ORANGE FLESHED SWEET POTATO PRODUCTION MANUAL FOR TRAINERS

The Ministry of Agriculture
Zambia Agriculture Research Institute
Msekera Research Station
Chipata, Zambia

Implemented by

Researching Soils, Crops and Water in Zambia

DEVELOPMENT OF THIS TRAINING MANUAL

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FOREWORD

This Orange Fleshed Sweet Potato Production Manual for trainers was produced under the Food and Nutrition Security, Enhanced Resilience Project (FANSER) in Zambia. FANSER has been initiated and commissioned by the German Federal Ministry of Economic Cooperation and Development (BMZ) as part of the Special Initiative ONE WORLD – No Hunger. The initiative aims to address the challenges of hunger and malnutrition. As part of the national Scaling Up Nutrition process and the 1000 Most Critical Days Programme (MCDP) II, FANSER aims to improve the nutritional situation of 110,000 women and 64,000 children under the age of two years in Eastern and Luapula Provinces.

Food-based approaches to address micronutrient deficiency have gained global attention in research and development. Under the Food and Nutrition Security, Enhanced Resilience (FANSER) Project, the production and consumption Orange Fleshed Sweet Potato (OFSP) is a key vehicle being used to address vitamin A Deficiency among women of reproductive age and children under the age of two years. OFSP is a success story because it is one of the cheapest and most important root crop sources of carbohydrates and vitamin A for small-scale farmers in Zambia. Studies conducted in Eastern Province of Zambia by the Zambia Agriculture Research Institute and its partners have shown that OFSP varieties are preferred for their early maturity (3 months only!), storability, taste, higher yields, and the vitamin A bonus as compared to local varieties. However, the average yields obtained by smallholder farmers are far below potential yields.

With this manual, we want to encourage agricultural extension staff and trainers, who work with small holder farmers, women groups etc. to continue the promotion of this highly effective nutritious crop as a contribution to Zambia`s fight against malnutrition.

Therefore, this manual has been developed to enhance information delivery and communication of OFSP farming practices for agricultural extension officers. They will be able to draw on this reference material in order to achieve increased OFSP productivity and nutritional-health benefits, particularly for women of reproductive age and children under the age of 2 years in agro-ecological region one and two of Zambia. It is envisaged that this manual will be handy for all agricultural extension officers and trainers who work to improve OFSP production and reduce vitamin A Deficiency.

Dr. Heike Hoeffler

Project Coordinator FANSER Project Zambia, GIZ

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ACRONYMS

FANSER	Food and Nutrition Security, Enhanced Resilience
OFSP	Orange Fleshed Sweet Potato
SP	Sweet Potato
SPVD	Sweet Potato Virus Disease
VAD	Vitamin A Deficiency
ZARI	Zambia Agricultural Research Institute

HOW TO USE THIS TRAINING GUIDE

This manual has been structured in a way which enables the maximum participation of all learners in the learning sessions. Working groups should be voluntarily formed based on mutual interest in the subject. The facilitator of the training is not supposed to be a lecturer, but should facilitate and enhance the sharing of information among the participants. It is important that the facilitator motivates all participants and encourages them to share their experiences and take part in discussions and practical lessons.

The manual uses different types of methodologies for delivering the training content to the target group in order to effectively facilitate adult learning. The icons on the left side of the pages indicate the different steps and types of methodological techniques used during the adult learning process.

LEARNING OBJECTIVES

The facilitator clearly explains the objectives of the training to the participants**.**

DURATION

The facilitator mentions how long the lesson will take to the participants.

TRAINING MATERIALS AND TOOLS

All the Training materials and tools should be made available in advance to effectively deliver the training.

DISCUSSION

The facilitator initiates and guides discussions by asking questions and encourage participants to share their knowledge, opinions, views or experiences.

GROUP WORK

The facilitator guides participants to form groups for discussions and exercises.

PRESENTATION

The facilitator asks the groups to make presentations after group discussions or exercises.

PRACTICAL EXERCISE

The facilitator leads and guides participants in carrying out practical exercises.

LESSON SUMMARY

Participants share the key points learnt and the facilitator summarizes the lesson.

Note to the Facilitator:

At the start of every lesson, it is good practice for the facilitator to do the following:

- *Welcome the participants to the training lesson on the particular topic.*
- *Set up the ground rules in order to have a smooth delivery of the lesson.*
- *Do a recap of the main content of the previous lesson.*
- *Explain what the focus of the lesson will be.*
- *Encourage participants to share their experiences and expertise openly.*

At the end of each lesson the facilitator should:

- *Allow the participants to ask questions to clarify or contribute comments..*
- *Ask participants to share highlights of what they have learnt during the lesson and how they will use it (small doable actions).*
- *Consolidate and summarize the discussion.*
- *Thank the participants for their participation and end session*

INTRODUCTION

Sweet potato (*Ipomoea batatas* (L.)), belongs to the family *Convolvulacea*. It is a perennial dicotyledonous, cultivated as an annual crop for both vines and storage roots. Resource-poor farmers in Zambia predominantly grow sweet potatoes; it is one of the most important root crop sources of carbohydrates. Sweet potatoes are usually found in several flesh colors such as white, yellow, orange, red, pink, violet, and purple. Yellow & white-fleshed sweet potatoes are the most commonly consumed but they lack vitamin A. Orange Fleshed Sweet potatoes (OFSPs) provide nutritional and health benefits, and are more important especially for women and young children. OFSPs are highly rich in beta-carotene, which is an excellent source of vitamin A. The leaves are also an excellent source of vitamin A. This helps to improve resistance to heart diseases, boosts the immune system and improves eye health.

OFSP is a suitable crop for Climate Change adaptation, Food and Nutrition security because it tolerates stresses such as drought, heat, and can grow in poor soils with relatively low inputs. It produces higher yields and superior gross margins than cereals. In comparison to the local varieties, the improved OFSP varieties produced by the Zambia Agriculture Research Institute (ZARI) have higher yield potential and shorter growing cycles of three to four months.

This training manual was developed to address some of the following major barriers to OFSP production, utilization and processing. These include limited access to “clean” planting materials, OFSP weevil infestation in the field, insufficient knowledge about the production and nutritional benefits of consuming OFSP, utilization and processing issues, poor agronomic practices, inadequate improved varieties, high losses due to rots, limited storage options, and poor development of products and markets.

OVERVIEW OF THE LESSONS AND TIME ALLOCATIONS

This manual is intended to be a trainers' guide on OFSP production targeting especially for smallholder farmers. The manual comprises of two parts as follows;

I. First part: from lesson 1 to 13 – OFSP production

II. Second part: from lesson 14 to 15 – Postharvest management practices

The manual consists of 15 lessons in total, grouped into half day sessions over about eight and a half days..

	LESSONS	TIME	DAYS
OFSP PRODUCTION	**Lesson 1**: Benefits of growing and consuming OFSP **Lesson 2**: Soil fertility management of OFSP production in the main field **Lesson 3**: Environmental conditions for growing OFSP	50 minutes 50 minutes 1 hour 40 minutes **Total 3h 20 min**	**Half a day**
	Lesson 4: Management of field pests and diseases in OFSP production **Lesson 5**: Management of post-harvest diseases and pests of OFSP production	2 hours 10 minutes 1 hour **Total 3h 10 min**	**Half a day**
	Lesson 6: Crop rotation and weeding in OFSP production **Lesson 7**: Making manure tea	1 hour 30 minutes 2 hours 10 minutes **Total 3h 40 min**	**Half a day**
	Lesson 8: Vine multiplication: site selection, nursery bed establishment vine selection, planting in the garden **Lesson 9**: Harvesting of OFSP vines from the garden	2 hours 50 minutes 1 hour 20 minutes **Total 4h 10min**	**Half a day**
	Lesson 10: Site selection for OFSP production in the main fields **Lesson 11**: Land preparation for OFSP production in the main field **Lesson 12**: Planting of OFSP vines in the main field	40 minutes 1 hour 50 minutes 2 hours **Total 4h 30min**	**Half a day**

	Lesson 13: Harvesting of OFSP in the main field	1 hour 20 minutes **Total 1h 20 min**	**Quarter of a day**

POST-HARVEST MANEGEMNT PRACTICES	**Lesson 14**: Processing and preservation of OFSP	3 hours 50 minutes **Total 3h 50 min**	**Half a day**
	Lesson 15: Storage of OFSP	3 hours **Total: 3h**	**Half a day**
	TOTAL	**26 HOURS: 20 MINUTES**	**ABOUT 8 HALF - DAYS**

OFSP ROOT PRODUCTION

OFSP has the potential to produce remarkably high yields of between 20 to 30 tons per hectare if given the right growing conditions. In order to produce high yields, it is important to put into practice all key recommendations on good agronomic practices in OFSP production.

Intended Learning Objectives

At the end of these lessons, participants should be able to understand the following:

- Benefits of growing and consuming OFSP
- Principles and practices of OFSP production
- Pests and disease management in the field and post-harvest management practices.

LESSON 1: BENEFITS OF GROWING AND CONSUMING OFSP

	LEARNING OBJECTIVES 1. To understand the benefits of growing OFSP. 2. To understand the benefits of consuming OFSP.
	**TIME** 50 Minutes
	**TRAINING MATERIALS** • Flip chart • Markers

STEP 1: INTRODUCTION (10 MINUTES)

Instructions for the facilitator:

- Explain that the focus of the lesson will be:
  - Benefits of growing OFSP
  - Benefits of consuming OFSP
- Methodology: Discussion in plenary
- Encourage participants to share their experiences and expertise openly.

STEP 2: DISCUSSION ON BENEFITS OF GROWING AND CONSUMING OF OFSP IN PLENARY (30 MINUTES)

Instructions for the facilitator:

- Ask participants about their personal experience on benefits of growing and consuming OFSP.
  - What type of sweet potatoes are you growing and why?
  - What are the benefits of growing OFSP?
- Provide important information by giving a talk on the benefits of producing OFSP considering what was shared in the plenary. After the talk, invite participants to ask questions for clarification.

BENEFITS OF GROWING OFSP

- OFSP tolerate stresses such as drought, dry spells, and heat and can even grow in poor soils with relatively low inputs.
- The improved varieties produce higher yields and give more income (superior gross margins) compared to other crops such as cereals.
- In comparison to the local sweet potato varieties, the improved OFSP varieties have higher yield potential and shorter growing cycles of three to four months.
- It has relatively low input requirements and is a low risk crop as compared to some other crops, e.g. maize.
- It can be preserved (e.g. dried) and processed in different forms such as puree, flour and baked products. This enhances availability, access and utilization to the household all year round. Therefore, OFSP production contributes to food and nutrition security at household level.
- Sweet potatoes can be used as part of livestock feed.

Figure 1: OFSP production

Instruction to the facilitator:

- Asks the participants to share their knowledge and experiences on the consumption of OFSP using the question below:
    - What are the benefits of consuming OFSP?
- Provide important information by giving a talk on the benefits of consuming OFSP while considering what was shared in the plenary. After the talk, invite participants to ask questions for clarification.

BENEFITS OF CONSUMING OFSP

- OFSP is highly rich in beta-carotene, which is an excellent source of vitamin A. The leaves are also an excellent source of vitamin A.
- Vitamin A helps to improve resistance to heart diseases, boosts the immune system and improves eye health. It furthermore reduces morbidity and mortality in pregnant women and lactating mothers and their infants under two.
- Orange-Fleshed Sweet potato (OFSP) is high in fiber and therefore helps improve digestion.
- OFSP varieties have higher yield potential and shorter growing cycles of three to four months in comparison to the local sweet potato varieties. Therefore, it can act as source of food security during lean periods.

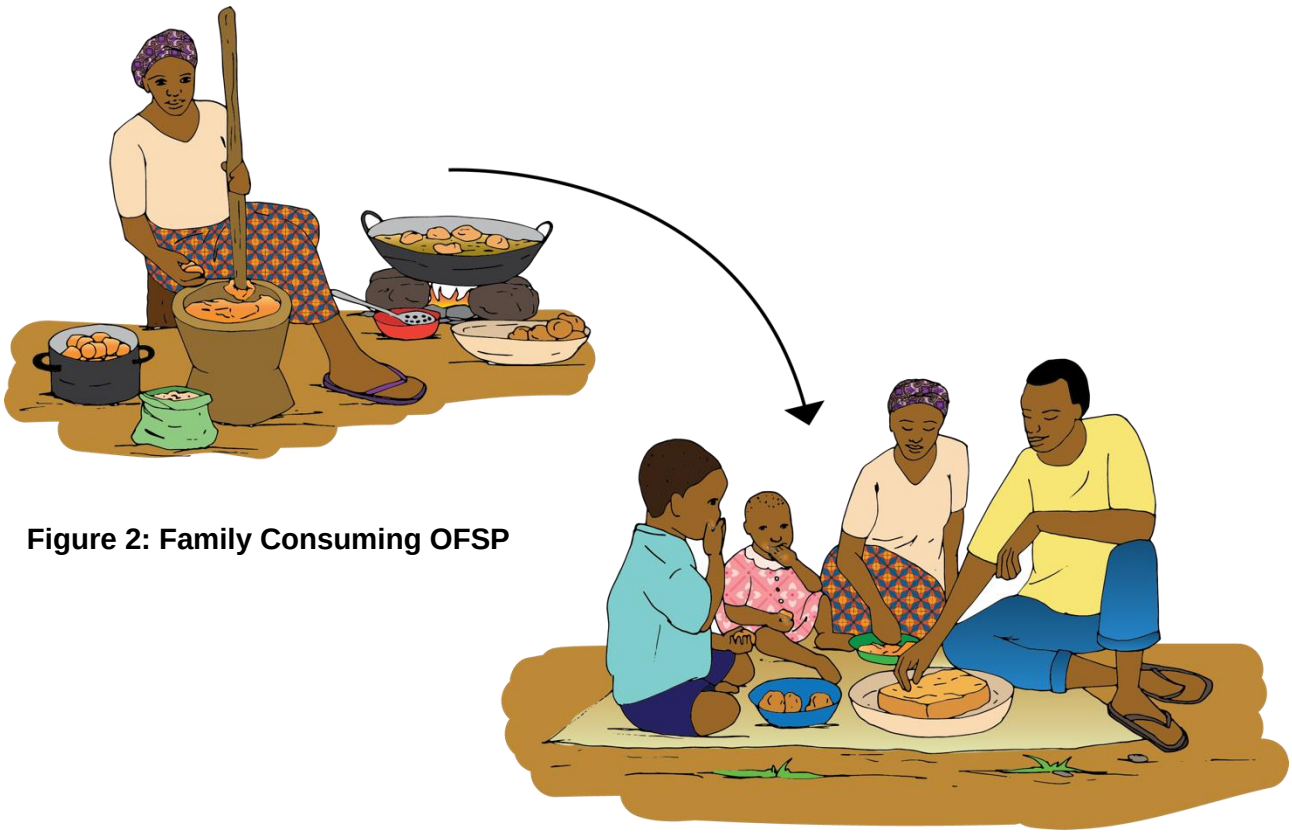

Figure 2: Family Consuming OFSP

STEP 3: SUMMARY (10 MINUTES)

Instructions for the facilitator:

- Ask participants to share the highlights of what they have learnt during the lesson and how they will use it.
- Consolidate and summarize the discussion.
- Thank the participants for their participation and end session.

LESSON 2: SOIL FERTILITY MANAGEMENT OF OFSP IN THE MAIN FIELD.

LEARNING OBJECTIVES

1. To know and understand how to manage and improve soil fertility in OFSP fields.

TIME

50 Minutes

TRAINING MATERIALS

- flip chart
- markers

STEP 1: INTRODUCTION (10 MINUTES)

Instructions for the facilitator:

- Recap on the main points from the previous lesson
    - What do you remember from the previous lesson?
    - Ask if anything from the previous lesson needs to be clarified.
- Explain to the participants that today we shall focus on soil fertility management in the main field.
- Methodology: Discussion in plenary
- Encourage participants to share their experiences and expertise openly.

STEP 2: DISCUSSION AND GIVING A TALK ON SOIL FERTILITY OFSP MAIN FIELD (30 MINUTES)

Instruction to the facilitator:

- Ask participants about their own personal experiences on soil fertility management.
    - How do you manage soil fertility in OFSP fields?
- In case the participants do not know the answer to the above question, the facilitator should provide important information by giving a talk on soil fertility management while considering what was shared in the plenary. After the talk, invite participants to ask questions for clarification.

SOIL FERTILITY IN THE MAIN FIELD FOR THE PRODUCTION OF OFSP

- Soil fertility is the component of overall soil productivity that deals with the soil's available nutrient status, and the soil's ability to provide nutrients out of its own reserves and through external applications for crop production.
- To ensure sustainable agricultural productivity, producers are advised to practice crop rotation.
- Therefore, it is good to plant sweet potatoes in a field that previously had a crop that is normally fertilized e.g. maize or a green manure crop so that the sweet potato crop benefits from the residual nutrients.
- Cultural practices such as residue retention, whereby a farmer buries crop residue biomass along with native grasses and shrubs in the ridges – this is in-situ composting (called Fundikila in the Northern province) – is another option for sweet potato production. The buried biomass provides the necessary nutrients for the sweet potato upon decomposition.

STEP 3: SUMMARY (10 MINUTES)

Instructions for the facilitator:

- Ask participants to share the highlights of what they have learnt during the lesson and how they will use it.
- Consolidate and summarize the main discussion points.
- Thank the participants for their participation and end session.

LESSON 3: ENVIRONMENTAL CONDITIONS FOR GROWING OFSP

LEARNING OBJECTIVES

- To gain knowledge of the environmental conditions for growing OFSP.
- To know the ideal temperature for OFSP production.
- To know and understand the amount of rainfall suitable for OFSP production.
- To know and describe the types of soil that are good for OFSP production.

TIME

1 hour 40 minutes

TRAINING MATERIALS

- Flip chart
- Markers

STEP 1: INTRODUCTION (10 MINUTES)

Instructions for the facilitator:

- Recap the previous lesson by asking participants to share what they learnt and add any key points which may not have been mentioned.
- Explain that during this lesson we shall focus on:
    - Ideal temperature for OFSP production.
    - Amount of rainfall suitable for OFSP production.
    - Types of soil that are good for OFSP production.
- Methodology: Discussion in plenary, Group work and Presentation
- Encourage participants to share their experiences and expertise openly.

