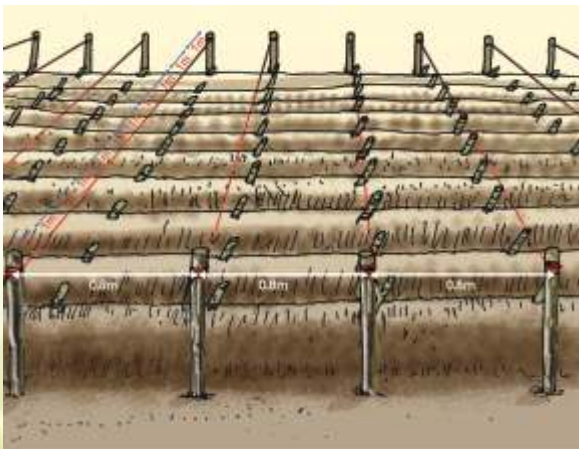
Planting

Cassava can be planted at various times of the year depending on the agroecology (April–May for early season, and August– October for late season in the rainforest; May–June for early season, and August–early October for late season in the savanna).



Cassava is planted on ridges, mounds, or flat ground. Planting can be done manually or mechanically using planters.

Cassava should be planted at a spacing of 1 m x 0.8 m (12,500 stands per ha) for root production. Closer spacing (1 m x 0.5 m) can be used for stem production.

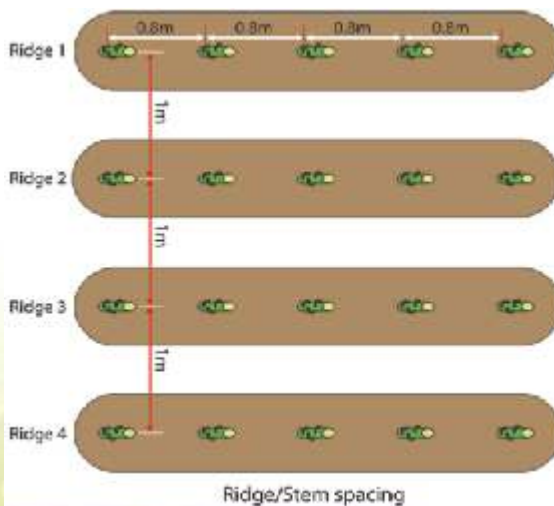


It is important for farmers to keep to the correct spacing because it helps in controlling weeds and also gives farmers optimum yield/result.

- ✎ Cassava stems should be planted or inserted in the ground vertically, at an angle of 45° .
- ✎ Ensure that the nodes of the cutting are turned upwards. This enables fast sprouting of the stems.
- ✎ Ensure that two-thirds of the stem is buried in the ground while one third is above the ground.
- ✎ Ensure moisture availability at least for the first 2–3 months after planting.
- ✎ When using mechanical planters, cassava stems are usually buried in the ground.

Gap filling or replacement of non-sprouted cuttings

After the initial planting, visit the field after 15–21 days to observe sprouting and plant growth and replace cuttings that have not sprouted.



Weeds and weed control

Weeds are among the major constraints to cassava production, and for cassava farmers to be successful, they must control weeds. Weed control in cassava can be done manually, mechanically, culturally, or chemically (use of herbicides). Manual weed control involves the use of hand/hoes. Mechanical weed control entails the use of motorised weeders. Cultural methods such as the use of cover crops, hand hoe, correct spacing, tillage, and cassava variety also help in the control of weeds.



Chemical weed control

This involves the use of herbicides which may be pre-emergence or post-emergence. Pre-emergence herbicides are herbicides that are applied before the weeds emerge while post-emergence herbicides are those that are applied on the field after the weeds emerge.

Pre-emergence weed control

Pre-emergence herbicides such as Primextra Gold (S-Metolachlor + Atrazine) or any other herbicide registered for pre-emergence weed control in Nigeria should be applied immediately after cassava is planted. Farmers should note that the efficacy of any pre-emergence depends on good land preparation. For example, if perennial weeds especially rhizomatous, tuberous, or tufted weeds are not killed during land preparation, a good pre-emergence herbicide may fail.

(For maximum efficacy, pre-emergence herbicides should be applied on the day after planting or at most two days after planting.)



