

CLIMATE CHANGE ADAPTATION

A manual for trainers

**Propagating food
crops in
Papua New Guinea**



Supported by the European Union



Jeffrey Waki and Cyril Kolese Atung

Acknowledgements

NARI gratefully acknowledges the generous support of the people of the European Union in the Action - Strengthening food production capacity and the resilience to drought of vulnerable communities.



Table of Contents

Introduction	1
Session 1 – Types of seed materials and their Propagation	3
Materials and methods.....	3
Session 2: Yam mini-sett and field planting	5
Materials and methods.....	6
Yam Propagation.....	7
Recap of session.....	10
Reference Handouts	10
Session 3: Taro propagation and field planting	11
Materials and methods.....	12
Photos showing taro mini-sett preparation	13
Detailed description of Taro mini-setts	14
Recap of session.....	15
Reference Handout.....	15
Session 4: Banana bit and field planting.....	16
Materials and methods.....	17
Propagation of Bananas.....	17
Recap of session.....	20
Reference	20
Session 5: Cassava mini-stem cutting and field planting	21
Materials and methods.....	21
Cassava Propagation	22
What is a Cassava mini stem?.....	22
Recap of session.....	23
Reference.....	23
Session 6: Sweet potato nodal cutting and field planting.....	24
Sweet potato Propagation	25
Recap of session.....	26
Reference.....	26
Concluding remarks	26



Introduction

Root tuber and banana (RTB) are crops considered as staples in PNG. Apart from banana, root tubers include sweet potato, yam, cassava, taro true and chinese taro. RTBs are normally planted from vines, tubers, stem cuttings, suckers and headsets, which are all collectively referred to as seed stocks. The seeds of next planting season or cycle are usually derived from previous cropping following a single harvest or after series of harvests have been completed.

While this is much appreciated, the continuous practice of collecting planting materials directly from old gardens and re-planting is seen as

important route for transmitting pests and diseases, resulting in cultivar degradation (yield decline) over time. Moreover, this has also limited access to obtaining maximum quality and increased number of planting materials to plant new gardens and also for distribution within and outside the village. The commercial changes also demand the supply of quality and huge volumes of seeds.

Climate change poses great challenge for adaptive agriculture. Drought events like that which was experienced in 1997 and recently in 2015-16 is predicted to continue recurring with high intensity and has caused devastation throughout the PNG country. Such experience requires simple but relevant technologies that are important for safeguarding the wellbeing of vulnerable farming households against climate calamities.

This manual is prepared to expand the knowledge base of Trainers regarding improved seed production techniques. These include rapid field multiplication of quality planting materials of RTBs, particularly, sweet potato, taro, yam and cassava. The overall goal is to build capacity of farmers/trainers to be climate smart and resilient in the face of difficult times.

Preliminaries: Getting to know each other

Farmers have diverse experiences and exposure in practically applying crop farming practices. They attend trainings with diverse farming backgrounds. Farmers may feel timid and uneasy when coming together to participate in trainings. Since any training session normally require full participation from trainees whether in theory or practice it is important that farmers get to know each other before the actual training sessions begin. This put all of them together in a learning environment.

To achieve this goal the following activities can be done:

Please don't start a training without reading -

Training villagers in PNG!

You can download a copy here-

<http://gutpela-png-gaden.net/library/record/view/id/43>

Muntwiler and Askin, 2004. Training villagers in PNG - a manual for trainers.

Remember, training is much more than giving technical information. The Muntwiler and Askin manual will provide lots of useful information to assist the process of your training.



Introduction



Working together

- Ask farmers to introduce themselves.
- Have them give their location and talk about their experiences with their gardens.
- Discuss together how many different crop types do they grow?
- How do they select and prepare materials for planting new gardens?
- What plant parts are normally used for planting?
- When do they normally harvest planting materials for next planting?
- Do they consciously prepare seed beds for raising planting materials?
- Are they concerned about diseases or insect pests that might come with new planting material for their gardens?
- Do they apply minimum cleaning to materials before planting?
- Have any of the participants received training on crop production covering some of the questions posed above?



Farmers will →

- Appreciate the importance of cleaning seed materials.
- Appreciate the purpose of rapid multiplication of planting materials especially when drought happens.