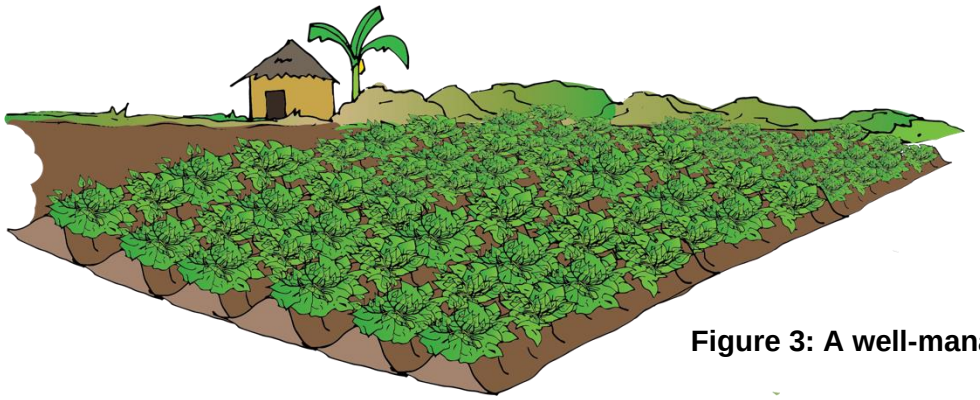

Figure 3: A well-managed OFSP field

STEP 2: WARM-UP DISCUSSIONS ON PRODUCTION OF SWEET POTATOES (10 MINUTES)

Instructions for the facilitator:

- Ask participants about their personal experience on benefits of growing and consuming OFSP.
    - Do you grow sweet potatoes?
    - What varieties do you grow?
    - When do you plant?
    - How long do the varieties take to grow?
- The facilitator thanks the participants for openly sharing their experiences.

STEP 3: DISCUSSION ON ENVIRONMENTAL FACTORS FOR SWEET POTATO PRODUCTION (30 MINUTES)

Instruction to the facilitator:

- Ask the participants to get in pairs with their neighbor and discuss the following questions:
    - Which are the key environmental factors for successful production of sweet potatoes?
        - Rainfall
        - Temperature
        - Soil type
        - Other factors…
    - What environmental challenges do you face in sweet potato production?
    - Which are possible solutions to address the challenges you face?

STEP 4: GROUP PRESENTATIONS FROM THE DISCUSSION ON THE ABOVE QUESTIONS IN PLENARY (40 MINUTES)

Instructions for the facilitator:

- Invite between 3 - 4 participants to share the highlights of the discussions and encourage other participants to add.
- Allow the participants to ask questions and make contributions to the presentation.
- Thank the participants for openly sharing their experience.

Provide important information by giving a talk on environmental conditions for OFSP production while considering what was shared in the presentation.

ENVIRONMENTAL CONDITIONS FOR SUCCESSFUL OFSP PRODUCTION

- OFSP is highly adaptable and can grow in most agro-ecological zones of Zambia. Temperature, rainfall and soil type are the main environmental factors that affect the growth and development of the OFSP crop.

RAINFALL

- The first 40 days after planting are critical for the establishment of OFSP vines and may necessitate the irrigation of OFSP to prevent crop failure in case of dry spells.
- Most cultivars are susceptible to waterlogging conditions.

TEMPERATURE

- OFSP vines are destroyed by frost mainly in the months of June and July.
- Low-lying areas and depressions, which are subject to frost in winter, must be avoided particularly for winter vine nurseries.

SOIL TYPE

- A well-drained sandy loam soil is preferred. Heavy clay soils should be avoided as they hinder root development resulting in cracked and poor shaped sweet potato tubers.
- Soils that are excessively acidic or alkaline often encourage bacterial infection and negatively affect yields.

STEP 4: SUMMARY (10 MINUTES)

Instructions for the facilitator:

- Ask participants to share the highlights of what they have learnt during the lesson and how they will use it.
- Consolidate and summarize the discussion.
- Thank the participants for their participation and end session.

LESSON 4: MANAGEMENT OF FIELD PESTS AND DISEASES IN OFSP PRODUCTION

LEARNING OBJECTIVES

1. To gain knowledge and understanding of OFSP diseases and pests in the field.
2. To gain knowledge and understanding of identification of diseases and pests in the field.
3. To discuss how sweet potato diseases and pests can be avoided or managed in the field.

TIME

2 hours 10 minutes

TRAINING MATERIALS

- Bucket
- Plastic bag
- Hand hoe

STEP 1: INTRODUCTION (10 MINUTES)

Instruction to the facilitator:

- Recap the main points from the previous lesson by asking the participants the following question.
    - What do you remember from the previous lesson?
- Explain that today we shall focus on management of diseases and pests in OFSP.
- Methodology: Group work and presentation
- Encourage participants to share their experiences and expertise openly.

STEP 2: GROUP WORK: DISCUSSION ON PEST AND DISEASE MANAGEMENT IN SWEET POTATOES (20 MINUTES)

Instruction to the facilitator:

- Divide the participants into two groups (A and B). Ask them the questions below on pest and disease management in sweet potatoes. Group A will discuss the questions on pests and group B will discuss the questions on diseases. Show the questions on the training cards or a flipchart and give each group the below:
- **Questions on pests**
    - Which are the common pests that attack OFSP during production?
    - How do you avoid or manage pests in OFSP production fields?
- **Questions on diseases**
    - Which are the common diseases of OFSP production in the field?
    - What are the symptoms of common diseases in OFSP production?
    - How do you avoid or manage pests in OFSP production?

STEP 3: GROUP PRESENTATION ON PESTS AND DISEASES IN OFSP PRODUCTION IN PLENARY (30 MINUTES)

Instructions for the facilitator:

- Ask the group representatives to present the points of their discussion on sweet potato pests and disease management.
- Allow the participants to ask questions and make contributions on the presentations.
- Provide important information by giving a talk on pests and diseases of OFSP while considering what was shared in the plenary. After the talk, invite participants to ask questions for clarification.

COMMON PESTS IN OFSP PRODUCTION

- Common pests of sweet potato include.
    - Weevil, grasshopper, rats, etc.
- Like any other crop, sweet potatoes get attacked by pests leading to reduction in yields.
- Pests are among several production risks factors that could be significantly contributing to these low yields.
- Many insects attack sweet potatoes. Sweet potato weevil (Cylas spp.) is the chief pest of sweet potato.
- The most damaging stage of the weevil is the larvae stage. The larvae mainly attack stems and roots, although they may also feed on leaves. Adult weevils lay their eggs in the bases of vines and in exposed roots (See Figure 4).

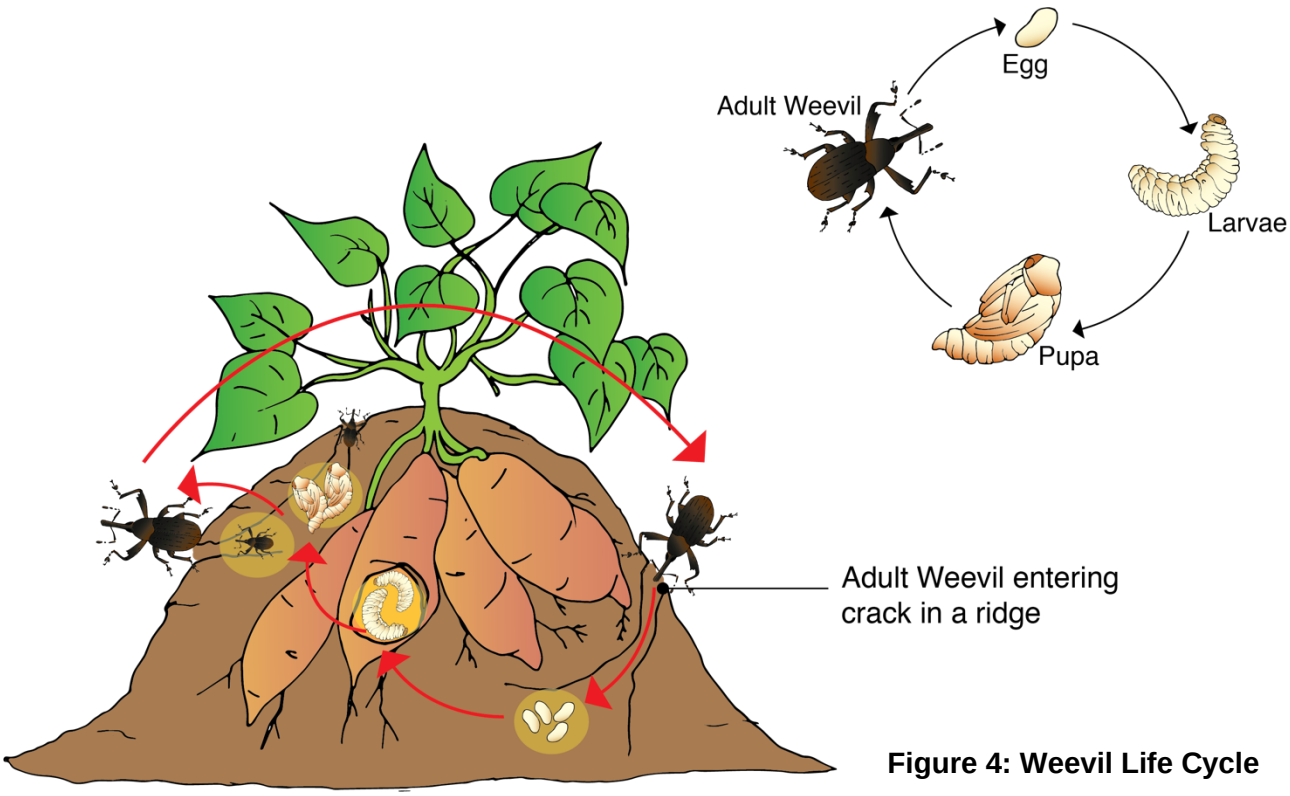

Figure 4: Weevil Life Cycle

- Weevil population damage is most prevalent during dry seasons, probably because soil cracks during spells or in droughts, thus exposing roots to weevils. During this period the plant is normally stressed and susceptible to attacks by pests and diseases.
- Common diseases of sweet potato include;
    - Sweet potato viral diseases (feathery mottle, chlorotic stunt)
    - Fungal diseases (Phomopsis Leaf Spot, Alternariosis, Anthracnose, Blight)
    - Bacterial stem and root rot, bacterial wilt, leaf and stem scab)

NOTE: *Viral diseases contribute the most to yield losses.*

THE LIFE CYCLE OF A VIRUS

Whitefly flies and aphids pick up virus particles by feeding on an infected sweet potato plant then transfering the virus from diseased to healthy sweet potato plants. Then the virus multiplies and spreads through the plant causing disease symptoms.

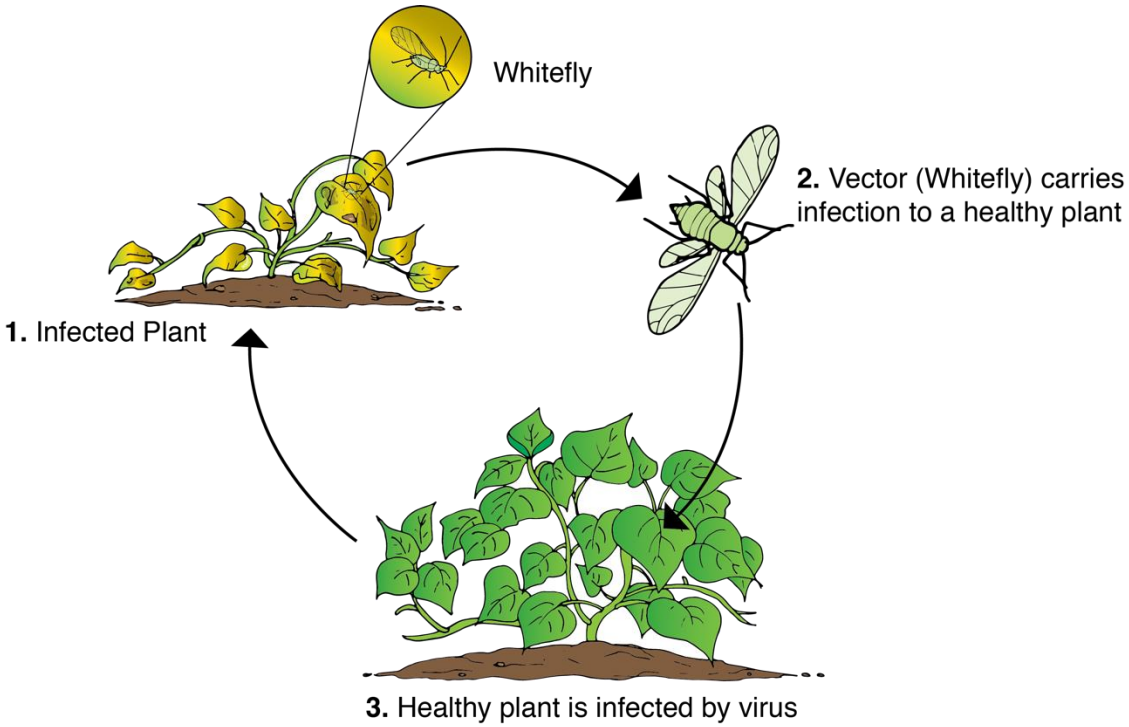

Figure 5: How OFSP viral disease is spread.

The figure below shows the difference between an infected OFSP plant and a healthy plant.

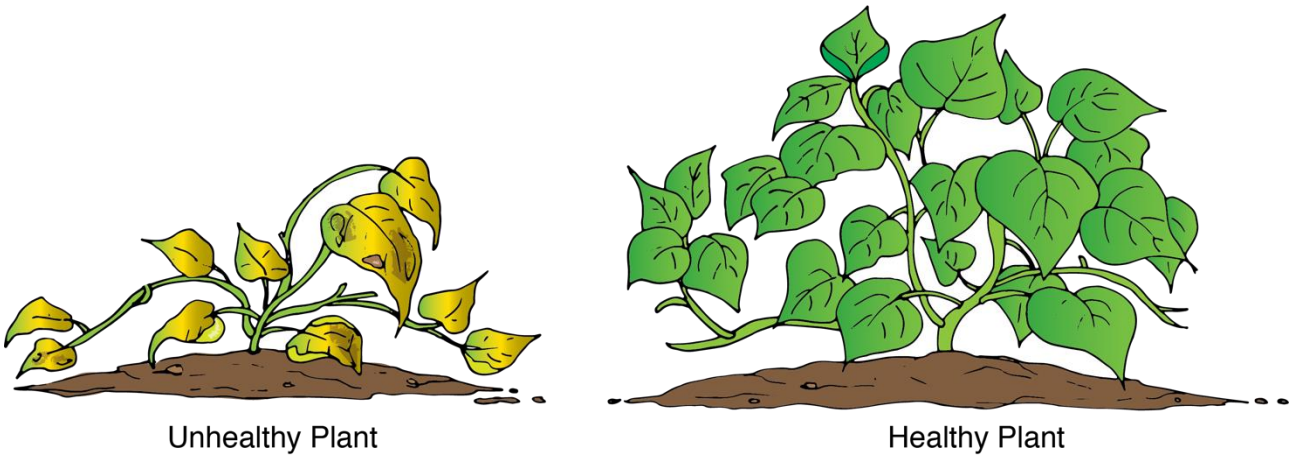

Figure 6: A healthy plant and unhealthy plant

PEST MANAGEMENT IN OFSP PRODUCTION

Farmers should integrate as many as possible of the following good agriculture practices.

- **Hilling up**: This refers to the covering of roots and parts of the stem of the sweet potato plant with fresh soil to reduce damage by weevils.

Figure 7: Hilling up

- **Field sanitation**: Remove volunteer plants in the field because they may harbour pests and diseases which can affect the new crop. A volunteer crop is a plant of the same species that grows on its own without deliberately being planted by the farmer.

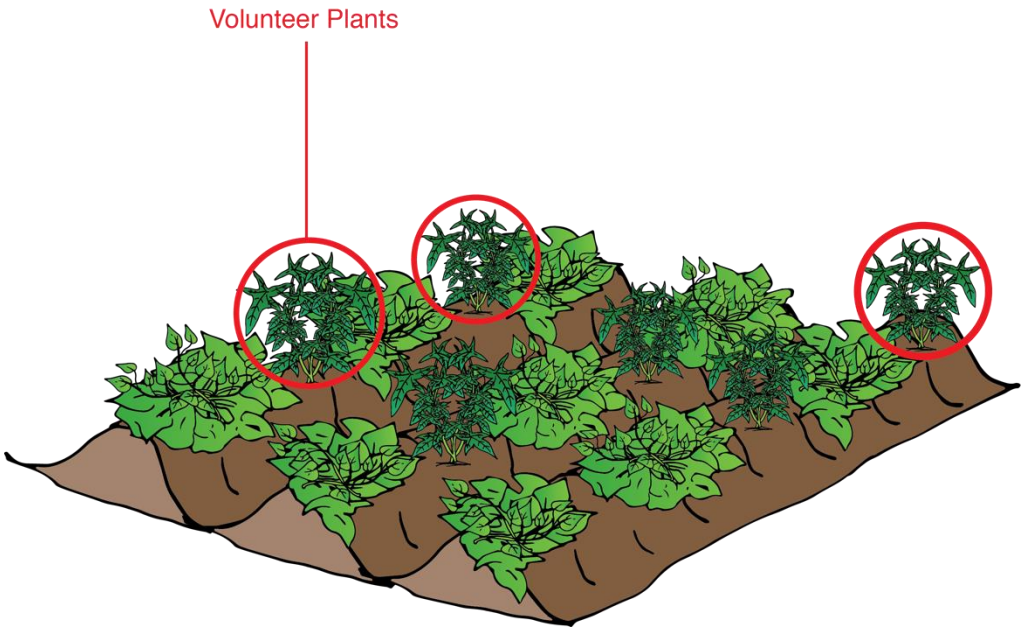

Figure 8: Volunteer Plants

- **Using clean planting materials free of pests**: Always use the apical portion of vines as planting materials.

- **Barrier crops**: Use cassava, maize, bananas or sorghum in strips at least 3-5m wide between existing sweet potato fields and your newly planted field.

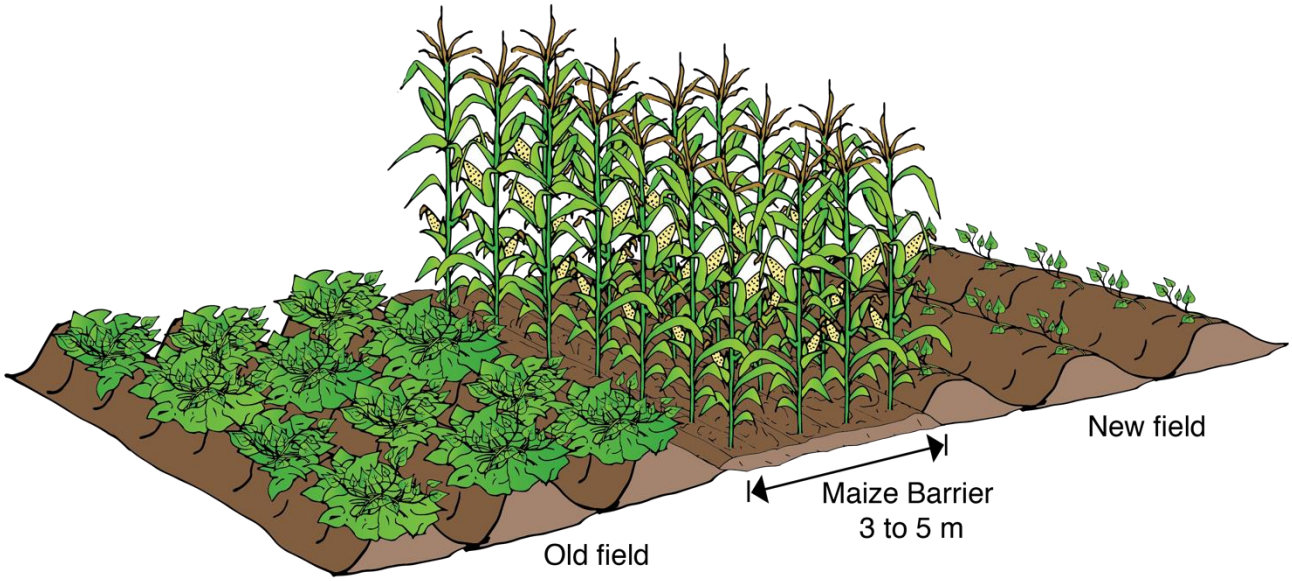

Figure 9: Showing a maize barrier between old and newly planted OFSP.

