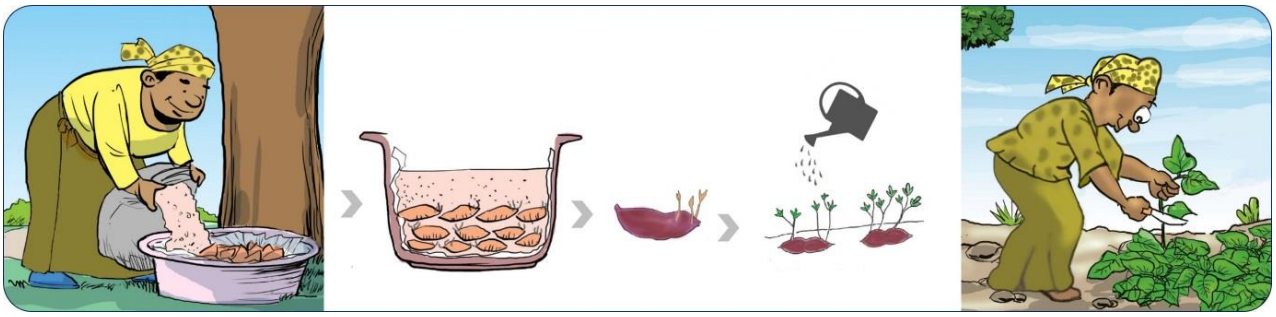
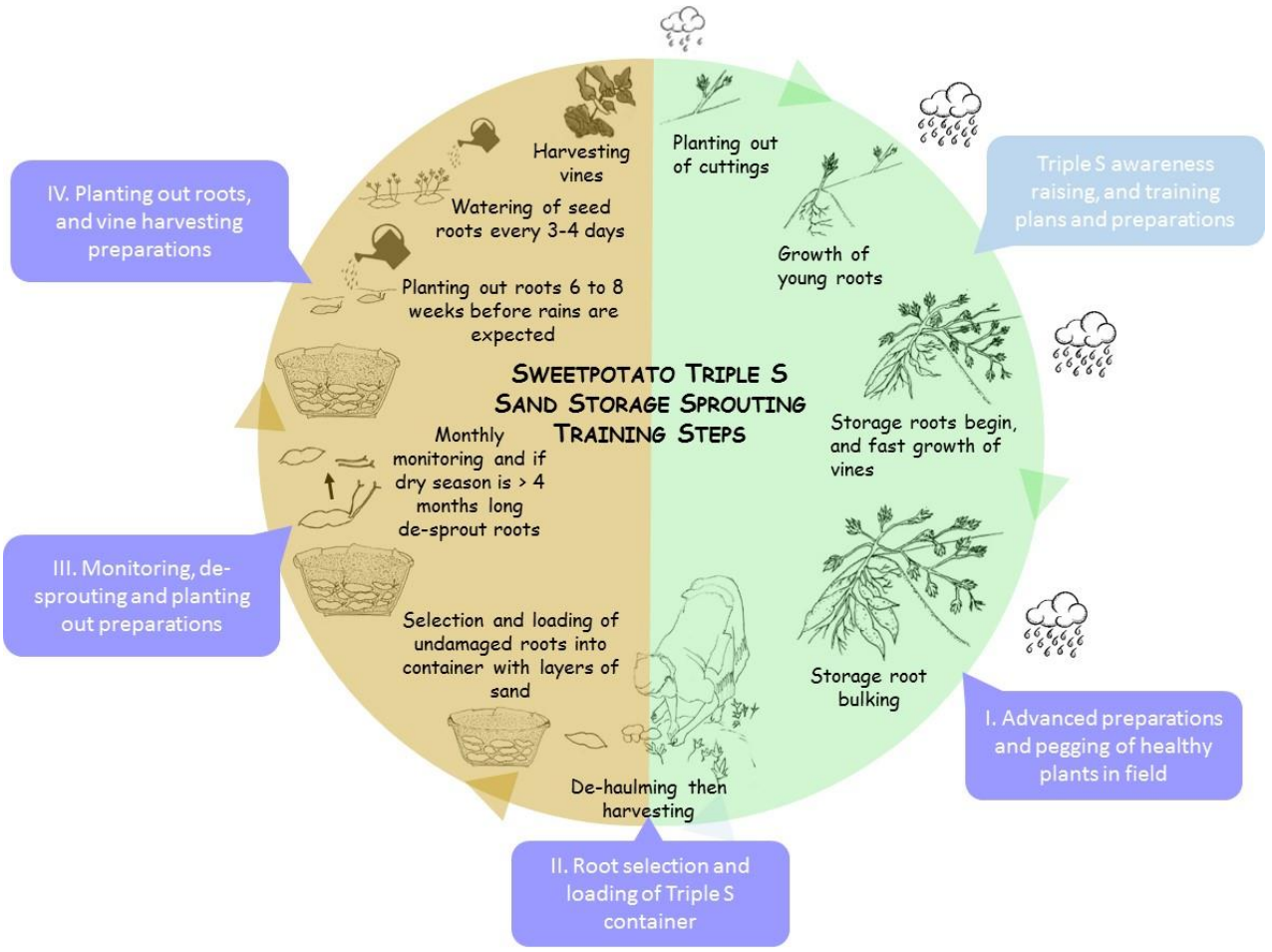
Guide for Trainers

Sweetpotato Planting Material Conservation

Triple S method: **S**and, **S**torage, **S**prouting





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CGIAR RESEARCH PROGRAM ON Roots, Tubers and Bananas

SUSTAIN Scaling up Sweetpotato through Agriculture and Nutrition

UNIVERSITY of GREENWICH
NRI | Natural Resources Institute

Preface

This Triple S training guide has been developed for all those involved in training smallholder farmers across Sub-Saharan Africa. We hope it acts as an easy-to-digest gender responsive resource material for supporting Triple S farmer training, and explaining the 'why' behind all the stages. Use of the Triple S (Sand, Storage, Sprouting) system for conserving sweetpotato over the dry-season and producing sufficient planting materials to plant at the start of the rains, enables farmers to harvest nutritious sweetpotato roots earlier in the season during the typically hungry period of the year, and to sell some of these early roots for higher prices, and to stagger their planting to help extend the harvesting period and yields, and to increase their resilience to increasingly variable climatic conditions.

To assist trainers in sharing the Triple S system with farmers, we have developed an accompanying set of A1 sized training flip-charts which can be rolled up and used in practical training sessions during the set-up of Triple S systems or planting out of Triple S roots. Additionally a set of three farmer handouts have been developed to act as memory aids for the farmers during the Triple S process. These Triple S training products can be downloaded at: http://www.sweetpotatoknowledge.org/project/sweetpotato-action-for-security-and-health-in-africa-sasha/

Acknowledgements: This Triple S Trainer's Guide has been produced as part of the CGIAR Research Program on Roots, Tubers and Bananas (RTB). Funding support for this work was provided by Harvest Plus, SASHA, SUSTAIN. However, it builds on work done by a wide range of researchers, extensionists and farmers during a number of different activities funded by different donors over the past 10 years.

The three Triple S training products have been developed by Tanya Stathers, in close collaboration with Sam Namanda, Sammy Agili, Margaret McEwan, Mihiretu Cherinet and Jude Njoku. The team worked with cartoonist Movin Were to create the illustrations. We acknowledge Richard Gibson (formerly of NRI) and Jan Low (CIP) who have provided technical support and encouragement during the development and implementation of the Triple S technology.

Photo credits: Sammy Agili, Sam Namanda, Mihiretu Cherinet, Tanya Stathers

Correct citation: Stathers, T., Namanda, S., Agili, S., Cherinet, M., Njoku, J., McEwan, M. 2017. Guide for Trainers - Sweetpotato Planting Material Conservation Triple S method: Sand, Storage, Sprouting. International Potato Centre, Nairobi, Kenya. 42pp. http://www.sweetpotatoknowledge.org/project/sweetpotato-action-for-security-and-health-in-africa-sasha/

Guide for Trainers - Sweetpotato Planting Material Conservation Triple S: Sand, Storage, Sprouting

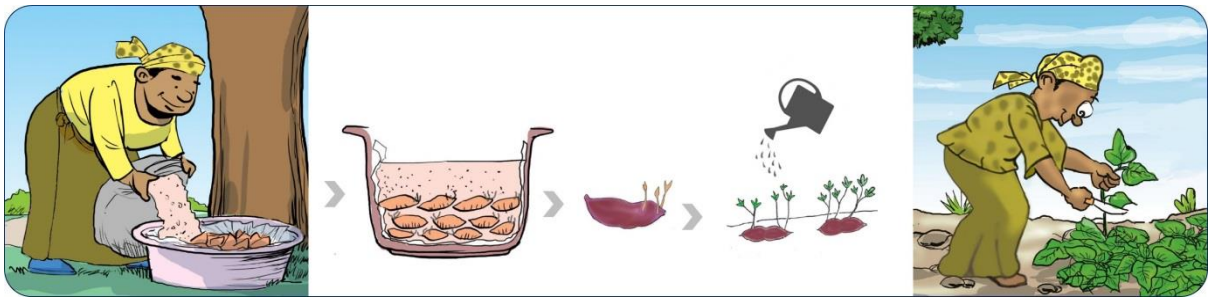
ISBN: 978-92-9060-479-2
DOI: 10.4160/9789290604792

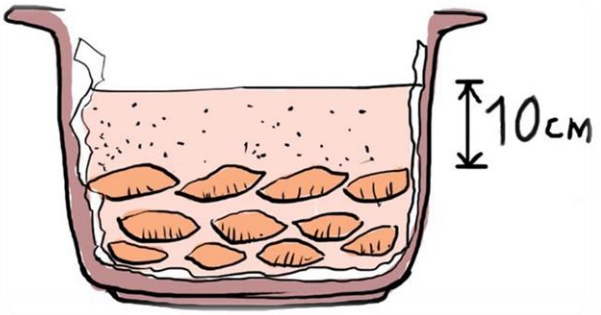
Contents

1. Introduction to Triple S

What is Triple S?

Triple S stands for Sand, Storage, Sprouting – the three main steps for using stored sweetpotato roots to conserve planting materials during the dry season. The roots are stored in dry sand during the dry season, and then planted out and watered before the rains arrive so that their sprouts can develop into vines and provide planting materials right at the start of the rains.





Loaded Triple S containers (above)

Healthy field of sweetpotato grown from Triple S materials (below)

This Triple S trainers guide has been developed for those training farmers in the use of Triple S and provides step-by-step descriptions of how to set up a Triple S system, and how to train farmers to set-up their own Triple S, it also provides detailed explanations of why each step or material or instruction is required.

What constraints does Triple S address?

Triple S addresses a number of important challenges.

CHALLENGE: Shortage of sweetpotato planting materials at the start of the rains	By storing healthy undamaged sweetpotato roots in sand through the dry season, households can protect and provide their own sweetpotato planting materials in time to plant at the start of the rains. Instead of having to wait and hope for shoots to appear from volunteer plants - if any survived the long-dry season, and only then begin to start the 6-8 week process of producing vines once the rains start. Such waiting, leads to farmers planting sweetpotato late (~8 weeks after the start of the rains) and in small areas, and to the roots (their food) only becoming available late in the season.
CHALLENGE: Bridging the hungry season	Planting sweetpotato at the start of the rains, enables households to harvest roots early in the season during what is typically the hungry period when other crops are not yet mature, and when food stocks are typically empty. Most cereal crops take ≥ 4 months to mature, while piecemeal harvesting of sweetpotato can start from just 2 ½ months after planting. Use of Triple S allows households to harvest sweetpotato ~3 months earlier than normal.
CHALLENGE: Optimising sweetpotato yields, availability and plant vigour	Planting on time (at the start of the rains) helps optimise sweetpotato yields and extends the sweetpotato piecemeal harvesting period, providing extra food security and diversity. Sweetpotato vines can be kept in swampy areas during the dry season but weevils and viruses can infect it and reduce the vigour of the ensuing crop, while Triple S helps farmers produce clean planting materials and retain plant vigour.
CHALLENGE: Limited access to swamp land or irrigated fields	Most farming households struggle to access swampy, wet and irrigated land where they can keep sweetpotato planting materials alive during the dry season (often > 5 months long). Triple S storage of roots in sand over the dry season removes this need, and only requires farmers to access small amounts of water to irrigate the planted out roots for 6-8 weeks before the rains start.
CHALLENGE: Costly and/or difficult-to-access inputs	Sweetpotato is a low cash-input crop that does not require expensive fertilisers. However, a lack of planting materials often leads to farmers having to purchase them. Triple S enables farmers to keep healthy sweetpotato roots from their own harvest, stored in sand from their own yards, in an old basin making it a viable option for resource-poor and remote households.
CHALLENGE: Limited income opportunities	The price of sweetpotato roots is high early in the season as very little other food is available then, this enables Triple S farmers to sell some of the early roots they produce at high prices and earn a good income.
CHALLENGE: Time spent searching for vines	Using Triple S to provide sweetpotato planting materials at the start of the rains removes the need for household members (usually the women) to spend hours wandering around between neighbours or travelling further afield to search for and request or purchase sweetpotato vines.
CHALLENGE: Increasingly unpredictable climatic patterns	Triple S use provides families with timely and climate-resilient access to sweetpotato planting materials. This fast-maturing crop is well-known for its relative drought tolerance and role as a crucial and nutritious food source in years where drought or long dry spells lead to the failure of other staples.