Session 1 Types and Propagation



Session 1 – Types of seed materials and their Propagation

Plant seed refers to the part of a plant that is used to produce the same kind of species in subsequent generation. It can refer to true botanical seed or vegetative parts. e.g. corns seed, taro suckers and cassava cuttings. Without seeds species gradually dye out and become extinct.

	<p>Farmers will →</p> <ul style="list-style-type: none"> • Learn to categorize crops into their different mode of propagation. • Understand the importance of maintaining and planting clean or healthy seed stocks
--	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Materials and methods

Target Participants: Crop farmers, extension service providers, school students, community organizations/institutions

Suggested Number of Participants: A maximum of 30 persons

Duration: 40 minutes.

	<p>Materials required</p> <ul style="list-style-type: none"> • Flip chart and masking tape or whiteboard • marker pens • white board markers • notebooks and pens and hand outs
	<p>Working together</p> <ul style="list-style-type: none"> • Write the title “Crops in your village –how they propagate” on the whiteboard or flip chart. • Engage each participant to do a list of 5 most important crops in their households. • Explain what a seed is, and, its importance. • Allocate the participants in 5 groups and assign them the following tasks:



Session 1 Types and Propagation



Tasks

- Collate individual group member's crop list into one removing the repeating ones.
- Base on their experience, ask the participants to identify the crops by their mode of propagation, as either (a) true-seeded, (b) vegetative (vines, stem, tuber) and (c) both seeded and vegetative.
- Ask the participants to discuss how and when seeds/seed stock are collected and prepared for planting
- Ask the participants to brainstorm on how seed/seeds stock cleaning is done for all or any of the crops before next planting cycle.
- Demonstrate how seeds/seedstock are derived from mother plants (refer to Handouts).
- Demonstrate how seeds/seedstock are cleaned before planting new gardens (Refer to Handouts).

Let the participants raise questions and queries, clarify, and conclude the session



Session 2: Yam mini sett and field planting



Session 2: Yam mini-sett and field planting



Yam is a staple crop in Papua New Guinea with cultural values. Among traditional yams, rotundata (or Africa) yam has been recently introduced and gaining popularity. Yam is cultivated from tubers alone following a brief dormancy period of at least two months.

Yams can be multiplied using a *mini set* technique. A mini-set is a small piece of yam cut from a tuber (mother seed yam) which is prepared specifically for production of planting materials.



Session 2: Yam mini sett and field planting



Farmers will →

- Prepare,
- sprout and field plant yam mini-sets

Materials and methods

Target Participants: Farmers, rural development officers, extension service providers, school students, and community/Faith-based organizations/institutions

Suggested Number of Participants: A maximum of 30 persons

Duration: 15 minutes.

	<h3>Materials required</h3> <ul style="list-style-type: none"> • Yam tuber (at sprouting stage), • wood ash, kitchen knife, • spade, sawdust (or cutgrass), • polythene sheet (optional), • watering can, • dry shed, loam soil (or soil mixture of topsoil, sand and manure), handouts.
	<h3>Thinking together</h3> <ul style="list-style-type: none"> • Lecture, • field demonstration, • discussions
	<h3>Working together</h3> <ul style="list-style-type: none"> • Write on the white board/flip chart or simply say the title “How to do a yam minisett” • Discuss how yams are normally propagated • Explain what yam mini-set is, and its usefulness • Demonstrate how to prepare a yam mini-set • Demonstrate how to sprout a yam mini-set in a nursery bed and a wooden box



Session 2: Yam mini sett and field planting



- Demonstrate how to field plant a sprouted yam mini-set
- Let the participants raise questions and queries, clarify, and conclude the session

Yam Propagation

Yams are vegetatively propagated from tubers and bulbils. Some species have also been able to be produced from vine cuttings. Headsets derived from tubers are predominantly used for planting new gardens following a brief dormancy period of at least two months. Yams are planted into gardens as soon as buds form on the tubers.