- **Mulching:** Helps retain soil moisture and reduce soil cracking and weevil infestation.
- **Early harvesting**: Early planting during the month of December is recommended because it allows harvesting before the coming of the long dry spell when there is more risk of weevil infestation. Studies have shown that weevil damage is most prevalent during dry seasons, probably because drought increases soil cracking, thus exposing roots to weevils. During this period the plant is normally stressed and susceptible to attacks by pests and diseases.
- **Crop rotation**: Rotate sweet potato with other crops (cereals or legumes).
- **Plot separation:** Sweet potato weevils do not often fly and will only fly short distances in order to find sweet potato plants. New fields should be planted some distance from existing and recently harvested fields.
- Organic disinfestation can be done by dipping vines in a mixture of ½ cup ash and 5 litres of water for 5 minutes just before planting

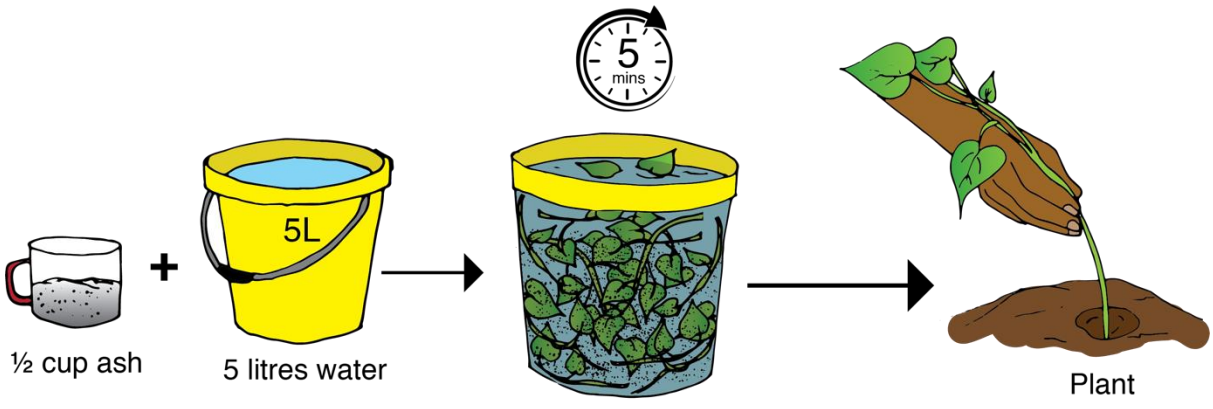

Figure 10: Treating vines

- **Weevil resistant varieties**: Deep rooting varieties seem to be attacked less than shallow rooting varieties. Early maturing varieties can also escape weevil damage as they are harvested early before the soils crack.

MANAGEMENT OF DISEASES IN OFSP PRODUCTION

The following includes sweet potato disease symptoms

- Stunting
- Leaf narrowing and distortion
- Leaf chlorosis
- Leaf mosaic or vein clearing

OFSP diseases can be managed through the following methods:

- Always using clean and pest and disease-free vines or roots when planting.
- Removing (roguing) any diseased plants as soon as the crop sprout.
- Planting OFSP varieties that are tolerant to viruses such as Olympia.
- Practicing crop rotation.
- Fields from which seed is sourced must be established away from old sweet potato fields.
- Before picking the vines, verify the source or confirm that the vines selected are healthy by visually ensuring those vines are free from both pests and disease infestation. This can be done by checking for obvious symptoms including eggs, larvae and even adult pests, dark spots on the foliage, folded, curled or shrivelled leaves.

STEP 4: PRACTICAL EXERCISE ON IDENTIFICATION OF DISEASES AND PESTS IN OFSP PRODUCTION (60 MINUTES)

Instructions to the facilitator:

- Select the sweet potato field for identification of pests and diseases beforehand.
- Guide the participants to identify pests and diseases observed in the field. Put the identified pests in transparent plastic bags.
- Ask them in plenary while in the field to name the pests and diseases identified and how to manage them effectively.

STEP 5: SUMMARY (10 MINUTES)

Instructions for the facilitator:

- Ask participants to share the highlights of what they have learnt during the lesson and how they will use it.
- Consolidate and summarize the main discussion points.
- Thank the participants for their participation and end session.

LESSON 5: MANAGEMENT OF POST-HARVEST PESTS AND DISEASES AND OF OFSP

LEARNING OBJECTIVES

1. To know and understand postharvest pests and diseases affecting OFSP during storage.
2. To know the causes of postharvest diseases of OFSP during storage.
3. To know and understand how to manage postharvest pests and diseases during storage.

TIME

1 hour

TRAINING MATERIALS

- Dry sweet potatoes
- Hand hoe
- Sacks
- Plastic bags

STEP 1. INTRODUCTION (10 MINUTES)

Instructions for the facilitator:

- Recap on the main points from the previous lesson
    - What do you remember from the previous lesson?
    - Ask if there any questions for clarification from the previous lesson
- Explain that today we shall focus on post-harvest pests and diseases in OFSP
- Methodology: Discussion in plenary
- Encourage participants to share their experiences and expertise openly.

STEP 2: DISCUSSION AND GIVING A TALK ON POST-HARVEST DISEASES AND PESTS OF OFSP (40 MINUTES)

Instructions for the facilitator:

- Ask participants for their personal experience on postharvest pests and disease in OFSP:
    - What common pests during postharvest of OFSP have you experienced?
    - How you did you manage them?
    - What common diseases during postharvest of OFSP have you experienced?
    - How did you manage them?
- Provide important information by giving a talk on pests and diseases during postharvest and storage of OFSP while considering personal experiences that participants shared.

POSTHARVEST PESTS

- Insect pests which attack OFSP include larger grain borer, lesser grain borer, red flour beetle, sweet potato weevil.

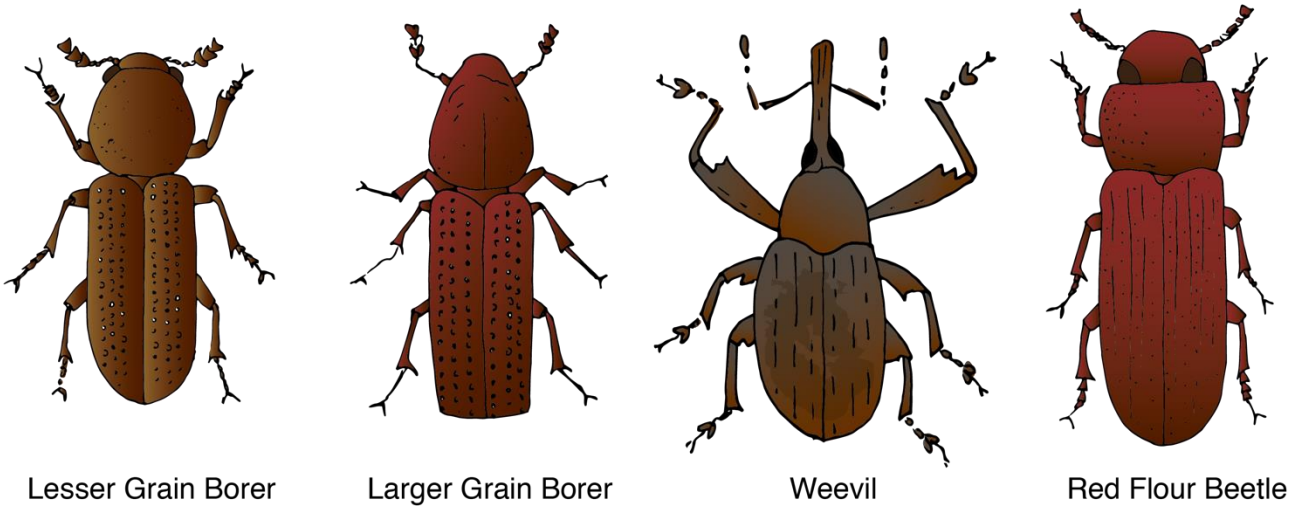

Figure 11: Post-harvest Pests

- These storage pests of sweet potatoes usually bore holes in the product and lay eggs.
- The larvae then feed on the product creating feeding tunnels.
- Many insects attack sweet potatoes. The sweet potato weevil (Cylas spp.) is the chief pest that causes significant losses in root quality.

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Figure 12: OFSP Root Damaged By Weevils

POSTHARVEST DISEASES

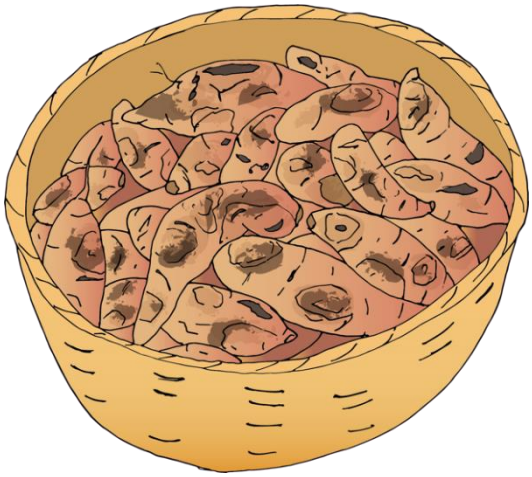


Figure 13: Roots affected by black rot.

- The diseases which develop on harvested sweet potato roots are called post-harvest diseases. The harvested roots may get infected in storage or on the way to market.
- Postharvest diseases of sweet potatoes are referred to as storage rots and are caused by fungi, bacteria, viruses and nematodes. The most important storage rots are, however, caused by fungal pathogens. The most common fungal pathogens are foot rot, Java black rot and soft rot (Mucor).
- Fungal diseases can spread by spores being blown in the wind from diseased crops to healthy crops. The disease can also be spread by spores splashed up by heavy rain from infected plants or plant parts to healthy plants or plant parts. Using disease-infected vines another way through which the disease spreads.
- To reduce the risk of disease infestation, care should be taken when handling the roots to avoid wounds. Furthermore, proper curing can reduce disease incidences.

PRESERVATION AND MANAGEMENT MEASURES FOR OFSP TO AVOID PESTS AND DISEASE ATTACKS

- **Drying:** The product should be sliced and well dried in shade in the field for six hours before storage to help prevent fungal decay (refer to lesson 14 on page 65.
- **Parboiling:** Freshly sliced sweet potato chips can be parboiled for 5 minutes or more then dried in shade to reduce the likelihood of infestation and insect damage.
- **Salting:** Salt applied at an application rate of 4-6 teaspoons of salt per kg of freshly sliced sweet potato chips prior to drying has been found to negatively affect storage pests.
- **Shaking:** The periodic rolling or shaking of sacks or containers of sweet potato chips may kill developing larvae

- **Storage duration:** The duration of the storage of dried sweet potato must be minimized. Dried sweet potato products like flour can be stored for six months.
- **Hygiene:** Larvae of the insect pests can survive in sweet potato flour which is in storage and can spread to new products. Products such as sweet potato flour should be stored in insect proof containers.
- **Traditional protectants**: Ash reduces the feeding damage or kills storage insect pests. This should be used in storage pits.
- **Insect proof containers**: The use of insect proof containers such as clay pots with sealed tops can be very effective in preventing insect damage to dried sweet potato chips or flour.

STEP 3: SUMMARY (10 MINUTES)

Instructions for the facilitator:

- Ask participants to share the highlights of what they have learnt during the lesson and how they will use it
- Consolidate and summarize the main discussion points.
- Thank the participants for their participation and end session.

LESSON 6: CROP ROTATION AND WEEDING IN OFSP PRODUCTION

LEARNING OBJECTIVES

1. To know and understand the importance and benefits of crop rotation.
2. To know and understand the crop rotation cycle for OFSP.
3. To improve knowledge in weed management.
4. To know and understand the disadvantages and advantages of weeds.

TIME

1 hour 30 minutes

TRAINING MATERIALS

- Hand hoe

STEP 1: INTRODUCTION (10 MINUTES)

Instructions to the facilitator:

- Recap on the main points from the previous lesson
    - What do you remember from the previous lesson?
    - Ask if anyone wants anything from the previous lesson clarified.
- Explain that today we shall focus on crop rotation and weed management in OFSP fields.
- Methodology: Discussion in plenary and practical exercise.
- Encourage participants to share their experiences and expertise openly.

STEP 2: DISCUSSION ON CROP ROTATION AND WEED MANAGEMENT OF OFSP IN PLENARY (30 MINUTES)

Instructions to the facilitator:

- Ask the participants to get into pairs with their neighbor and discuss the following questions:
    - What are the benefits of crop rotation?
    - What are some of the crops that can be rotated with OFSP?
    - How do you manage weeds in OFSP fields?
    - What are the advantages and disadvantages of weeds?

- Invite up to 5 participants to share their points from the discussion and ask other participants to add.
- Allow the participants to ask questions and make contributions to the presentation.

Instructions to the facilitator:

- Show the illustrations on weeding and crop rotation to the participants and ask them to compare the discussions with what they see in the picture.
- Provide important information by giving a talk on weeding and crop rotation of OFSP while considering what was shared in the presentation.

WEED MANAGEMENT IN OFSP PRODUCTION

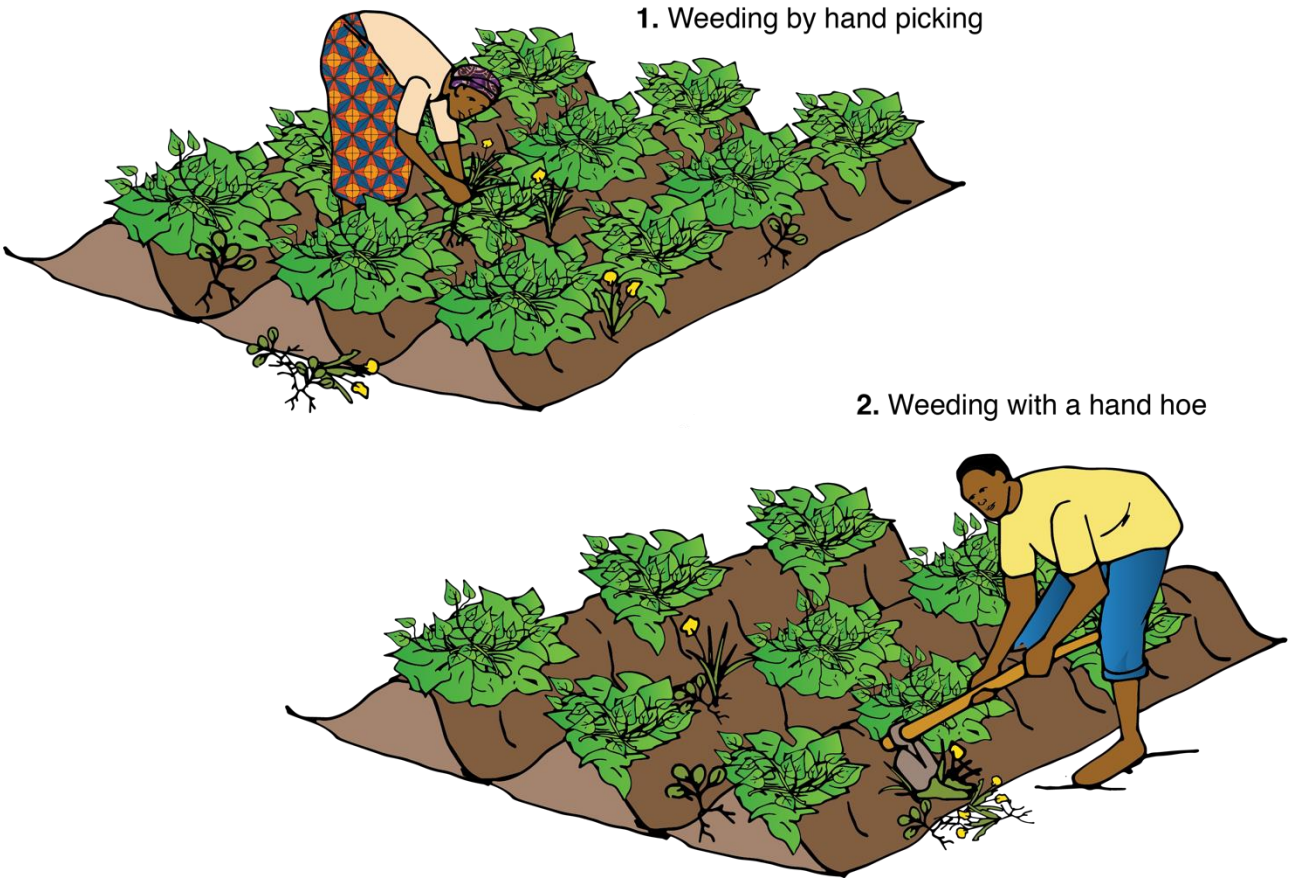


Figure 14: Weeding by hand and hand hoe

- Weeds should be controlled during the first two months after planting.
- If not controlled, some weeds compete with the sweet potato plants for nutrients, water and light, and may also harbour pests and diseases. However, some weeds can be beneficial in the following ways:
    - The bright flowers of some weeds can attract beneficial insects that prey on pests.
    - Providing the much-needed organic biomass that can contribute to soil fertility.

- Nutrient recycling as some weeds are deep rooted.
- Provision of soil cover.

- Weeds are typically removed manually. They can be removed using a hand hoe earlier when the crop is still young (about 4 - 6 weeks) while hand weeding can be done later when the crop is approaching maturity.
- Weeding immediately after rains should be avoided as this would lead to the removal of more soils from the ridges and weeds can be easily transplanted through running water. At the same time hand-weeding/hoe weeding when the soil is too dry is normally very tedious and might result in leaving the weed roots in the ground where they can re-sprout. Therefore, weeding should be done when the soil is neither too wet nor too dry.
- Once the vines have grown and covered the ground, there is little need for further weeding.
- Removing weeds in the field before they have formed seeds is an important weed control strategy for the next crop. This prevents the weeds from producing seeds that would germinate in the next cropping season.
- Crop rotation and intercropping helps prevent the build-up of weed populations. Mulching can reduce weed emergence significantly.