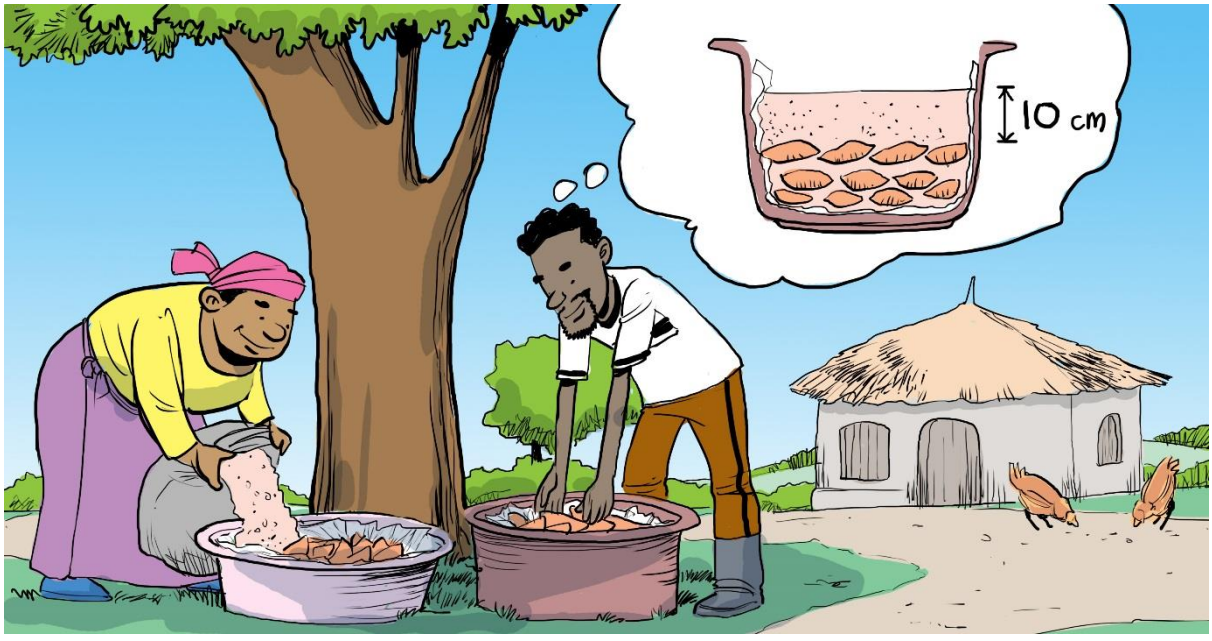
WHAT DOES TRIPLE S INVOLVE?

Triple S involves a farmer selecting healthy undamaged sweetpotato roots at harvest time prior to the beginning of the prolonged dry season, and storing them in layers of dry sand in an old basin lined with a piece of newspaper for the duration of the dry season. The stored roots need to be inspected monthly, and then 6-8 weeks before the rains start they are planted out into a root-bed and watered twice a week.

Farmers need training to acquire the knowledge and skills to set up and manage a Triple S system. This Triple S trainer's guide provides training materials and step-by-step instructions on how to set-up and manage a Triple S system.

Currently, many farmers do not plan ahead regarding their sweetpotato planting materials and just assume some volunteer sweetpotato roots left behind in a nearby field will start to grow and provide a few vines that can then 2 months later be cut and planted. But this behaviour means they only usually have limited amounts of vines to plant and a far-shorter growing season, as the first 2 months of the rains have usually gone before their sweetpotato crop is even planted.

Many people do not know or believe that you can store sweetpotato roots after harvest and manage them so they sprout and produce vines at the time needed for planting (i.e. at the start of the rains). A significant mind-shift is required in most farming households for them to start thinking about conserving sweetpotato planting materials between seasons in the same way they do for their cereal or legume seeds. We need to help farmers become aware and skilled in selecting and storing their sweetpotato seed, so their families' can consume and sell more and better quality sweetpotato earlier and for longer during the year.



2. Using these Triple S training materials

The lack of sweetpotato planting materials available when the rains start, is a major constraint to sweetpotato production across sub-Saharan Africa. The Triple S technique of storing healthy sweetpotato roots in sand, and then planting them out and watering them to produce sprouts in advance of the rains; provides farmers with an on-farm source of planting materials in time for the start of the rains. Planting sweetpotato on time, helps farmers' to produce food early in the season during the otherwise lean/ hungry period. Subsequent harvests of planting materials from the Triple S root bed enables farmers to increase and stagger their planting, which helps reduce dry-spell related risks, and provides roots, food and income from root sales for a longer period of the year.

Advantages of **Triple S**:

- Early Vines
- Early Planting
- Early Roots
- Early Food
- Early Income
- Food Diversification
- Climate Resilience

This **Triple S trainers' guide** contains: **outline plans for Triple S training sessions**, and **step-by-step instructions** on how to set-up a Triple S system. Together with the accompanying set of **Triple S farmer training flip charts**, and the **Triple S farmer handouts** they will help you get the Triple S technique into use at scale. The Triple S farmer training tools were designed around a framework of four training sessions, preceded by an awareness raising/ sensitisation meeting. These training sessions could occur one after the other in a single morning, or through visits to farmer groups at key crop stages during the sweetpotato cycle as shown in the following figure. The trainer should keep a record of who attended the training sessions, what they each set-up in terms of Triple S and who each of them then trained on Triple S. This information should be updated each session.

The accompanying set of 'Triple S farmer training flip charts' enable the training to be easily delivered in the shade of a tree by a field or homestead where practical hands-on learning activities can occur. The farmer handouts will act as memory aids to the farmers, helping to remind them of how and why each step should be done, and acting as a tool for them to train other farmers with.

The training flip charts and handout materials should not replace the use of practical hands-on activities for farmer learning[1].

These Triple S training materials are available electronically on the Sweetpotato Knowledge Portal at: http://www.sweetpotatoknowledge.org/project/sweetpotato-action-for-security-and-health-in-africa-sasha/

[1] Topic 1 - Helping Adults to Learn of the 'Everything You Ever Wanted to Know about Sweetpotato - ToT Training Manual' provides helpful guidelines on becoming a skilled facilitator, planning a training course, and ideas for learning-by-doing activities.

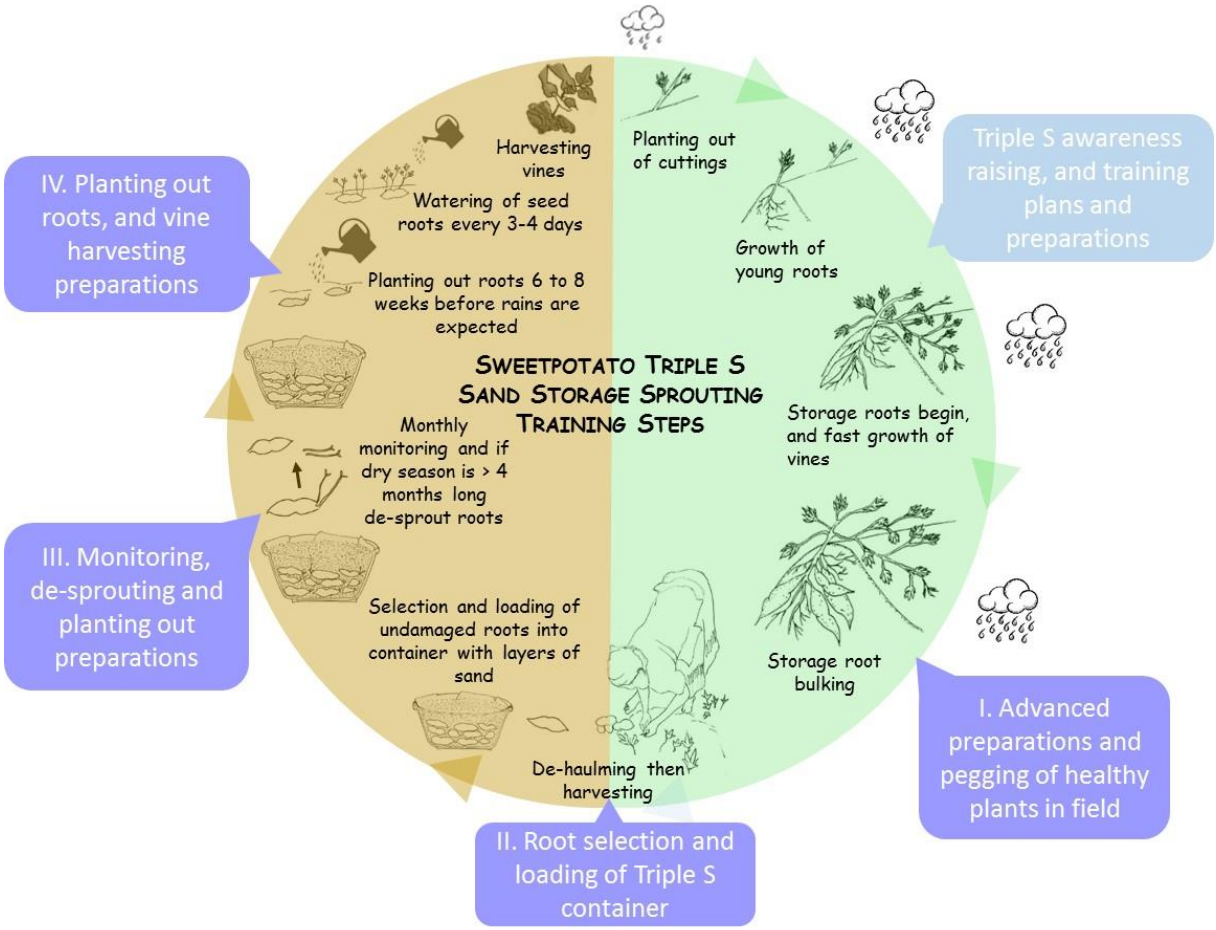
AWARENESS RAISING/ SENSITISATION MEETING

Prior to organising any Triple S farmer training, meet with knowledgeable local stakeholders to:

- ensure that there is a need for Triple S in the area;
- raise awareness about the benefits of Triple S;
- find out about the sweetpotato activities, varieties and cultural practices in the target area;
- identify training participants (and it should be remembered that Triple S is very suited to resource poor farmers, both men and women, young and old);
- make logistical arrangements for focal fields, homesteads, dates and times for the training.

The Triple S team should then meet with local leaders and key stakeholders to explain the purpose of Triple S and what it involves, videos can help show the year-long Triple S process in a few minutes. Make the session participatory and interactive, not a lecture. Give the participants a chance to express any concerns or confusion they have about Triple S.

Suggested timings of Triple S farmer training steps to match the crop cycle



TRAINING SESSION I. TRIPLE S EXPLANATION, PLANS AND PREPARATIONS

Participants will:

- understand how Triple S can ensure sufficient sweetpotato planting materials are available at the start of the rains and how this can benefit different types of households;
- know what is required to set up a Triple S system;
- be able to use their seasonal calendar to work out when their Triple S activities need to occur;
- be able to identify and mark healthy plants in the field for subsequent Triple S use;
- have planned who they will each be sharing the Triple S technique with.

When: at root bulking stage (~1 month before harvesting)

Topics	*Suggested learning activities*

– Introductions
– Triple S: what is it, how does it help
– Overview of Triple S training session plans
– Developing their Triple S calendar
– Calculating their Triple S requirements
– Equipment for Triple S
– Selecting and marking healthy plants to use for Triple S
– De-haulming to help cure sweetpotato roots
– Looking ahead to the next session
	• Ice breaking introductory activity (see suggestions in Appendix 1)
	• Quick run through of the day's aims, programme and timings
	• *Presentation*: use flip charts 1-5, and probing questions
	  ○ how can Triple S help improve your food security?
	  ○ when should you store your Triple S roots?
	  ○ when do we expect the rains to start here, are there any signs to watch out for?
	  ○ when would this mean we need to start planting out and watering our Triple S stored roots?
	  ○ enter the months for each activity on your handout calendar
	  ○ how much planting material will we get from 40 Triple S roots, and over how many weeks of vine harvesting?
	  ○ what equipment does each farmer require for Triple S?
	• *Field activity*: move to nearby sweetpotato field, ask participants to walk through the crop and carefully observe the plants. Discuss the group's observations. Ask 3 of them to walk through the field again and to stop where they find a diseased plant, join them and discuss the importance of not using roots from diseased plants for Triple S storage, and the need for rogueing of virus infected plants. Find a healthy plant and discuss its characteristics. Then ask group to get into pairs, give each pair 5 sticks, and ask them to use the sticks to mark healthy plants they find and could use the roots of for Triple S. Ask each pair to join another pair and check their selection of healthy plants. Discuss, demonstrate and plan for de-haulming.
	• *Demonstration*: Setting up and loading a Triple S container
	• *Group activity:* plan how each will train 10 other farmers. Trainer to take records for follow-up in next session.
	• Overview of next session, what will be covered and fix date

Materials:

- ☐ Nearby field of sweetpotato at root bulking stage, so participants can practice identifying and marking healthy plants to provide roots for use in Triple S
- ☐ Short sticks to use for marking healthy sweetpotato plants
- ☐ Equipment for facilitator to demonstrate Triple S (basin, newspaper or sisal sack, coarse dry sand, ~60 sweetpotato roots)
- ☐ Triple S training flip chart, trainer's guide, farmer handout 1
- ☐ Farmers' should bring their own note books and pens

TRAINING SESSION II. HEALTHY ROOT SELECTION AND LOADING OF THE TRIPLE S CONTAINER

Participants will: practice Triple S using roots selected only from healthy plants; understand why roots need to be harvested carefully; be able to set up a Triple S system in their own homes

When: at sweetpotato harvest time, when the roots are at optimum maturity

Topics	*Suggested learning activities*

– Introductions and farmer recap of Session I learning
– Overview reminder of the Triple S process
– Careful harvesting of roots for Triple S
– Deciding which roots to use
– Preparing and loading the Triple S container
– Storing the Triple S container
– Keeping the Triple S safe during storage
– Looking ahead to the next session
	• Ice breaking introductory activity, ask two farmers to recap what they learnt during Training Session I
	• Quick run through of the day's aims, programme, timings
	• *Presentation*: use flip charts 1-6, and probing questions
	  ○ how do we identify healthy and unhealthy sweetpotato plants, why did we mark healthy plants last session?
	  ○ how does de-haulming plants before harvest help?
	  ○ how can we harvest carefully to reduce root damage?
	• *Field activity*: move to nearby field, ask participants in 4 groups (each with a portion of the field) to:
	  ○ check marked plants (if they were not de-haulmed) still look healthy, and remove sticks from any diseased ones
	  ○ carefully harvest all roots from the marked healthy plants
	  ○ to help curing, place the roots in the shade of a tree, cover with canvas not plastic, do not wash roots
	  ○ carefully carry the roots back to the homestead
	• *Presentation:* use flip charts 7-9 and probing questions
	  ○ what would happen if we used roots from diseased plants?
	  ○ how can we tell if roots might be infested by weevils?
	  ○ what would happen if we used immature roots?
	  ○ why do we use: newspaper; cool dry coarse sand; a 10 cm layer of sand on top; roots of a certain size; a storage location with a thatched roof preferably?
	• *Demonstration:* which roots to use in the Triple S; how to prepare the cool dry coarse sand and the Triple S container; how to load the roots and sand in layers; final layer of sand; ideal storage location for Triple S
	• *Small group activity:* each group to slowly set up a Triple S: select and load roots; record date, number, location; facilitator to move between groups observing and questioning
	• *Presentation: use flip chart 10-11 and probing questions*
	  ○ why, when, how to monitor the roots in your Triple S
	• *Group activity:* plan how each will train 10 other farmers
	• Overview of next session, what will be covered and fix date

Materials:

- ☐ Same nearby field of sweetpotato with healthy plants marked, the participants will check current health of these plants and harvest them carefully and carry the roots back to the homestead
- ☐ Harvesting equipment: normal hoes, fork hoes, sticks, or other harvesting tools, sack to carry
- ☐ Farmers' own equipment for setting up their Triple S system – *ideal to have 4 sets if 4 groups* (basin plus other containers the farmers want to test, e.g. basket, box; newspaper; clean, cool coarse dry sand; sweetpotato roots (that the group harvested); cool, dark site for storing the Triple S e.g. inside a thatched roof hut or under a raised structure); pen and notebook
- ☐ Triple S training flip chart; trainer's guide; farmer handout 2

TRAINING SESSION III. MONITORING, DE-SPROUTING AND PREPARING TO PLANT OUT STORED ROOTS

Participants will: know what problems can occur in Triple S stored roots; be able to monitor, unload, reload their Triple S and take the necessary action if they find rotting, weevilled or sprouting roots; know how to prepare and manage the root bed for planting out Triple S roots

When: one month after setting up the Triple S system

Topics	*Suggested learning activities*
– Introductions and farmer recap of Session II learning – Monitoring Triple S roots during storage – De-sprouting where dry season is > 4 months – Preparing your root bed – Why Triple S helps – Looking ahead to the next session	• Ice breaking role play, ask farmers to get into 4 groups and each group to spend 5 minutes practicing a 1 minute role play of how they set-up their Triple S. Performance & discussion. • Quick run through of the session's aims, programme, timings • *Presentation*: use flip charts 10-11, and probing questions ○ what are we looking for when we monitor our Triple S? ○ what do we do if we find weevil damaged roots, or rotten or rat eaten, or shrivelled roots? ○ when might we want to de-sprout roots, how, how often? ○ how often should we monitor our Triple S? • *Demonstration:* using nearby Triple S container (note: carry it outside into the shade), facilitator then demonstrates how to: ○ carefully unload the Triple S, inspecting each root ○ decide what action (if any) to take for each root ○ carry out the recommended actions ○ de-sprout roots, discussing the need for de-sprouting only in locations where dry season is long (> 4 months) ○ re-load remaining roots into Triple S, and return to storage • *Small group activity*: in 4 groups, each group should work on unloading, checking, taking any action necessary and reloading a Triple S (if only 1 other Triple S nearby, then get each participant to unload and decide on action needed for a few roots). Participants should list the number of roots that had sprouted, were damaged and the reason for damage, and differences they noted between roots of different sizes. Facilitator to move around, checking and helping. • *Presentation:* use flip charts 12-13, and probing questions ○ when to use a spacing of 30 x 30cm instead of 60 x 60cm? ○ why make a small depression above or between roots? ○ why do we not remove the sprouts just before planting? ○ how often to water the roots when we plant them out? ○ how long after root planting till we can harvest vines? ○ what tools do we need for preparing the root bed? • *Group discussion:* why do we practice Triple S? • *Small group*: update on each person's training of 10 farmers • Overview of next session, what will be covered and fix date

Materials:

- ☐ Triple S previously set-up at farmer's home; plus ideally 4 other Triple S nearby for group work
- ☐ Clean mat or old sacking on which to place roots, clean bucket for sand, fresh newspaper
- ☐ Triple S training flip chart; trainer's guide; farmer handout 3

SESSION IV. ROOT BED PREPARATION AND PLANTING OUT 6-8 WEEKS BEFORE THE RAINS START

Participants will: share their experiences of root storage problems their Triple S system had and how they managed them; be able to prepare a root bed and plant out Triple S stored roots; know how to harvest vines, optimize vine quantities harvested, calculate their Triple S root requirements

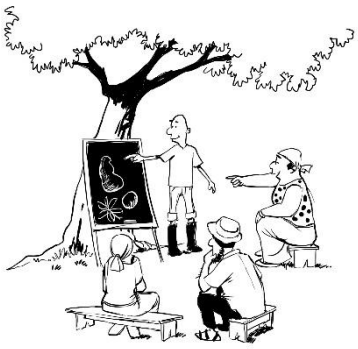
When: 8 weeks before rains are expected to start

Topics	*Suggested learning activities*
– Introductions and farmer recap of Session III learning – Monitoring Triple S roots during storage – Root bed preparation – Planting out Triple S roots – Vine production and harvesting from Triple S roots	• Ice breaking role play: in 3 groups each group will role play one of: i) selecting and marking healthy plants, ii) loading a Triple S, iii) monitoring a Triple S. Performances & discussion. • Quick run through of the session's aims, programme, timings • *Presentation*: use flip charts 10-11, and probing questions ○ what did you find when you monitored your Triple S? ○ how often did you monitor your Triple S? ○ what problems did you encounter? ○ when should you prepare your root bed? ○ which roots to use for planting out? • *Demonstration:* unload Triple S and carefully carry the roots to the nearby field where they will prepare the root bed. Facilitator to: ○ discuss what size seed root bed to prepare ○ prepare part of the root bed ○ plant out about 10 roots, explaining spacing, positioning of roots, need for depression above or between the roots, ○ discuss watering requirements, show watering technique • *Small group activity*: in 4 groups, each group will prepare an area of the seed bed, and plant out some Triple S roots, and water them. Facilitator to move around, checking and helping. • *Presentation:* use flip charts 12-16, and probing questions ○ watering requirements of planted Triple S roots? ○ speed of vine growth from roots? ○ why do we need to fence in the root bed area? ○ how to harvest and plant out the cuttings? ○ how to get large subsequent vine harvests? ○ why can staggered planting be advantageous? • *Group calculations:* how many Triple S will I need to set up to supply me with planting materials for 0.3ha? • *Demonstration then practice of:* vine harvesting technique, including vine length, age, quality, transport, storage method • *Small group*: update on each person's training of 10 others • *Reflection session*: What aspects were difficult to understand? What other information is needed? Any aspects of Triple S or the training that need adapting to the local context?

Materials:

- ☐ Triple S previously set-up at farmer's home; nearby field where root bed can be placed;
- ☐ Hoes (each farmer to bring one); watering can and ~20 litres of water; fencing materials
- ☐ Triple S training flip chart; trainer's guide; farmer handout 4

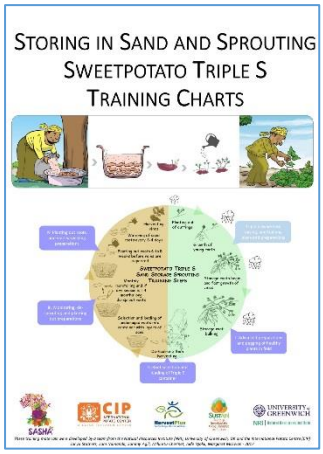
ACCOMPANYING TRIPLE S FIELD TRAINING FLIP CHARTS AND FARMER HANDOUTS

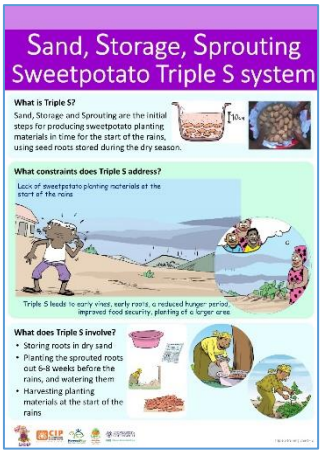


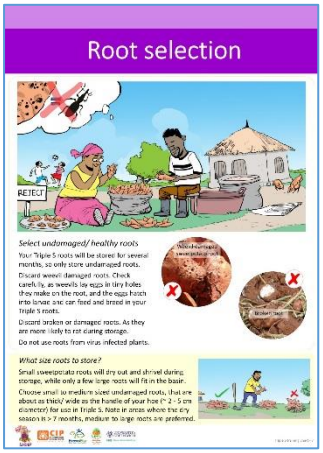
Flipcharts: A set of 'Triple S field training flipchart', composed of 16 A1-size colourful and informative sheets, have been developed to support the field training. These flip charts can be rolled up and carried around, enabling the training to be delivered in the shade of a tree next to a sweetpotato field or homestead where the practical 'learning-by-doing' activities can occur.

Examples of some of the flipchart sheets are shown below. The flipchart sheets should each be printed onto A1-size sheets of strengthened/coated paper (e.g. 'never tear paper') to optimise their lifespan. They are available electronically at: http://www.sweetpotatoknowledge.org/project/sweetpotato-action-for-security-and-health-in-africa-sasha/

If you have not been able to access electronic copies of the flipchart pages and would like e-copies please send an email to: M.McEwan@cgiar.org or T.E.Stathers@gre.ac.uk or S.Namanda@cgiar.org



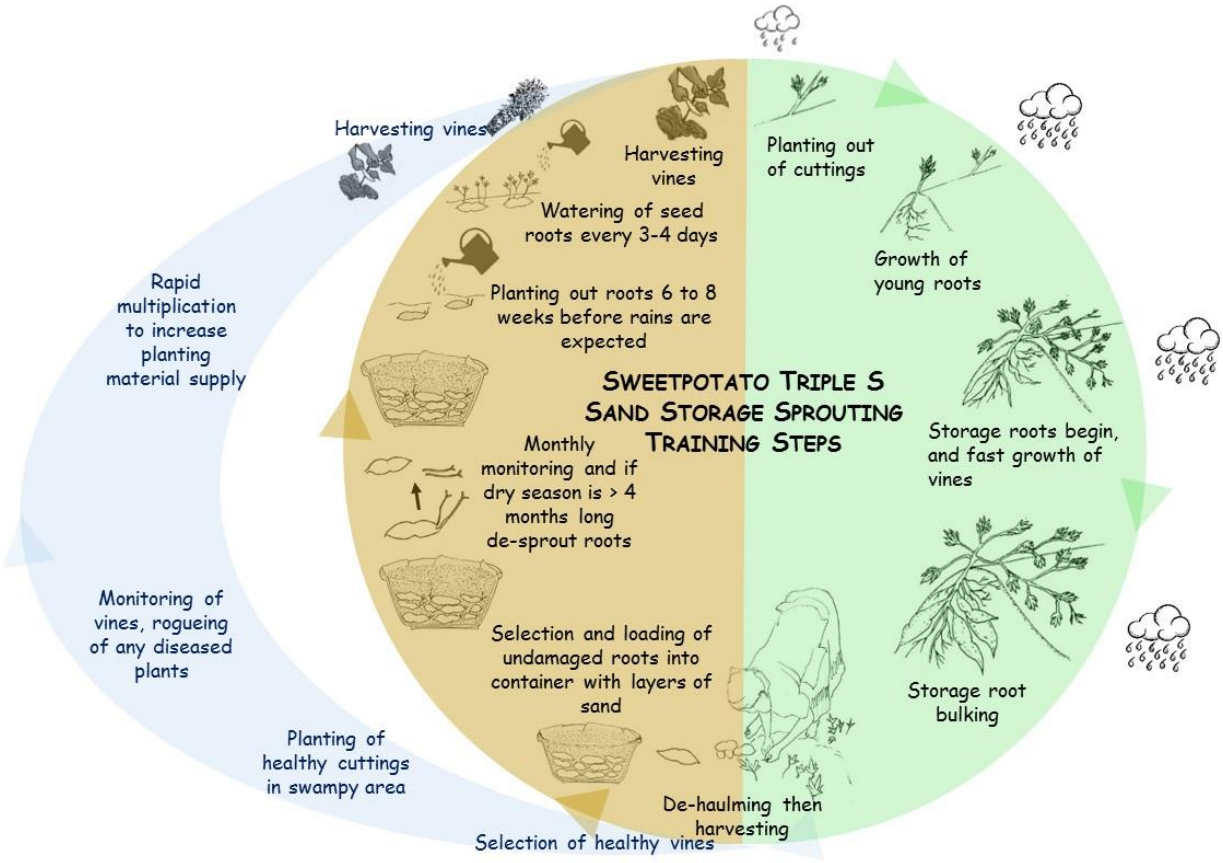




Handouts: Three brief handouts have also been prepared to accompany the Triple S farmer training. Examples of them are shown below.

3. PLANNING FOR TRIPLE S

THE SWEETPOTATO CROP CYCLE



An overview of the sweetpotato crop cycle is shown above. The timing of each stage will vary in different locations and be dependent on the: seasonal calendar; timing and amount of the rains; soil type, temperature and altitude; and the sweetpotato varieties being grown.

Ideally, cuttings of sweetpotato planting materials should be planted at the start of the rains. As the rains continue the young roots start to develop, and then from about four weeks after planting the storage roots are initiated and the vines start to grow rapidly and the leaf area increases. Storage root bulking typically starts from ~6 weeks after planting, with a few roots on some plants being ready for harvesting from ~10 weeks after planting, although most will be ready from 12 to 16 weeks after harvesting. Timing of the different crop stages will vary by variety and growing conditions[2].

Triple S activities (mainly during the dry-season represented by the brown half of the circle in the diagram above) typically start during the storage root bulking stage, with farmers walking through their field to peg healthy sweetpotato plants from which they will harvest roots to use in setting up their Triple S basin (see Section 4). At 3-5 days prior to harvest, the foliage can be cut off the pegged plants to help cure and protect the roots during storage. At harvest time, the roots from these pegged plants are harvested carefully and transported back to the homestead for sorting (see Section 5). Undamaged small to medium sized roots are selected (see Section 6), and placed inside the Triple S container in layers of cool, dry, coarse sand (see Section 7). The loaded Triple S container is then placed into a cool dark storage location, and monitored at monthly intervals during the dry season (see Section 8). If the dry season is longer than 4 months, then the roots will need to be de-

[2] See Section 6.6 of the Everything You Ever Wanted to Know About Sweetpotato ToT manual for more details

sprouted during storage (see Section 9). A root bed should be prepared in a fertile easy to water location, and protected from livestock grazing by a fence (see Section 10). The Triple S roots are planted out 6-8 weeks before the rains are due to start and watered twice a week.

Usually the shoots start to appear above the soil in the root bed 7 to 10 days after the Triple S roots have been planted out. Although this can vary with variety and environment. Vines can start to be harvested and used as cuttings for planting out the field about 6-8 weeks after the roots were planted out. However, farmers should wait for the rains to start before harvesting vines. A second vine harvest should be possible from the root bed after a further month, enabling the farmer to expand and stagger the planting of their sweetpotato crop.

Where farmers have access to swampy or irrigated areas, they can use these places to conserve their sweetpotato vines during the dry-season, then rapidly multiply them prior to the rains so as to have sufficient planting materials for their field and/ or to sell once the rains start *(blue area of diagram)*.