Post-emergence weed control

After applying pre-emergence herbicide, visit your farm weekly starting from 4 weeks after pre-emergence herbicide application. As soon as 30% of the weeds in the farm reach the 4– 6 leaf stage, apply the appropriate post-emergence herbicide as spot treatment using a spray shield. If these steps are properly carried out, cassava should form a canopy and there may be no need for additional weeding until harvest. Farmers can use any of the registered post-emergence herbicides such as fusilade forte or glyphosate.



Caution in using glyphosate as a post-emergence herbicide

Glyphosate as a post-emergence should be applied under the canopy of cassava with a spray guard fitted to the nozzle, provided the cassava is 8 weeks old or more. Care must be taken when using glyphosate. Please note that glyphosate can only be applied with a

knapsack sprayer as directed spray. It cannot be applied in a cassava field with a tractor mounted boom sprayer. For mechanized large-scale farms, a tractor-drawn motorised rotary weeder is an option.



If using mechanical or hand weeding, farmers are advised to visit their farms 2 weeks after planting to observe the emergence of weeds. As soon as 30% of the weeds in the farm reach the 4–6 leaf stage, begin to weed. Repeat this activity until cassava forms a canopy. The disadvantage here is the frequency involved and associated costs.

Some selected herbicides for pre-planting, pre-emergence, and post-emergence in cassava

Glyphosate: This herbicide is used for total weed control during pre-planting and as a post-emergence herbicide.

- ✎ Glyphosate is sold in the market as Roundup Turbo, Touchdown Forte, Delsate, Sarosate, Glycel, Force up, Clearweed, etc.
- ✎ Quantity (Liters per ha) needed per hectare: Read labels for rates.

Fusilade forte: This is a post-emergence herbicide used to control grasses. It should be combined with a broadleaf post-emergence herbicide for good weed control. Read labels for rates of application.

Primextra Gold (S-Metolachlor + Atrazine): This is a pre-emergence herbicide used for control of most annual grasses and broadleaf weeds.

- ✎ Apply Primextra Gold apply after planting (1–2 days) but before crops and weeds emerge.
- ✎ The seed bed (ridges/flat) should be moist and clean.
- ✎ Quantity (Liters per ha) needed per hectare: Read labels for rates.

Lagon (Aclonifen + Isoxaflutole): This is a pre-emergence herbicide for the control of most annual grasses and broadleaf weeds.

- ✎ Quantity per ha: 1–1.25 liters
- ✎ Apply after planting (1–2 days) but before crops and weeds emerge.
- ✎ The seed bed (ridges/flat) should be moist and clean.

Sprayer calibration

Calibration is essentially getting your sprayer ready for use. It is a very important aspect of any spraying function as it ensures that the pesticide/herbicide is applied at the rate on the product label.

Application in excess of the recommended rate is prohibited, can damage crops, and is uneconomical. On the other hand, continuous application of lower dosage may lead to weed resistance, which is a serious problem.

Steps for calibrating a knapsack sprayer

Check and ensure that all parts of the sprayer are functioning properly. Clean the knapsack sprayer and set the pressure gauge at low (L) for herbicides as marked on top of the diaphragm sprayer tank. Use the green, yellow or red flooding polijet nozzle for band spraying herbicides. For broadcast spraying, use the fan nozzle. Fill the tank with water and pump to a suitable pressure and check for leaks and drips. Correct any problems before proceeding with the calibration. Calibrate the sprayer in the field at the beginning of the season before actual spraying by following these steps:

Using a measuring tape, mark out a rectangular area in your field 10 meters long by 10 meters wide. This is approximately 100 m².



- ✎ Fill your sprayer tank with water to the maximum mark.
- ✎ Spray the marked area walking at a normal and comfortable pace and using a constant pumping speed.
- ✎ After you have sprayed and covered the marked area, calculate the water used by taking the difference in water levels on the spray tank before and after the spraying operation.
- ✎ If 3 liters of water were able to spray 100 m^2 , then the delivery rate for $10,000\text{ m}^2$ will be approximately 300 liters.
- ✎ Suppose the knapsack sprayer tank capacity is 20 liters (for example a CP 3 sprayer), then you need to fill the sprayer 15 times (15 sprayer loads) to spray $10,000\text{ m}^2$ (1 hectare) of farm. That is, you divide 300 liters by 20 liters to get 15.
- ✎ Suppose you are using a 20-liter spray tank and the recommended rate for the herbicide is 4 liters per hectare ($10,000\text{ m}^2$), divide the 4 liters (4000 milliliters) of herbicides by 15 loads which is equivalent to 267 milliliters per sprayer tank.

