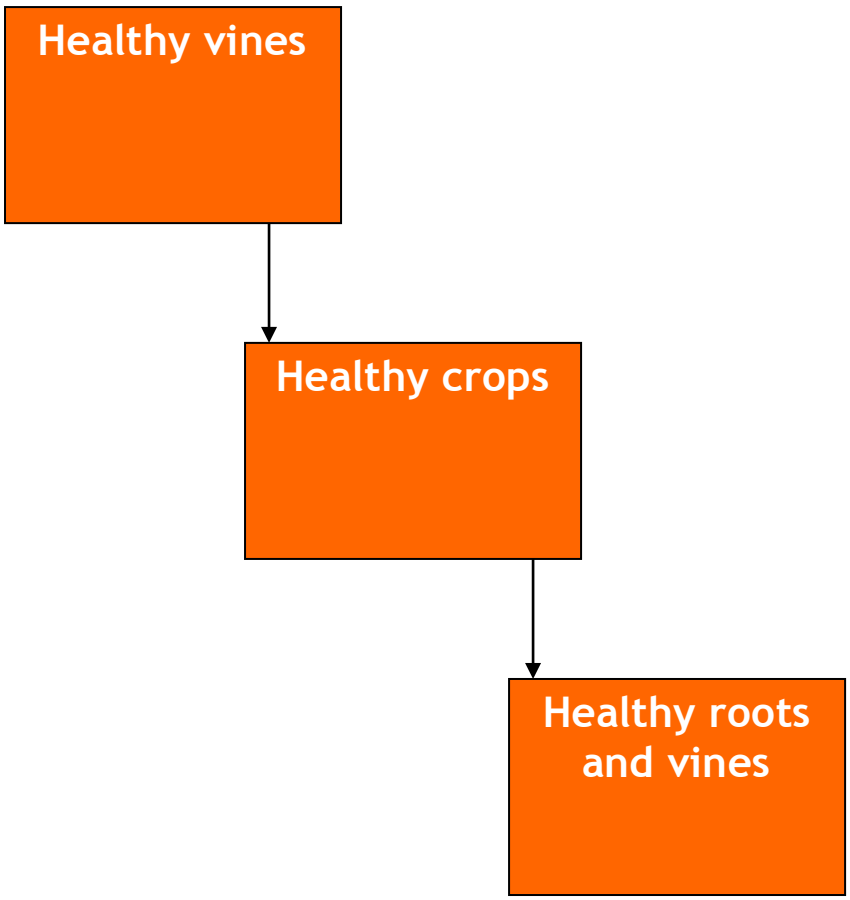
Sweetpotato Seed Systems

A Farmer Trainers' Guide



SWEET POTATO SEED STSTEMS: A Farmer Trainers' Guide

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CONTENTS

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PART ONE: INTRODUCTION

1.0 Background about sweetpotato

Botanically sweetpotato or Spanish potato is called *Ipomoea batatas* (L.) Lam, belongs to the morning glory family (*Convolvulaceae*) and originated from Latin America. Sweetpotato ranks as the world's seventh most important food crop, after wheat, rice, maize, potato, barley and cassava. More than 133 million tonnes are produced globally per year. Uganda is the main sweetpotato-growing country in Africa (Anon. 2002), with production of over 2.7 million tonnes, mostly for human consumption and the second leading producer after China at 117 metric tonnes globally (FAO 2003). Historically, sweetpotato has been a lifesaving disaster crop, for example the Japanese have used it when typhoons demolished their rice fields, it kept millions from starvation in famine-plagued China in the early 1960sand in Uganda, when a virus ravaged cassava crops in the 1990s, rural communities depended on sweetpotato to keep hunger at bay. Sweetpotato is high in carbohydrates and vitamin A and can produce more edible energy per hectare per day than wheat, rice or cassava. It has an abundance of uses, ranging from consumption of fresh roots or leaves to processing into animal feed, starch, flour, candy and alcohol. The crop can be grown in poor soils with little fertilizer and has hardy nature and broad adaptability.

Although Uganda is the second largest producer of sweetpotato after China, farmers still realize low yields, averaging only 4,500 kg per hectare (1800 kg per acre) compared to 30,000 kg per hectare (12,000 kg per acre) obtained on research stations. The wide yield gap is due to a number of reasons, including a) use of local varieties with low yield potential, b) pests and diseases, c) shortage of planting materials, d) non-availability of improved varieties, and e) poor crop husbandry practices such as poor seed bed preparation, low or high plant population, late planting, late weeding and poor soil fertility management.

1.1 Objectives of this manual

The driving goal of the Reaching End-User Vitamin A Sweetpotato project is improving the livelihood of poor people through sustainably enhanced production and productivity. Thus the broad objective is to promote strategies that result in increased returns from sweetpotato enterprise through improved field crop performance and timely availability of clean planting material to primary producers. The specific aims include updating and enhancing the abilities of field personnel with improved production techniques, which will eventually be translated into improved production and increased consumption, and stimulate widespread dissemination through popular demand for introduced varieties.

This manual has been designed specifically to train farmer trainers and subsequently farmers promoting and/or participating in improved sweetpotato storage root production, vine multiplication and conservation. As simple, applicable and relevant technology, the manual contains the latest recommended practices, taking into account local practices. For example, in Bukedea, using roots to produce vines is not new to the farmers because they have been depending on the sprouts that emerge either from root escapees of the previous season's crop or from roots intentionally left in the ground or by planting a later crop prior to the dry season to generate sprouts as soon as the rains begin. Thus, the critical issue is how farmers can improve on their practices by referring to the recommended practices. In a participatory manner the trainees should recognise and appreciate that there is a need to adopt the introduced skills to perfect their own. In some instances farmers will need to be convinced to drop their practices such as collecting vines that show symptoms of sweetpotato viral infections because they are normally ignorant of the mechanisms through which the disease is spread and end up sourcing infected vines especially when the choice is limited. Appropriate comparative samples of what is clean and diseased and references on the effect should be provided.

1.2 Scope of training content

The curriculum and learning activities follow the phenology of the crop using simple tools that can be used by the trainees. The layout of the guide starts by highlighting the importance of sweetpotato in Africa with particular reference to Uganda as the leading producer in sub-Saharan Africa in comparison to China. This gives a special consideration for beneficiaries to fill that they are dealing with a crop that is not minor as thought but has a recognised position in the farming systems besides being their own.

The second chapter is a collection of basic quick reference technical material that the trainers will need as they facilitate the **topic**s incorporated in the manual. The third chapter presents session guides for the season-long learning curriculum so that the trainers can conduct planning, exercises and demonstrations where applicable, and copies of the monitoring forms. Whereas the primary intent was to compile a specific technical information pack for vine multipliers, the root-production approach proved inseparable because farmers sometimes grow the crop as a multi-purpose crop for production of vines and roots and roots are also a source of vines. Also at inception the project distributed vines to farmers to produce roots for consumption and to ensure success in basic root-production techniques. The fourth chapter provides information on extra-curriculum activities that are aimed at stimulating and enhancing participants' activeness and conveying messages in alternative channels including plays, songs, story telling and drama.

1.3 How the instructional manual was developed

- The primary draft on vine multiplication was developed on the basis of the reference Farmer Field School manuals which also emphasised the intensive approach.
- The draft was used as a guide for training sessions that were needed to enable field activity implementation and to start a series of pre-tests and explorations of technical issues needed for inclusion in the final documents. The comments from the extensionists, promoters and the entire technical team were very useful.
- Corrections were made and then circulated for further review and consultations were made on particular techniques such as application of fertiliser.
- Selected findings from experimental and monitoring activities were considered.
- Practical exercises were embedded in the training for confidence building through hands-on activities.
- Demonstrations were conducted for crucial field practices such as method of planting and identification of clean planting material.
- Pre-training tests were developed for extensionists to understand and determine the technical level attained and desired for the field experts.

