



THE BASICS OF WEED MANAGEMENT IN CASSAVA PRODUCTION IN LIBERIA

A training manual





GAFSP
GLOBAL AGRICULTURE
FUND FOR PROGRESS



IITA
INTERNATIONAL
INSTITUTE OF
TROPICAL AGRICULTURE



The Basics of Weed
Management in Cassava
Production in Liberia

THE BASICS OF WEED MANAGEMENT IN CASSAVA PRODUCTION IN LIBERIA

Michael Edet

International Institute of Tropical Agriculture (IITA), Liberia

2019

To Headquarters from outside Nigeria:
IITA, Grosvenor House, 125 High Street,
Croydon, CR0 9XP, UK

Within Liberia:
IITA, Liberia office, Central agricultural Research Institute (CARI), Suakoko,
Bong County
ISBN: 0000000000000000
Printed by IITA

Correct citation: Michael Edet, 2019. The Basics of weed management in cassava
production in Liberia, IITA, Liberia, Central Agricultural Research Institute, CARI,
Suakoko, Bong County. 39pp



CONTENT

Introduction	6
Products from cassava root	7
Steps in setting up a cassava farm	9
Basic activities in cassava production	9
Site selection	10
Field measurement	11
Advantages of site measurement	12
Land preparation and tillage	12
Planting materials	14
Stem cutting handling	15
Planting	19
Replacement of non-sprouted cuttings	20
Weed control	22
Chemical weed control	23
Pre-emergence weed control	23
Post-emergence herbicide application	25
Caution in using glyphosate as a post-emergence herbicide	25
Safe use of herbicides	31
Managing soil fertility in cassava	33
How to identify fertile soil	33
Fertilizer application	34
Fertilizer types and Rates/ha using blanket recommendation	34
Liming	35
Harvesting of cassava rates	35
When is harvesting done?	35
Cassava Processing	36
Conclusion	36

ACKNOWLEDGEMENT

The author would like to acknowledge Godwin Atser and Friday Ekeleme of the Cassava Weed Management unit funded by Bill and Melinda Gates foundation; also Jonathan Alumona of IITA-ATASP-1 project.

LIST OF FIGURES

Figure 1: A typical calendar for cassava production in Liberia.

Figure 2: IITA released cassava varieties in Liberia

Figure 3: One-hectare budget (USD) for producing cassava in Liberia
(average for all counties)

PREFACE

This guide is in response to demands from cassava stakeholders in Liberia who have been spending a lot of money and energy on weed management on cassava farms. 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.

INTRODUCTION

Cassava is a perennial woody shrub with an edible root, which is widely grown in Liberia and other tropical and subtropical areas of the world. Cassava originated from tropical America and was first introduced into Africa in the Congo basin by the Portuguese around 1558. Today, it is a dietary staple in most of tropical Africa. 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. The demand for cassava as raw material for industrial uses dramatically increased. However, this demand is not fully satisfied due to low cassava production.

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 are estimated at between 50 and 90 percent. Poor weed control and other agronomic constraints impedes cassava production and put yield of cassava in Liberia at average of about 6 tons per ha (t/ha).

On the other hand, 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 you 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.

Products from cassava root

Cassava roots are consumed either boiled or processed into products such as flour(for confectionary), gari, fufu, akpu, chips, attieke (cassava couscous), tapioca, abacha, dumboi, morning kalama, deepa, gari yorgor, roasted, GB, dumboi. Cassava can also be processed into industrial products such as starch, ethanol and animal feed.



Cassava/Wheat Bread



GAFSP
GLOBAL AFRICA FUND FOR
SUSTAINABLE PROGRESS



ITA
INTERNATIONAL
TRADING ASSOCIATION





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 calender 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 Extension officer 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	Generally 12 months after planting														

Figure 1. A typical calendar for cassava production in Liberia.