CROP ROTATION OF OFSP

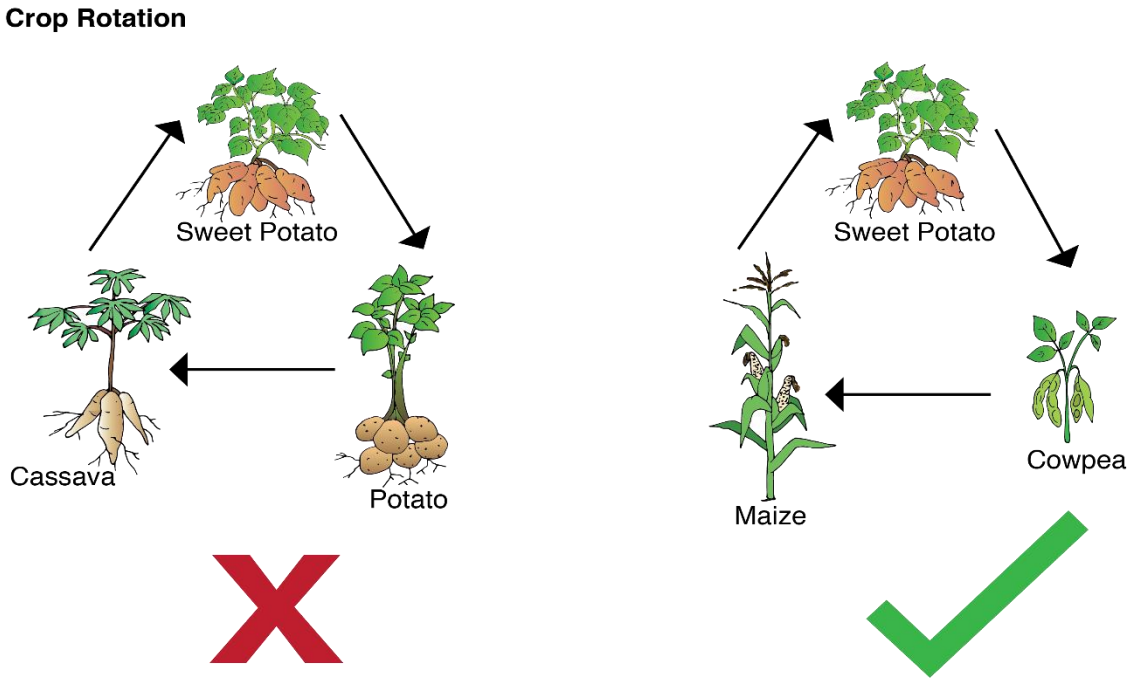


Figure 15: Crop Rotation

- Crop rotation is the planned sequence of growing different crops with different characteristics and requirements on the same piece of land at different times.
- Crop rotation helps prevent the build-up of weed populations and reduces field pests and diseases.
- Sweet potatoes should never follow roots (cassava, yams) or tuber (Solanum potato) crops, because these have similar nutrient requirements and might be susceptible to similar types of pests and diseases. In a proper crop rotation, sweet potato can follow either a cereal such as maize, sorghum, rice, finger millet; or legumes such as beans, cowpeas, soybeans or sesame.

STEP 4: PRACTICAL EXERCISE ON WEED MANAGEMENT IN OFSP PRODUCTION (40 MINUTES)

Instructions to the facilitator:

- Identify the sweet potato field in which to conduct the practical exercise on weeding beforehand.
- Then ask the identified participants to demonstrate how to weed with hands and with a hoe. Encourage them to clearly explain the steps during the demonstration.
- Allow every participant to take part in the demonstration process.

STEP 4: SUMMARY (10 MINUTES)

Instructions for the facilitator

- Ask participants to share the highlights of what they have learnt during the lesson and how they will use it.
- Consolidate and summarize the main discussion points.
- Thank the participants for their participation and end session.

LESSON 7: MAKING MANURE

LEARNING OBJECTIVES

1. To know and understand the procedures for manure tea making and application.

TIME

2 hours 10 minutes

TRAINING MATERIALS

- Well decomposed manure (cow dung or poultry manure etc.); or fresh manure; or leaves of nutrient-rich plants such as tithonia, comfrey, or leguminous plants such as gliricidia.
- Drum
- Porous sack
- Stick
- Water
- Combination of different legumes such as leaves of velvet beans, jack beans, cowpea and agroforestry tree species such as Moringa, Leucaena, Gliricidia and Tithonia.

STEP 1. INTRODUCTION (10 MINUTES)

Instructions for the facilitator:

- Recap on the main points from the previous lesson
    - What do you remember from the previous lesson?
    - Ask if there is anything they'd like clarified from the previous lesson.
- Explain to the participants that today we shall focus on making manure tea for nurseries during the vine multiplication.
- Methodology: Discussion in plenary and practical work.
- Encourage participants to share their experiences and expertise openly.

STEP 2: LEAD A DISCUSSION IN PLENARY ON THE FOLLOWING (20 MINUTES)

Instructions for the facilitator:

- Ask participants the questions below in plenary for discussions.
    - What is manure tea?
    - What is the importance of manure tea?
- In case the participants do not know the answers, the facilitator should provide important information by giving a talk on manure tea while considering what was shared in plenary.

MANURE TEA

- Manure tea is the extract of livestock manure, or leaves of nutrient-rich plants which is steeped in a porous bag submerged in water as shown on page 34.
- The manure extract, just like compost, is used for the fertilization of different crops including OFSP vines especially at nursery.
- This is an organic alternative to chemical fertilizers and is a more sustainable practice of fertilization.

THE IMPORTANCE OF MANURE TEA

- Manure tea, just like compost, is used for the fertilization of vegetables. This is an organic alternative to chemical fertilizers and is a more sustainable practice of fertilization.
- As opposed to solid organic inputs such as manure or compost whose nutrient release is relatively slow, manure tea has the advantage of rapidly providing nutrients that are already solubilized to the crop.
- The process of making manure tea is relatively simple and can be done by any farmer.
- It should however be noted that manure tea cannot be used as a substitute to solid organic inputs. This is because the main benefit of the manure tea, just like chemical fertilizers, is to supply highly soluble nutrients to the crop. The tea does not contribute to the maintenance of soil organic matter. Therefore, manure tea should always be used as a supplement to solid organic inputs.

STEP 3: PRACTICAL EXERCISE ON HOW TO MAKE MANURE TEA FOR NURSERY BEDS (90 MINUTES)

Instructions for the facilitator:

- Show the participants the illustrations on the manure tea making procedures below, and ask them the following questions while in the field to explain what they see in the picture.
    - What materials do you need to make manure tea?
    - What are the procedures/steps for making manure tea?

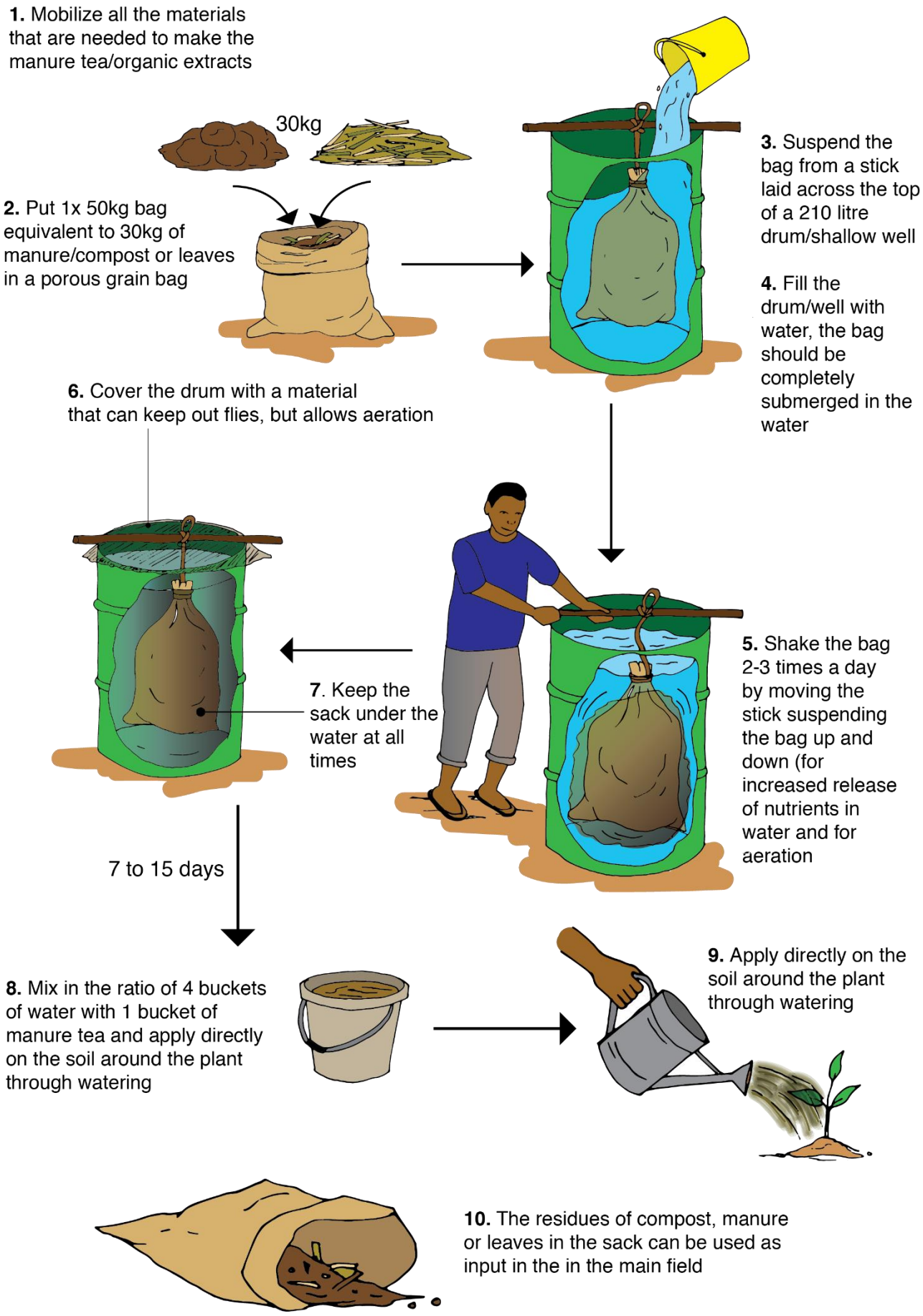


Figure 16: Tea manure making procedures.

Instructions to the facilitator:

- Identify the site in which to do the practical exercise on manure tea making beforehand. Make sure all the required materials and equipment are available in advance.
- Identify the participants who can demonstrate the procedure for making tea manure beforehand.
- Show the participants the illustration above and ask them to explain the steps observed. After the observations ask them the following questions for discussion:
    - What materials do you need to make tea manure extract?
    - What are the procedures to follow for making tea manure extract?
- Then ask the identified participants to demonstrate tea manure procedures.
- Allow every participant to take part in the demonstration process and ask questions for clarification.
- Provide important information by giving a talk on manure tea for OFSP while considering what was shared in the presentation.

WHAT IS THE PROCEDURE FOR MAKING MANURE/COMPOST TEA?

- Manure/compost extract can be made from either compost, animal manures and green manure biomass, or a combination of two or all the above materials.
- Green manure biomass can come from plants such as velvet beans, jack beans, and from agroforestry tree species such as, Moringa, Gliricidia and Tithonia.
- Having selected and decided on a suitable site, you can now follow the following step-by-step guide to make the manure extract:
    - Mobilize all the materials that are needed to make the manure/compost extracts.
    - Put about 30kg of manure/compost/desired leaves in a 50kg porous/grain bag.
    - Suspend the bag from a stick laid across the top of a 210 liters' drum/shallow well.
    - Fill the drum/well with water, the bag should be completely submerged in the water.
    - Shake the bag 2-3 times a day by moving the stick suspending the bag up and down for increased release of nutrients in the water and for aeration.
    - Cover the drum with a material that can keep out flies but allows aeration.
    - Always keep the sack under the water.
    - The extract should be ready to use after 15 to 21 days. The residues of compost, manure or leaves in the sack can be used as input in the nursery.
    - The extract should be ready to use after 15 to 21 days (the manure tea should be applied directly on the soil around the plant using a watering can or a container with holes on the base - bottom)
    - The residues of compost, manure or leaves in the sack can be used as input in the main field or in the nursery.

STEP 4: SUMMARY (10 MINUTES)

Instructions for the facilitator:

- Ask participants to share the highlights of what they have learnt during the lesson and how they will use it.
- Consolidate and summarize the main discussion points.
- Thank the participants for their participation and end session.

LESSON 8: VINE MULTIPLICATION: SITE SELECTION, NURSERY BED ESTABLISHMENT, VINE SELECTION AND PLANTING IN THE GARDEN.

LEARNING OBJECTIVES

1. To know and understand how nursery beds should be prepared.
2. To know and understand how vines should be selected and prepared.
3. To know and understand vine multiplication planting methods.
4. To know and understand how to irrigate and harvest vines for planting in the main field.
5. To know and understand how to harvest and pack the mature OFSP vines on nursery beds.

TIME

2 hours 50 minutes

TRAINING MATERIALS AND TOOLS

- Sweet potato vines
- Knife
- Measuring tape
- Stick
- Watering cans
- Pens

STEP 1. INTRODUCTION (10 MINUTES)

Instructions for the facilitator:

- Recap on the main points from the previous lesson
    - What do you remember from the previous lesson?
    - Ask if there is anything they'd like clarified from the previous lesson.
- Explain to the participants that today we shall focus on OFSP vine multiplication procedures.
- Methodology: Group work, Presentation and Practical exercise.
- Encourage participants to share their experiences and expertise openly.

STEP 2: DISCUSSION IN GROUPS ON OFSP VINE MULTIPLICATION PROCEDURE (30 MINUTES)

Instruction to the facilitator:

Divide the participants into two groups (A and B) and give them the following questions to discuss. Write the questions below on the flip chart and ask them to discuss: *Questions for group **A***

- What are factors to consider when choosing a site for vine multiplication?
- How are nursery beds prepared?
- What factors should be considered when selecting the vines for the nursery?

*Questions for group **B***

- How do you plant the vines for seed multiplication?
- How often should nurseries of vines for sweet potatoes be irrigated?
- How do you harvest the vines for planting in the main field?

- Ask the group representatives to present the main content of their discussion.
  - Allow the participants to ask questions and make contributions to the presentation.
  - Consolidate and summarize the discussion from the presentation.
- Provide important information by giving a talk on vine multiplication while considering what was shared in the plenary. After the talk, invite participants to ask questions for clarification.

FACTORS TO CONSIDER WHEN SELECTING A SITE FOR VINE MULTIPLICATION

- The site should be fertile, with well-drained soil, near a reliable water source, protected from livestock damage and should be easily accessible (refer to lesson 10, on page 47). Farmers should avoid planting sweet potatoes on previous sweet potato fields to minimize or avoid risks of pests and disease infestation.
- Isolate the multiplication plots from disease prone areas.
- Nurseries should be established near the communities that are going to benefit from the vines to minimize the transport costs.

NURSERY BEDS PREPARATION FOR OFSP VINE MULTIPLICATION

- Nurseries should not be established on land that had sweet potatoes the previous season.
- Time needed for the decomposition of plant material prior to planting should be taken into consideration. The land should be tilled at least 4 weeks prior to planting at the beginning of the dry season. Narrow beds of 1.2 m wide should be made.
- Additional space for walkways/alleys between beds measuring 1 meter should be left between beds to avoid the mixing of different varieties of vines between nursery beds.

- Beds should be 1- 5m long, 1.2m wide and 20-50cm deep. Orient the beds across the field slope to ensure even watering. Loosen the soil; mix with compost manure/ humus-rich soil.

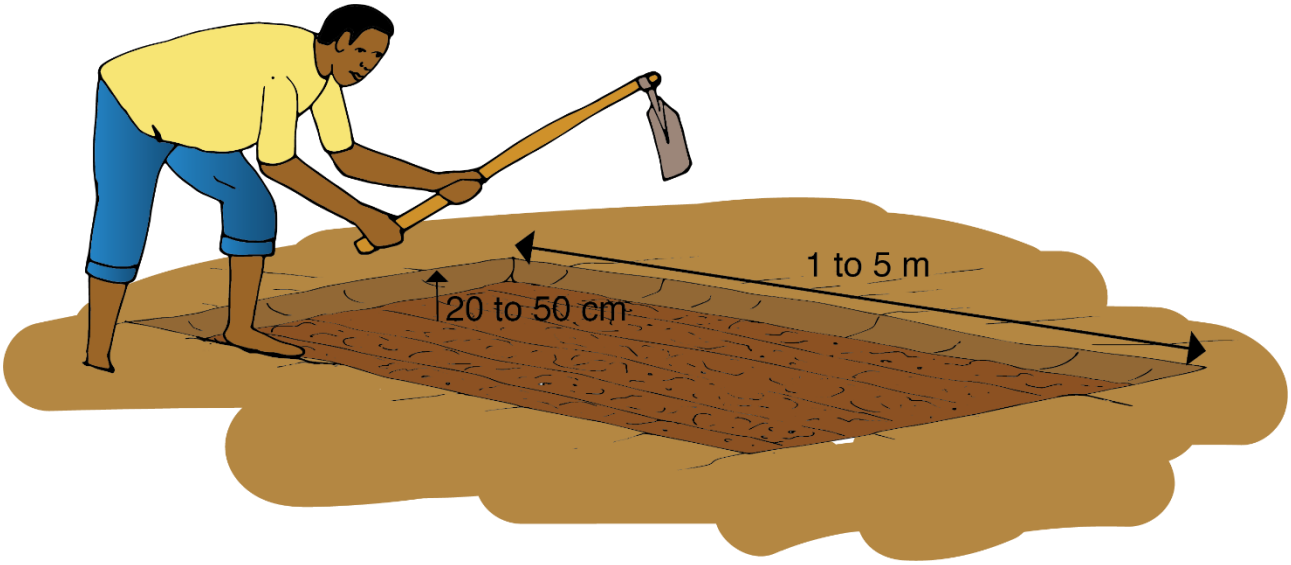


Figure 17: Nursery bed preparation

- Apply dried farmyard manure/compost at a rate of 2.5 kilograms per square meter by spreading it across the nursery bed.

Note: Rate should depend on soils in an area.

OFSP VINE SELECTION

- Vines should be obtained from reliable sources, ideally from a primary site with good control of quality and be those preferred by farmers. The age of the mother crop is an important factor. The vines should be picked from 2-3 month-old mother crop.
- Vines from 2-3 months old crop are more vigorous than those from 4-5 months old crop and comparatively free from weevils. The variety should be any of the orange fleshed sweet potatoes preferred by the consumers. When the younger mother crop is less than 2 months old it may fail to overcome the shocks from sunlight and chances of survival is minimal.
- The vines should be free from pests, mainly weevils, and from diseases such as sweet potato virus diseases.