Session curtain raiser

Session 1: Getting to know each other and subject orientation (30 minutes)

The objective is to create an interactive learning environment and understand the learning objectives.

Method: Self introductions and completion of circulated attendance form. Each participant is then provided with a piece of paper or card to write down their individual expectations of the meeting. These are collected and read or displayed by the facilitator while collating/grouping similar answers, summarising (as in tables below) and clarifying and sorting out those that lead to the theme of the training session.

Exercise 1: Example 1: What is your expectation during this workshop?

Table 1: Summary of the participants' expectations

No.	Expectation	Frequency	Comment
1			
2			
3			
4			
5			

Example 2: What is the major problem associated with sweetpotato production in your area?

Table 2: Summary of understanding the problems affecting sweetpotato?

No.	Problem	Rank	Potential solution	Rank
1				
2				
3				
4				
5				

For example:

PART TWO: SWEETPOTATO PRODUCTION

Session 2: Importance of sweetpotato - facts about sweetpotato (10 minutes)

The objective of this session is to enable the participants to recognise the important role of the crop worldwide and especially to individual households.

- Botanically sweetpotato or Spanish potato is called *Ipomoea batatas* (L.) Lam and belongs to the morning glory family (*Convolvulaceae*) and originated from Latin America.
- Because of its versatility and adaptability, sweetpotato ranks as the world's seventh most important food crop—after wheat, rice, maize, potato, barley and cassava. More than 133 million tonnes are produced globally per year. Asia is the world's largest sweetpotato-producing region, with 125 million tonnes of annual production. China—at 117 million tonnes—accounts for 90 percent of worldwide sweetpotato production followed by Uganda at 2.7 million tonnes. Nearly half of the sweetpotato produced in Asia is used for animal feed; the remainder is primarily used for human consumption, either as fresh or processed products.
- In contrast, although African farmers produce only about 7 million tonnes of sweetpotato annually, most of the crop is cultivated for human consumption. African yields are quite low—about a third of Asian yields because differences in crop management —indicating huge potential for future growth.
- Historically, sweetpotato has been a lifesaving disaster crop, for example the Japanese have used it when typhoons demolished their rice fields, it kept millions from starvation in famine-plagued China in the early 1960sand in Uganda, when a virus ravaged cassava crops in the 1990s, rural communities depended on sweetpotato to keep hunger at bay.
- Nutrition. Sweetpotato is high in carbohydrates and vitamin A and can produce more edible energy per hectare per day than wheat, rice or cassava. It has an abundance of uses, ranging from consumption of fresh roots or leaves to processing into animal feed, starch, flour, candy and alcohol. The crop can be grown in poor soils with little fertilizer and has hardy nature and broad adaptability.

Sweetpotato is widely consumed in almost all the communities in Uganda and is increasingly becoming an income-generating crop in areas such as the Teso region. However, farmers still realize low sweetpotato yields, which average only 4,500 kg per hectare (1800 kg per acre) compared to 30,000 kg per hectare (12,000 kg per acre) obtained on research stations. The wide yield gap is due to the following reasons including a) use of local varieties with low yield potential b) pests and diseases c) shortage of planting materials d) non-availability of improved varieties and e) poor crop husbandry practices such as poor seed bed preparation, low or high plant population, late planting, late weeding and poor soil fertility management.

Session 3: Development of an area-specific sweetpotato annual calendar

The objective of this session is for participants to generate an annual sequence of farm activities as a basic guide for planning an activity schedule for sweetpotato. It should help to answer the question of "when" different activities should be done and provide a guide for implementing the various intervention activities.

Method: Participants to be divided into sub-groups to develop the sweetpotato calendar by filling in the table below and a common activity scheme will be drawn during the plenary session. This information will provide a guide for designing this season's activities.

Exercise 2: Development of sweetpotato activity annual production calendar

Table 3: Sweetpotato calendar

Month	Activity	Remarks
January		
February		
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		

Exercise 3: Discussion of the developed annual calendar and its implications to activity work plan for sweetpotato

Session 4: Sweetpotato pre-planting activities

The aim is to enable the participants appreciate the importance of timely field preparations and plantingand factors affecting vine quality

a) Selection and preparation of sites

Fields should not be located next to the previous or recent sweetpotato gardens to minimise pests and disease cross infection. Sweetpotato requires well drained, easy to work soils. The crop can be grown in any soil, but sandy loams give the best yields. Avoid growing the crop in stony soils or water-logged areas such as clay soils.

ii) In a proper crop rotation, sweetpotato can follow either cereals such as maize, sorghum, rice, finger millet or legumes such as beans, cow peas, soyabeans and sesame (simsim). Sweetpotato should never follow root (cassava, yams) or tuber (S*olanum* potato) crops, because these have almost similar nutrient requirements.

iii) Land preparation is done using either a hand-hoe or plough. It aims at turning over the topsoil and, in the process, plant residues are incorporated into the soil. Prepare the field well in advance (at least 2 weeks) before planting sweetpotato, to allow enough time for plant residues to rot and release nutrients as food for the crops. Deep cultivation improves the oxygen supply in the soil, which favours the growth of bacteria that help in decomposing the organic matter. It also ensures that annual weeds are buried so that they do not compete with the young sweetpotato planting material. In addition, the compacted parts that have been trampled by humans, animals and tractors become loose again, thus increasing aeration and water infiltration and good drainage. Furthermore, deep cultivation is essential for good storage root growth and expansion to realise higher yields. Dig diversion waterways and plough along the contours to minimise soil water wash off.

iii) Monitor the weather to plant when rains are expected, to avoid loss of planted vines through desiccation. Avoid late season planting because it results into reduced root yield.

iv) Divide the field into portions based on the quantities for the different varieties and plant single variety plots

b) Sourcing and selection of vines

Select your planting material from a clean, healthy, vigorous-looking crop, which should be 2 or 3 months old. Vine cuttings from such a crop produce a vigorous crop and better yield, whereas vines cut from an old crop (4–6 months) produce a less vigorous crop and poor yield. This is because as the crop approaches maturity, food stored in stems (vines) is channelled to the enlarging storage roots.

The best planting material is the stem (vine) tip - the top 30 cm of the vine, when planting material is abundant. This part most easily recovers from cutting and planting "shock" and it grows faster than the lower parts of the vine. In addition, the tip is more likely to be free of sweetpotato weevil and stem borer eggs. The middle parts of the vine may also be used if there is a shortage of planting material. Avoid, as much as possible, the basal (lower) parts of the vine as these may have eggs, larvae or adult weevils inside.

Before picking the vines, verify the source or confirm that the vines selected are healthy by looking to see that the vines are:

- free from both pest and disease infestation by checking for obvious symptoms including eggs, larvae and even adult pests, dark spots on the foliage, folded, curled or shrivelled leaves.
- still fresh and of desired vine length (20–30cm)
- and also the field suitably and readily prepared before cutting the vines to ensure planting within 2–3 days after cutting to avoid deterioration

c) Vine storage

Planting of sweetpotato vine cuttings is preferably done as soon as possible, after they are selected and cut. However, this may not always be possible, for instance, when it is too hot, when the field is not yet ready, labour for planting may be scarce. Cuttings can be kept for a maximum of 7 days before losing condition, leading to a large reduction in storage root yield. Storing vine cuttings for 1–3 days does not affect the final yield. To preserve the food reserves in the stem, most of the leaves on the cuttings should be removed, leaving only a few leaves at the tip. Then the cuttings are tied in small bundles with their bases covered with a wet cloth or sack. The bundles are kept in a cool and shady place.