TRIPLE S ACTIVITY TIMING AND CALENDAR

Farmers need to plan in advance when their Triple S activities need to happen, so they can coordinate them with their other activities.

Before harvest:

- One month before harvesting their sweetpotato, when the roots have already started to bulk and cause the soil above them to crack, the farmer will need to walk through their crop and peg 25 healthy plants so their roots can be harvested and used to load one Triple S basin.
- A few days prior to harvest, they will need to de-haulm the pegged plants to help cure their roots.
- Organise all the equipment required to set up their Triple S container (e.g. basin, newspaper, dry coarse sand) and decide on a cool dark place where it can be stored during the dry-season.

At harvest:

- Carefully harvest and transport the roots from the pegged plants to the homestead.
- Select small-medium undamaged roots, load them into Triple S basin between sand layers as recommended.
- Store the loaded Triple S container in a cool, dark place where it will not get damaged.

After harvest:

- Each month monitor the Triple S container, unload all the roots and check each root, discard any rotten or weevilled damaged roots, before replacing the newspaper and reloading the basin.
- If dry-season is > 4 months long, roots will need de-sprouting after either 3 or 4 months storage.

6-8 weeks before the rains start:

- Root bed prepared in a fertile, easy-to-water location, and area fenced to protect from livestock.
- Plant out Triple S roots with sprouts facing upwards, water twice per week

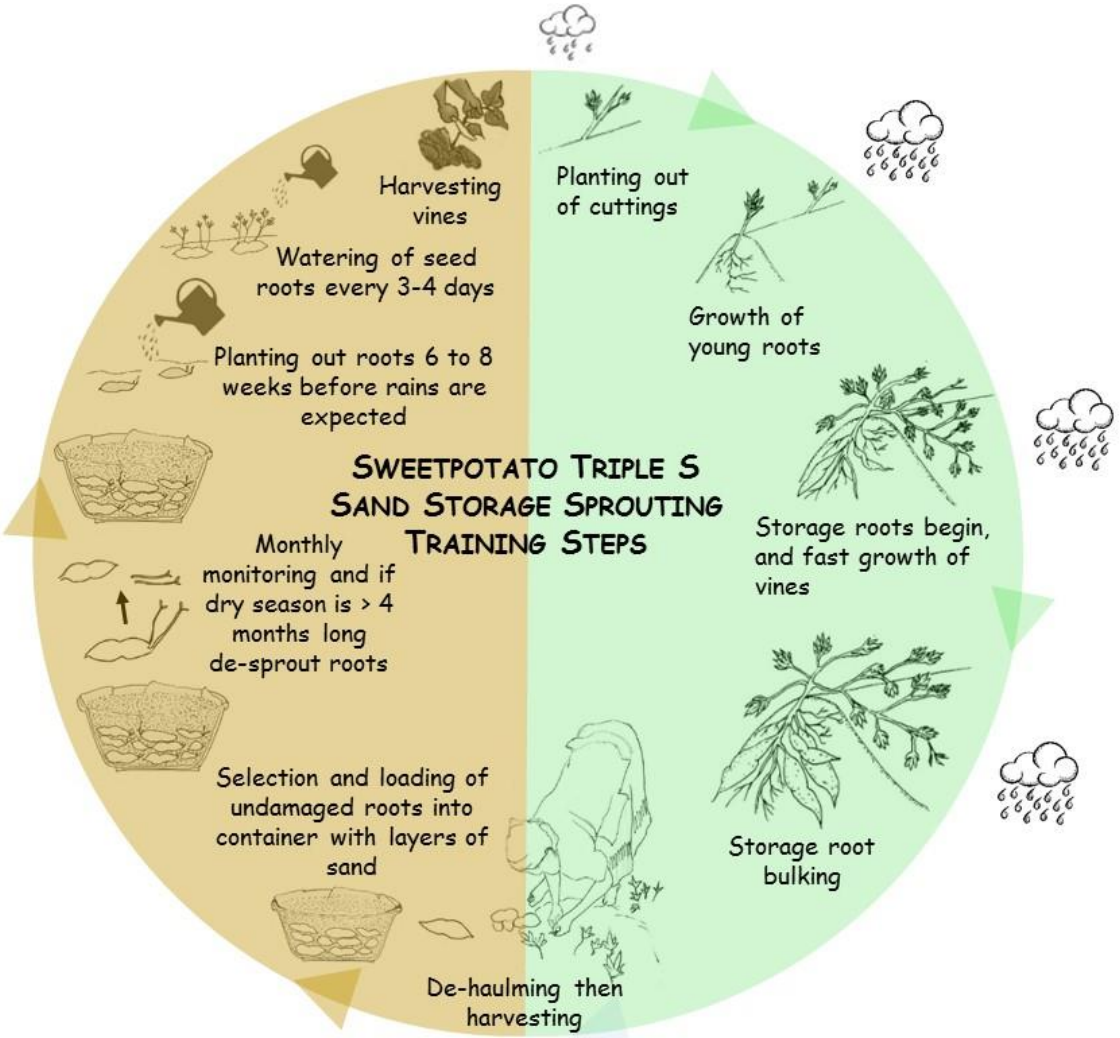
At start of rains:

- Cuttings harvested from plants in the root-bed, and used to plant out sweetpotato field.

4 weeks after start of rains:

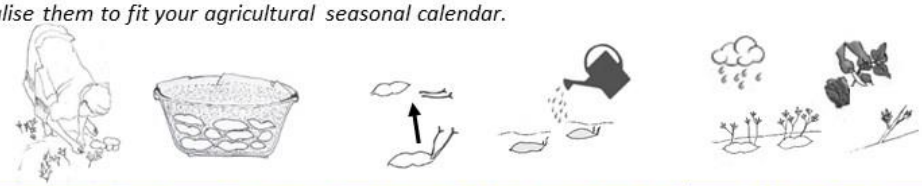
- Second harvest of vines from plants in root-bed used to plant out next part of sweetpotato field.

Planning backwards from when the rains start, we can work out which month each of the activities is '*expected*' to happen in. Help farmers calculate their own timings and enter them into the calendar on their handout. BUT remember Triple S timing is linked to the rains not the months, so flexibility is important. Examples of the timing of activities in different locations are given on the calendar below.



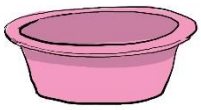
TRIPLE S CALENDAR EXAMPLES FROM DIFFERENT COUNTRIES

Remember Triple S timing is driven by the rains, not by calendar dates so the below are just examples, and you will need to contextualise them to fit your agricultural seasonal calendar.



Location *[add your timings]*	Harvesting, root selection & storage of Triple S roots	Dry-season period *[months]*, monitoring	De-sprout roots	Planting out in root bed & water every 3-4 days *(6-8 weeks before rains)*	Start of rains. Vine harvesting & planting of cuttings *every 4 weeks from:*
Mozambique	Apr/ May	Jun to Sept *[3]*	No need	Oct to Nov	Jan/ Feb
Kenya *-Western*	July/ August	Sept to Jan *[5]*	Oct/Nov	Feb/March	April
Uganda *-Northern*	Nov/Dec	mid Nov to Mar *[4]*	No need	mid Jan/ Feb	mid Mar/Apr
Ethiopia *-Tigray*	Oct/Nov	Oct to Jun *[9]*	Jan and Apr	May/ June	Jun/Jul
-SNNPR - Belg	Oct/Nov	Oct to Feb *[4]*	No need	February	Mar/April
-SNNPR - Meher	Oct	Oct to Apr *[9]*	Jan/Feb	March	Apr/May
Nigeria *-Derived savannah*	Oct/ Nov	Nov to Apr *[6]*	No need	February	Apr/May
Burkina Faso *-Western*	Oct - Dec	Nov to Mar *[5]*	Dec/Jan	April	June/ July

TRIPLE S EQUIPMENT NEEDS

☐ 

Old **basin**, or other container for storing roots in. Do not use a cardboard box.

☐ 

Old **newspaper** to line the basin

☐ 

Coarse, dry sand – *can be swept from around the yard, must be cool before using*

☐ 

Undamaged, small to medium-sized **sweetpotato roots**

☐ 

Sticks to use as pegs to mark healthy plants

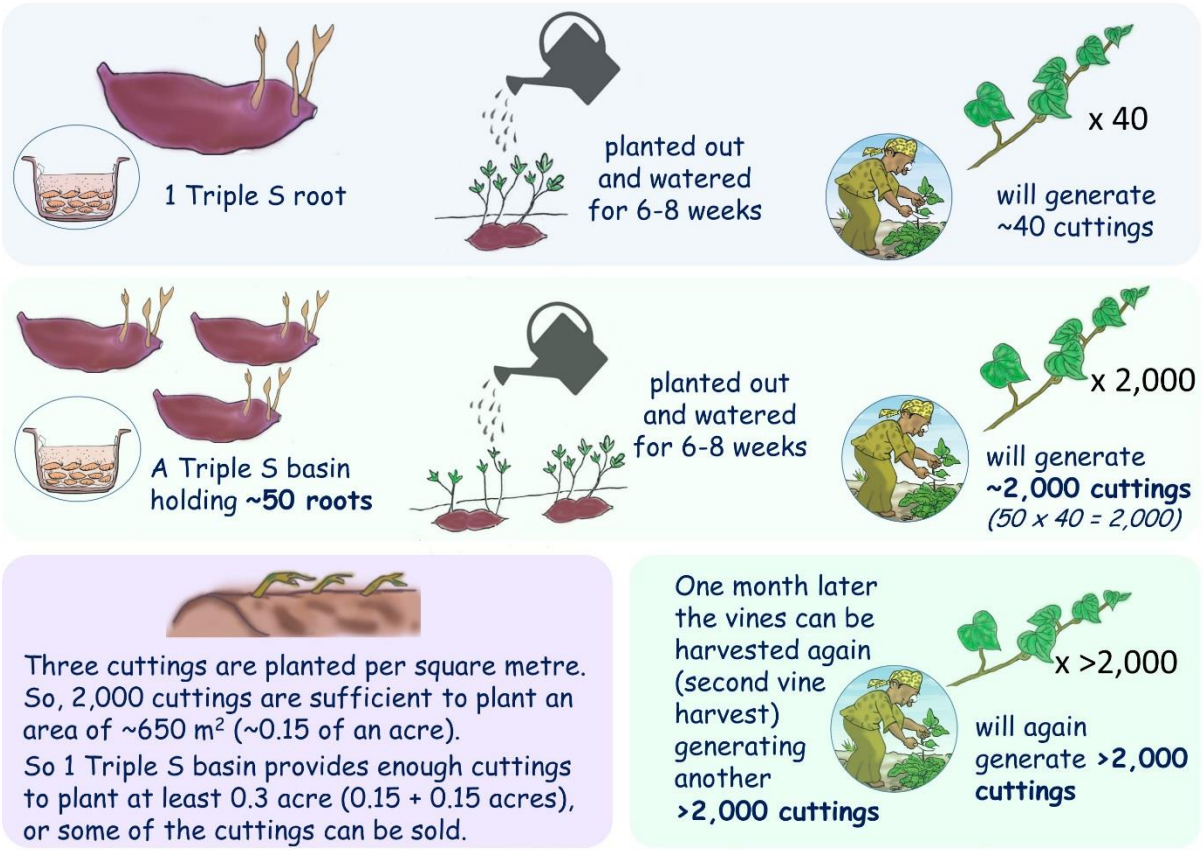
☐ 

Fork hoe to help harvest roots carefully

☐ 

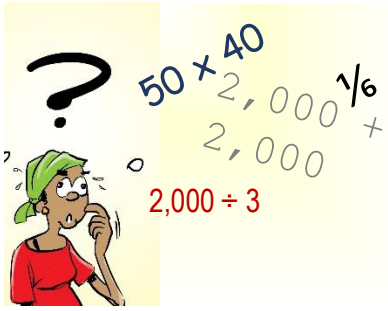
Watering can to water seed roots after planting them out

TRIPLE S CALCULATIONS



One Triple S root planted out and watered for 6-8 weeks can generate ~40 cuttings.

One Triple S basin typically holds 40-50 roots => 1,600 to 2,000 cuttings 6-8 weeks after planting out.



If the cuttings are then planted at a density of 3 cuttings per square metre (*as is typical in Uganda*), then 1,600 to 2,000 cuttings are sufficient to plant an area of 533 to 667 m^2 = 0.13 to 0.16 of an acre.

Then a month later, the vines in the root bed can be harvested for a second time, providing another 1,600 to 2,000 cuttings, enabling an additional 0.13 to 0.16 of an acre to be planted to sweetpotato or the cuttings to be sold.

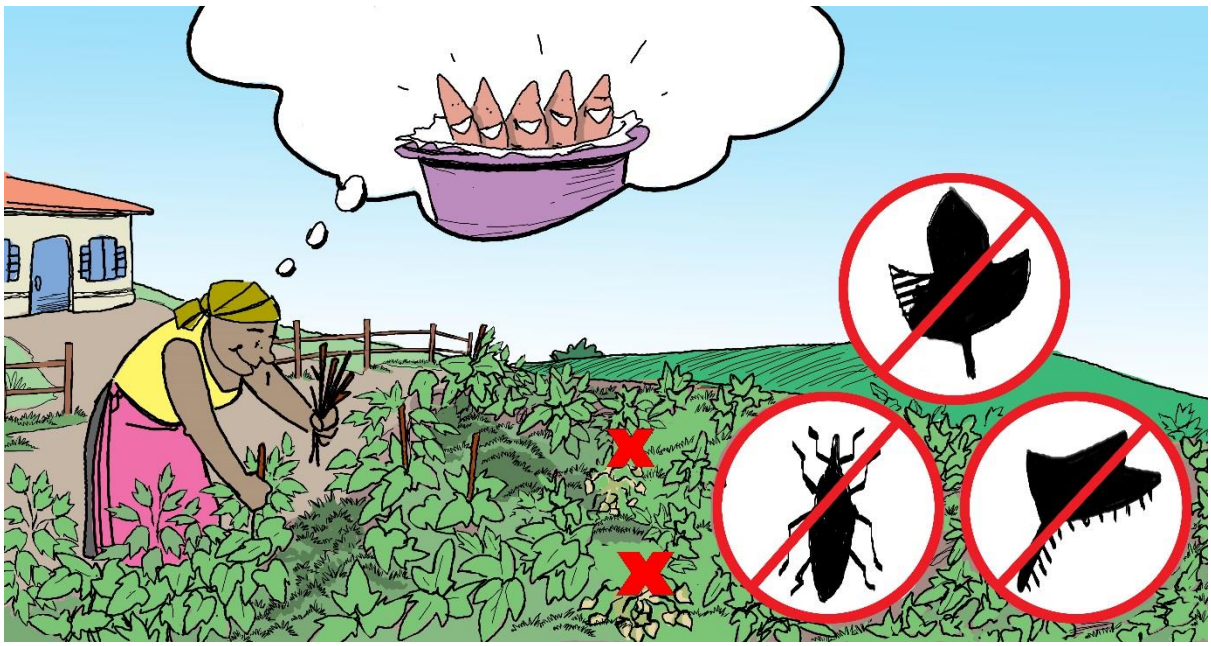
So, two Triple S basins of 40-50 roots each, will provide 3,200 to 4,000 cuttings 6-8 weeks after planting out. If the cuttings are then planted at a density of 3 cuttings/ m^2, then 3,200 to 4,000 cuttings are sufficient to plant an area of 1067 to 1333 m^2 = 0.26 to 0.33 of an acre.