No.	Yam Species	Common name	Propagation method
1	<i>Dioscorea alata</i>	Greater yam	Head set
2	<i>Dioscorea nummularia</i>	Pacific yam	Head set
3	<i>Dioscorea esculenta</i>		Head set
4	<i>Dioscorea bulbifera</i>		Head set, bulbils
5	<i>Dioscorea pentaphylla</i>		Head set
6	<i>Dioscorea rotundata</i>	African yam	Head set



Session 2: Yam mini sett and field planting



What is a Yam Mini-sett?

A small piece of yam cut from a tuber (mother seed yam) which is prepared specifically for production of planting materials.

Yam Tuber



Yam Mini-setts



How to Prepare Mini-Sett

Cut a mother seed yam into several cylindrical pieces about thumb size long (5 cm) and remove some tuber flesh. An average mother seed yam can give 20-40 mini-setts.

Mix 4-5 handfuls of ash in one normal household bucket (4 litres) of water to make wood ash solution, or prepare dry wood ash. Place fresh cut mini-setts into baskets or string bags if wood ash solution is used.

Dip the bag containing mini-setts into the wood ash solution while holding the handle of the bags. If using dry wood ash, then treat individual mini-setts separately.

Spread the treated mini-setts under shade for two hours to dry off. Do not place mini-setts in direct sunlight.

Plant mini-setts in well prepared nursery beds or wooden seed boxes (40 cm x 50 cm x 40 cm) with holes at the bottom to allow water drainage as shown below.



Session 2: Yam mini sett and field planting

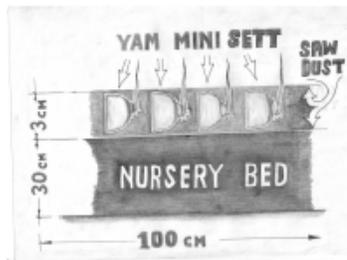


Methods of Sprouting Mini-setts

Sprouting in Nursery Bed

Prepare well drained nursery bed 100 cm wide and 30 cm height as shown in the diagram. Then spread fresh moist sawdust or sandy loam soil 2-3 cm thick. Spread mini-setts on the moist sawdust side-by-side close together as shown in the picture below.

Planting of Yam Mini- setts in the Nursery Bed

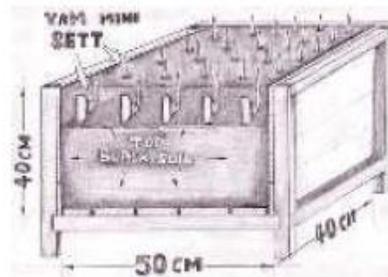


Cover the mini-setts with moist sawdust/soil or mulch. Water regularly to keep the bed moist during dry periods and to provide cover during

rainy days. Mini-setts should sprout within 3-4 weeks.

Mini-setts are ready for transplanting as soon as sprouting occurs but when true leaves are not yet developed.

Sprouting in Boxes



Place moist sawdust/soil in box (2-3 cm thick), then place mini-setts on the sawdust with cut surface side-by-side close together and cover with sawdust/soil and add water.

Water regularly to keep sawdust/soil moist and cover during rainy days.



Session 2: Yam mini sett and field planting



Field Planting

Plough and prepare the field ready for planting. Dig holes of one arms length deep (100 cm) and one spade length wide (30 cm) for clay loam soils, however, a depth of 2 spade lengths (60 cm) can be used in loose or sandy loam soil.

Planting holes should be half an arm length (50 cm) apart (plant spacing). Place a stick at the center of the hole for a guide and fill the holes with compost, mulch and black soil until one spade length (15 cm) below the mouth of the hole. Remove the stick and place sprouted mini-sett on top of the mulch/ compost and soil and with the mini-sett sitting in the center of the hole where the stick was placed. Cover with topsoil then water.

Note:

- *Use Sandy loam soils where sawdust is not available. The soil should be sterilized (cooked) before using.*
- *Use dry grass as mulch to keep soil moist*

Recap of session

The participants are given the opportunity to ask further questions and discuss what has been delivered in the session.

- You, the trainer make sure that women and men share information together.
- Listen carefully to people's experiences – you are learning together.
- The facilitator makes further clarifications and ends the session.