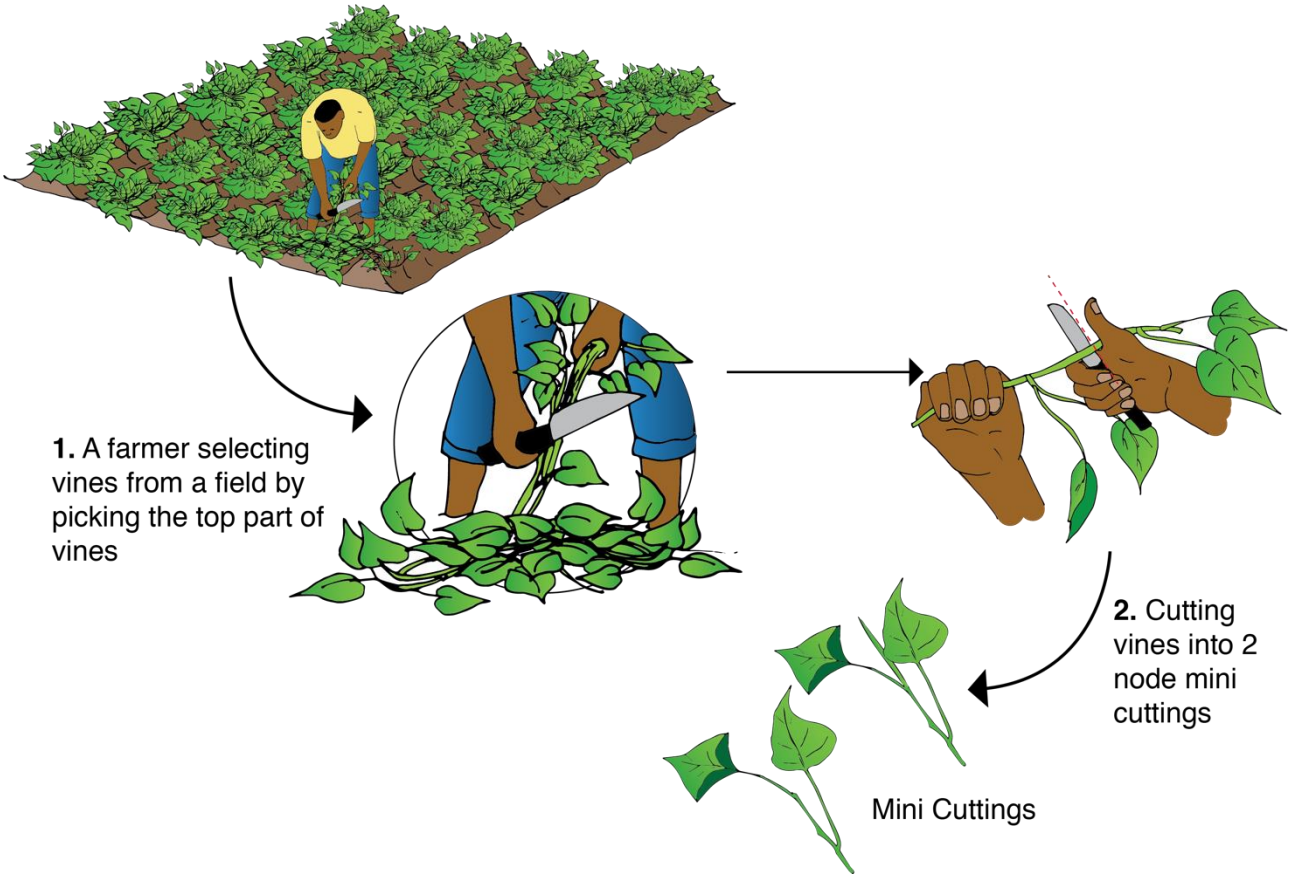


Figure 18: Preparation of mini-cuttings

- Disinfection of tools to cut the vine should be done to make sure that no disease or pest transmission from tools takes place.
- Vines should not be dry for good plant establishment. The top portion of vines (25-30cm) should be cut and used for preparing mini-cuttings (2 to 3 node cuttings) for rapid multiplication.
- Numerous mini cuttings can be obtained from apical plant parts where leaves have been cut off from vine cuttings. Vines should be cut into mini cuttings so that each mini cutting has two to three nodes or is 25-30 cm long. Mini cuttings should be planted upright.

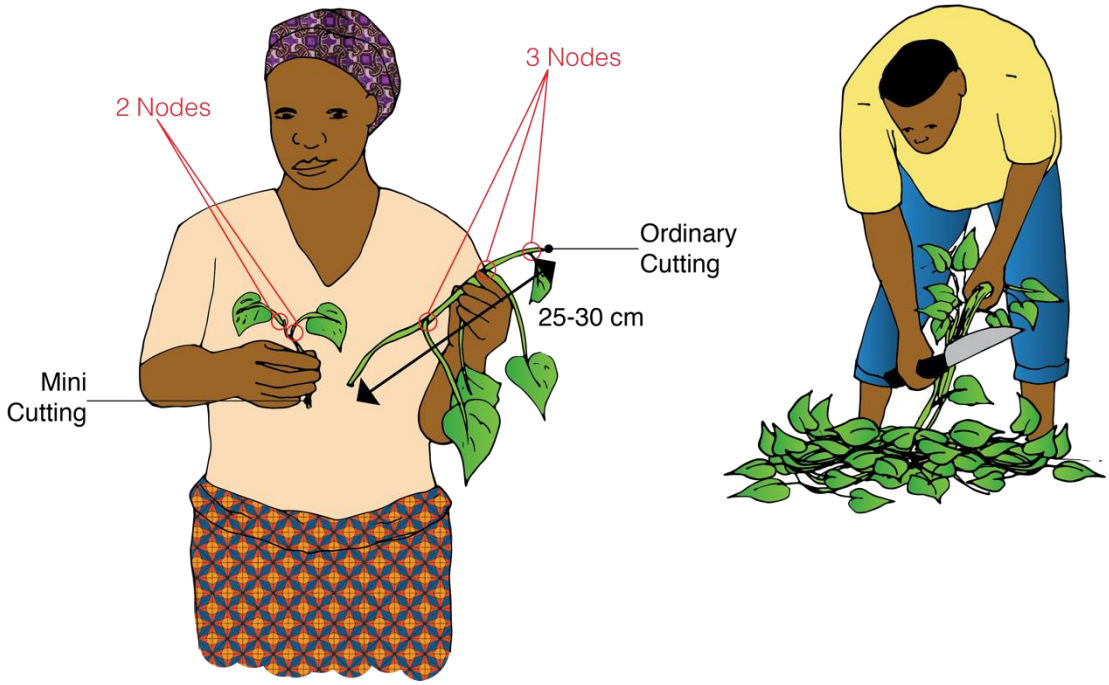


Figure 19: Two nodes cutting and three nodes cutting.

PLANTING

- The depth of planting should be carefully considered to avoid shallow planting. It is recommended that about 15cm (2 nodes) of the vine should be planted into the soil.
- Labels with the date of planting and variety type should be placed on the bed or section of the nursery for easy follow-ups and subsequent activity scheduling especially where nursery expansion is required.

Figure 20: planting OFSP vines in the garden

CONVENTIONAL MULTIPLICATION (WHERE A FARMER HARVESTS BOTH VINES AND ROOTS)

- This normal practice involves dual-purpose production of roots and vines. Under this method, the multiplication rate is lower due to low plant population per unit area.
- Conventional multiplication is done at a plant spacing of 1m x 1m, with 3 vines per square metre.

RAPID MULTIPLICATION (WHERE A FARMER HARVESTS THE VINE ONLY)

- Use of mini cuttings to rapidly increase planting materials in short time. The technique can ensure the availability of adequate planting material at the beginning of the rainy season so that planting can be done on time.
- For instance, at a spacing of 20cm x 10cm, a plant population of 50 vines per square metre is attained at planting time.

MODIFIED RAPID MULTIPLICATION (WHERE A FARMER HARVESTS BOTH VINES AND ROOTS)

- This modification may be more appropriate for farmers as they can multiply vines for sale and harvest some storage roots.
- The beds are sunken; 10 m long. 2.5 kilograms of manure per square meter is applied and mixed thoroughly with soil before planting.
- The cuttings are planted 0.5m between rows x 0.2m intra-row. The cuttings are planted upright with two nodes below the soil surface.

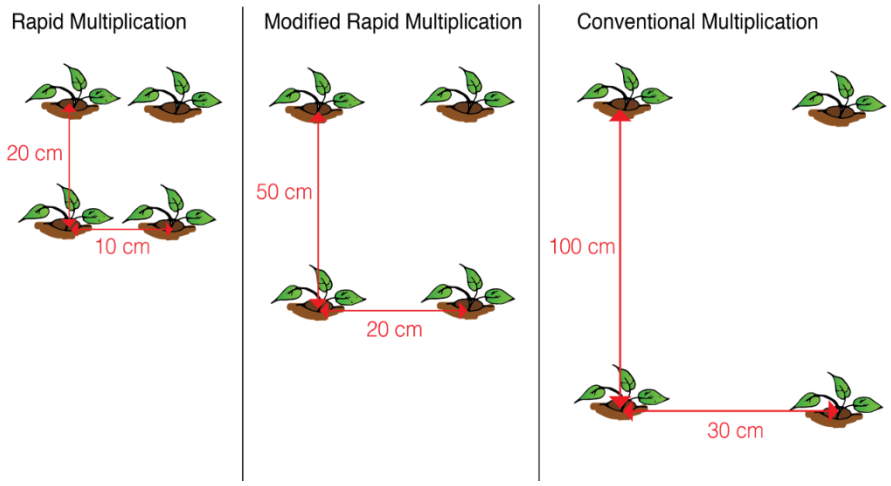


Figure 21: planting densities for the three multiplication methods

Measure a 1 by 5 metres piece of land equivalent to the length of ½ by 2½ pieces of Chitenge materials.

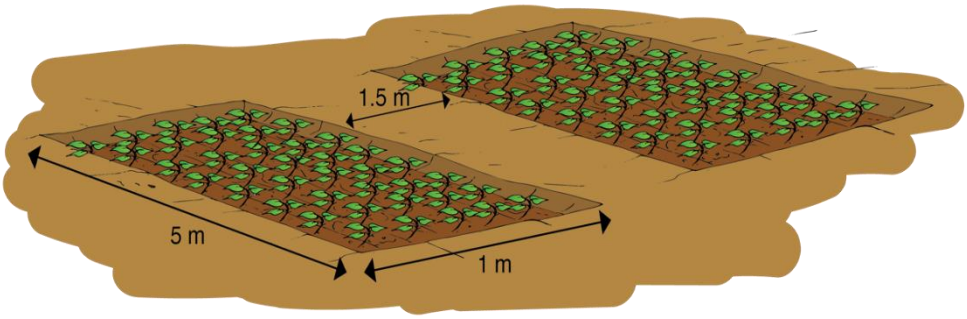


Figure 22: Layout of nursery beds

- Under this system, the vines should be harvested later than 60 days after planting to avoid a negative effect on storage root production.
- OFSP Nurseries should be well protected from animals and thieves, especially by means of fencing.

Figure 23: Protecting of the nursery from livestock

IRRIGATION OF NURSERIES

- Irrigate 2 times a day, early morning and late afternoon with a hose pipe or watering can. Weed periodically to maintain clear nursery beds. Remove all diseased and pest infected plants.
- Where there is excessive sunlight and heat, use mats or other locally available materials to shade the nursery beds. Remove the mats when the first leaves start developing.
- Avoid keeping the mats for more than 2 weeks to prevent poor growth (vines would grow long internodes, with weak stems and smaller leaves).

APPLICATION OF TEA MANURE

- After the manure tea is ready (2-3 weeks), apply the tea once every week directly to the soil around the plant using a watering can. If the farmer does not have a watering can, the tea can be sprinkled with a hand.

STEP 3: PRACTICAL EXERCISE ON VINE MULTIPLICATION: SELECTION, NURSERY BED ESTABLISHMENT AND PLANTING IN THE GARDEN (120 MINUTES)

Instructions to the facilitator:

- Identify the sweet potato mother fields in which to conduct the practical exercise on vine selection and a site for land preparation.
- Identify the participants with experience to demonstrate how to select vines, prepare beds and plant the vines. Encourage them to clearly explain the steps during the demonstration.
- Allow every participant to take part in the demonstration process.

STEP 4: SUMMARY (10 MINUTES)

Instruction for the facilitator:

- Ask participants to share the highlights of what they have learnt during the lesson and how they will use it
- Consolidate and summarize the main discussion points.
- Thank the participants for their participation and end session.

LESSON 9: HARVESTING OF OFSP VINES FROM THE GARDEN

LEARNING OBJECTIVES

1. To know and understand indicators of a mature vine.
2. To know how to harvest mature OFSP vines from the garden.

TIME

1 hours 20 minutes

TRAINING MATERIALS

- Knife
- Sack
- Ropes

STEP 1: INTRODUCTION (10 MINUTES)

Instructions to the facilitator:

- Recap the previous lesson by asking participants to share what they learnt in the previous lesson and the facilitator adds any key points which may not have been mentioned.
- Explain that today we shall focus on harvesting of OFSP vines.
- Methodology: Discussion and Practical exercise.
- Encourage participants to share their experiences and expertise openly.

STEP 2: DISCUSSION AND PRACTICAL EXERCISE ON HARVESTING OF OFSP VINES. (60 MINUTES)

Instruction to the facilitator:

- Request the participants to go to the garden site for the practical exercise on harvesting of OFSP vines.
- While in the garden, the facilitator should guide the discussions in plenary using the questions below:
    - When is the right time to harvest the vines?
    - What are the signs of mature OFSP vines?

    - During and after harvesting, what should we consider to avoid damage to and easy spoilage of the OFSP vines?
- After the discussion, the facilitator asks participants with experience in harvesting the OFSP vines to demonstrate how to harvest. In case the participants don't have experience on how to harvest, the facilitator can demonstrate.
- Allow the participants to ask questions and make contributions during the practical exercise.
- Provide important information by giving a talk on harvesting of OFSP while considering what was shared in the presentation.

HARVESTING AND AFTER HARVESTING MANAGEMENT OF VINES.

- To avoid rapid drying of vines, harvest should be done in the morning and in the evening, when there is less direct sun and it is cooler.
- In the first harvest, harvest the top portion and leave the lateral branches on the lower portion to grow. This is normally at 30–60 days after planting.
- However, this is dependent on soil fertility and moisture adequacy. Timely harvesting helps to minimize water and nutrient waste or translocation of nutrients to unwanted roots (sinks). Always keep the vine cuttings under shade before planting to minimize drying or rotting of vines. Label bags with the variety name, date of harvest and name of multiplier.

CAUTION DURING HARVESTING OF OFSP VINES

- Avoid tightly pressing vines while packing into bags as this may damage the plants.
- Travel during the cool hours of the day or at night.
- During harvest, avoid pressing or compacting the vines as this would lower their market value by making the roots prone to damage and pathogenic infections.
- Harvested vines should be hardened for 2 to 3 days by keeping them in shade before planting in the main field.

STEP 5: SUMMARY (10 MINUTES)

Instructions for the facilitator:

- Ask participants to share the highlights of what they have learnt during the lesson and how they will use it.
- Consolidate and summarize the main content of the lesson.
- Thank the participants for their participation and end session.

LESSON 10: SITE SELECTION FOR OFSP PRODUCTION IN THE MAIN FIELD

LEARNING OBJECTIVES

1. To gain knowledge on factors to be considered for site selection for OFSP production.
2. To know and understand the importance of site selection.

TIME

40 Minutes

TRAINING MATERIALS

- Flip charts
- Markers

STEP 1. INTRODUCTION (10 MINUTES)

Instructions for the facilitator:

- Recap the previous lesson by asking participants to share what they have learnt and mention any key points which may not have been mentioned.
- Explain that during this lesson we shall focus on:
    - Factors to consider for site selection for OFSP production.
    - Importance of site selection.
- Encourage the participants to share their experiences and expertise openly.

STEP 2: DISCUSSION ON SITE SELECTION FOR SWEET POTATOES PRODUCTION IN PLENARY (20 MINUTES)

Instructions for the facilitator:

- Ask the participants the questions below for discussion in plenary. Allow participants to raise questions and share their opinions
    - Why is the proper selection of the site for OFSP production important (just as for any other crop)?
    - What should we consider when selecting the site for OFSP production?

- Provide important information by giving a talk on site selection for OFSP production while considering what was shared in the presentation.

WHAT IS SITE SELECTION?

- Site selection is the decision-making process of selecting a location where you want to grow your OFSP.
- It is decided based on many variables like the availability of needed resources, fertility of the soil, and soil type, among other factors.

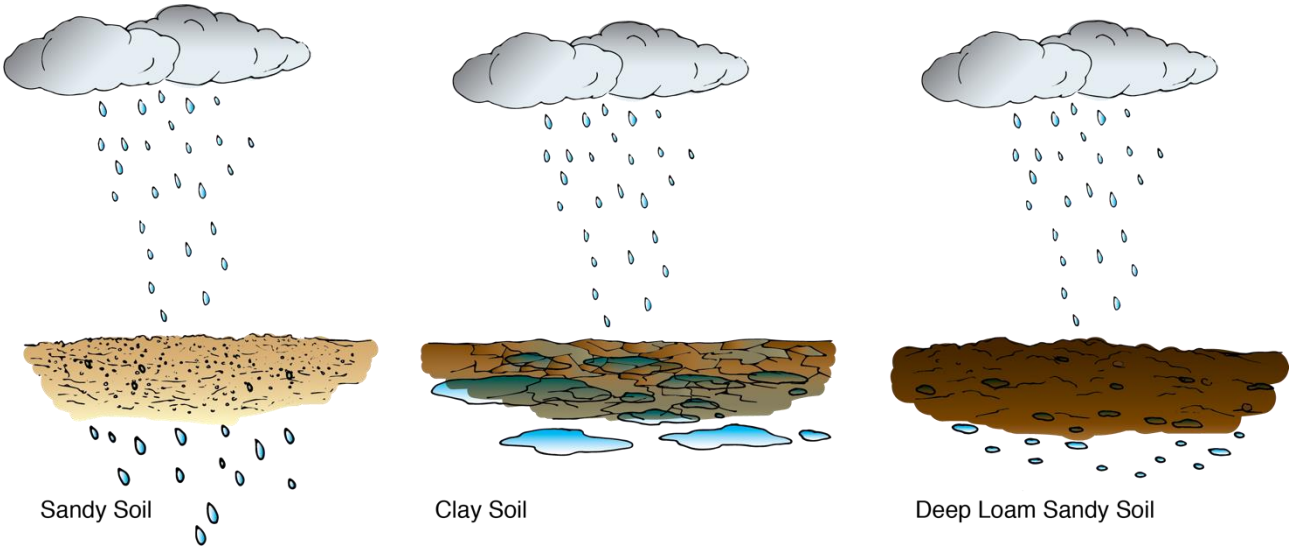


Figure 24: Different soil types

- Where there is adequate land, fields selected to produce OFSP should be located at least 20m away from previous sweet potato fields to avoid the spread of pests and diseases.
- If the farmer has limited land and cannot avoid planting next to the old sweet potato fields, then the farmer should ensure the old sweet potato fields are completely cleared of old roots and vines and fed to livestock well in advance of preparing the land for OFSP production.
- OFSP does best on deep, moderately fertile, sandy loam soils with adequate drainage.
- OFSP should not be grown in stony soils or waterlogged areas such as clay soils.