Then a month later, the vines in the root bed can be harvested for a second time, again providing 3,200 to 4,000 cuttings, enabling an additional 0.26 to 0.33 of an acre to be planted to sweetpotato (giving a total area of 0.52 to 0.66 acres of sweetpotato) or the cuttings can be sold.

If you find this complicated? Then try the practice questions in Appendix 2.

4. Using healthy roots for Triple S

Field selection of healthy plants from which to harvest roots for use in Triple S



To produce a healthy crop we have to start with healthy seed. So, in the case of Triple S we need to ensure that the roots we store are healthy. To do that we need to ensure the roots stored in the Triple S container come from healthy plants.

By walking through the sweetpotato crop about a month before harvest, healthy plants can be identified and then pegged/marked by placing a stick into the ground next to each healthy plant.

It is important that mature roots are used in Triple S. Signs that roots are mature include, the lower leaves of the plant turning yellow and falling off, firm root skin, and soil cracks above the roots due to the bulking roots. Do not use roots from older fields (plants > 6 months old), as roots may not sprout or may sprout too early.

Yellow lower leaves of mature plant

If we estimate that each sweetpotato plant will produce about 4 roots, then to set up one Triple S basin of 40-50 roots we need to harvest the roots from 20 healthy plants.

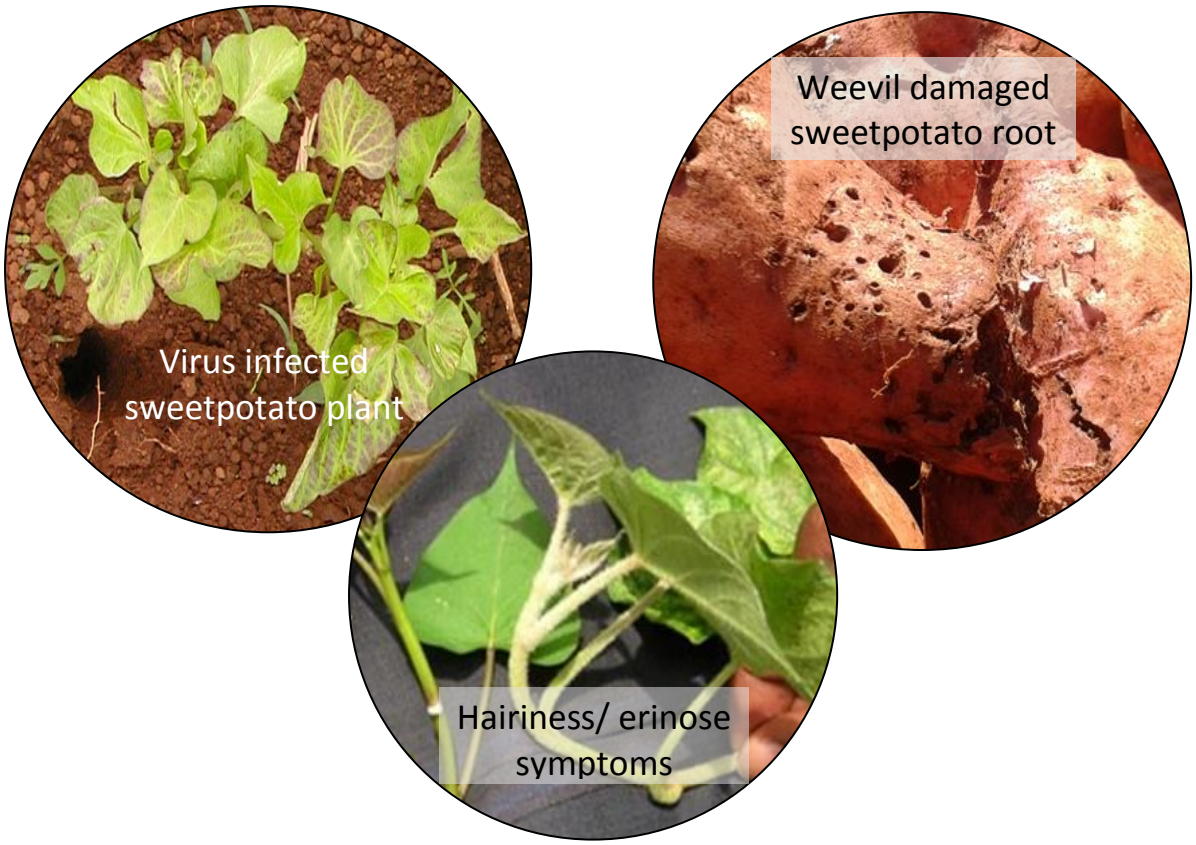
20 plants x 4 roots each = 80 roots

If only 50% of these roots are of sufficient quality and size (small to medium) to be used for Triple S

There will then be 40 good quality roots to use in the Triple S basin

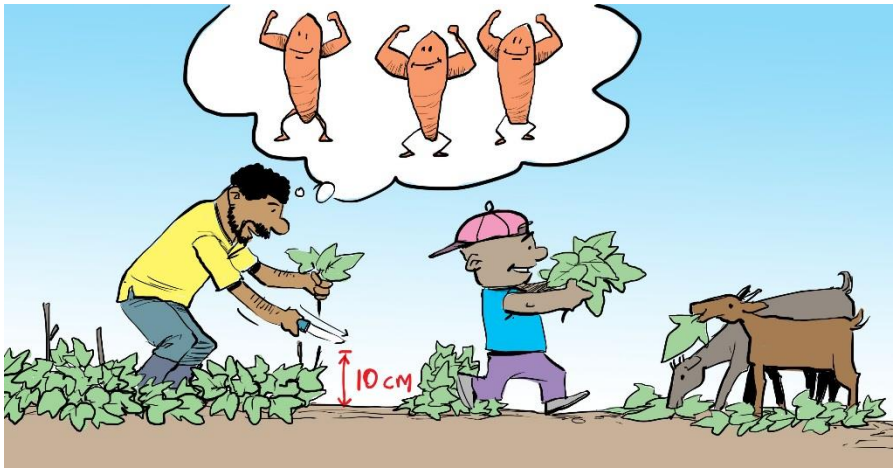
It is therefore wise to peg about 25 healthy plants, and then two weeks before harvest walk through the field again to see whether any of the plants have developed disease or pest attack symptoms and if any have then remove the pegs next to them.

Unhealthy plants include those with virus or other disease symptoms, such as dwarfed plant, or tight crinkled crowded leaves, plants with spots on their leaves, as well as plants with excessive hairiness (mites) or any signs of weevil damage (see Appendix 3 for more details on the symptoms and lifecycles of these pests and diseases). Unhealthy plants should be rogued (removed).



As well as coming from a healthy plant, the roots used in Triple S should not be damaged or bruised by pests, rough harvesting or handling.

De-topping/ de-haulming sweetpotato plants to trigger in-ground curing of roots



Cutting the foliage (vines) off the pegged plants prior to harvest is called de-haulming or de-topping and it causes physiological changes in the roots to occur. These changes are known as curing, and they help roots heal any wounds on them and produce a thicker skin to protect them from disease and limit the weight loss and shrinkage which will otherwise occur after harvest.

This de-topping or de-haulming should be done 3-5 days prior to harvest. Note: It is important that a stem length of ~15cm above ground is left following de-topping. The cut foliage can be fed to livestock, or made into silage.

During the de-topping process, the vines can be checked to make sure they do not show evidence of weevil tunnels down through them. Roots from plants with weevil tunnelling down the length of their stems should not be stored as Triple S roots as there are likely to be weevil eggs or larvae in them.

5. CAREFUL HARVESTING

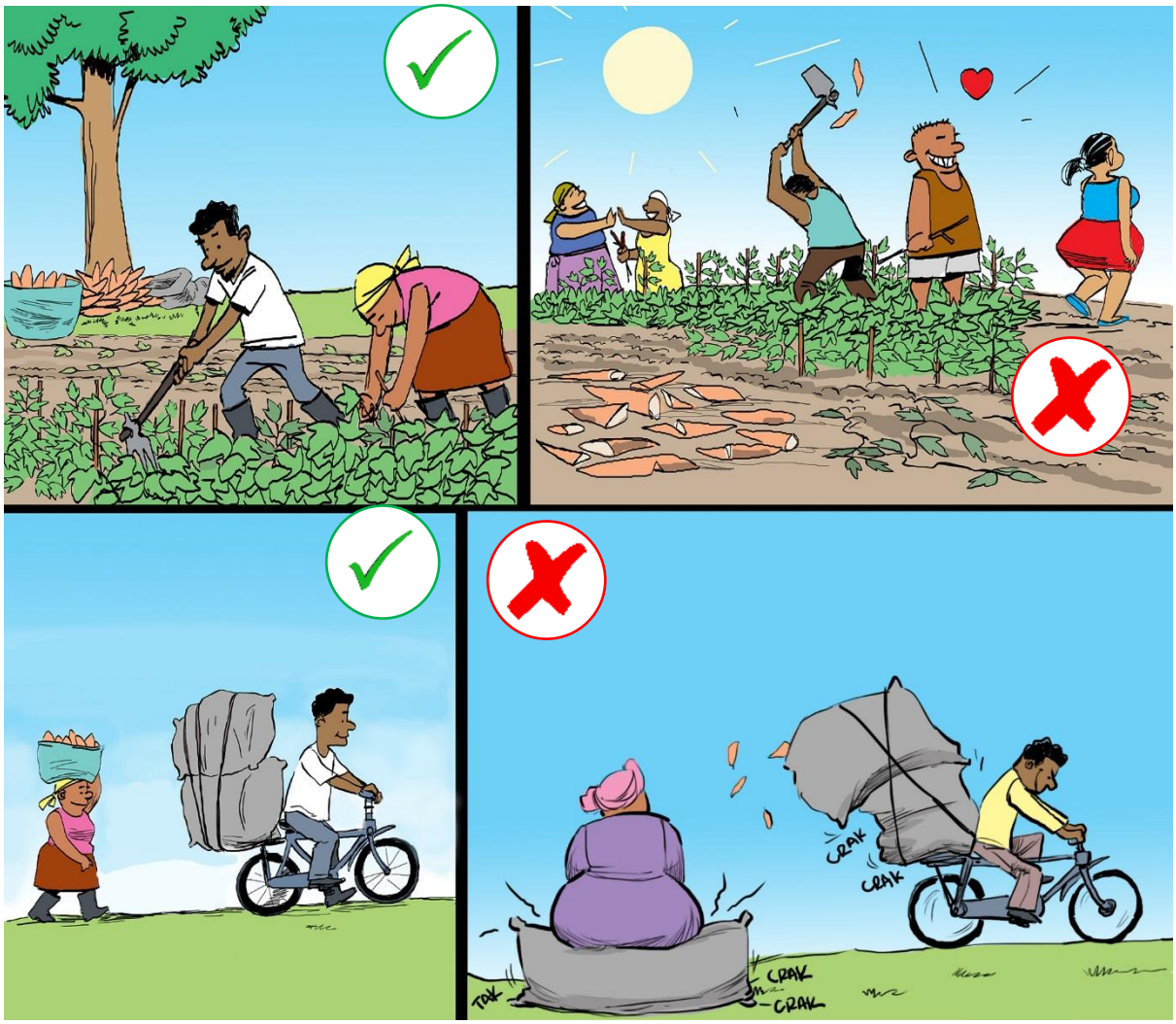
Careful harvesting will help reduce skin damage, breakages and bruising of the roots.

Try and harvest the roots when the soil is dry as opposed to very wet, but harvesting in extremely dry hard soil may result in the use of excessive force and root damage. Farmers should harvest roots to be used in their Triple S systems themselves, as labourers may not understand the importance of ensuring the roots are harvested undamaged.

Use of a fork hoe, and careful slow work will make it easier to harvest the roots undamaged.

Place the freshly harvested roots under the shade of a nearby tree for 2 to 3 hours, and cover them with a canvas sheet (not a plastic or polythene sheet). Do not wash the roots.

The best roots will then need to be selected from all of the harvested roots, this is typically done at the homestead and so care needs to be taken while transporting the roots to the homestead. Sacks should not be overfilled or bumped or dragged along paths. Baskets or sacks of Triple S roots should never be dropped to the ground from a height nor sat or stood on. It is better to carry the Triple S roots in smaller quantities in baskets, covered to protect the roots from direct sunlight.



Sweetpotato roots for use in Triple S must be carefully harvested and transported to prevent damage and bruising

6. Selection of roots for Triple S storage

As the Triple S roots will be stored in sand for several months, it is vital that only healthy, undamaged roots are used to set-up the Triple S system. These roots should be:

- harvested from healthy, disease-free plants (see section 3 above)
- mature, cracking of the soil above the roots indicates maturity and root bulking stage has been reached, together with yellowing and loss of the plant's lower leaves
- small to medium-sized: if roots are too small and thin they will dry out during storage and produce poor quality vines; if roots are large too few will fit in the Triple S basin. Triple S roots should be small to medium sized, and at least as thick as the handle of a hoe. In areas with a long dry season (>7months), farmers prefer to use medium to large sized roots

- weevil-free, any roots show any signs of weevil damage should not be used in Triple S. Even tiny pin-prick sized holes can contain weevil eggs that will develop in to larvae and feed within the root during root storage and then emerge as adults and feed on other nearby roots, and destroy next season's sweetpotato planting materials. The weevil lifecycle can be seen in Appendix 3.

- rot free, any roots that show any signs of discoloration or soft rots should not be used in Triple S, as these can grow and spread during root storage and destroy next season's sweetpotato planting materials

- undamaged, as wounds and breakages provide easy entry points for rot causing pathogens and leading to rapid drying out of roots and poor quality planting materials.