Reference Handouts

- LAL 003(E).Yam Mini-set Information



Session 3: Taro propagation



Session 3: Taro propagation and field planting



Taro is an important staple in the wet-lowland areas of Papua New Guinea. The crop is cultivated vegetatively using head corms, suckers, stolons. Taro can be fast-propagated on the field using mini-set technique. Taro mini-sets are cut pieces of taro corm, or the underground part of taro that has buds or eyes.



Farmers will →

- Be able to prepare,
- sprout and field plant a taro mini-set.



Session 3: Taro propagation



Materials and methods

Target Participants: Farmers, rural development officers, extension service providers, school students, and community/Faith-based organizations/institutions

Suggested Number of Participants: A maximum of 30 persons

Duration: 15 minutes.

	<h3>Materials required</h3> <ul style="list-style-type: none">• Taro corm (mature), wood ash, kitchen knife, spade, sawdust (or cutgrass), polythene sheet (optional),• Watering can, dry shed, loam soil (or soil mixture of topsoil, sand and manure), handouts.
	<h3>Working together</h3> <ul style="list-style-type: none">• Write on the white board/flip chart or simply say the title “How to do a taro miniset”.• Discuss how taros are normally propagated• Explain what taro mini-set is, and its usefulness• Demonstrate how to prepare a taro mini-set• Demonstrate how to sprout a taro mini-set in a nursery bed, a wooden box and polybags• Demonstrate how to field plant a sprouted taro mini-set• Let the participants raise questions and queries, clarify, and conclude the session.



Session 3: Taro propagation



Photos showing taro mini-sett preparation





Session 3: Taro propagation

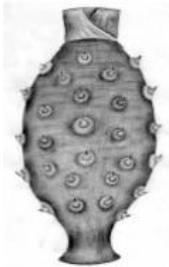


Detailed description of Taro mini-sets

What is taro mini-sett?

Taro mini-sets are cut pieces of taro corm, or the under ground part of taro that has buds or eyes.

Taro Corm



Taro Mini-sett



Preparation of Taro Mini-sets as Planting Material

To prepare taro mini-sett, uproot mature taro plant and remove the top, and gently clean the corm.

Cut the corm into pieces containing buds or eyes.



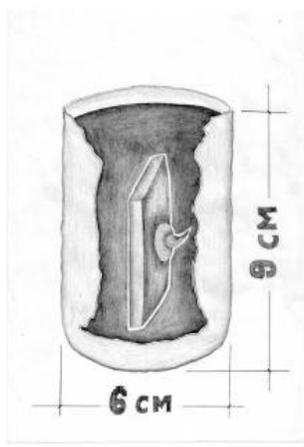
Treat the cut sides of each mini-sett with wood ash and place the treated sides facing upwards under shade to dry over night before potting.

Soil Preparation for Planting of Mini-sets (in polythene bag)

Collect black topsoil and fill up polythene bag (size 6 cm x 9 cm) with soil as shown in the diagram.

Place each mini-sett in a polythene bag with

the bud facing in an upright position, then cover with soil and water as shown in the diagram below.



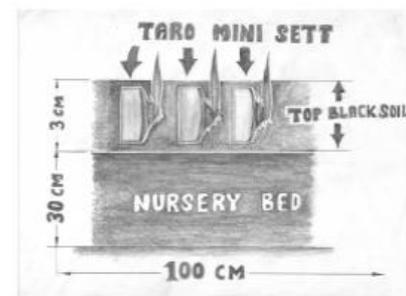
Mini-sett Planted in Polythene bag

Water the planted mini-sets three times a week and ensure the soil stays moist.

Soil Preparation for Planting of Mini-sets in Nursery Beds

Prepare a well drained nursery bed 100 cm long and 30 cm high.

Make furrows and place taro mini-sets side by side close together as shown in the picture below.



Cover the mini-sets with topsoil and water.



Session 3: Taro propagation



Water the planted mini-setts three times a week to keep the soil moist. Mini-sett should be ready for planting after three to four weeks.

Note:

The advantage of taro mini-sett technique is that a lot of taro planting materials can be produced at one time. One medium size taro corm (20 cm x 6 cm) can easily produce 6-8 mini-setts.

Recap of session

The participants are given the opportunity to ask further questions and discuss what has been delivered in the session. The facilitator makes further clarifications and ends the session.