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 sandy-loam 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 earth worm cast. It is an indicator of fertility of the soil.
- ✎ Carry out a soil test. You can contact the Agricultural extension officer or District Agricultural Officers (DAOs) in your Counties for help.

Field measurement

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.





Advantages 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 apart 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.
- ✎ Although, some farmers plant on flat due to labor involved in making mounds or ridges. Research has been established that cassava grows and yields well on mound and ridges compared to flats. Planting on the above mentioned structure is also a climate-smart strategy.





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 varieties with high dry matter. The yellow varieties will also be recommended for gari 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 IITA improved varieties that are high yielding and disease and pest resistant. A total of 16 improved cassava varieties have been released in Liberia out of which 4 are biofortified yellow root varieties. Please contact IITA office in Liberia or CARI in Suakoko.



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 it is prepared. Long storage of cassava stems is not encouraged.
- ✎ For longer storage (not exceeding 30 days), cassava stems should be stored upright in the soil under shade. The base of the stems should touch the soil and moistened regularly during hot weather, 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.



TMS-91/0416	High dry matter, multiple pests resistance, high starch, high dry matter and high yielding
TMS 95/0289	Multiple pests resistance, high yielding, high dry matter and high starch
TMS-01/1663	Yellow roots, high CMD resistance, average dry matter and high yielding
TME - 1	Local landrace that has been released as a variety
TMS-94/0239	Multiple pests resistance, high yielding, high dry matter and high starch
TMS-92/0057	High dry matter, multiple pests resistance, high starch, poundable, high yielding and stay green
TMS-95/0306	Multiple pests resistance, high dry matter, high yielding and high starch
TMS-MH95/0414	Multiple pests resistance, high yielding, poundable, high dry matter and high starch
TMS-96/0097	Multiple pests resistance, high yielding, high dry matter and high starch
TMS 98/0505	Multiple pests resistance, high yielding, high dry matter and high starch
TMS-01/1235	Yellow roots, high CMD resistance, average dry matter and high yielding
TMS-00/0357	Multiple pests resistance, high yielding, poundable, stay green, high dry matter and high starch
TME – 7	Multiple pests resistance, poundable, high dry matter, high yielding and high starch
TMS-95/0166	Multiple pests resistance, early bulking, high yielding, average dry matter drought tolerant and stay green
TMS-01/0040	High dry matter, multiple pests resistance, early bulking, high yielding, pink skin, stay green, drought tolerant and high starch
TMS-14(2)1425	High dry matter (25%), moderate CMD resistance, early bulking, high starch and high yielding (>25t/ha)
TME 419	High dry matter (25%), moderate CMD resistance, early bulking, high starch and high yielding (>25t/ha) and
TMS-92/0326	High CMD resistance, early bulking, high yielding, stays green and drought tolerant.
TMS-98/0581	High dry matter (25%), high CMD resistance, high yielding (>25t/ha), stays green and drought tolerant.
TMS 01/1206	Yellow roots, high CMD resistance, average dry matter and high yielding
TMS-01/1368	Vitamin A cassava, yellow root, moderate CMD resistance and high yielding (>25t/ha)
TMS-01/1412	Vitamin A cassava, yellow root, high CMD resistance and high yielding (>25t/ha)
TMS-01/1371	Vitamin A cassava, yellow root, moderate CMD resistance and high yielding (>25t/ha)

Figure 2: IITA released cassava varieties in Liberia

NOTE:

***Yield per ha:** 20-35 tons/ha (depending on management practices) for some of the varieties

***DM content** – As spelt out in the descriptors above.....

***Top 5 varieties:** TMS 01/0040, TMS 95/0289, TMS 98/0505, TMS 95/0166 and TMS 92/0057



Planting



Planting with a cassava planter

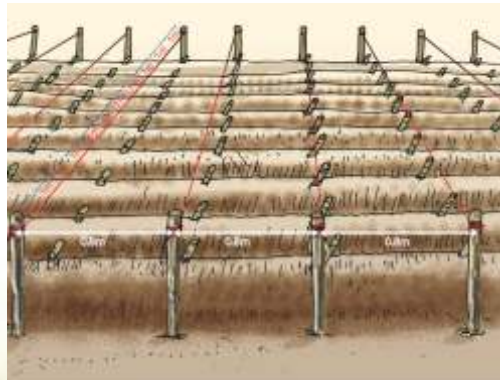




Cassava can be planted throughout the year in Liberia but major planting period starts from March-October.