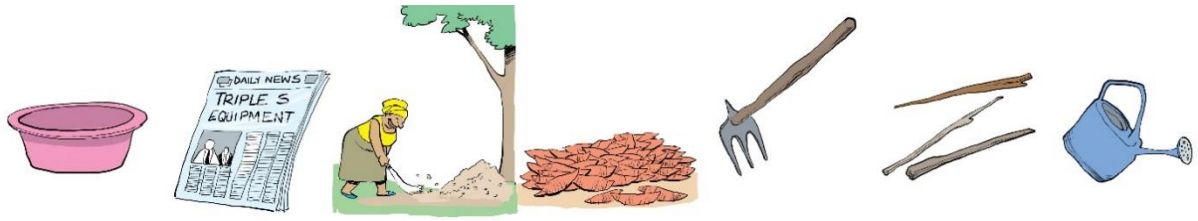
WHETHER TO COMBINE TWO OR MORE VARIETIES IN A TRIPLE S BASIN?

If the Triple S is being set-up to provide planting materials for a crop that will be consumed by the household, then roots of more than one variety can be placed in the same Triple S basin.

However, if the planting materials being produced will be sold commercially, it is important for the farmer to know which variety is being stored and grown and thus they should store the roots of different varieties in separate and labelled Triple S containers to avoid confusion.

Some varieties have very different root skin colours, in that case it would be easy for the farmer to know which variety is which. However, the leaf shapes might still be similar so that if producing planting materials to sell confusion could then arise. Plus if a variety with a spreading growth habit and a variety with an up-right/erect growth habit are mixed together in the field it may lead to reduced growth and productivity of one or the other of them. Additionally, some varieties have very different sprouting characteristics (early, slow, strong, weak etc.), if they are mixed together in one Triple S basin it will make management of the Triple S process much more complex.

7. Preparing and loading the Triple S container



Equipment:

The following items are needed to set up a Triple S container:

- about 40 healthy, mature, undamaged, small-to-medium sized sweetpotato roots. *Note: some farmers prefer to use large basins that can hold 100 roots in 3 layers.*
- a clean container large enough to hold about 40 sweetpotato roots plus a 10cm layer of sand on top. Old plastic washing basins or cooking pans are typically used. Farmers may want to experiment and compared basins with other containers such as baskets. Some farmers in Uganda found that sacks did not work well.
- two pages of a newspaper, for lining the basin to help absorb any moisture.
- about 1 bucket of cool, dry, relatively coarse sand. This can be swept from around the yard, but must not be placed in contact with the roots when hot as it will damage the roots and cause rotting. The sand can be swept, picked clean and placed under the shade of a tree to cool. Coarse sand is better than fine sand, as any water will drain through it and help reduce the occurrence of root spoilage.

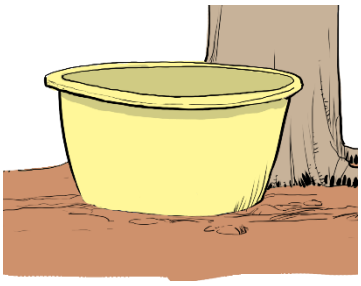
  However, in extremely dry hot areas the stored roots may dry out more quickly during storage if coarse sand is used, and so in these conditions it is likely to be beneficial to use a finer sand. Farmers in very hot dry locations may wish to experiment to determine which type of sand best suits their situation.

- a cool, safe, low-light condition storage location for the Triple S basin. Thatched huts often provide cool low-light environments. Some farmers have been keeping the Triple S basins under their beds, or in the corner of the sitting room. It should be remembered that the Triple S basin needs to be regularly monitored but protected from chickens, children etc.

And thinking ahead… it should be remember that the planting out of Triple S roots 6-8 weeks prior to the rains will require:

- fenced fertile area of a field, close to the homestead or a water source
- hoe
- water source
- watering can

SETTING UP AND LOADING THE TRIPLE S CONTAINER

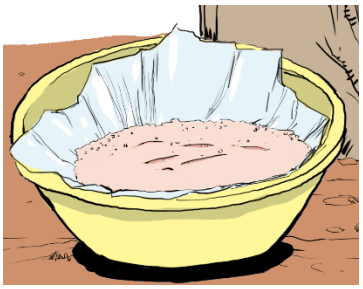


1. Gather all the necessary equipment together in a shady spot

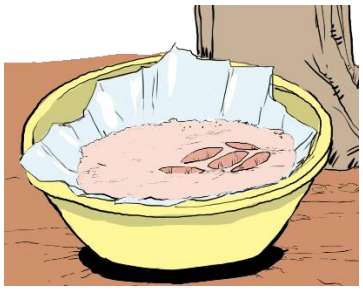
2. Place the newspaper inside the basin, to act as an absorbent layer across the bottom and sides of the basin

3. Add a layer of cool, dry, coarse sand about 2-3 cms deep

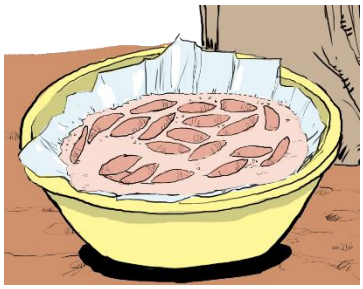
4. Then add a layer of undamaged, healthy roots. Position the roots so that none of them are touching each other, and so that they are not touching the edge or base of the container



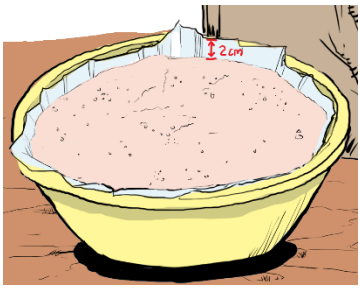
5. Cover the roots with a layer of cool, dry, coarse sand



6. Add another layer of roots, again making sure they do not touch each other or the edge of the basin. Cover them with a layer of cool, dry, coarse sand



7. If there is space in the basin, add a third layer of roots. Again make sure they do not touch each other or the edge of the basin



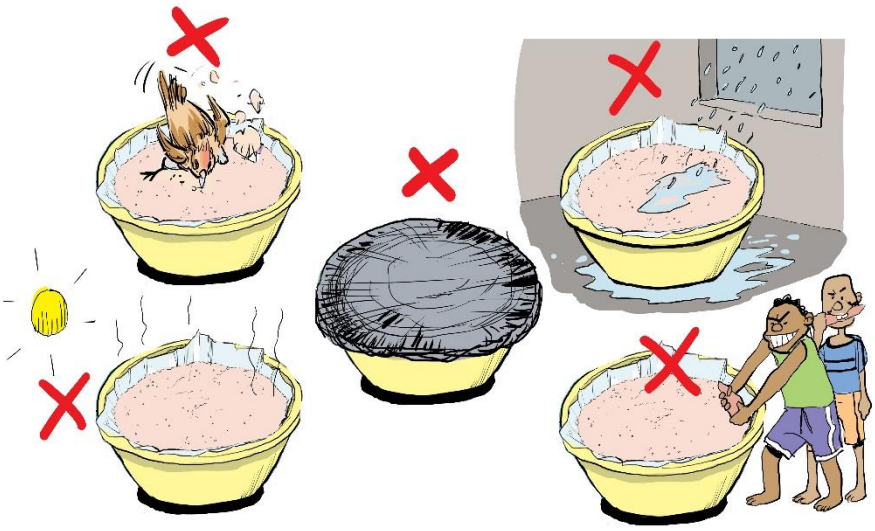
8. Finish with a deep layer of sand (~10 cm thick) to help prevent rodent or weevil damage and sprouting

Storing your Triple S system safely

Two people may need to carry the loaded Triple S basin into its cool, dark, storage location. A thatched hut, or a secure shady cool area under a raised granary or structure, or space inside the home are often used. The Triple S must be kept in a protected place.

Care should be taken to ensure that:

- chickens do not dig or nest in the sand at the top of the Triple S
- it will not get rained on, or too hot
- the basin does not get tightly covered
- the whole household are aware of the Triple S basin and know that it contains next year's food security so should not be tampered with or eaten.



Triple S record keeping

The farmer should keep a note of how many roots they put into their Triple S container/s, of which variety and on what date.

These records can be updated during the regular monitoring to keep track of whether any roots had to be discarded during the Triple S, and if so, how many and due to what problems.

Records should also be kept on the date of any de-sprouting done, the sprouting rates, and the date and number of roots planted out, the quantity of planting materials obtained and on which dates.

8. Monitoring the Triple S

Monitoring of the roots in the loaded Triple S container should be done every month. This enables the farmer to keep an eye on whether the Triple S container has been interfered with by rodents, chickens or people, or whether any roots are sprouting, rotting or shrivelling.

Records should be kept of any observations made, or actions taken and the date at each monitoring.

At each monthly monitoring all the roots should be carefully unloaded and examined. Any rotten or weevilled roots should be discarded, as the other roots may become infected or infested otherwise.

The layer of newspaper lining the Triple S basin should be changed if it has disintegrated. Disintegrating newspaper is a sign that there is moisture around the roots and this can cause rotting. The moisture may be a result of root respiration, or may be a sign that the sand had not been dry enough.

After checking all the roots, the Triple S basin should be reloaded following the same procedure as used at set-up.

If the Triple S is happening in a location with a prolonged dry season (>4 months long), then the roots will need de-sprouting during storage (see section 8 for details of when and if to de-sprout Triple S roots).

9. De-sprouting of roots during Triple S storage

Usually during storage the roots in the Triple S container will start to grow small sprouts. These sprouts typically start to appear just at one end/tip of the root, if they are broken off new sprouts may then start to grow from the sides of the root as well as from its ends. These extra side sprouts can help produce larger amounts of planting materials when the roots are planted out.

Sprouts growing from one end of the stored roots

As the sprouts grow they deplete the nutrients stored in the root, mainly the carbohydrates, but also the water. If sprouts are allowed to keep on growing during Triple S root storage they will deplete the root's nutrients to such as extent, that when the root is then planted out it will not have sufficient nutrient reserves left to support the shoot growth in the period before the plant has established its own root system to obtain water and nutrients from the soil. As soon as stored roots start producing sprouts, their rate of respiration increases and this leads to more rapid weight loss and shrivelling of the root as their resources are used up.

Storing the Triple S in a cool place with low-light conditions, such as inside a thatched hut can reduce the amount of sprouting that occurs, as sprouting is less rapid in cool temperatures. The 10 cm thick top layer of sand in the Triple S container will also help reduce the rate of sprouting, and help prevent rodents and weevils from finding and eating the Triple S roots.

Sprouting is often delayed in roots which have been harvested with the root stalk still attached. Farmers should try to harvest their roots carefully with the root stalk attached to help delay early sprouting during storage.

Roots of varieties with a high dry matter content tend to sprout more than those with lower dry matter.

Only Triple S roots being stored for > 4 months should be de-sprouted, and then only once.

For dry seasons of > 5 months long: it is advisable at the 3 month monitoring, to gently break off all the sprouts by hand before then re-loading all the roots carefully into the Triple S container with a fresh layer of newspaper, and using sand to ensure none of the roots are touching each other or the edge of the container, and that there is a 10cm thick top layer of sand. Do not use a knife to remove the sprouts as it may damage other parts of the roots.

If the dry season is expected to be 5 months long: then de-sprout at the 2 month monitoring check

If roots are only being stored for 4 months or less: then they do NOT need to be de-sprouted, but the Triple S should still be stored in as cool and dark a storage place as possible.

After de-sprouting it typically takes 4 weeks for the roots to produce new sprouts. It is beneficial to plant out sweetpotato roots with small finger-length sprouts as they develop shoots more quickly, this is why the de-sprouting should ideally be done 2 months before the roots will be planted out.

10. Preparing the root bed, planting out and watering Triple S roots

The Triple S roots should be planted out into a pre-prepared root bed 6-8 weeks before the rains are expected to start. Once planted, the roots will need regular watering so they can produce sufficient vines to cut and use as planting materials for the farmer to plant their field with as soon as the rains start.

A root bed should be:

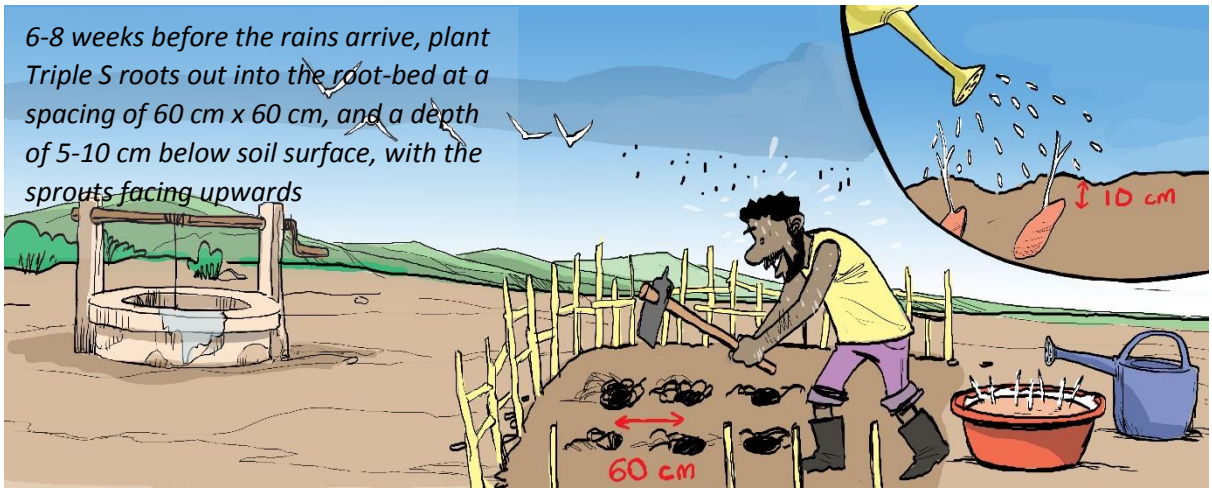
- prepared in advance in an area with fertile soil,
- fenced to protect the vines that grow from being eaten by roaming livestock, as they are likely to be some of the only foliage available at the end of the dry season,
- close to a water source, to facilitate the twice weekly watering,
- close to the farmer's home so they can monitor it easily.

The roots will be planted out at a spacing of 60 cm x 60 cm (~2ft x 2ft). One Triple S basin of 40-50 roots will require a root bed of about 6m x 2m, or 3m x 4m.

The root bed can be either raised bed style or on the flat (ground level). Raised beds are ideal for root bulking as the long as the soil type will not result in them drying out too fast. When roots are planted on the flat, deep tillage is required to ensure the roots can penetrate downwards.

Some farmers incorporate manure into the root bed during its preparation, while others add it or another nitrogen-containing fertiliser during the first vine harvest. Soil clods can be positioned around the emerging shoots to protect them from hot sun and goat damage.