During the storage period, roots may develop at the base of the cuttings. This is called "pre-sprouting." The cuttings should then be carefully planted with the roots. Storing the vine cuttings hardens them, that is, they become tougher and more resistant to the "shock" of planting. Establishment is faster when vine cuttings are pre-sprouted. However, there is no yield advantage from this practice.

Exercise 4: Desired attributes for quality of planting material (20 minutes)

Sets of bundles of vine with different quality parameters are presented for description

Photo 1: Trainers' confidence building exercise on vine quality definitions

Session 5: Planting activities (20 minutes)

Participants to conceptualise the importance of recommended planting techniques as compared to the existing practices

a) Methods of planting

Sweetpotato is grown on mounds and ridges of varying sizes, but rarely on the flat. The mound type of seedbed is the most common, whereas ridges are used in hilly or sloping areas to control soil erosion. A mound should be 100 cm (3 ft) wide and 60 cm (2 ft) high; the distance between mounds should be 1 m (3 ft). Ridges should also be 100 cm (3 ft) apart and 60 cm (2 ft) wide. Although the difference in yield between ridge and mound seedbed is small, research has been demonstrated that ridges give much higher income than mounds, simply because making ridges requires less labour. Ploughing using oxen or tractor is also possible when ridges are chosen. However, mounds are better in flat areas that are infested with mole root rats.

b) Planting time, methods and plant population

Avoid planting late in the growing season as this exposes the crop to drought and weevil damage. Weevil damage reduces both yield and quality of storage roots especially during dry spells. Planting on mounds is the commonest method used by most farmers in Uganda. Other methods include planting on ridges and flats.

c) Placement of vines in the soil

The planting operation involves pushing the lower parts of the vine cuttings into the soil so that they are nearly horizontal. About 20 cm (8 inches) or two thirds of the cutting should lie beneath the soil surface.

d) Plant population

When mounds are used, three vine cuttings are planted singly in a triangular pattern below the tip of each mound, giving a plant population of about 33,300 plants per ha (or 13,500 plants per acre). If planting is on ridges, single vine cuttings spaced 30 cm (1 ft) apart, are planted in one row along the ridge top, giving the same plant population as mounds.

Exercise 5: Field demonstration on methods of planting and vine placement (30 minutes)

Each variety should be planted as a single stand even if on the same field for easy management including weeding. The sub-plots should be separated by 1-meter alleys/walkways as in the table below. After planting each variety/sub-plot should be labelled with date of planting and name of variety indicated.

Table 4: Field planting plan

Kabode (Blue)		Vita (Red)
Kakamega (White)		Ejumula (Green)

Plant three vines per hill spread singly on the sides of each hill about 1 x 1 m as shown below on the left.

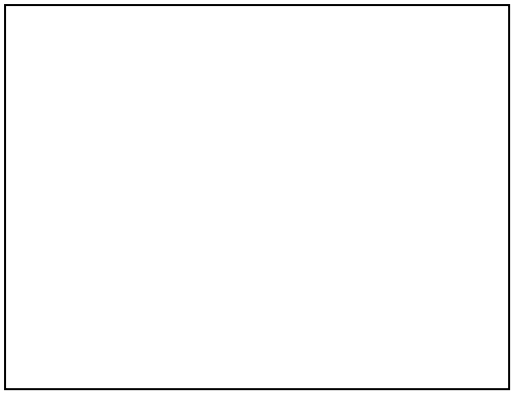


Photo 2: Planting on mounds

Plant single vines at the spacing of 30 cm between plants on a ridge of 1m wide

(A demonstration on planting on ridges may be necessary)

Session 6: After planting field activities (20 minutes)

This session should help participants to appreciate the importance of different agronomic practices and relate observed symptoms to crop performance

Session 6.1: Field agronomic practices (10 minutes)

Rouging and gap filling

Rouging is the removal of plants that have disease especially sweetpotato virus disease (SPVD) symptoms and gap filling is re-planting in spots where the planted vines have died within the first 2 weeks after planting.

Weeding

Weeds are unwanted plants that compete with the crop for nutrients, light, water and growing space, and provide refuge for insect pests. Selectively eliminate the unwanted plants. Those that are useful can be cut back if they are too vigorous, including those that easily die. They can be left in the field as mulch or used as fodder. Weeding should be accomplished before the sweetpotato vines cover the soil.

Hand weeding is done twice when the seedbed has been well prepared - the first time around 3 weeks after planting and the second time at 6 weeks after planting. Late weeding encourages serious competition between crop and weeds for sunlight, nutrients and water; this leads to low yield.

Herbicides such as Roundup (glyphosphate) can provide easy and effective control of most of the problem weeds encountered in sweetpotato fields. A good practice is to dig planting ridges or mounds 2–3 weeks prior to planting then spray any weeds that emerge before planting. The vines of sweetpotato grow slowly at first and it is essential to make sure the land is weed free until the crop is well established and growing strongly.

Session 6.2: Pest and disease control (45 minutes)

Infestation by pest is a major limiting factor in then successful production of sweetpotato (Talekar 1988) and integrated crop management techniques are not only effective but also economical in disease control (Namanda *et al*. 2003).

Session 6.2.1: Meaning of integrated pest and disease management

The concept of integrated pest management (IPM) refers to applying a combination of control approaches used to reduce pest or disease damage to tolerable levels and not aiming at complete elimination. The techniques include use of cultural farm practices such proper agronomic practices, planting tolerant varieties, environmental modifications and appropriate or minimal chemical pesticides. The choice of control components depends on the key pest or disease to control, which part of the plant is attacked, the kind of loss caused and control measures available.

Session 6.2.2: Description and management of major pests attacking the stems and storage roots

a) Sweetpotato weevils (SPW)

Development cycle:

- Adult lays eggs at the base of the plant which hatch into larvae within 3–7 days
- Larvae pupate in the tunnels within 11–33 days
- Adults emerge within 3–28 days
- On average egg to adult development takes 32 days

Description:
- Larvae (most destructive stage) are white, legless, curved, delicate and stay within the roots
- The small and brownish or black and large SPW are more common than those with a bluish black abdomen and reddish brown thorax

Mode of destruction
- Larvae tunnel into the vines and storage roots causing significant damage by depositing frass, resulting in roots producing toxic substances that render them inedible
- Larvae also feed inside the vines causing malformation, thickening and cracking of affected vines
- Adults feed on the vines and stems and external surface of storage roots causing feeding punctures

b) Clearwing moth

Development cycle:
- Adult moth lays butches of yellowish eggs on vines and leaf stalks which hatch into larvae after a few days
- Larvae bore into the vines and tunnel downwards towards the vine base where pupation takes place just above the ground level

Description:
- Larvae can reach 2.5 cm long, whitish, with a hyaline patch on their backs, with a brown head capsule
- Wings spread outwards at acute angle to bodyline posing like a wasp

Mode of destruction:
- Larvae burrow into the hard part of stem base causing swelling at soil level and easy breakage
- Larvae can tunnel through the vine into the storage root (usually only the root tip is affected)
- Feeding on the vines and stems and external surface of storage roots causes feeding punctures
- Vines swell at soil level and easily break off

c) Sweetpotato bug

Development cycle:
- Adult bug lays eggs on the underside of leaves or on the stem which hatch into gregarious nymphs after about 15 days. Both the eggs and young nymphs are guarded by the mother bug.
- The nymphs develop into adults in 85–88 days