Cassava is either 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 of 1 m x 0.5 m (20,000 stands per ha) can be used for stem production.

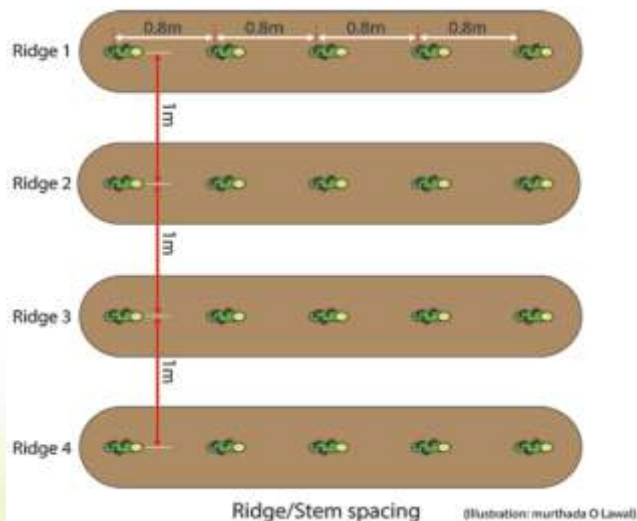


It is important for farmers to keep to the correct spacing because it helps in controlling weeds and also gives farmers optimum yield/result.

- ✎ 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 horizontally.

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, weeds must be controlled. Weed control in cassava can be done manually, mechanically, culturally, or chemically (use of herbicides). Manual weed control involves the use of hand/hoe. Mechanical weed control entails the use of motorized 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 Liberia 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.)





GAFSP



ITA



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 largescale farms, a tractor-drawn motorised rotary weeder is an option. 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 required per hectare, read the label for the recommendation.

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

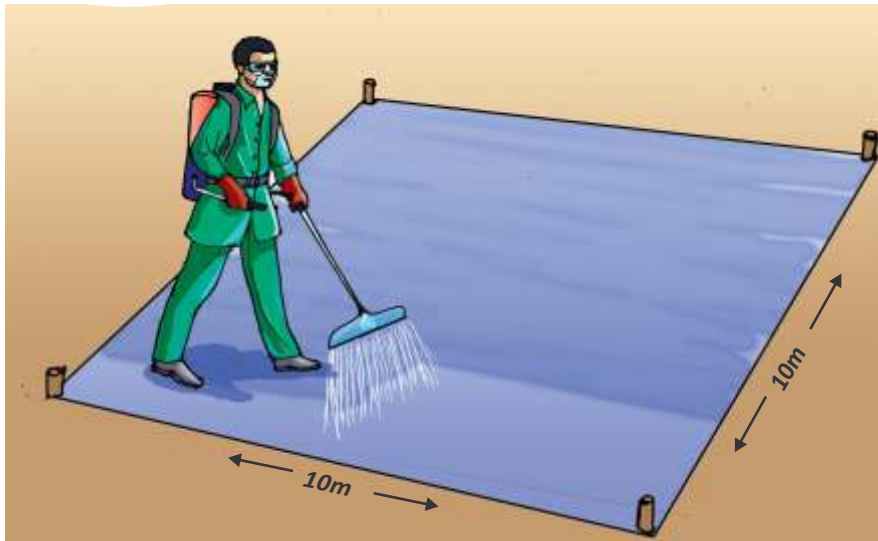
Sprayer calibration

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 100m².
