Reference Handout

- LAL 002(E). Taro Mini-sett Information
- Bub026. NARI TOKTOK: Best Practice Note for Taro Farmers



Session 4: Banana propagation



Session 4: Banana bit and field planting



Banana is the second most important staple crop in PNG. Propagation is done by suckers. Bananas can be rapidly multiplied in the field using the banana bit techniques. Banana bits are pieces of corm, or the underground part that has roots and buds or eyes.



Farmers will

Be able to prepare,
sprout and field plant banana bits.

Know that diseases are causing problems in PNG. Farmers must be careful when they move bananas from one place to another.



Session 4: Banana propagation



Materials and methods

Target Participants: Farmers, rural development officers, extension service providers, school students, and community/Faith-based organizations/institutions

Suggested Number of Participants: A maximum of 30 persons

Duration: 15 minutes.

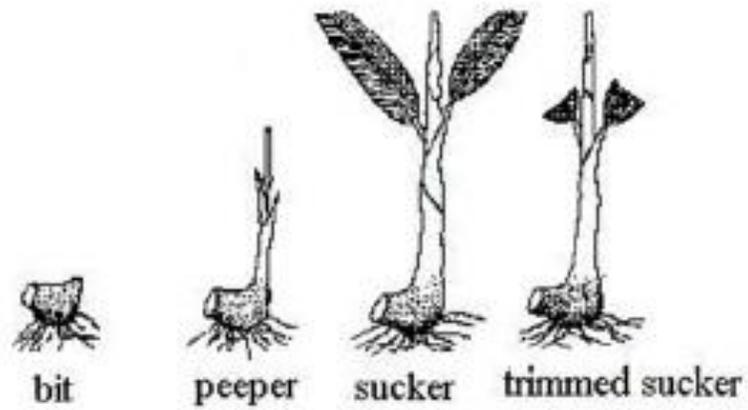
	<h3>Materials required</h3> <ul style="list-style-type: none"> • Corm of fully grown banana plant (just before flowering), • wood ash, kitchen knife, spade, sawdust (or cutgrass), • polythene sheet (optional), • Watering can, dry shed, loam soil (or soil mixture of topsoil, sand and manure), handouts.
	<h3>Working together</h3> <ul style="list-style-type: none"> • Write on the white board/flip chart or simply say the title “How to do a banana bit”. • Discuss how bananas are normally propagated • Explain what banana bit is and its usefulness • Demonstrate how to prepare a banana bit • Demonstrate how to sprout a banana bit in a nursery bed, a wooden box and polybags • Demonstrate how to field plant a sprouted banana bit • Let the participants raise questions and queries, clarify, and conclude the session

Propagation of Bananas

Bananas are vegetatively propagated from suckers. These seed/planting materials are produced from underground stem which are normally referred to as corm. The corms carry mature eyes or buds which initially grow out as rhizomes, emerge as peeper and then suckers (offshoot of parent plant/corm). Sword suckers have better growth potential as compared to broad leaf and water suckers.



Session 4: Banana propagation



Suckers at different vegetative stages and the distinct sucker types



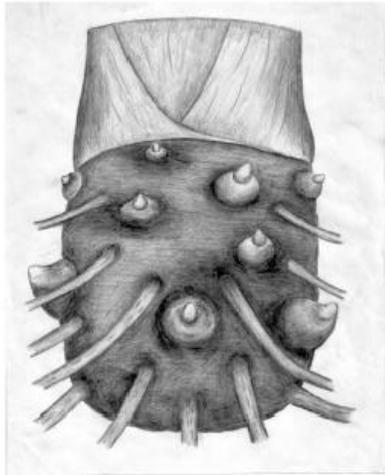
Session 4: Banana propagation



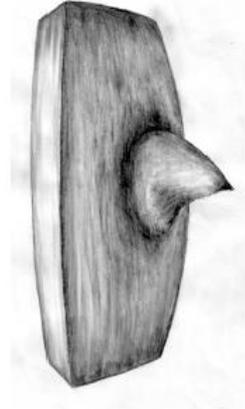
What are Banana Bits?

Banana bits are pieces of corm, or the underground part that has roots and buds or eyes.