Description:
- Nymphs are gregarious
- Adult is 2 cm long

Mode of destruction
- Nymphs and adults pierce the stems and petioles causing the plant to wilt or stunted through sucking

Integrated pest management of stem and storage root feeders

Aim at reducing infestation:
- By avoiding planting uninfested vines, usually avoid cuttings from the base of the stem
- Alternating host plants
- Rotating crops
- Removing volunteer plants

- Timely planting and prompt harvesting to avoid dry periods
- Planting away from weevil-infested fields
- Hilling up of soil around the base of plants and filling in of soil cracks and ensure that roots are not exposed on the surface
- Destroying infested plant parts (roots, stem bases)
- Removing vines and storage roots from the field after harvesting to avoid build up especially during dry season
- Flooding (irrigating) the field for 24 hours after completing harvest
- Treating the vines with insecticide such as carbofuran or diazinon for 30 minutes prior to planting to minimize on initial infestation in the field
- Hand picking and destruction of bugs

Session 6.2.3: Description and management of major foliage pests of sweetpotato

a) Sweetpotato butterfly

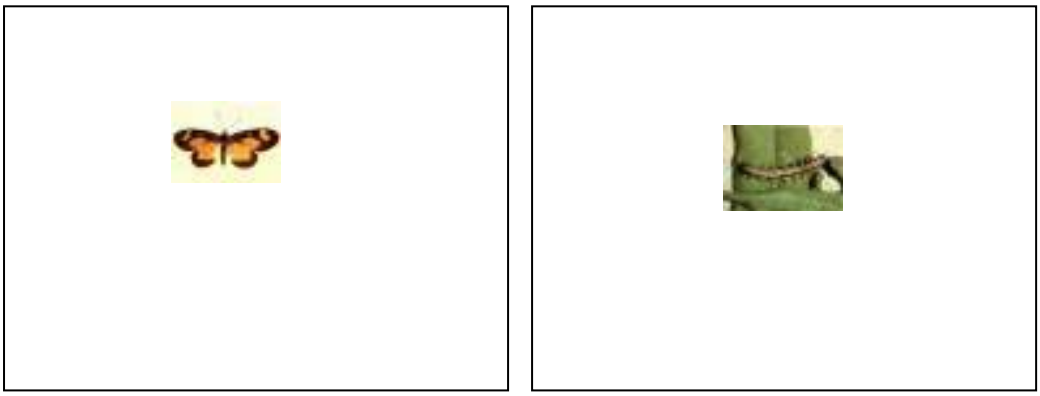


Photo 3: Adult butterfly and caterpillar

Development cycle:

- Pale yellow eggs are laid in batches on both surfaces of the leaves which hatch into greenish black larvae (caterpillars) covered with branching spines
- Life cycle takes 27–50 days

Description:

- Larvae are concentrated in a protective webbing during the first 2 weeks after hatching which then become solitary and hide from the sunlight on the ground during the day
- Pupae are yellowish and hang singly on the underside of leaves or on another support
- Adult has orange wings with brown markings at wing margins and are strong fliers

Mode of destruction

- Caterpillars feed on leaves: young caterpillars feed on the upper surface, whereas older ones eat the whole leaf except for the primary midribs. Complete defoliation may result from severe attacks
- Outbreaks are sporadic and seasonal and usually occur at the beginning of the dry season

Control

- Monitor for possible outbreak of sweetpotato butterfly adults and damage
- Webs containing young caterpillars should be collected and destroyed weekly
- Early planting and harvesting enables the crop to escape severe attacks
- Chemicals such as carbaryl or pyrethrum can be used

Session 6.2.4: Control of millipedes, vermin, rodents other selected sweetpotato pests

a) Rodents: Root rats, field rats and squirrels

- Control of root rats: Do not plant sweetpotato on ridges; plant *Tephrosia* herbs around field; trap with 'Mutoto' traps
- Field rats controlled by: weeding garden; harvesting when crop is ready; using break-back traps; deploying biological control agents, e.g cats. Snakes hunt down the rats and destroy nesting sites

Rats and mole/root rats (*enfuko, efuttoand enyuru*) occasionally feed on sweetpotato storage roots either by digging through the ridges and mounds or accessing the exposed roots. They often spoil more roots than they actually eat. Signs of their damage and presence include: small mounds of freshly dug soil, sweetpotato vines being pulled back down into the soil, holes in the sides of ridges or mounds

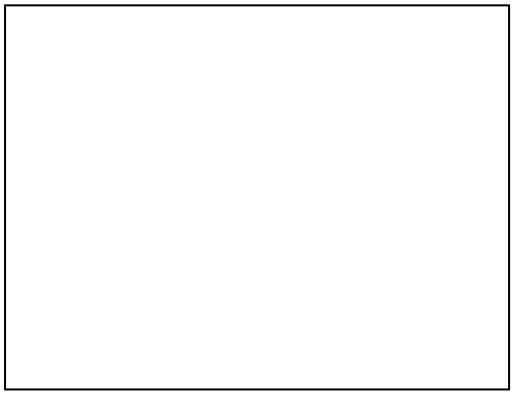


Photo 6: Mole rat

Rodent damage can be reduced by:

- Destroying rodent burrows
- Keeping the field and surrounding areas clean of vegetation and rubbish to help reduce rodent populations
- Digging a deep ditch around the perimeter of their field to prevent rodents from digging tunnels straight into the fields.
- Use of repellent materials inside their unblocked burrows
- Some traditional control practices include:
  - Spreading the leaves of repellent plants such as *intwinti*
  - Placing a mixture of cow dung and pepper in the burrows and burning it to smoke the rodents out, or pumping the smoke into the tunnel to try and suffocate the animals
  - Planting the deep-rooted, poisonous shrub *Tephrosia vogelii* in the field to repel mole rats
  - Placing human faeces in the rodent burrows
- Drowning the rodents by pouring water into the hole/ burrow, mixtures of hot water and pounded hot chilli pepper are reported to kill them
- Traps can be set in locations where livestock and children will not interfere or get hurt by them
- Any poisons that kill the rodents will also seriously harm humans and livestock, so poisoning is not recommended unless closely supervised, as baits may be eaten by livestock or children. Use of phosphine tablets in tunnels is effective.

NB: Rodent control works best if done on a large scale, so it is worth trying to interest one's neighbours.

b) Millipedes

- Infestation tends to be severe at the beginning of the season and common in areas with low soil fertility

- Different species attack sweetpotato
- Other crops attacked are *Solanum* potato, ground nuts, maize, beans
- Do not plant sweetpotato following groundnuts
- Cultural management practices: crop rotation, destruction of nesting sites

c) Vermin e.g. monkeys and wild pigs
Control by:
- Planting the field away from forested areas, controlled hunting and planting fields in blocks
- Capture one monkey, paint him red and let him go
- A bell can also be hung on the neck of a monkey

NB: Vermin should not be poisoned

d) Domestic animals
Control by using the law, planting crops in blocks, spraying cow dung or urine on foliage

e) Guinea fowl
These often destroy sweetpotato roots, but the level of damage does not warrant control