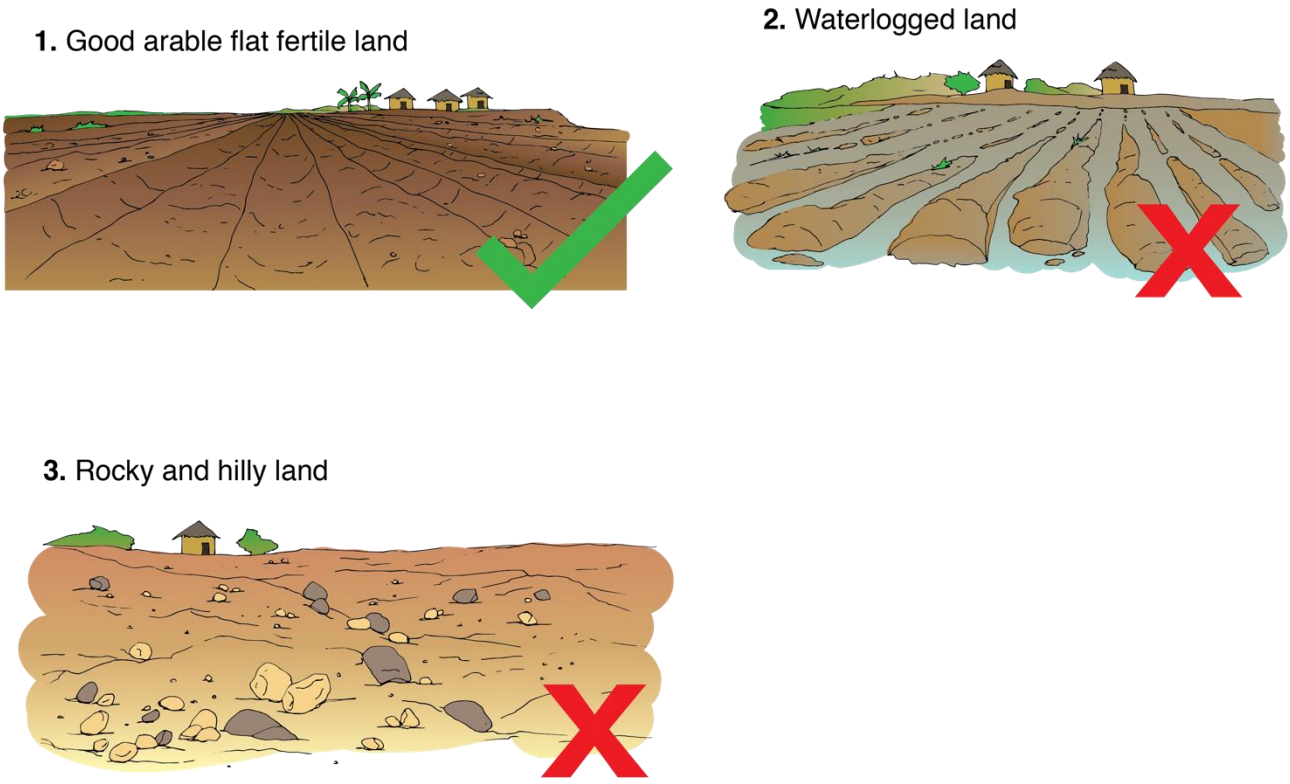


Figure 25: Shows good site and bad site for OFSP production

STEP 3: SUMMARY (10 MINUTES)

Instructions for the facilitator:

- Ask participants to share the highlights of what they have learnt during the lesson and how they will use it.
- Consolidate and summarize the discussion.
- Thank the participants for their participation and end session.

LESSON 11: LAND PREPARATION FOR OFSP PRODUCTION IN THE MAIN FIELD

LEARNING OBJECTIVES

1. To develop the skills of participants in land preparation for sweet potato production.
2. To gain knowledge and understanding of the importance of land preparation.
3. To make sure participants know the factors to consider during land preparation.

TIME

1 hours 50 minutes

TRAINING MATERIALS

- Flip charts
- Markers
- Hand hoes
- Rake
- Shovels
- Pegs (sticks)
- Ropes

STEP 1. INTRODUCTION (10 MINUTES)

Instructions for the facilitator:

- Recap the previous lesson by asking participants to share what they learnt in plenary and mention any key points which may not have been mentioned.
- Explain that during this lesson we shall focus on:
    - Land preparation for sweet potato production.
    - The importance of land preparation.
    - The factors to consider during land preparation.
- Methodology: Discussion and Practical exercise.
- Encourage the participants to share their experiences and expertise openly.

STEP 2: DISCUSSION AND SHARING OF EXPERIENCES ON LAND PREPARATION (30 MINUTES)

Instruction to the facilitator:

- Explain to the participants that first we will have introductory discussions on their experiences with land preparation. After that they will get additional information on the topic and then we will go to the field for a practical exercise.
- Guide the discussion using the following questions below:
    - What are your experiences regarding land preparation for sweet potato production?
    - How do you prepare land for sweet potato production?
    - When do you start preparing the field for OFSP?
- Provide important information by giving a talk on land preparation for OFSP production while considering what was shared in the discussion.

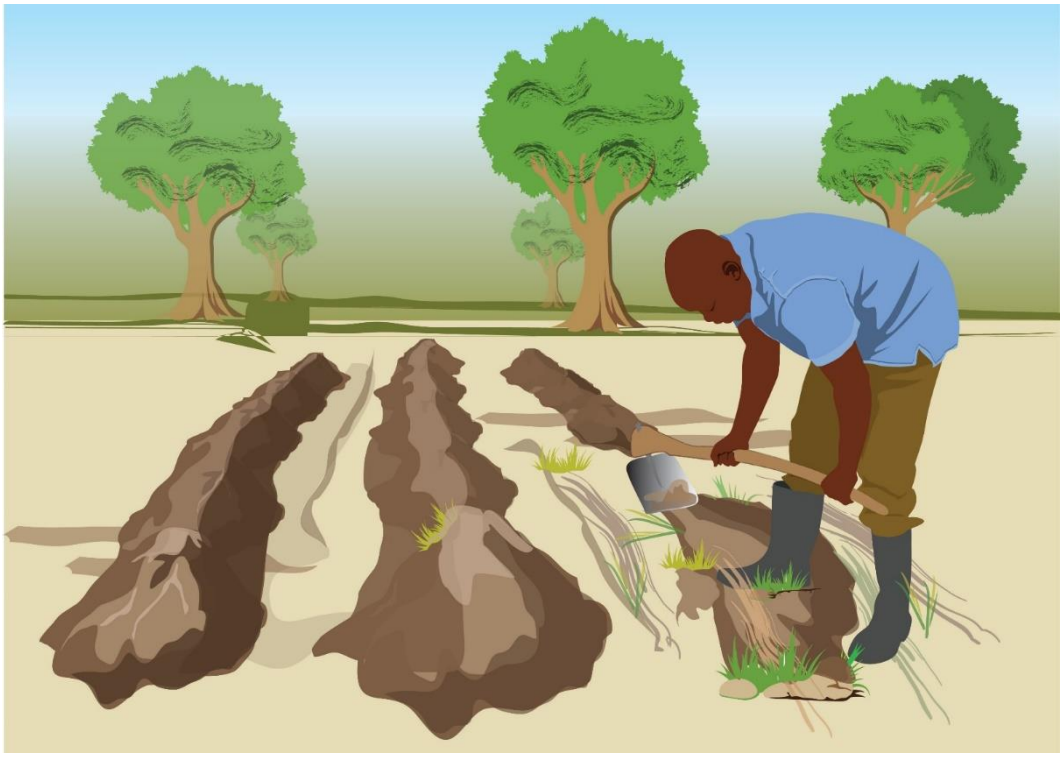
LAND PREPARATION

- Land preparation is done to provide the necessary soil conditions that will enhance the successful establishment of vines. Sweet potatoes are normally planted on ridges to ensure good drainage and make harvesting of the sweet potatoes easier.
- Deep cultivation improves the oxygen supply in the soil, which encourages the growth of soil microorganisms that help in the decomposition of organic matter. In addition, deep cultivation is essential for good storage root growth and expansion in order to realize high yields.
- Land preparation involves making ridges suitable for planting OFSP.

Figure 26: Demonstration on land preparation

- The distance from the crest of one ridge to that of the next one should be 1m, and the average ridge height in well-drained soil should be 0.45m.

- For measurements, you can use a tape to make 1m markings on the ground. You can use pegs and ropes to guide the making of ridges.
- Ensure that annual weeds are buried in the ridges to prevent competition with the young OFSP plants.
- Apart from ridges, farmers can also use hills for production of OFSP. This practice is especially commonly used in the southern part of Zambia.



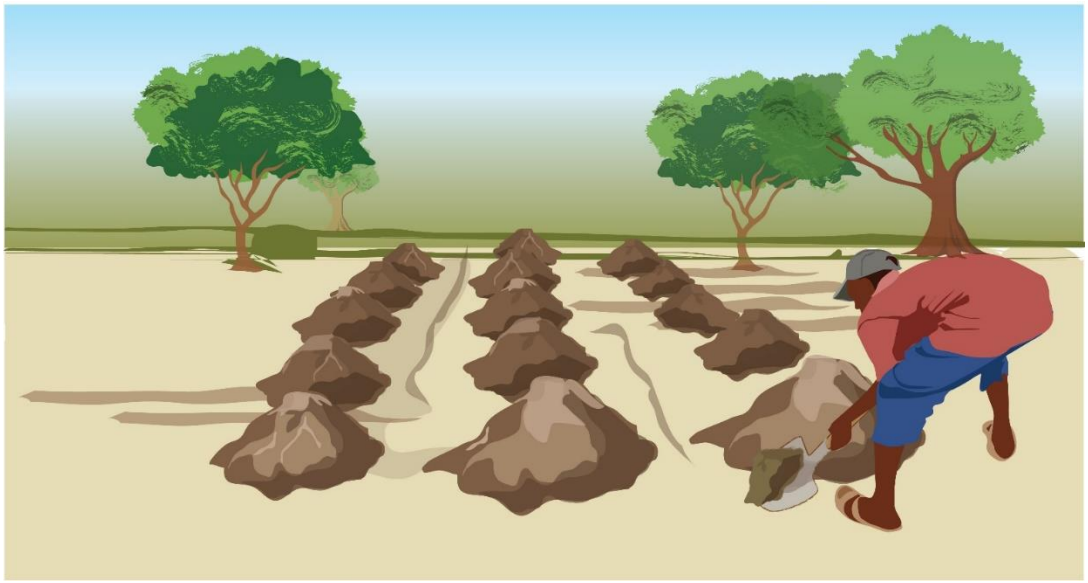


Figure 27: Demonstration of land preparation for mounds/hills

STEP 3. PRACTICAL EXERCISE ON LAND PREPARATION (60 MINUTES)

Instructions for the facilitator:

- Identify the site for land preparation and organize the materials and tools beforehand. Visit the field with participants for the practical exercise.
- Ask for volunteer farmers with experience in land preparation for OFSP to demonstrate how to prepare the land in the field.
- Ask the farmer to explain the demonstration process clearly to the participants.
- Prepare sticks for the measurements of the distances between ridges and for the height. The sticks can be measured using the chitenge material.
- Allow every participant to take part in the demonstration and ask questions.

STEP 4: SUMMARY (10 MINUTES)

Instructions for the facilitator

- Ask participants to share the highlights of what they have learnt during the lesson and how they will use it.
- Consolidate and summarize the discussion.
- Thank the participants for their participation and end session.

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LESSON 12: PLANTING OF OFSP VINES IN THE MAIN FIELD

LEARNING OBJECTIVES

1. To help participants understand suitable planting times for OFSP.
2. To make sure participants gain knowledge needed and understand owhat to look for in vines during vine selection before planting.
3. To demonstrate the spacing of vines when planting.

TIME

2 hours

TRAINING MATERIALS

- Flip chart
- Markers
- OFSP vines
- Small hoe for planting the vines
- Measuring tape/rope

STEP 1. INTRODUCTION (10 MINUTES)

Instructions for the facilitator:

- Recap the previous lesson by asking participants to share what they learnt in plenary and mention any key points which may not have been mentioned.
- Explain that today we shall focus on:
    - Planting OFSP vines for root production
    - Best planting time
    - Considerations when selecting the vines
- Methodology: Group work, presentation and practical exercise
- Encourage participants to share their experiences and expertise openly.

STEP 2: DISCUSSION IN GROUPS ON PLANTING OF OFSP VINES (20 MINUTES)

Instruction for the facilitator

- Divide the participants into small groups of 5-7. Each group should be given the questions below for discussion:
-
    - What is the ideal time for planting sweet potatoes and why?
    - How much space do you leave between vines when planting sweet potatoes?
    - How long do you keep your vines after cutting before planting?

STEP 3: GROUP PRESENTATIONS FROM THE DISCUSSION OF THE ABOVE QUESTIONS IN PLENARY. (40 MINUTES)

Instructions for the facilitator:

- Ask the group representatives to present the points of their discussion on factors to be considered when planting OFSP.
- Allow the participants to ask questions and make contributions to the presentations.
- The facilitator thanks the participants for openly sharing their experiences.
- Summarize the main points from the discussions and inform the participants that you will give them additional recommendations on how the planting of sweet potatoes should ideally be done.

IDEAL TIME FOR PLANTING OFSP

- Planting time is the period during which local conditions such as rainfall and temperature are optimum for normal plant growth.
- OFSP can be planted at any time so long as there is no frost and there is enough moisture in the soil.
- The recommended planting time for sweet potatoes is when there is good rainfall in December or early January.
- However, OFSP can be planted by targeting peak market periods (September to December) so long as there is enough moisture in the soil or an available water source for irrigation.

IMPORTANCE OF EARLY PLANTING

- It is best to plant OFSP early in the rainy season so that it has the entire rainy season to grow.
- Late planting may expose the crop to drought and weevil damage.
- Weevil damage reduces both yield and quality of storage roots especially during dry spells.
- Root yields are significantly lower if planting is done in February or later under rain-fed conditions in agro-ecological regions I & II.

IMPORTANCE OF MONITORING THE WEATHER

- Farmers should take note of the weather and monitor the change patterns so that they plant in timely fashion when the likelihood of having rains is high to avoid loss of planted vines through dehydration (loss of water).

QUANTITY OF PLANTING MATERIAL REQUIRED FOR A LIMA

- Spacing between vines (cuttings) on the ridge should be 25-30cm, and this would result in a total population of 8,333 to 10,000 vine cuttings per Lima.
- It is important to have enough vine bundles by the onset of the rains to achieve a set target.
- A Lima (50m by 50m) requires 83 to 100 bundles (100 vine cuttings per bundle) or five to six 50 kg bags full of vine bundles.
- A vine bundle consists of 100 cuttings measuring between 25cm to 30cm long.

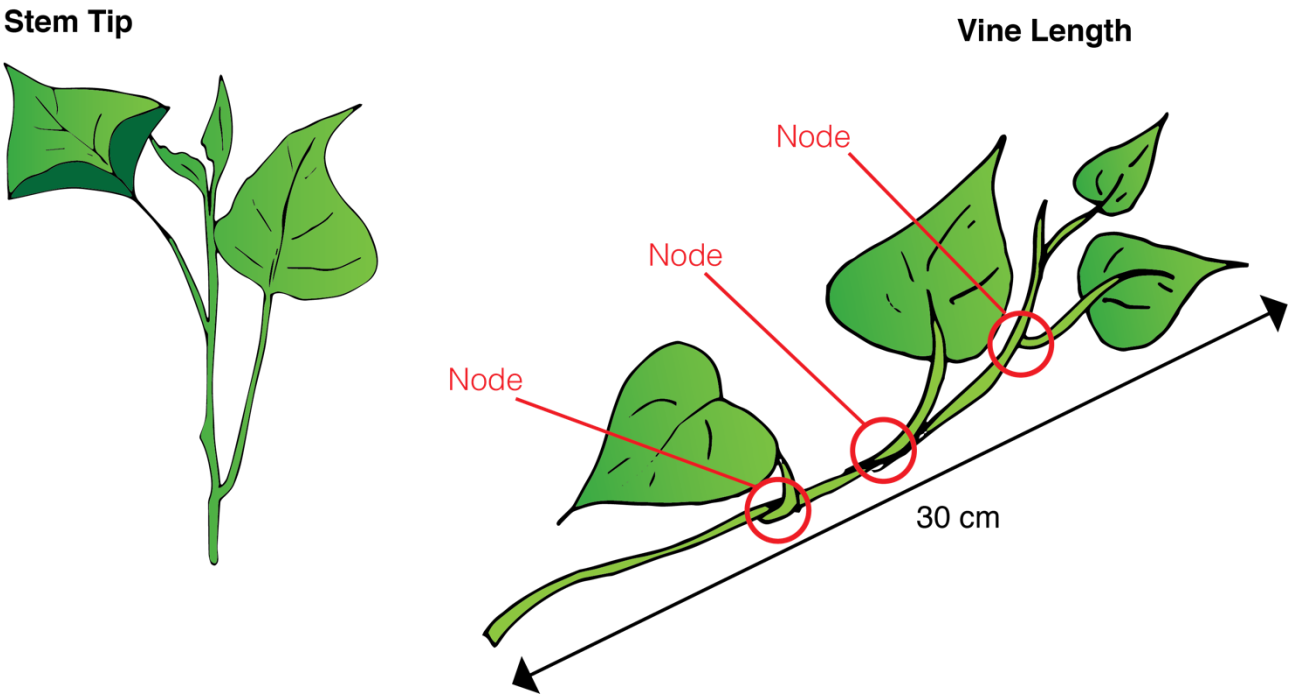


Figure 28: OFSP vine cutting showing three nodes

IMPORTANCE OF PLANTING VINES WITHIN 2-3 DAYS OF CUTTING

- Planting must be done within 2- 3 days after cutting the vines to reduce loss of moisture from the vines. It is therefore important to ensure that the field is ready before the cutting and distribution of vines.
- Vine cuttings can be planted immediately after cutting, or they can be hardened by keeping them in a shady place for 1 to 3 days. During hardening, roots will begin to grow on the cuttings, and the cuttings will become tougher and more resistant to the “shock” of planting.
- Farmers need vines bundles from a clean, healthy, vigorous looking crop, which should be 2 or 3 months old.
- Vine cuttings should be fresh (maximum 2-3 days) and of desired length (20-30cm) and should include at least three nodes.
- About two thirds of the cutting should lie beneath the soil surface when planting.
- The best part of the plant to use for planting is the top part of the vine measuring about 30 cm. This part most easily recovers from cutting and planting “shock”, and it grows faster than the lower parts of the vine. In addition, this top section is more likely to be free of sweet potato weevil and stem borer eggs.