Banana Corm



Banana Bit



Selection of Banana Corms

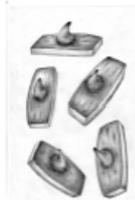
Select a plant close to flowering or one that has recently bunched at 8th months or more after planting. The corm from a harvested mother plant can also be used, however this may not provide sufficient banana bits.

Preparation of bits for Planting Material

To prepare bits, cut and remove the banana stem and uproot the corm from the ground.

Gently clean the corm and remove leaf sheaths to expose emerging buds or eyes.

Cut the corm into bits containing the selected buds or eyes.



Trim the bits into a uniform shape and peel the outer layer of skin a few centimeters away from the bud to remove unwanted buds. Avoid

narrow shaped bits that have buds close to the cut surface or at the bottom. The bud should be at the center of the bit.

Store the bits in a cool place and plant within a week of preparation.

Planting Method

Dig holes one spade length deep and one spade length wide (30 cm x 30 cm).

Apply one medium Besta tin (48 grams) of chicken manure in the hole and thoroughly mix it with soil.

Place banana bit into the hole at an angle (45°), with the cut surface facing upwards and the bud facing the soil.

Plant the banana bits into small holes and cover with moist soil.



Session 4: Banana propagation



Two important considerations

Ensure the soil is moist by watering at least twice a week.

Ensure the soil is free from weeds.

Note:

Banana shoots should emerge within 3 weeks from planting. Bits failing to emerge should be replaced immediately.

One average size corm can produce 6-8 bits each of which will grow into a banana plant

Banana bit technique is the fastest way of multiplying planting materials when big quantities are needed.

Recap of session

The participants are given the opportunity to ask further questions and discuss what has been delivered in the session. The facilitator makes further clarifications and ends the session.

Reference

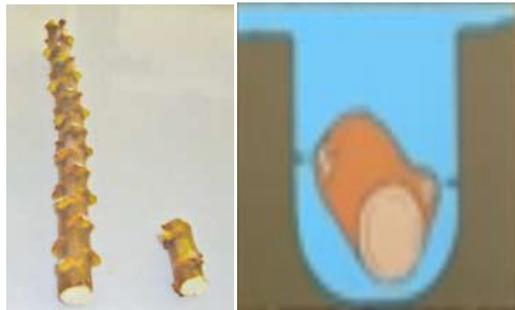
LAL 001 E - Banana Bit Information.



Session 5: Cassava propagation



Session 5: Cassava mini-stem cutting and field planting



Cassava is normally propagated from stem cuttings. A 90 cm long single stem with 80–100 intact nodes will normally produce 3 plants, each 30 cm long with the conventional method. The rate of getting new planting materials is very low with this approach. Planting materials can be rapidly multiplied using a mini-stem technique. The mini-stem technique uses small stem pieces, which means that a single cassava stem will yield more planting material than the conventional method. For example, 90 cm stem will produce 40-50 two-node cuttings or 20-25 four-node cuttings with the mini-stem technique.



Farmers will →

- Participants will be able to prepare,
- sprout and field plant cassava mini-stem cuttings

Materials and methods

Target Participants: Farmers, rural development officers, extension service providers, school students, community/Faith-based organizations/institutions

Suggested Number of Participants: A maximum of 30 persons

Duration: 15 minutes.



Session 5: Cassava propagation



	<h3>Materials required</h3>
	<ul style="list-style-type: none">• Stem of mature cassava plant, secateur or hand saw, spade, sawdust (or cutgrass), polythene sheet (optional),• watering can, loam soil (or soil mixture of topsoil, sand and manure), handouts. <h3>Making cassava mini stems</h3> <ul style="list-style-type: none">• Discuss how cassava is normally propagated• Explain what cassava mini stem is, and its usefulness.• Demonstrate how to prepare and sprout a cassava mini stem in a nursery bed and unperforated polythene bags (clear)• Demonstrate how to field plant a sprouted cassava mini stem• Let the participants raise questions and queries, clarify, and conclude the session.