Session 6.2.3: Description and management of major diseases (30 minutes)

a) Alternaria leaf spot

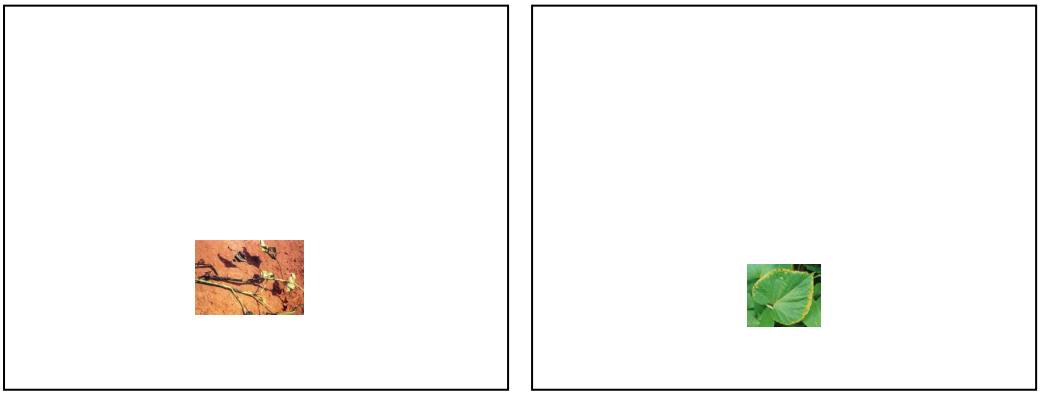


Photo 7: Alternaria symptoms

- First small, brown/grey/black oval lesions with typical bulls' eye appearance of concentric rings, on leaves, stems and petioles
- On the lower side of the leaf, blackened veins are observed. Subsequently the lesions widen, surrounded by a yellow halo

Cause and spread
- Caused by a fungal pathogen
- Through soil, plant debris, infected plant material, splashing rain and water
- Increased humidity, wetter and high altitude conditions lead to high level of disease and lesion size
- The most damaging fungal disease affecting sweetpotato foliage in Africa

Management
- Destroy or burn infected crop material
- Use clean planting material
- Rotate crops
- Use of resistant varieties

- Use fungal sprays for commercial production of vines

b) Sweetpotato little leaf (SPLL)

Photo 8: impact of sweetpotato little leaf
Pencil roots at harvest (20 weeks) and healthy roots

Symptoms

- Little leaf, proliferation of stems on the plant, yellowing and stunting of the whole plant, large numbers of fibrous roots
- Unmarketable, pencil-shaped storage roots

NB: The symptoms of little leaf should not be confused with small leaves caused by zinc deficiency. Zinc deficiency is often more pronounced in dry plantings where poor early root growth results in small leaves and shortened internodes. The main difference between zinc deficiency and SPLL is a lack of sap in the SPLL-affected plants

Cause and spread

Caused by a phytoplasma, a type of bacterium that lives in the phloem or food-conducting tissue of plants

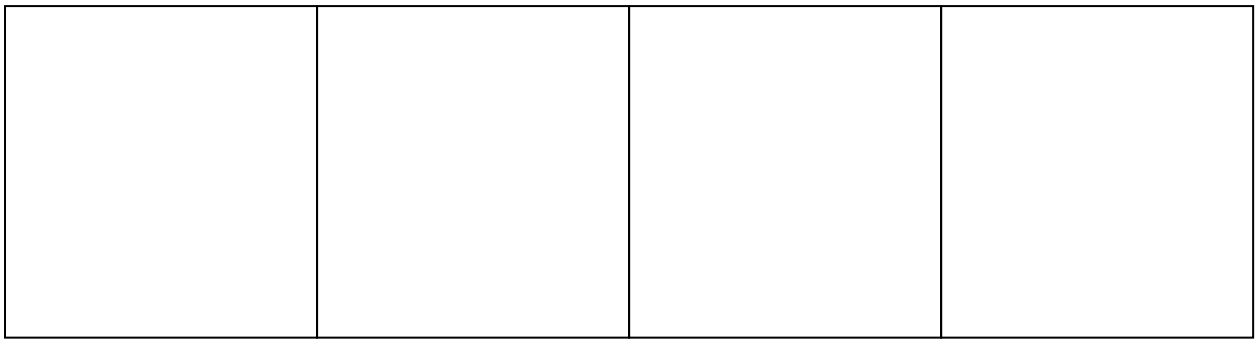
- Leafhoppers transmit the phytoplasma into and within a sweetpotato crop

Management

- Replacement of plant lot
- Field surveillance and roguing out infected plants
- Planting clean vines
- Isolating vine beds and banks from old fields
- Rotation

c) Sweetpotato feathery mottle virus (SPFMV)

Symptoms



Purple spots Vein clearing Russet crack Leaf mottling
Curling & dwarfing

Photo 9: Symptoms of Sweetpotato virus disease (SPVD)

- Purplish spots, mild vein clearing, or small yellow chlorotic spots
- Usually more pronounced under conditions of environmental stress and will always show first on older leaves

Cause and spread

- Belongs to the potyvirus group of plant viruses.
- Easily spread by planting infected cuttings or roots, and by aphids including the cotton aphid *(Aphis gossypii)* and the green peach aphid *(Myzus persicae)*
- Severe impact on the marketability of roots, can be up to 20 percent lower than from healthy plants

Management

- Replacement of plant
- Field surveillances and roguing out infected plants
- Planting clean planting vine
- Isolation vine beds and banks from old fields
- Rotations

Exercise 6: **Referring pest and disease specimen collected by participants and others provided**

The facilitator should lead the participants to complete the table below and then wrap by highlighting the management of the most common pests and disease. **(90 minutes)**

Session 7: Maturity period and harvesting

Sweetpotato roots are ready for harvesting between 3 and 8 months after planting. Varieties such as Ejumula, Kabode, Kakamega and Vita mature within 5 months after planting. If the crop is harvested too early the roots will not be fully developed; too late and the roots may be fibrous and possibly pest-infested thus reducing yields.

Piecemeal harvesting involves the farmer moving around the field looking for cracks on the mounds and ridges, which they perceive as being indicative of a sizeable root and then removing selectively larger roots after which the earth is heaped up over the remaining smaller ones to allow continued bulking. The practice involves harvesting small quantities and normally starts as early as 2 months after planting for some varieties. Varieties with longer maturity period are usually more suitable for piecemeal method than early maturing ones which have all their storage roots maturing at almost the same time. Harvest duration is a function of factors including variety, soil type, availability of other foods, household size, disease and pest infestation and weather conditions.

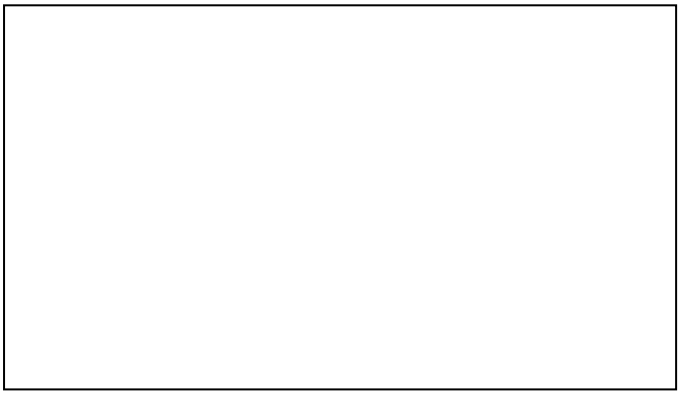


Photo 10: Piecemeal harvesting

Complete harvesting involves wholesale removal of the plants irrespective of whether all the roots are mature or not and is mainly for commercial sweetpotato growing.