- ✎ 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 100m, then the delivery rate of 10,000m² 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 2(15 sprayer loads) to spray 10,000 m (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 m²), 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) or any of such agencies present in Liberia.
-  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



Soil fertility and cassava

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

Managing soil fertility in cassava

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. earth worm casts). The presence of worm casts indicates good fertility.

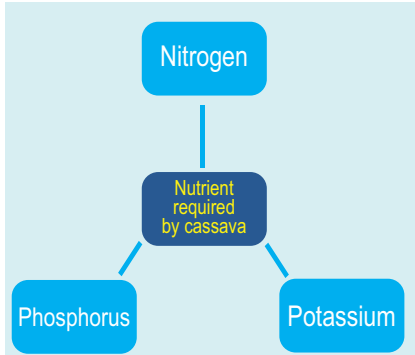
Specific recommendation for fertilizers is being investigated by the African Cassava Agronomy Initiative (ACAI).



WORM CASTS

Fertilizer application

As much as possible, the soil where the cassava is to be planted should be analyzed at the Bureau of Soils. However, if this is not possible, the following may be used:



Element	Deficient (mg/kg)	Adequate (mg/kg)	Toxicity (mg/kg)	External required (mg/kg)
pH		4.5-6.5 No unit		
N	<30	> 120		26-420
P	< 12	> 50		28-78
K	< 3	> 10		4-65
Al			>20-80	

Fertilizer types and Rates/ha using blanket recommendation

- ✎ NPK 15:15:15- 12 bags (50 kg)
- ✎ NPK 20:10:10- 9 bags (50 kg)
- ✎ NPK 12:12:17- 15 bags (50 kg)

WORM CASTS

Apply fertilizer at 4-8 weeks after planting your cassava. Apply fertilizer in a ring form, 10 cm from the plant or broadcast with care around the cassava plant, making sure the fertilizer does not touch the cassava stem or leaves.

Liming



It is recommended that 5 bags (50 kg) of agricultural lime be applied /ha during land preparation only when the soil is acidic.

Harvesting of cassava root

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 both in starch and dry matter content.
- ✎ 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.



Cassava 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. It could be processed locally or industrially.

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.

Activity	Cost
Land lease	120
Clearing and stumping – 5 labour for 5 days @ \$5USD each	125
Ridging (manual) - 5 labour for 4 days @ \$5USD each	100
Cost of stem IITA improved cassava stem – 60 bundles @ \$5USD each = 300	300
Planting – 5 labour for 3days @ \$5 =150	75
Pre-emergent herbicide application-3 labours for 1 day @ \$10 USD each	30
1 st weeding - 10 labour for 1 days @ \$5USD each	150
2 nd weeding - 10 labour for 1 days @ \$5USD each	150
3 rd weeding - 10 labour for 1 days @ \$5USD each	150
Slashing - 10 labour for 1 days @ \$5USD	50
Harvesting - 10 labour for 1 days @ \$5USD each	50
Total	1300
EXPECTED YIELD PER TON	
Root yield (15-30t/ha) @ rate of 1,200 -1,500 Lib Dollars/50kg bag of fresh root.	
1200-1500 Lib Dollars/50kg bag of fresh roots	
600-800 LD/50kg bag	
NOTE: This is the Selling price @ Montserrado County (Monrovia and environs)	
Other Counties	
Exchange rate = 150 LD to \$1.0 USD	

Figure 3: One-hectare budget (USD) for producing cassava in Liberia (average for all counties)

References

I.Y. Dugje, F. Ekeleme, A.Y. Kamara, L.O. Omoigui, A.Tegbaru, I. A. Teli, and J. E. Onyibe. 2008. Guide to safe and effective use of pesticides for crop production in Borno State, Nigeria. 24 pp.

Stefan Hauser, Lydia Wairegi, Charles L. A. Asadu, Damian O. Asawalam, Grace Jokthan and Utiang Ugbe. 2014: Cassava system cropping guide. Africa Soil Health Consortium, Nairobi.