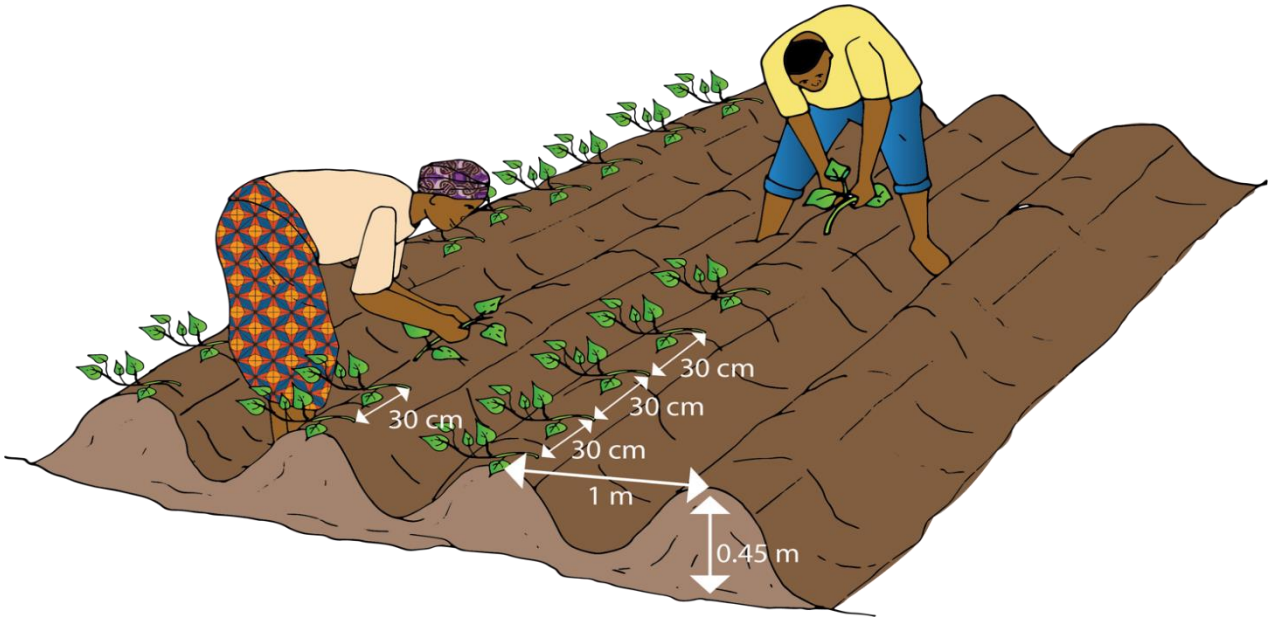


Figure 29: Farmers planting OFSP vines

- The planting operation involves pushing the lower parts of the vine cuttings into the soil, such that they are nearly horizontal.

STAGGERED PLANTING

- Planting can also be staggered with successive plantings made over a period of weeks or months between December and January if conditions are favorable.

- Staggered planting has the following benefits:
    - Promotes availability of more vines to plant during the season.
    - It is possible to plant on a larger total area.
    - The risk of yield loss due to unforeseen dry spells is spread out.
    - There is less likelihood of labour shortage as labour requirement is spread over a longer period.
    - Smoother supply of roots over a prolonged period.
    - **Take note**, however, that planting in February is a risk for commercial root yield as it would be too late.

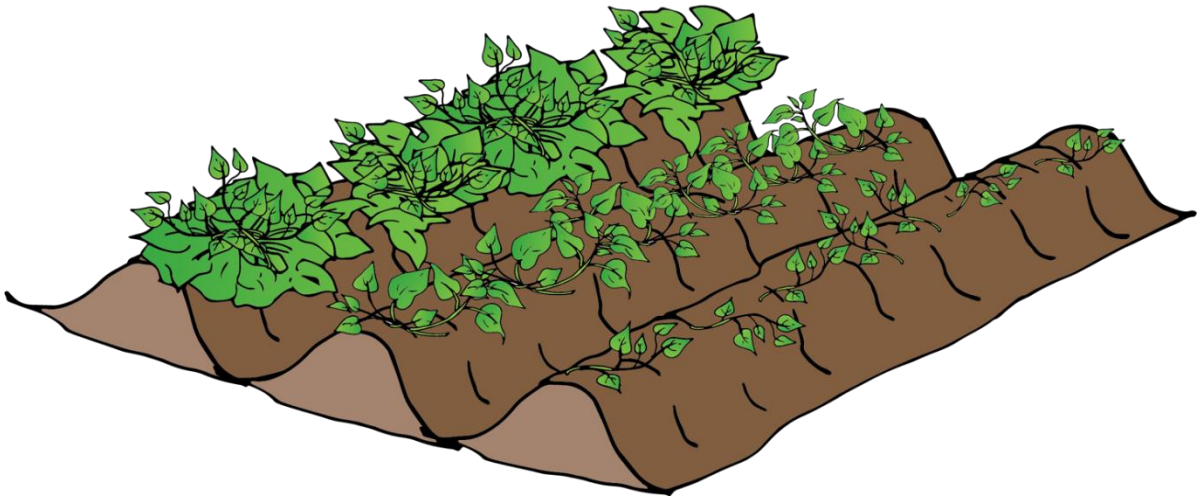


Figure 30: staggered planting

STEP 4: PRACTICAL EXERCISE ON PLANTING OF OFSP VINES (40 MINUTES)

Instructions to the facilitator:

- Identify the site for planting of OFSP vines in field beforehand.
- Ask the participants the following questions while in the field:
    - How are vines cut and hardened?
    - How are vines planted?
- Then ask the participants who have experience of planting OFSP to demonstrate how to plant vines in the field.
- Ask the farmer to explain the demonstration process clearly to the participants.
- Allow every participant to take part in the demonstration.

STEP 5: SUMMARY (10 MINUTES)

Instructions to the facilitator:

- Ask participants to share the highlights of what they have learnt during the lesson and how they will use it.
- Consolidate and summarize the main lesson content.
- Thank the participants for their participation and end session.

LESSON 13: HARVESTING OF OFSP

LEARNING OBJECTIVES

1. To understand and identify the indicators of OFSP maturity.
2. To know the disadvantages of delayed harvesting of OFSP.

TIME

1 hours 20 minutes

TRAINING MATERIALS

- Hoe
- Wheelbarrow
- Sack

STEP 1: INTRODUCTION (10 MINUTES)

Instructions to the facilitator:

- Recap the previous lesson by asking participants to share what they have learnt in plenary and add any key points which may not have been mentioned.
- Explain that today we shall focus on the harvesting of OFSP.
- Methodology: Discussion in pairs and practical exercise.
- Encourage participants to share their experiences and expertise openly.

STEP 2: DISCUSSION ON HARVESTING OF OFSP IN PLENARY (20 MINUTES)

Instruction to the facilitator:

- Ask the participants to get into pairs with their neighbor and discuss the following questions:
    - When is the right time to harvest sweet potatoes?
    - What are the signs of maturity in sweet potatoes?
    - What are the disadvantages of delayed harvesting of OFSP?
    - During and after harvesting, what should we consider in order to avoid damage and easy spoilage of the OFSP?

- Invite up to 5 participants to share points from their discussions and ask other participants to add.
- Allow the participants to ask questions and make contributions to the presentation.
- Provide important information by giving a talk on harvesting of OFSP while considering what was shared in the presentation.

BEST TIME TO HARVEST AND INDICATORS FOR MATURITY OF OFSP

- Sweet potatoes have no specific time of maturity. Sweet potatoes continue to grow if environmental conditions remain favorable.
- The harvest time is determined by the expected root size. This implies that OFSP should be harvested when the bulk of the roots have reached the desired size for consumption or market.
- In some varieties, harvesting can be done within 3-4 months while late maturing varieties may take as long as 6 months. The Olympia variety for instance is ready for harvest by the 5th month with a potential yield of 6,250.00 kg/Lima with good management.
- Normally harvesting of sweet potatoes is done from around April to July depending on the time of planting.
- Indications of maturity include yellowing of leaves, drying of vines, releasing of sap from mature roots and cracking of ridges, though this could also be due to moisture stress or soil related issues.
- Piece meal harvesting is done where bigger roots are removed from the plant while smaller ones are left to continue growing. Piecemeal harvesting means that after harvesting the bigger roots, the remaining smaller ones are planted back in the soil with the vines.

CAUTION DURING HARVESTING OF OFSP

- During harvest, avoid bruising the roots as this would lower their market value by making the roots prone to pathogen infection.
- Harvested roots should be dried for a period of six hours in the shade to allow healing of wounds.

DISADVANTAGES OF DELAYED HARVESTING OF SWEET POTATOES

- Delayed harvesting makes OFSP roots prone to weevil infestation and mole attacks.

STEP 3: PRACTICAL EXERCISE ON HARVESTING OF OFSP (40 MINUTES)

Instructions to the facilitator:

- Identify the field for the practical exercise on harvesting of OFSP beforehand. Make sure all the required materials and equipment are available in advance.
- Identify the participants with experience to demonstrate how to harvest OFSP beforehand.
- While in the field, ask participants who already know how to harvest to demonstrate how harvesting is done.
- Encourage them to clearly explain the steps during the demonstration.
- Allow every participant to take part in the demonstration process.

STEP 4: SUMMARY (10 MINUTES)

Instructions for the facilitator:

- Allow the participants to ask questions for any clarification.
- Ask participants to share the highlights of what they have learnt during the lesson and how they will use it.
- Consolidate and summarize the main content of the lesson.

LESSON 14: PROCESSING AND PRESERVATION OF OFSP

LEARNING OBJECTIVES

1. To know how OFSP can be processed.
2. To demonstrate different methods of processing OFSP.
3. To know and understand how OFSP can be preserved.
4. To gain knowledge on different methods of preservation of OFSP.

TIME

3 hours 50 minutes

TRAINING MATERIALS

- Different sizes of OFSP roots
- Pots
- Plates
- Braziers
- Water
- Knives
- Cooking sticks
- Salt
- Solar dryers/rack
- Rack

STEP 1: INTRODUCTION (10 MINUTES)

Instructions to the facilitator:

- Recap the previous lesson by asking participants to share what they learnt in plenary and add any key points which may not have been mentioned.
- Explain that today we shall focus on the processing and preservation of OFSP.
- Methodology: Discussion in plenary and practical exercise.
- Encourage participants to share their experiences and expertise openly.

STEP 2: DISCUSSION ON PROCESSING OF OFSP IN PLENARY. (30 MINUTES)

Instruction to the facilitator:

- Show the participants the illustrations for processing of OFSP on cards and ask them to explain what they see.
- Ask them the below questions to guide the discussion:
    - How do you process OFSP after harvesting?
    - Which methods of processing do you know?
    - To the participants who don't process, what are the reasons for not processing?

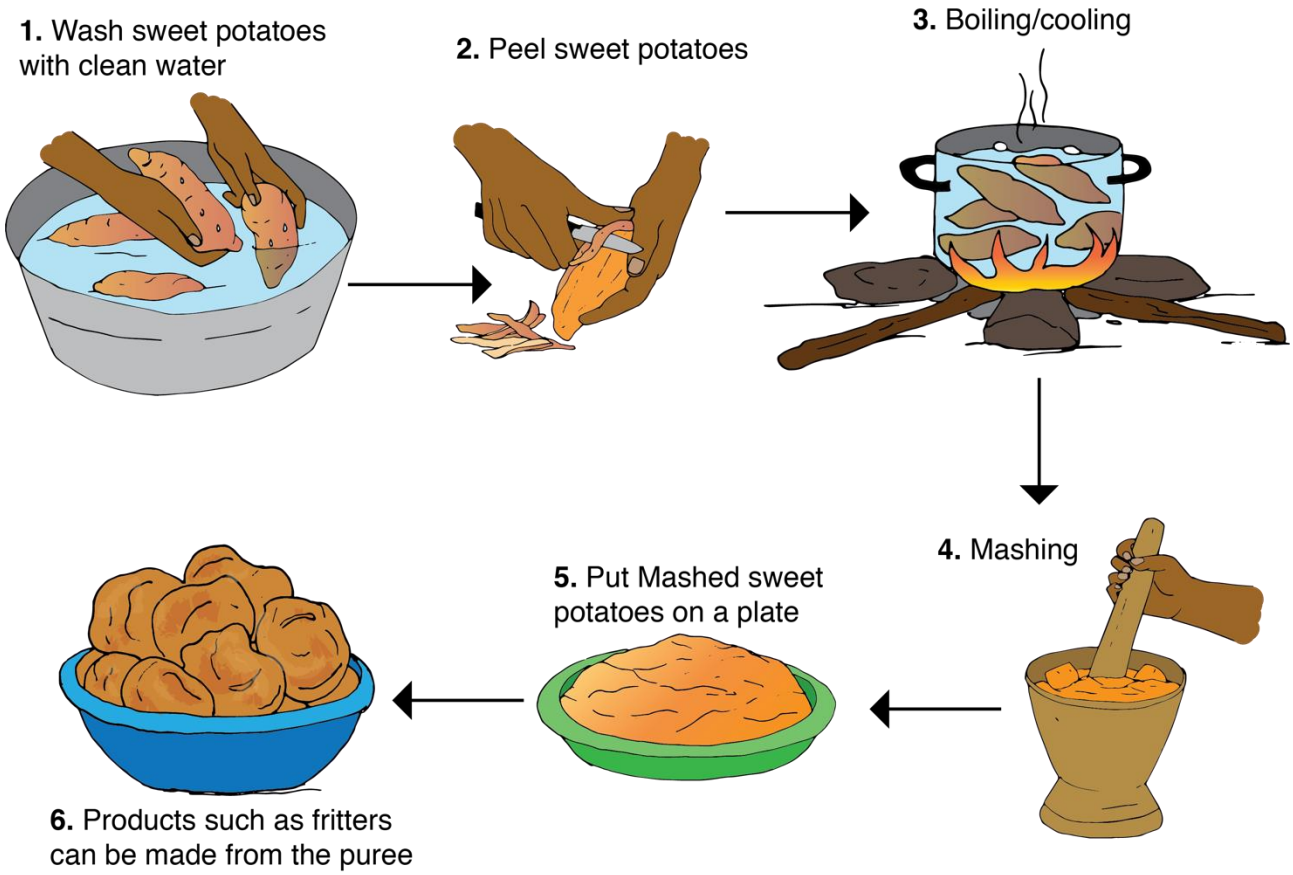


Figure 31: Production of fritters from OFSP puree

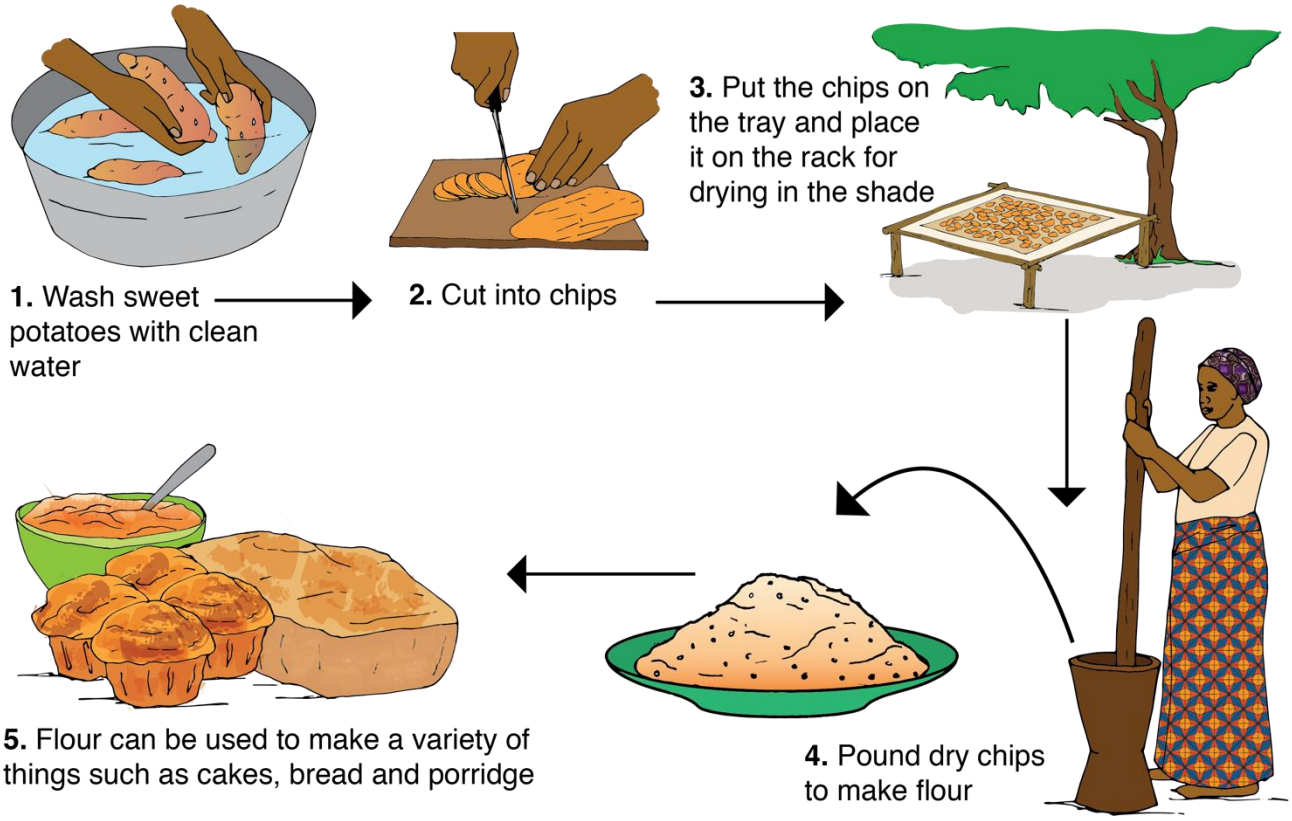


Figure 32: production of flour from OFSP

- Provide important information by giving a talk on processing of OFSP while considering what was shared in the plenary. After the talk, invite participants to ask questions for clarification.

PROCESSING OF OFSP

- This is the process of sorting, grading, cleaning, peeling, cooking and drying of OFSP for immediate or future consumption or for the purpose of adding value to the fresh potatoes for marketing.
- The fresh roots can be boiled or roasted, and then may be further processed by mashing into a puree to use as a source of vitamin A in child feeding.
- In addition, a range of products including breads, chapattis, cakes, juices, porridge, etc., can be made.

STEP 3: DISCUSSION ON PRESERVATION OF OFSP IN PLENARY (30 MINUTES)

Instruction to the facilitator:

- Show the participants the illustrations for preservations of OFSP on cards and ask them to explain what they see.
- Ask them the following questions below to discuss further:
    - Which methods do you know for the preservation of sweet potatoes?
    - What are some of the preservation methods you use for sweet potatoes and why?
    - How do you store the preserved sweet potatoes?