Session 7.1: Assessment of root yield

Estimation of root yield under the piecemeal type of harvesting is normally difficult and even under wholesale harvesting farmers can only usually recall the number of bags of marketable roots filled but not the quantity of smaller roots that could not be sold. On average a bag of marketable roots ranges from 150 to 180 kg. The number of plants in the selected sample unit are counted and recorded, and the quantity of storage roots in the field can be easily assessed by estimating the yield of three representative sample units of 2 m² each. The harvested sample roots are counted and weighed then an average of all the samples is extrapolated into either acre or hectare standard units of area.

Table 6: Harvest data record sheet

Variety name	Number of heaps harvested	Total number of plants harvested	Number roots		Weight of roots	
			Marketable	Unmarketable	Marketable	Unmarketable

Reason for the best yields
a)
b)

c)

Reasons for the worst yields
a)
b)
c)

Reasons for the unmarketable yields
a)
b)
c)

PART THREE: VINE MULTIPLICATION TECHNIQUES

Session 8: Vine characteristics and sources in Uganda

Tables 7 and 8 show the characteristics affecting sweetpotato vine production, advantages and disadvantages of the common sources of vines in Uganda.

Table 7: General characteristics of sweetpotato vines

Character	Importance	Recommendation
Bulky and highly perishable	Not ease to transport large quantities	Requires open transport trucks and delivery made within 24 hours after packing
Vegetatively propagated	Slow multiplication rates and easy transmission of pests and diseases	Need technologies that will improve on the rate of multiplication and management techniques to minimise disease and pest infestations
Vegetation withers/dries during prolonged drought	Loss of planting material (vines)	Adopt conservation technologies
Plant part sources	Roots and growing plants	Both are potential sources of vine production

Table 8: Common informal seed vine sources in Uganda

Source	When commonly applied	Advantage	Disadvantage	Recommendation
Root slips or sprouts from previous fields	Mar-April	Most reliable source after prolonged dry spell	Contributes to spread of pests and diseases	Explore deliberate production of vines using clean roots
		Allow growers to produce planting material under minimal soil moisture	Delay in getting planting material due to waiting until vines are harvestable of length (30 cm) excluding the stump (15 – 20 cm)	Select moist retaining site for multiplication
			Comparative use of vines for consumption outweighs the seed advantage	Prioritise the use of small and medium sized roots for seed vine production
Growing fields	May – November	Adequate planting Material accessible	Spread of pests and disease because the primary production is roots and not vines	Cautiously consider disease and pest management issues
		Timely planting		
Buying	March – April	Access to planting material even if it is not available. Vines available on time and enjoys good market price	Chances of buying mixed varieties or not true to type are high. Normally low quality and costly	Buy from reputable vine multipliers

Session 9: Meaning of the seed vine and steps in the multiplication process

Session 9.1: Meaning of the seed vine and qualifications of a seed grower

The planting material of sweetpotato is a "vine" (shoot cutting) that grows from and is a clone of the mother plant. Note that a seed vine is different from a vine seed in that the seed vine refers to vines originating from known seed producers and informally certified as free from pest and disease infestations, true to type and a known field source; "healthy vines" and vine seed is planting material from any sources other than seed-growers' multiplication fields.

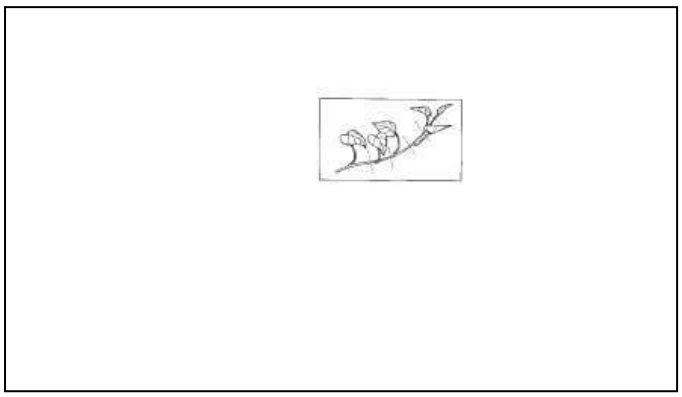


Photo 11: Recommended vine cutting

The pre-requisites for an entrepreneurial vine grower include:

- Access to land that is in close proximity to a reliable source of water for periodic irrigation (avoid water sources that are fed by drainage and alleys between beds)
- Soils should be fertile and well drained. and the field adequately isolated from previous or old fields
- The farmer should have a basic practical knowledge and skills for production of high quality planting, and have an interest in the enterprise.

Session 10: Vine multiplication process

Session 10.1: Preparation for planting

Table 9: Activities during preparation for planting

Practices	Recommendation	Importance
Site selection	The site should be fertile, easy to work well drained soils and near a water source that is not fed by drainage and water alleys or run-offs from old or previous fields. Beds should isolate by at least 100m from old and previous sweetpotato fields' and areas suspected to harbour pets and diseases transmissions	Minimise pest and disease transmission, easy irrigation and facilitates good initial plant establishment
Land preparation (1st & 2nd preps)	Ample time at least 4 weeks to planting	Facilitate organic decomposition
Nursery bed Preparation	Loosen the soil, mix with compost manure, prepare to moderate soil tilling	Fast establishment and growth
Bed preparation	Moderate soil tilling and oriented across the field slope. Prepare raised nursery beds 1 - 2 m wide , 10 - 20 m long and 20 cm high with a mixture of loose, humus-rich soil, organic compost and kitchen or rice hull ash. If available, apply well decomposed farmyard manure at a rate of 2.5 kg m-2 , NPK (17 - 17 - 17) at the rate of 400g per m-2 (if available) and insecticide (carbofuran) - mix these thoroughly with soil before planting.	Enable easy establishment of planted cuttings and minimise on soil water wash
Seed selection	Vines should be obtained from healthy and vigorous growing plants. Healthy storage roots are selected from plants that produced a high yield, and planted in seedbed away from other sweetpotato crop. The vines selected for harvesting should be true to type, free from pests and diseases infections and about 2 months old crop.	Minimise the disease transmission and facilitate easy establishment
Cutting vine	Top 25-35 cm portion. Vines selected from a crop that is 2-3 months old are more vigorous than those from 4-5 months old. The food reserves from the stems and leaves of older plants are transferred to the rapidly expanding storage root	Recovers quickly from cutting shock and more like to be free from pests and diseases
Watering	Soften the soil	Avoid injuring vines through bruising
Fencing	Construct barriers to ward off livestock and un-invited visitors	Avoid destruction
Bed size and layout	Narrow beds of 1.5 m widen and provide additional space for driveways and alleys between beds	Facilitate easy planting, weeding, fertiliser application, harvesting practices without workers damaging the plants

Exercise 7: Participatory subgroup sessions/presentations and plenary discussions on vine selection and bed preparations

Participants will visit a nearby field to pick samples of healthy and unhealthy vines and roots, and each sub-group will note the reasons for each category on the charts for presentation during the plenary.

Exercise 8: Assess the potential of a selected sample site for vine production

The facilitator will choose a sample site and each sub-group will take notes on its capability or incapability to be used for vine production. These will be presented during the plenary for participatory discussion and make joint recommendations for possible improvement or rejection

Session 10.2: Planting practices

Table 10: Ethical planting techniques

Activity	How	Importance

Placement	Plant upright and at high density	Upright emergence of the shoots
Spacing	High density planting	High vine production per unit area
Depth of planting	Avoid shallow planting	Minimises exposure of vines during watering
Watering	Light watering prior to planting to minimise on desiccations	Provide conducive establishment conditions
Labelling the beds	Indicate the date of planting, variety	Easy follow ups and subsequent activity scheduling

Exercise: Participants to prepare beds and plant. Discussions on the methodology should be done during the plenary.