Cassava Propagation

Cassava is normally propagated from stem cuttings. A 90 cm long single stem with 80–100 intact nodes will normally produce 3 plants, each 30 cm long with the conventional method. The rate of getting new planting materials is very low with this approach. Planting materials can be rapidly multiplied using a mini-stem technique. The mini-stem technique uses small stem pieces, which means that a single cassava stem will yield more planting material than the conventional method. For example, 90 cm stem will produce 40-50 two-node cuttings or 20-25 four-node cuttings with the mini-stem technique.

What is a Cassava mini stem?

Cassava mini-stem is a small stem piece having 2-4 nodes which is primarily used to produce more planting materials.

Preparation of mini-stem and sprouting of mini-stem



1. Select healthy cassava stems. (Left). too young (Mid). woody/old. (Right). softwood/right stage



2. Cut as many 2-4 node stem pieces or mini-stems including the shoot (10-15cm long)



Session 5: Cassava propagation



 <p>3. Sterilize the mini-stems in 10 % bleach (for 5 minutes and briefly rinse in clean water. And further decontaminate in insecticide solution (ratio 1ml insecticide into 1 litre water)</p>	 <p>4. (a) Sprout the mini-stem in well drained nursery bed 200 cm long and 15-20 cm high. Make furrows and place cassava mini-setts side at 10cm x 10cm spacing</p>
	<p>5. Gently uproot the mini-stems and transplant into field</p>
<p>4. (b) Sprout the mini-stem in a clear polythene (plastic). The shoots will form between 2-4 weeks.</p>	

Recap of session

The participants are given the opportunity to ask further questions and discuss what has been delivered in the session. The facilitator makes further clarifications and ends the session.

Reference

Commercial Cassava Production: Technical Bulletin. Issue 5/ 2011. www.cardi.org



Session 6: Sweet potato propagation



Session 6: Sweet potato nodal cutting and field planting



New sweet potato plants are normally raised from vine cuttings and tuber sprouts. They serve as initial materials to start the process of multiplication in nursery.



Farmers will →

- Be able to prepare,
- sprout and field plant a sweet potato tuber and vine cuttings

Materials and methods

Target Participants: Crop farmers, extension service providers, school students, community organizations/institutions

Suggested Number of Participants: A maximum of 30 persons

Duration: 15 minutes



Session 6: Sweet potato propagation



	<h3>Materials required</h3> <ul style="list-style-type: none">• Sweet potato vines,• Sweet potato tubers• Kitchen knife, spade, polythene sheet• Watering can, mulch (grass cut), loam soil (or soil mixture of topsoil, Sand and manure), handouts
	<h3>Working together</h3> <ul style="list-style-type: none">• Write on the white board/flip chart or simply say the title “How to do sweet potato nodal and tuber propagation”.• Discuss how sweet potato is normally propagated• Explain what sweet potato nodal and tuber propagation is, and its usefulness• Demonstrate how to prepare a sweet potato nodal cutting and tuber• Demonstrate how to sprout a sweet potato nodal cutting and tuber in a nursery bed and polythene nursery bags (black)• Demonstrate when to harvest and field plant sprouted sweet potato vines <p>Let the participants raise questions and queries, clarify, and conclude the session</p>

Sweet potato Propagation

Tuber sprouting and multiplication

- Select a mature tuber
- Wash and rinse in water
- Sterilize in 10% bleach solution and final rinse in water
- Place into polypot, nursery bag or nurser bed away from direct sunlight
- Mulch with grass or dry leaves.
- Water twice daily to sprouting. It may take 2-4weeks to sprout and continue produce vines.
- Vines can be plucked out and planted into field or further multiplied in the nursery.



Session 6: Sweet potato propagation



Vine sprouting and multiplication

- Select healthy looking vines from the field or from sprouted tubers. The vine should continue producing flag leaves.
- Cut a piece using a pair of scissors or sharp knife into 2-node without detaching the leaves. Shoot tip should be reserved with a fully opened leaf.
- Sterilise the cuttings in 10% bleach for 2-3 minutes and rinse in water.
- Plant into prepared bed or nursery trays with a node into the soil.
- Water twice daily to sprouting. It may take 2-4weeks to sprout and continue produce vines.

Recap of session

The participants are given the opportunity to ask further questions and discuss what has been delivered in the session. The facilitator makes further clarifications and ends the session.

Reference

Concluding remarks

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....