Once the root bed has been prepared, the roots in the Triple S basin should be unloaded and each of them checked to ensure they are not being damaged by weevils, are not rotting, and that none of the sprouts on them look yellow or weak, as this can be a sign of virus infection. Any roots suspected of having weevil, virus or rotting problems should be destroyed and not be planted out in the root bed. Ideally, only the well-sprouted roots should be planted out, as they develop vines more quickly.



6-8 weeks before the rains arrive, plant Triple S roots out into the root-bed at a spacing of 60 cm x 60 cm, and a depth of 5-10 cm below soil surface, with the sprouts facing upwards

Root planting: The Triple S roots are typically planted out in the root bed at a spacing of 60 cm x 60 cm (~2 ft x 2 ft). Each root should be planted at a depth which ensures there will be a 5 - 10cm deep covering layer of soil between the root and the soil surface. This will mean the sprouts on the roots will be buried beneath the soil, the sprouts should be facing upwards. A small depression should be formed above each root to help conserve soil moisture. A small stick can be placed next to each root at planting to help the farmer target their watering.

In locations where water is very scarce, farmers have adapted the Triple S system by planting out the roots at a closer spacing of 30 cm x 30 cm (1ft x 1 ft), and forming a depression in the centre between each group of 4 roots and directing their watering into that depression. Additionally, farmers have been using mulching to help conserve soil moisture.

A farmer group plants out Triple S roots in Homa Bay, Kenya

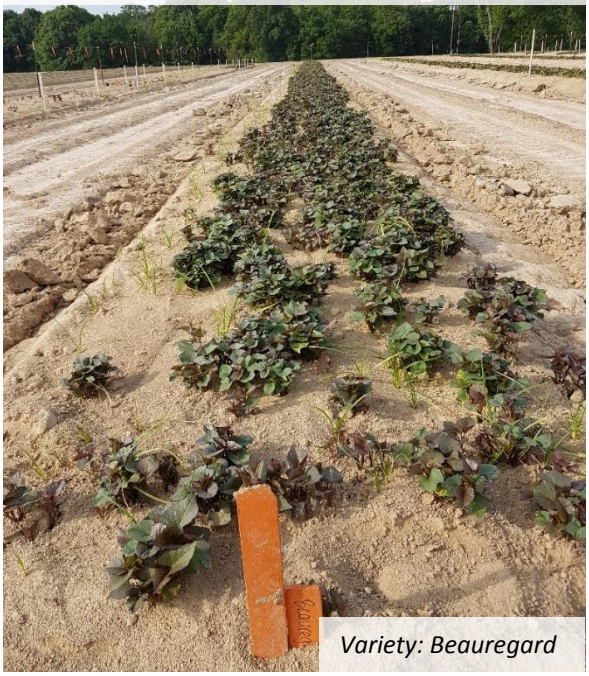
Watering: The roots should be watered at the time of planting, and then twice per week for 2 weeks. After this, the watering should be reduced to just once per week, until the rains are thought to be just 1 to 2 weeks away from arriving and then watering should stop to help harden and prepare the vines for cutting and planting out.

Watering around the planted root will help its feeder roots and shoots to develop. Approximately 1 watering can of water (~10 litre capacity) should be used to water 10-15 plants, so 40 roots will require about 3 watering cans of water twice per week.

In areas where water is scarce and the roots have been planted more closely together (30cm x 30cm), 40 roots will require about 1.5 watering cans of water twice per week.

During the second week after planting out, the shoots should become visible above ground level. The timing of this will be dependent on the variety, the sprout development stage at planting (foliage will develop fastest from well-developed sprouts), and the environment (particularly temperature and soil moisture) (the photos below show how this can differ between varieties).

Comparison of the foliage development of two different varieties of sweetpotato, three weeks after planting out their Triple S stored seed roots

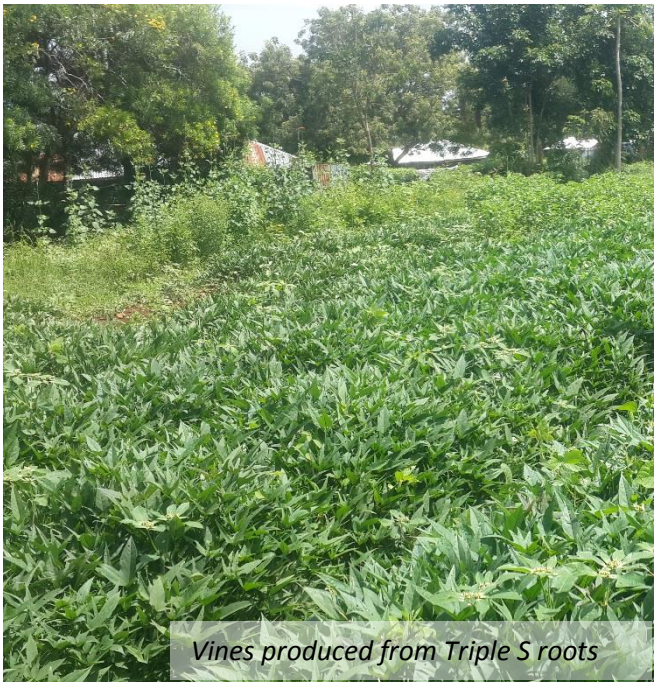


Variety: Beauregard

Variety: Bellevue

11. VINE PRODUCTION FROM YOUR PLANTED TRIPLE S ROOTS

It is usually possible to harvest vines from the Triple S roots 6-8 weeks after the roots were planted out. A second vine harvest should be possible one month later.



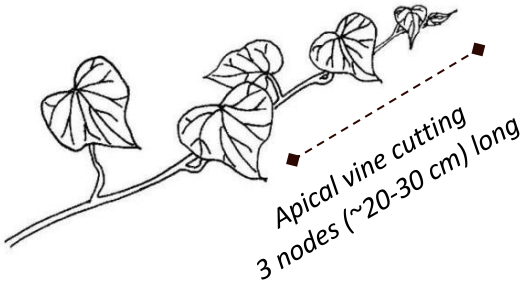
Vines produced from Triple S roots

Some farmers stake the vines of spreading varieties to help increase the vine growth. The apical shoots can also be pinched out to force the plant to develop more side shoots.

To harden the vines before harvest, watering should be stopped 1 week beforehand. During vine harvesting, future vine yield can be increased by leaving a 15 cm length of vine above the soil surface.

Farmers should prepare the field area where they will plant out the sweetpotato cuttings prior to harvesting the vine, so that the time between vine harvest and planting is as short as possible. Any cut vines should be kept in a cool shady placed after harvesting and before planting.

The top/ apical, 3 node-long (~20-30cm) portion of vines of healthy looking plants should be used as planting materials. The apical part most easily recovers from cutting and planting shock, establishes fastest, and is more likely to be free of insect life stages (e.g. eggs, larvae, pupae).



If the vine is long enough, several cuttings each 20-30cm long can be taken. But a 15cm long portion of the plant's stem should be left remaining above soil level to produce the next vines. Vines should only be cut once the rains have established.

Prior to planting, the leaves can be removed from the cuttings to help reduce water loss. The cuttings should be planted upright or at a slant at a spacing of 3 cuttings/m^2, with at least two of the nodes buried under the soil, to encourage faster growth. Some farmers cover the whole cutting with soil initially to protect them, or shade them using soil clods.

Planting material supply calculations

During the first vine harvest of the root seed bed at 8 weeks after harvesting:

40 roots will each produce about 40 cuttings of 25-30 cm length = approximately 1,500 cuttings which is enough to plant 450 m^2 (i.e. 25 x 18 m).

The second harvest (1 month later) will give a higher yield of vines, e.g. 30% more or 2,000 cuttings, so the area planted can be extended by 600 m^2 (20 x 30 m).

Or the second vine harvest could be sold – with an estimated income of ~USD$12 *(Note: prices of cuttings differ with the location and the type of market)*.

12. Triple S Frequently Asked Questions – the in-depth explanations

Farmers and other stakeholders usually have lots of questions about Triple S.

The list below provides detailed explanations to the most commonly asked questions. Use this list of questions as a review exercise to test your own understanding, cover the answers, read each question, think what your response would be and then check the answer to see whether you have understood.

Q1: Which is the best container to use to store the roots in?

A1: Any locally available, low cost container, that is sturdy but not too heavy to carry when loaded. Old plastic wash basins have been used in many areas.

Q2. Other than coarse sand, are there other materials we can store Triple S roots in?

A2: Ash… will desiccate (dry out) the roots. Soil…. is too moist, and encourages rotting. Sawdust… may decompose during storage and encourage rotting and sprouting. So, they should not be used.
Coarse, cool, dry sand works best. But remember, there is a difference between fine and coarse sand. Coarse sand is better, as any water will drain through. Fine sand, will "cake" if it becomes moist and roots will be more likely to rot.

Q3: Which size roots should I use for Triple S?

A3: Small to medium size, mature roots (about the diameter of a hoe handle).

Q4: How do I tell if the roots are mature and ready for harvesting to use in Triple S?

A4: The soil around the plant will start cracking due to the bulking roots below; and the lower leaves of the plant become yellow.

Q5: Why is it helpful to cure the roots before using storing them in Triple S?

A5: Curing helps to thicken the skin, and heals or prevents minor wounds. This reduces likelihood of rotting during root storage.

Q6: What different ways are there to cure roots?

A6: De-haulming/ de-topping (cutting the foliage off) the plant two weeks before harvesting, but leave at least 10 cm of stem above ground. The tip (apical) portions of the cut-off vines could then be planted near a water source.

After harvesting, the roots should be placed in shade under a tree. Cover them with banana leaves, or a mat (but not plastic sheets).

Q7: Why does the last layer of sand in the Triple S bucket have to be 10 cm deep?

A7: It is important to ensure that the top layer of roots is well covered, otherwise they will sprout too soon.

Q8: Can I store two different varieties in one Triple S container?

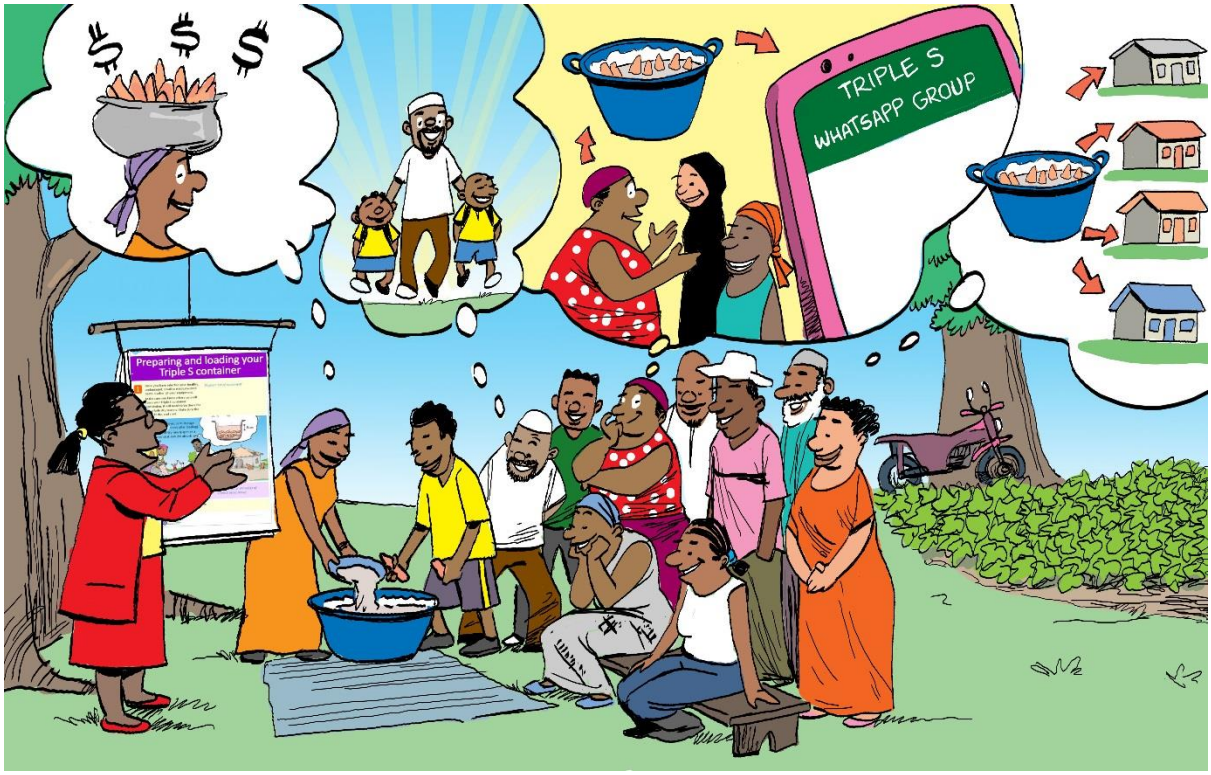
A8: If using Triple S for production of planting material for household use, then two varieties can be stored in the same container, but it is better if the roots can be distinguished by skin colour.

However, if Triple S is being used to produce planting materials for sale, it is important to keep each variety in

	a separate container and to keep the root seed beds separate. This way you can easily tell the customer the correct name of the variety, and when harvesting cuttings it will help ensure varieties do not get mixed up.
Q9: How can I tell if there are weevils in the roots?	*A9: There will be tiny pin-prick marks on the roots, where the weevils have laid their eggs. The larvae will hatch and start to tunnel and feed inside the roots.*
Q10: Why do we need to de-sprout the roots?	*A10: Only roots intended for storage for longer than 4 months should be de-sprouted. If their sprouts are left on, during the long storage period they will deplete the food reserves in the root, and then the vines that grow from those depleted roots would be weak.*
Q11: Do all varieties store and then sprout well with Triple S?	*A11: Varieties can differ in the time it takes for them to start sprouting. Higher dry matter varieties sprout quicker. Longer maturing varieties – may take longer to sprout. But Triple S can be done with all varieties.*
Q12: Can Triple S be used in areas where the dry season is short?	*A12: Yes, Triple S is even beneficial where there is no pronounced dry season. Triple S root based system reduces exposure to pests and diseases; increases the vigour of planting material; and the farmer will be able to obtain vines of the right age (i.e. not too old)*
Q13. What is the best spacing to use in the root seed bed?	*A13: In most areas, roots should be planted out at 60 cm x 60cm spacing. In particularly water stressed areas roots can be planted out at 30cm x 30cm.*
Q14. How frequently should I water my roots after planting them out in the seed bed?	*A14: Twice a week during the first two weeks after planting them out. Then once per week, until about 10 days before the rains are expected, and then stop watering them so the vines harden.*
Q15. What happens if after 8 weeks when the vines are ready for cutting and planting out, the rains have not come?	*A15: Keep on watering the vines, only plant them out once you are sure the rains have started.*
Q16. Why do we stake the vines of some sweetpotato varieties in the root seed bed?	*A16: Trailing the vines of spreading varieties up sticks, encourages more lateral branches and so increases the number of cuttings that can be harvested.*

Please send us details of any other Triple S questions you regularly get asked.