Session 10.3: After planting agronomic practices

Table 11: Ethical planting techniques, continued

Activity	How	Importance
Regular watering	Daily 2 -3 times a day during non-rain season and as necessary during the wet seasons	Avoiding bed drying especially during dry seasons, soften the soil for root initiation and maintain adequate soil moisture for plant growth. Irrigation after each cutting helps rejuvenate the beds and activate applied fertilisers.
Gap filling	Should be done as soon as growth failure at buds is noticed	Maintain plant population
Weeding	Hand and light hoeing are used to remove weeds, diseased plants and off typesand cover exposed underground stems with soil	Minimise competition for nutrients, spread of diseases and maintain variety integrity
Pest and disease Management	Rouging, avoid previous sweetpotato fields, runoff water, apply pesticide	Produce clean planting material
Fertiliser application	Apply compost manure as a basal fertiliser by incorporating in the beds. Top dress with NPK or urea, 250 g/m² squared applied between rows whenever harvesting is done	Encourages vigorous growth and increased lateral emergence
Choice of vines to cut	Positively select vines from vigorous mother plants	Ensure clean starter material and known yield performance
Harvesting and tools to use	Sharp blades to cut at slanting angle	Minimise on pathogen transmission and vine healing
Timely harvesting	Before creeping or touching the soil especially for indeterminate varieties	Minimise water and nutrient waste or translocation to unwanted roots (sinks)
Primary vine harvesting	Harvest top portion and leave the lateral branches on the lower portion to grow. Normally at 40–60 DAP	Recovers quickly in subsequent multiplicative beds and laterals to provide vines for secondary harvesting
Auxiliary harvesting	Ratooning is normally done every 2 weeks after first harvesting and should not continue beyond 4 after planting	Multiplier process to generate more vines

Exercise 9: Participate in determining rates of fertiliser application and applicability of positive and negative selections. Calibrate equipment for fertiliser application

Session 13: Farm records for sweetpotato vine production enterprises

Exercise 10: Participants to be led through different types of records related to vine production enterprises. We may need more templates on records for this section

Example of record forms for vine multipliers for participant to fill using hypothetical data

Table 13: Sample record sheet 1

Farmer Name…… Group ……

Season …… Year ……..

Plot	Date of planting	Quantity planted	Average cost

Plot	Date of planting	Quantity harvested	Use		
			Own	Sold	Others

Instructions on how to use the table above
The trainer should illustrate the use of the table using hypothetical data. Assume that a farmer had established a bed area of 50 plants and after 60 days 50 cuttings of 30-cm long are harvested (refer to column 2 in the table). The cuttings are further divided into 15–20-cm cuttings that are used to establish other beds. Therefore the cumulative number of plants for vine production will be 150 plants (Columns 2 + 3 = column 5) at two different growth stages. It is assumed that the stamp will bear 2–3 laterals which will be subsequently ratooned (note that at 60 days it is only the 50 plants that have been stumped giving about 100–150 laterals, which will be harvested within two weeks). Column 6 refers to vines available for field planting to produce roots or vines that would be supplied by the vine grower. Since the vines generated from the stumping were being re-cycled to produce more vines then at 60 days the farmer is assumed to have no vines for the final grower. It is also important to note that the life span of the beds should note exceed 4 months after initial planting, therefore, the rounds of cutting will be dictated by the rate at which the growing vines or laterals attain the harvestable length of 30cm above the stump height of 10–15 cm. The higher the plant vigour the greater the number of cutting rounds.

Table 14: Vine production enterprise record

Date	Activity	Details	Activity cost	Cumulative total cost
	Field preparation			
	Planting			
	Watering			
	Weeding			
	Harvesting			
	Packing			
	Labelling			
	Fencing			
	Fertiliser			
	Spraying			

	Chemical			
	Plant population			
	Monitoring			
	Field hire			

Exercise 11: Participants to confirm, include and re-arrange the activity list suggested in the table and using records from their previous activities in vine production complete the table above

Table 15: Vine sales record

Activity	Plot 1	Plot 2	Plot 3	Plot 4
Mean yield/acre				
Farm price (UGSH.)				
Harvesting cost				
Packing material				
Loading				
Un-loading				
Association fees				
Communication				
Transport				
Packing				

Exercise 12: Participants to validate the activities in the table and use their experience to complete the details and related costs

PART FOUR: SNAP AND SUPPLEMENTARY SESSIONS

Introduction

These sessions could be fitted in between sessions or independently, depending on the message the trainer would like to convey. For example, if the participants seem generally inactive or dozing, then the trainer could try to re-capture their attention by engaging them in a stimulating game or role play. In case there is a particular practice or challenge that could be explained better through drama or poem, then lead the trainees into participation. The actions or outcomes should be voluntarily interpreted with reference to practical or touching experiences and life situations. Evaluation or planning meetings normally come at the end of the presentation to review emerging issues or to identify the training or implementation gaps that need addressing.

Session 14: Introduction to monitoring and evaluation, and facilitation approach (30 minutes)

Session 14.1: Introduction to monitoring and evaluation

Monitoring is continuous assessment of programme activities to determine whether implementation is as per plan. Periodic, for example, weekly field visits should be made to identify implementation constraints and facilitate re-planning. For example: is the material clean as defined? Are fields prepared on time? Is planting on time? Is the training applicable or relevant? How much planting material has been delivered?

Evaluation is an assessment of the programme after a given period of implementation which can be mid-term. It looks at efficiency and effectiveness and brings out lessons learned. For example: what is the performance of the crop after one month? Was the training successful attended and completed?

The monitoring tools should be verifiable indicators that determine the progress of the programme activities. The indicators should be simple, measurable, attainable, realistic and time bound (SMART) For example: number of extensionists trained, number of promoters trained, acreage planted and yield of sweetpotato.

Session 14.2: Introduction to facilitation skills

This is a training programme that occurs in community fields and combines farmers' traditional knowledge of land management with a more thorough understanding of the ecology of crop field eco-systems

The Reaching End-User training sessions on seed systems are non-formal adult education that should:

- provide a deeper understanding of crop ecology and observational, analytical and problem solving skills
- be organised around a season-long series of scheduled meetings
- facilitate dissemination of skills through the traditional knowledge pathways.

Thus, the long-term goal is sustainability of participants to continue expanding their knowledge and to help others to organise activities. The principles should be:

- Learning by doing
- What the farmer wants rules
- Learn how to learn
- The field is the best learning ground
- Problem posing/problem solving
- Extension workers are facilitators and not teachers
- Systematic training process
- Entails whole production cycle
- Group based

Exercise 13: Practical use of selected monitoring tools

Participants to be introduced to the various monitoring tools to be used

Session 15: Evaluation of workshop trainings

The objective is to evaluate the participants' conceptualisation of the contents presented and assess the extent to which they can be applied, and identify priority areas for technical support.

Exercise 14: Sample exercise on workshop training evaluation

The session facilitator will explain the importance of the exercise and the scoring rating to be used. The exercise will be done individually following the guidelines below:

Table 16: Workshop evaluation form 1

Session	Usefulness	Applicability	Suggestions
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
X			

Scores: 1. Usefulness: Very useful = 4, useful = 3, fairly useful = 2, not useful = 1

2. Applicability: Very applicable = 4, applicable = 3, fairly applicable = 2, not applicable = 1

NB: farmers will always want to award higher scores to the best so it may be helpful to follow the order suggested to get the necessary information

Table 17: Workshop evaluation form 2

	Good	Fair	Poor	Suggestion
Coverage				
Practicability				
Content				
Presentation				
Relevance				
Expectations				
Experimentation				
Duration				
Precision				
Applicability				

What needs to be improved next time?	How to improve it?
1.	•
2.	•
3.	•

Exercise 15: Planning and implementation of relevant action plan

This exercise will be derived from the project activities.