Safe use of herbicides

Herbicides assist in weed control but they need to be handled with care so they do not harm the environment, plants, and applicators.

Here are some safety tips.

- ✎ Do not eat, drink, or smoke during spraying of herbicides.
- ✎ Wear appropriate personal protective equipment (mask, gloves, overall, and rain boots).
- ✎ People without personal protective equipment should stay away from spraying.
- ✎ Spray in the direction of the wind. You can toss ash to know the direction of wind.
- ✎ Spray only when the wind is not strong and there is no indication of rain.

- ✎ Herbicides should be applied by only trained personnel. Children should not play with or touch herbicides. They must stay away.
- ✎ Maintain the sprayer and the nozzles to ensure optimum performance of the sprayer.
- ✎ Before application, read the label on herbicides to know the correct dosage.
- ✎ Use only herbicides approved by the National Agency for Food and Drug Administration and Control (NAFDAC).
- ✎ Destroy and bury empty containers of herbicides in the farm far away from water points.
- ✎ After spraying, do not wash the sprayer in nearby stream or places of water supply. Wash the sprayer in the farm.
- ✎ Do not use empty containers to convey water, salt, or vegetable oil. Discard them.
- ✎ After spraying, take your bath, change, and wash your clothes before eating.



Soil fertility and cassava

Cassava like any other crop demands good soil for optimum productivity. Therefore farmers must select fertile soils to grow cassava.

How to identify fertile soil

1. Look out for good vegetative growth: A fertile soil supports good crop growth. Yield is low in poor soils and plant growth is stunted.
2. Look out for visual symptoms or signs of biological activities on the soil surface (e.g. worm casts). The presence of worm casts indicates good fertility.

Specific recommendation for fertilizers is being investigated by the African Cassava Agronomy Initiative (ACAI), and will be made available to farmers in due course



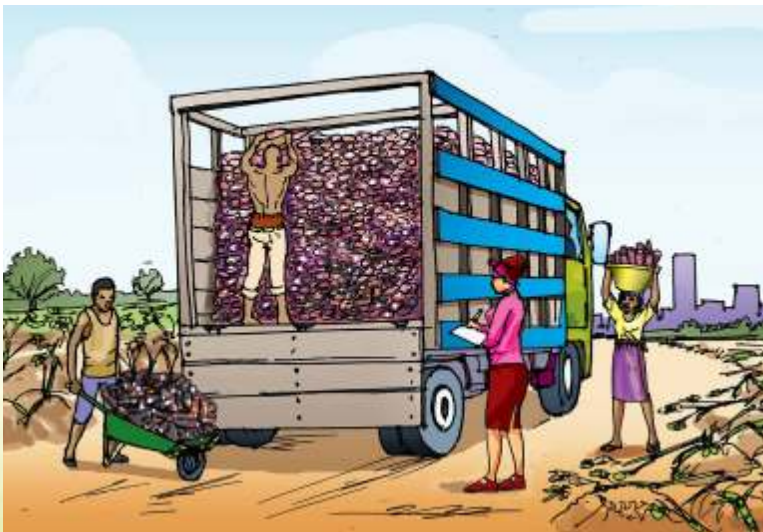
WORM CASTS

Harvesting

Cassava roots attached to the main stem can remain safely in the ground for several months. However, after harvest, the roots start deteriorating within 2 to 3 days, and rapidly become of little value for consumption or industrial use.

When is harvesting done?

- ✍ Harvest cassava when the roots are old enough to have accumulated enough starch but have not yet become fibrous.
- ✍ An optimum period of 10 to 15 months after planting is recommended when the yield and quality are highest.
- ✍ Harvesting too early results in low yield.
- ✍ Leaving the roots too long in the soil also exposes them to rodents and ties down the land unnecessarily.
- ✍ Harvest cassava during fairly dry weather so that you can easily remove soil from the roots. Roots harvested in wet conditions get soil stuck on them and this can lead to inaccurate weight records.



Processing

Harvested roots must be processed immediately after harvest and therefore there should be proper arrangements of transporting the roots either to the market or to the processing center before roots are harvested.

Conclusion

To achieve high yield, farmers must combine good agronomy with improved seeds, and proper weed control. The steps highlighted in this publication therefore provide a simple pathway that would enable farmers improve their productivity, incomes, and ultimately their livelihoods.

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