PRESERVATION OF OFSP

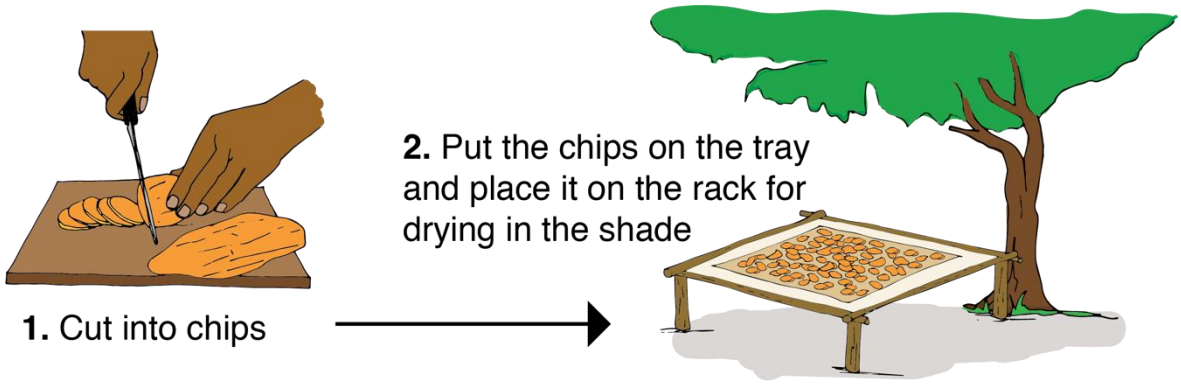


Figure 33: drying of the OFSP chips in the shade

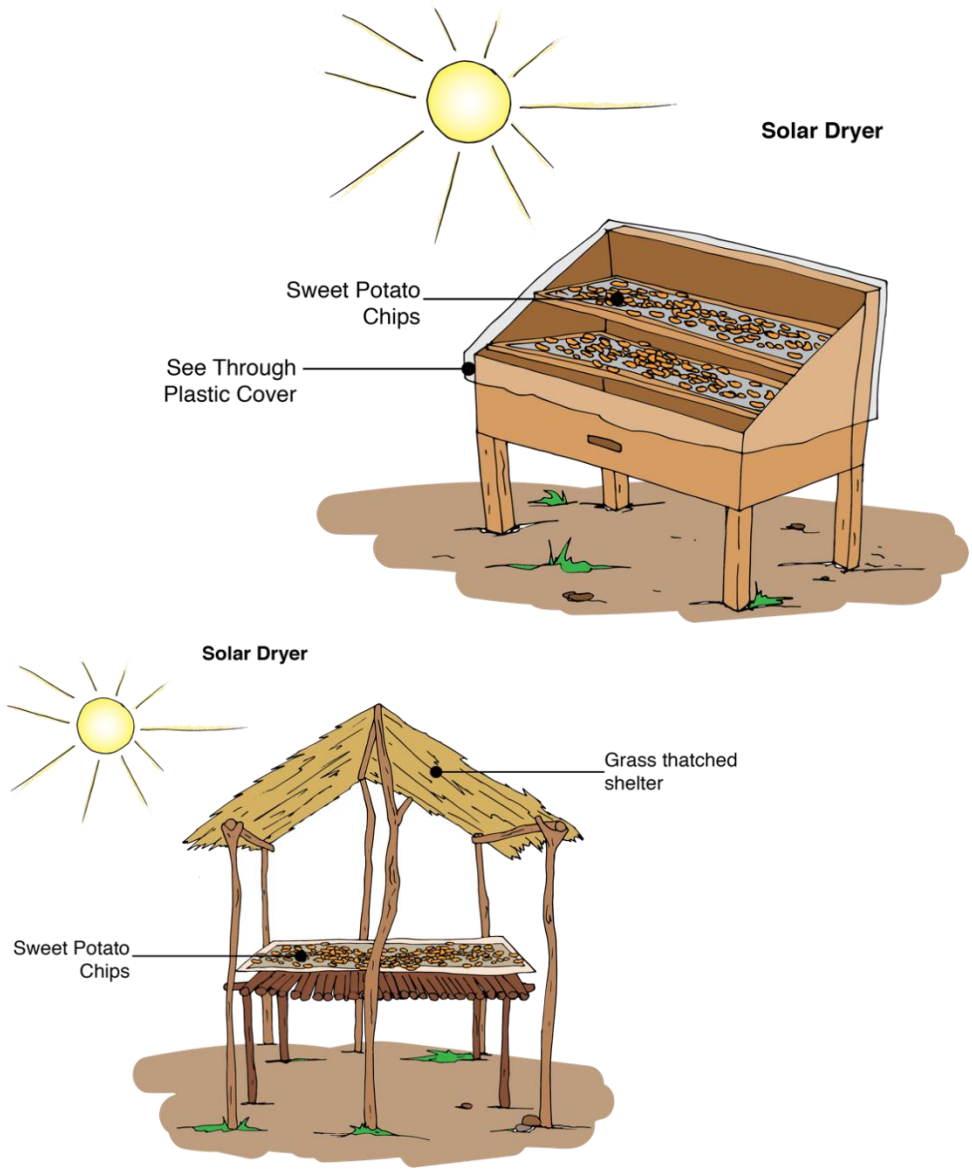


Figure 34: Drying OFSP using a solar dryer and drying under the shade

Instruction to the facilitator:

- Provide information by giving a brief talk to the participants on preservation of OFSP while considering what was shared in the plenary. After the talk, invite participants to ask questions for clarification.
- Preservation is the process of keeping OFSP from decay and spoilage by maintaining the quality until they are consumed or sold.
- The fresh roots can also be cut or pounded into chips or small pieces, dried in shade using a solar dryer, and kept as an important food stock to cook and eat during the year or made into flour, cereal or noodles.

STEP 4: PRACTICAL EXERCISE ON PROCESSING AND PRESERVATION OF OFSP (90 MINUTES)

Instructions to the facilitator:

- Identify the household in which to do the practical exercise on processing and preservation of OFSP beforehand. Make sure all the required materials and equipment are available in advance.
- Identify the participants who can demonstrate the different methods of processing and preservation beforehand.
- Then ask the identified participants to demonstrate the processing and preservation of OFSP. Encourage them to clearly explain the steps during the demonstration.
- Allow every participant to take part in the demonstration process.

STEP 5: SUMMARY (10 MINUTES)

Instruction to the facilitator:

- Ask participants to share what they found most interesting about what they learnt during the lesson and how they will use it.
- Consolidate and summarize the main discussion points.
- Thank the participants for their participation and end session.

LESSON 15: STORAGE OF OFSP

LEARNING OBJECTIVES

1. To know and understand how OFSP can be stored.
2. To gain knowledge on different methods of storage.

TIME

3 hours

TRAINING MATERIALS

- Hoe
- Sweet potato
- Clean dry grass or dry sticks
- Saw dust
- Ashes
- Mat or any metal sheet
- Newspaper
- Wheelbarrow

STEP 1: INTRODUCTION (10 MINUTES)

Instruction to the facilitator:

- Recap the main points from the previous lesson by asking the participant the following question.
    - What do you remember from the previous lesson?
- Explain that today we shall focus on storage of OFSP.
- Methodology: Group work, presentation and practical exercise.
- Encourage participants to share their experiences and expertise openly.

STEP 2: DISCUSSION IN GROUPS ON STORAGE OF OFSP (30 MINUTES)

Instruction to the facilitator:

- Divide the participants into small groups of 5 - 7 and ask them to discuss the questions below on storage.
    - Which methods do you know which are used for storage of sweet potatoes?
    - How do you store sweet potatoes after harvesting and why?
- Ask the group representatives to present the main content of their discussion.

STEP 3. GROUP PRESENTATIONS FROM THE DISCUSSIONS IN PLENARY. (40 MINUTES)

Instructions for the facilitator:

- Ask the group representatives to present the points of their discussion on OFSP storage.
- Allow the participants to ask questions and make contributions to the presentations.
- Provide important information by giving a talk on storage of OFSP while considering what was shared in the plenary.

STORAGE OF OFSP

- If storage is desired after harvesting, the roots should be sorted out to leave only clean and unbruised OFSP. Such roots should be left in the sun to cure naturally for six hours before storage.
- The roots should then be dusted with wood ash and stored in accordance with any of the following procedures:

PIT STORAGE USING ASHES

- Dig a pit of 0.5m x 0.5m. Line the bottom of the pit with clean dry grass or dry sticks. Pack cured and ash-treated roots in the pit up to 15cm from the upper ground level. Cover lightly with dry grass and topsoil.
- Finally, cover with a mat or any metal sheet to keep out rain water, in case of rains.

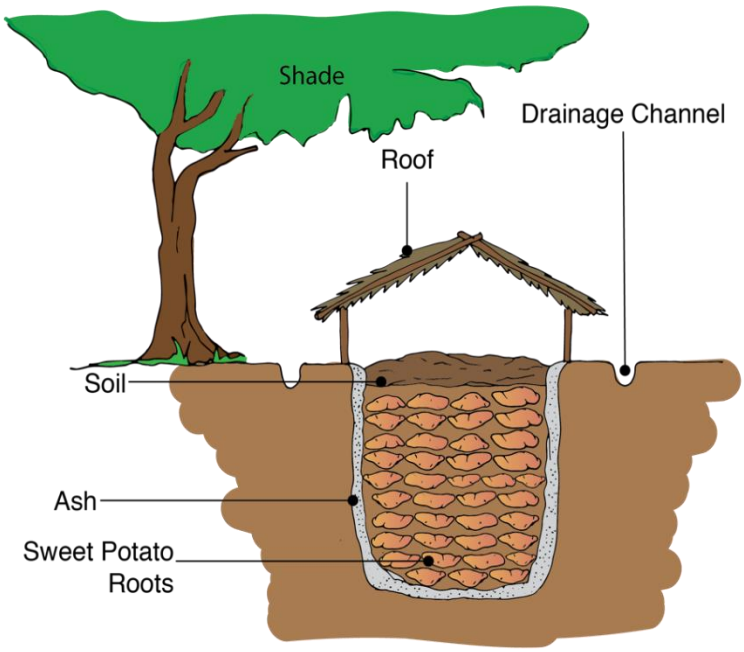


Figure 35: Pit storage of OFSP Roots

PIT STORAGE USING SAW DUST

- Dig a pit of 0.5m x 0.5m. Line the bottom of the pit with sawdust. Place a layer of sawdust of about 5 cm thick at bottom and put the OFSP and cover with about 5 cm of saw dust. Finally, cover with a mat or any metal sheet to keep out rain water, in case of rains.

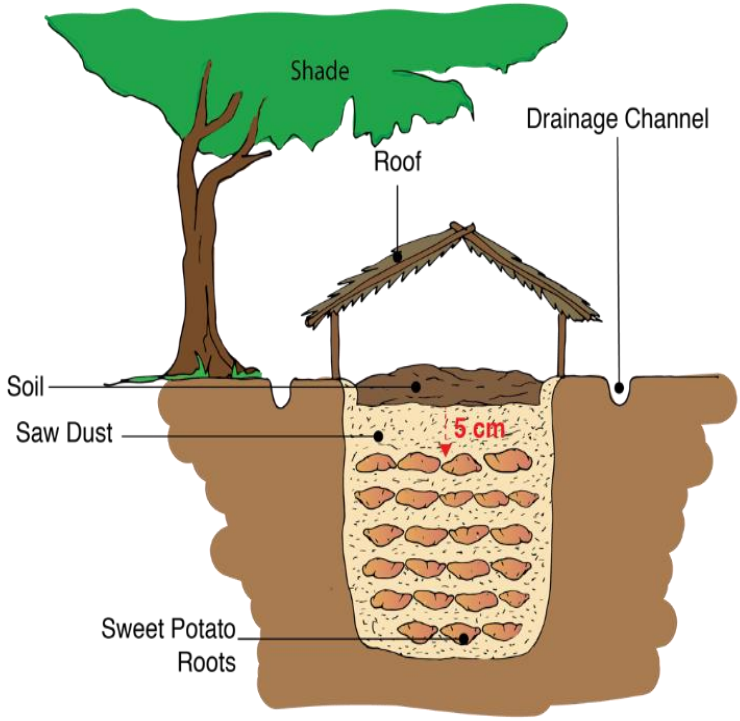


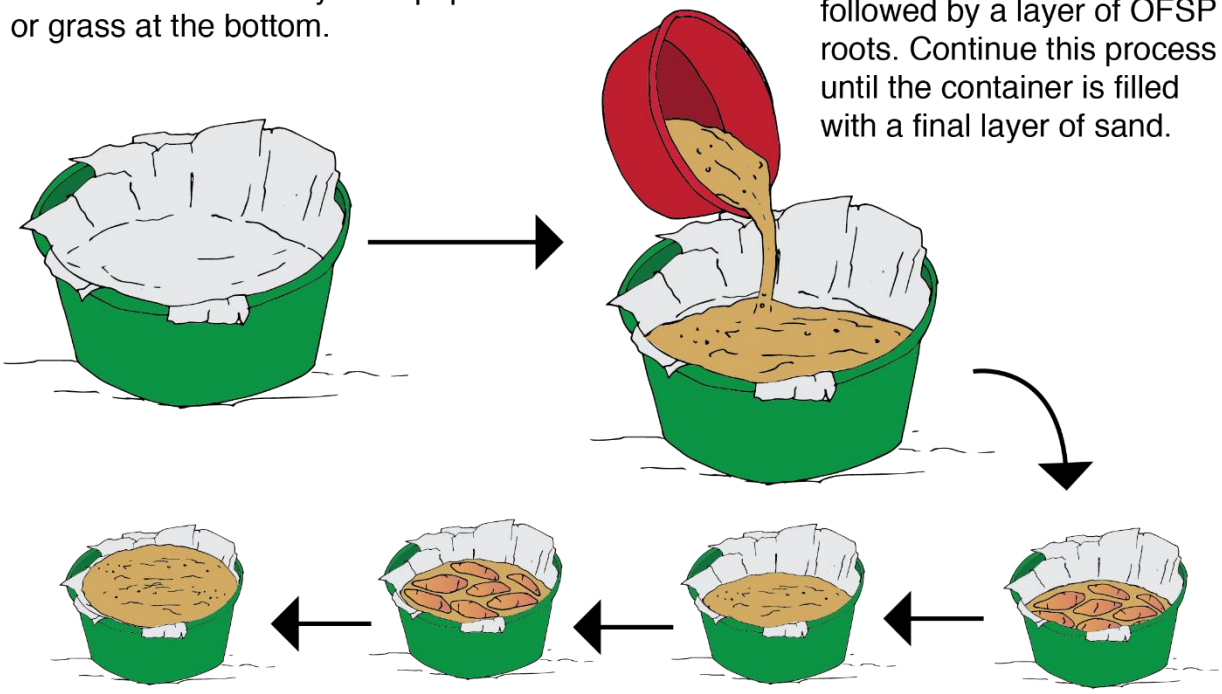
Figure 36: Saw dust heap

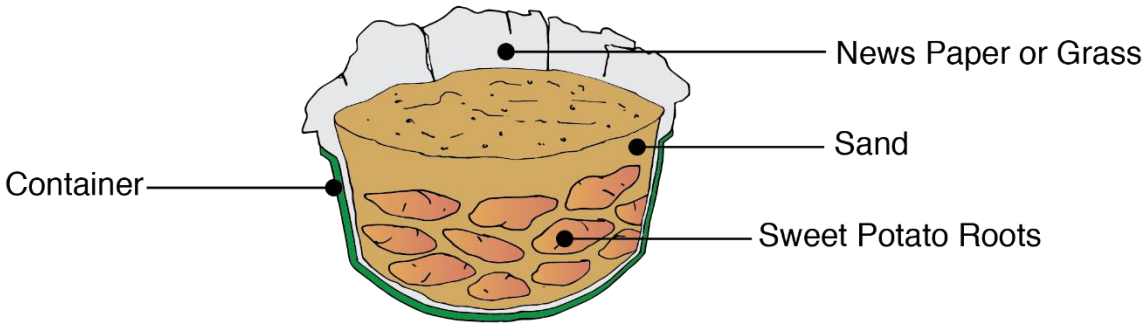
STORAGE IN CONTAINER USING SAND

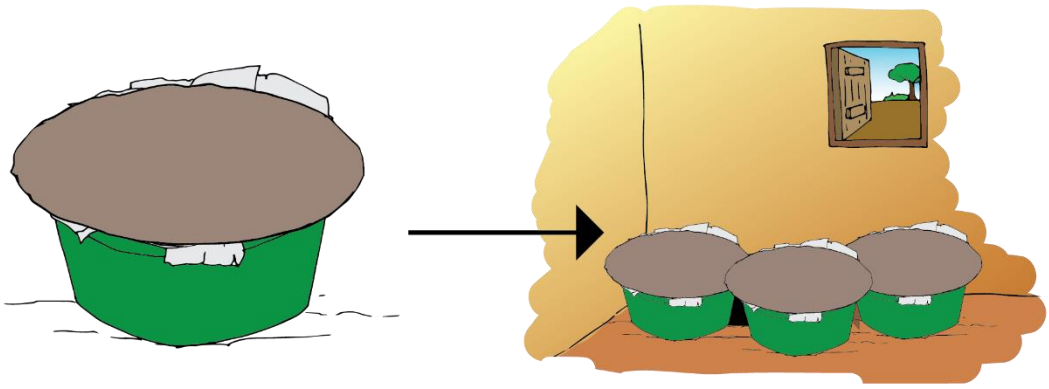
- Get a clean and dry polythene container that can accommodate the quantity of roots available. Line it with either a dry newspaper or grass at the bottom.
- Put a layer of dry sand followed by a layer of OFSP roots. Continue this process until the container is filled with a final layer of sand.
- The container can then be protected from moisture getting to the roots by covering it. The container can then be placed in a cool dry place.

1. Get a clean and dry polythene container that can accommodate the quantity of roots available. Line it with either a dry newspaper or grass at the bottom.

2. Put a layer of sand followed by a layer of OFSP roots. Continue this process until the container is filled with a final layer of sand.







3.The container can then be protected from moisture getting to the roots by covering it. The container can then be placed in a cool dry place.

Figure 37: Storage in sand

STEP 4: PRACTICAL EXERCISE ON STORAGE OF OFSP (90 MINUTES)

Instructions to the facilitator:

- Identify the household in which to do the practical exercise on storage of OFSP beforehand. Make sure all the required materials and equipment are available in advance.
- Identify the participants who can demonstrate the different methods of storage beforehand.
- Then ask the identified participants to demonstrate the storage. Encourage them to clearly explain the steps during the demonstration.
- Allow every participant to take part in the demonstration process.

STEP 5: SUMMARY (10 MINUTES)

Instructions for the facilitator:

- Ask participants to share the highlights of what they have learnt during the lesson and how they will use it.
- Consolidate and summarize the main content of the lesson.
- Thank the participants for their participation and end session.

LITERATURE CONSULTED

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