Group dynamics

The major objective of group dynamics is to stimulate and develop the participants' interest, cohesiveness, problem-solving skills and encourage collaboration and creativity. The provocative dynamic exercises are fun while providing experience and inciting participants to use teamwork to solve problems. Below are selected dynamic exercises that are targeted to bring out the challenges on enterprise development, cohesiveness, commitment and creativity. Depending on what message the facilitator would like to pas over, the energisers may come at the beginning or middle of the session. Below are examples, but there are several versions of such spicing exercises which the trainer could use or adopt.

Enterprise game

Objective: to highlight the development of vine multiplication as a commercial undertaking

Duration: ?????? minutes

Steps:

i) The participants are divided into groups based on the available number (members are asked to observe critically whatever is going to happen until the end of the game, especially the behaviour of other participants)
ii) Each group selects a Managing Director of their choice
iii) Each Managing Director is given an executive seat while the rest of the group members stand a metre behind him or her (they are asked to be of use to the MD but are not supposed to be heard talking and thus, a watchman to enforce order is also appointed)
iv) The facilitator gives out cards to MDs labelled A to E
v) The facilitator gives instructions that each question asked has one correct answer to be provided by the MD
vi) The MD gets +10 or -10 marks for each correct and wrong answer respectively, and zero for opting not to answer
vii) The facilitator then asks five questions and marks are awarded for the groups according to the criteria described above

Discussion

viii) Each group is asked to give reasons for the choice of their MD
ix) Make comments are made on the participants' behaviour during the game
x) Using the answers provided the facilitator emphasises the different aspects of enterprise development

Counting 10 strides between stool and start position and/ or deliver the message to the guest

Objective: To raise awareness about working together and communicating with each other

Duration: 15 minutes

Materials: Cloth to tie over the eyes, stool or bottle and stick

Steps

i) Tie the cloth over the eyes so that the participant cannot see. Ask the participants to walk from a set staring position to a stool and hit it with a stick or pick up bottle to deliver to the guest
ii) Let selected participants from each subgroup have a go

Discussion
Why cannot we do simple things with our eyes open? How could we have managed to do this task? What are the lessons we learnt from this?

Wayward whispers

Objective: To raise awareness about communication processes, especially about how messages can become distorted and to demonstrate how communication can be more effective.

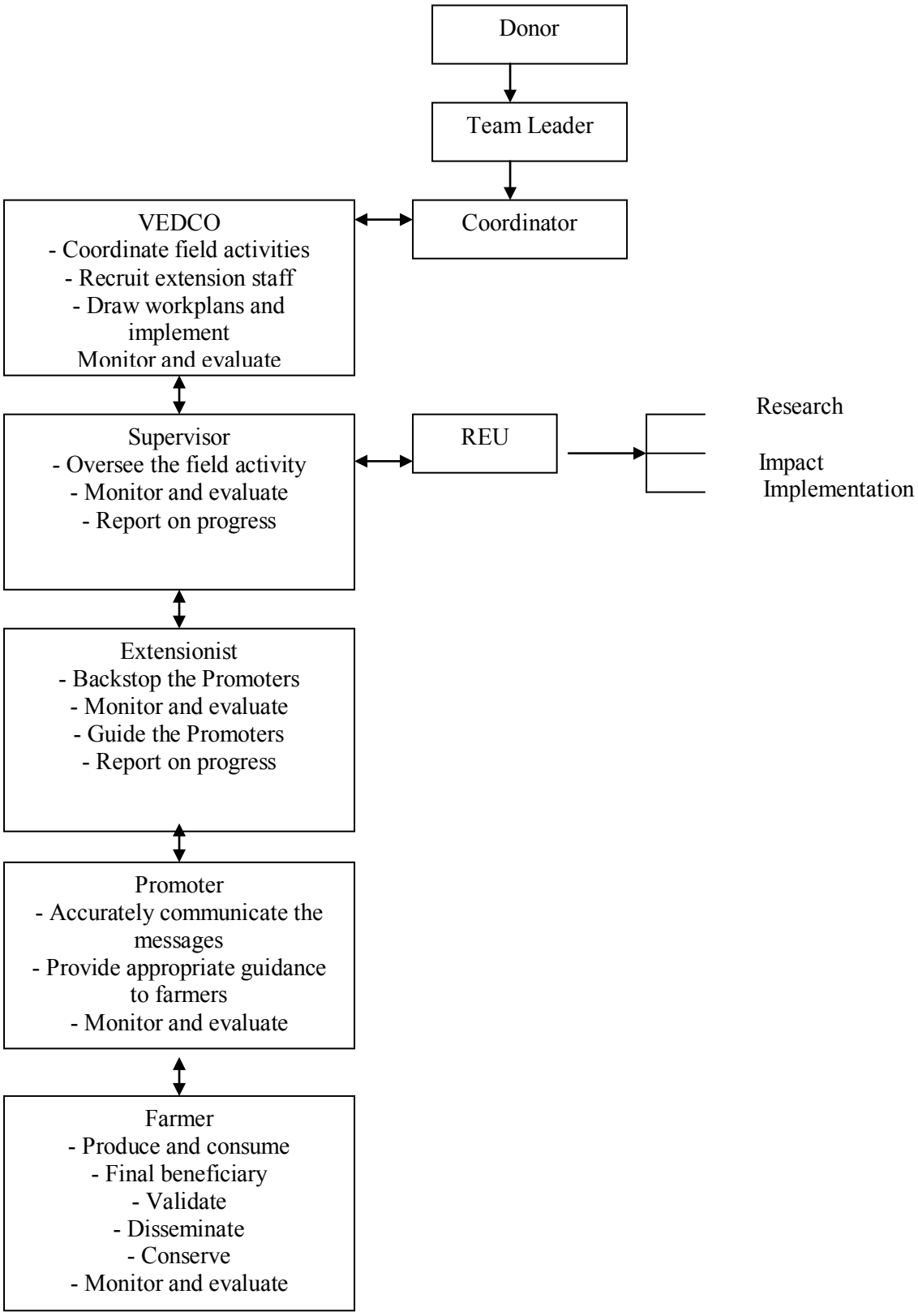
Duration 10 minutes

Steps
i) The participants form groups by calling out in turn the numbers 1 and 2
ii) Each group lines up
iii) One representative from each group goes to quietly receive the message from the facilitators to their immediate neighbour in the line they have formed. They may say it once. That individual then whispers the message to the next person until the message reaches the final person
iv) When the message has reached the last persons in all the sub-groups, the message is delivered back to the facilitator, who asks the last people in all sub-groups to reveal the message they heard and then the facilitator tells the groups the original message

Discussion
How does the message change when it is conveyed from one person to another? What were the weaknesses in the message itself hampering correct transfer? What were the weaknesses of the people transferring the message? How can we communicate in a better, more effective way?

Appendices

Appendix 1: Roles of different stakeholders in REU sweetpotato project implementation (20 mins)



Appendix 2: Developing training scheme for promoters (30 minutes)

Important Trainees should be guided to develop the training schemes for their trainees by completing the table below

Table 17: Template for developing the trainees' scheme

Date: Venue:

Session	Description of activities/energizers	Time		Materials
		Start	End	
1				

Prepared by ……..

Appendix 3: Attendance list of participants at REU training held at ……on …….

Category of Trainees: ……..

No.	Name	Address	Signature
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

Facilitated by ……..