13. SCALING UP AND OUT TRIPLE S



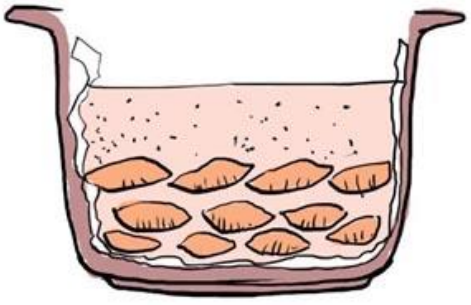
Those trained in Triple S will be able to plant their sweetpotato crop at the start of the rains, and reap the rewards of harvesting food earlier in the season, reducing their hungry season, and providing an opportunity to earn income selling some roots while the prices are high, increasing their yields and extending their harvesting period and resilience to increasingly variable climates.

If half the community were able to plant their sweetpotato crop at the start of the rains as a result of practising Triple S, just imagine what change it would bring to the community in terms of food and livelihood security. Training is an expensive investment in terms of time and resources, and it is important to maximise the impact of that investment.

During each training we need to support the participants' in planning how they will then train 10 other farmers in the Triple S technique, and if each of those 10 farmers trains 10 others then this will rapidly help increase awareness about Triple S and food security in the community. Encourage them to become Triple S champions and make a difference in their community.

Remember Triple S is suitable for many different types of farmers… women, men, youth, elders, resource-poor and wealthier.

Tell your colleagues, local teachers, radio stations and those you meet at agricultural or community development meetings all about Triple S. Start raising awareness of and interest in Triple S as a simple technology which farmers can practice to improve their lives.



Involving local leaders and key stakeholders such as NGO workers or extensionists in Triple S training and identifying Triple S champions among them can help scale up Triple S.

APPENDICES

Appendix 1. Ideas to use as ice breakers and energisers

You can use the quick ice breakers and energisers suggested below to help participants: feel at ease or more open to express their experiences, questions and problems; or to wake them up if they seem tired; and to help the group work together. They should not take more than 5 minutes.

Mirror Image

Participants sort themselves into pairs. Each pair decides which one of them will be the 'mirror'. This person then copies (mirrors) the actions of their partner. After some time, ask the pair to swap roles so that the other person can be the 'mirror'.

Know yourself

Ask the participants to get into pairs. Ask one members of each pair to close his or her eyes. The person with their eyes closed must then tell the other person in as much detail as possible what s/he him/herself is wearing (colours, pictures or writing on T-shirts, dresses, wraps etc., holes, watches, jewellery etc.). The person who has their eyes open may probe for details.

Then ask them to exchange roles, and ask the previous observer to closes their eyes and tell his/her partner in detail what s/he has in her/his pockets or handbag (without feeling or touching).

Discuss: Why are we not more observant? How can we increase our own observation skills?

Signature

Ask the participants to imagine writing their own signature on a form, then ask them to practise writing it using their whole body as opposed to their hand.

Role play review

Ask the participants to get into small groups of 4 or 5, and to act out different aspects of the Triple S method, e.g. pegging, de-haulming and harvesting roots; loading a Triple S container, etc..

When the wind blows

If you have chairs arrange them in a circle, make sure there is one less chair than there are people. One person stands in the centre of the circle, the others sit on their chairs. The person in the centre says (for example), "If you are "wearing red" the wind is blowing" – and all those wearing red have to stand up and quickly move to another empty seat. One person will get left in the middle. It is then that persons turn to decide who moves, e.g. "If you like "drinking sweet tea" the wind is blowing". Or the person in the middle can say "Hurricane" and then everyone has to get up and run to another seat. If you don't have chairs, you could instead draw squares on the ground, to stand within.

There are various online resources for ice breakers, group dynamics and energisers. For example: http://www.excellerate.co.nz/blog/free_energisers_and_group_games.html

Appendix 2. Triple S calculation practice

One Triple S root planted out and watered for 6-8 weeks can generate ~40 cuttings.

One Triple S basin typically holds 40-50 roots => 1,600 to 2,000 cuttings 6-8 weeks after planting out.

If cuttings are planted at a density of 3 cuttings/ m^2
then 1,600 to 2,000 cuttings are sufficient to plant an area of 533 to 667 m^2 (0.13 to 0.16 of an acre).

Then 1 month later, the vines in the root bed can be harvested for a second time, providing another 1,600 to 2,000 cuttings, enabling an additional 0.13 to 0.16 of an acre to be planted to sweetpotato or the cuttings to be sold.

Try the practice calculations below to help build your confidence. Cover up the step-by-step calculations and try and figure out the answer, then check to see if you have calculated it correctly.

1. **Farmer Amina wants to plant 0.5 acre of sweetpotato at one time in order to sell it all to a large trader who will come and harvest the roots. How many Triple S basins should Amina set up?**

Step-by-step calculations:

So, 1 acre = 4,047 m^2, therefore 0.5 acre = 2,023 m^2. If Amina plants cuttings at a spacing of 3 per square metre, then she will need at least 2,023 x 3 = 6,069 cuttings.

We know from our earlier calculations, that one Triple S basin of 40-50 roots produces 1,600 to 2,000 cuttings 6-8 weeks after planting the roots out.

So, 3 Triple S basins of 40-50 roots would produce 4,800 to 6,000 cuttings.

And 4 Triple S basins of 40-50 roots would produce 6,400 to 8,000 cuttings.

So Amina would probably be wise to set-up 4 Triple S basins of 40-50 roots each, and then she will have sufficient planting materials to plant the whole 0.5 acre area at one time, and can sell any remaining planting materials. She will also be able to harvest her root bed again a month later and obtain another 6,400 to 8,000 cuttings which she could sell or use to plant another field.

2. **Farmer George wants to plant 0.25 acre of sweetpotato, but he wants to plant half of it at the start of the rains and the rest of it a bit later to help spread risk in case the season is not good and to allow his family to piecemeal harvest the roots as food for a longer period of time. How many Triple S basins should George set up?**

Step-by-step calculations:

So we know 1 Triple S basin of 40-50 roots will provide 1,600 to 2,000 cuttings 6-8 weeks after planting out. And if the cuttings are planted at a density of 3 cuttings per square metre, then 1,600 to 2,000 cuttings are sufficient to plant an area of 533 to 667 m^2 (0.13 to 0.16 of an acre).

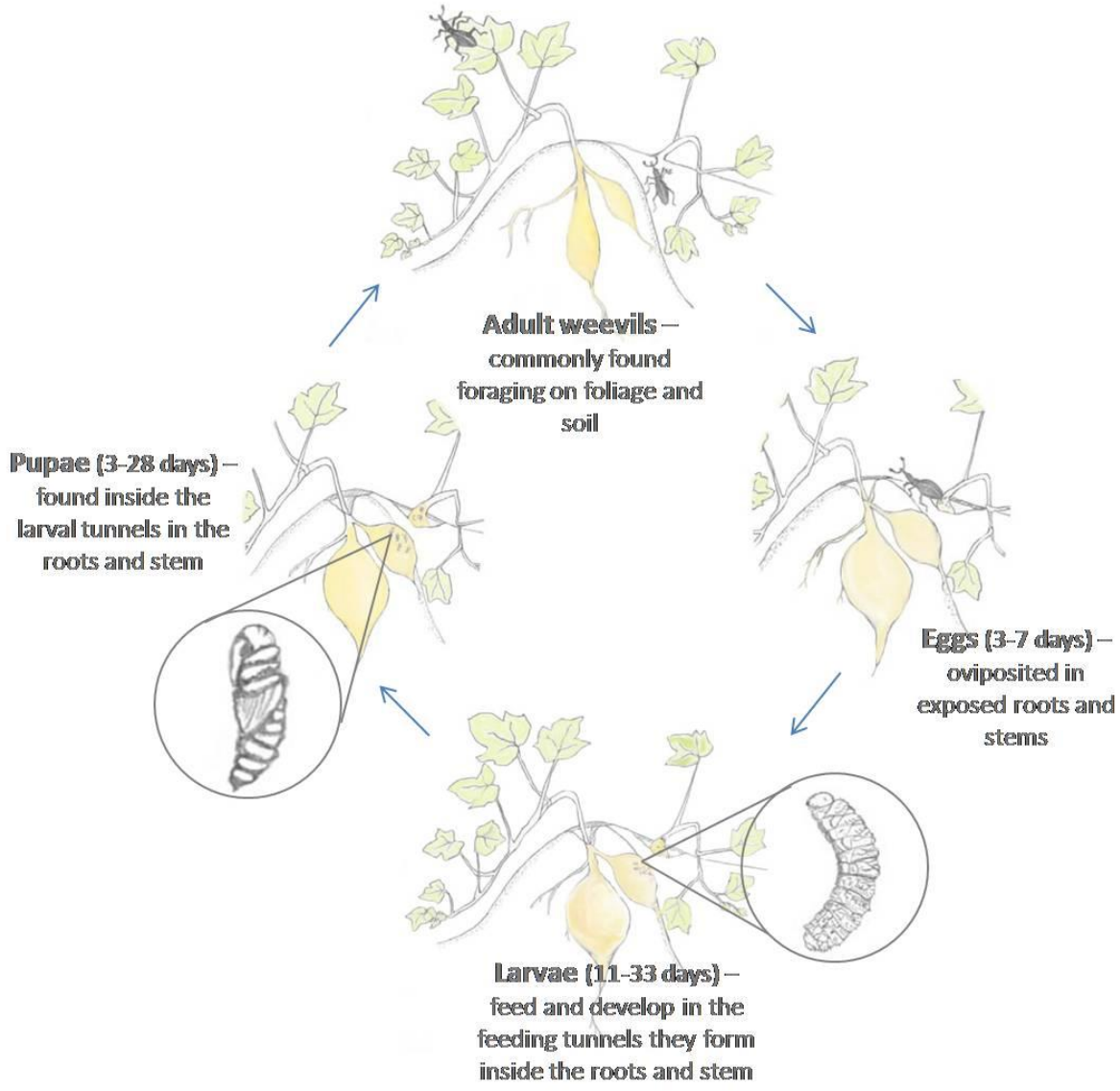
We also know that the second vine harvest of the root bed, one month later would provide another 1,600 to 2,000 cuttings, which could be used to plant another 0.13 to 0.16 acres.

So 1 Triple S basin of 40-50 roots would provide enough cuttings for George to plant 0.15 acre at the start of the rains, and one month later he would be able to again harvest cuttings from his root bed to plant another 0.15 acres, leading to a total of ~0.3 acres of sweetpotato being planted.

Appendix 3. Overview of key sweetpotato pests and diseases

Extracted from the Everything You Ever Wanted to Know About Sweetpotato ToT Manual

Life cycle of the sweetpotato weevil, *Cylas* spp.

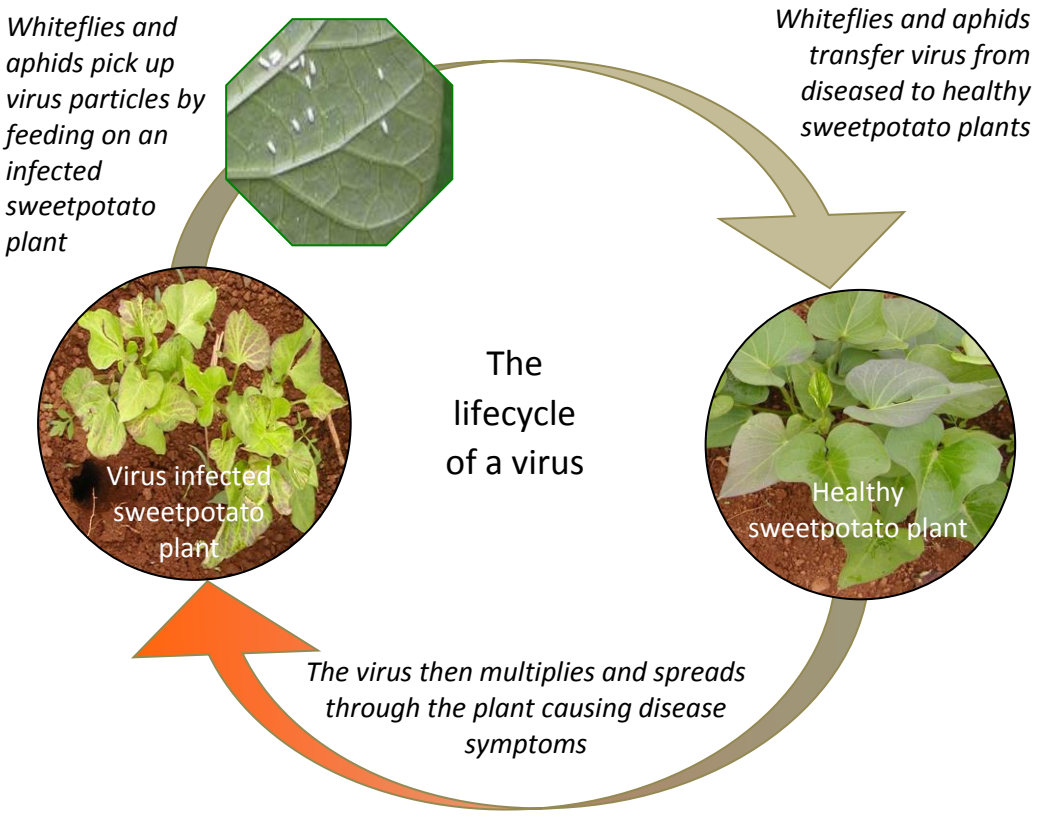


Source: Stathers et al., 2005

Adult weevil on root

Signs of weevil feeding activity on roots

Lifecycle of sweetpotato viruses



Viruses are so small you cannot see them. However, you can see their effects as, despite their small size, they are the most damaging group of disease organisms affecting sweetpotato in Africa.

Common symptoms of virus infection in plants, including sweetpotato, are:

- diminished growth/ stunting causing the plant and leaves to remain small
- chlorosis (paleness) of the leaf tissue so that the diseased plants stand out from the rest of the crop. This can be general or in a pattern, often either between the lead veins in a mosaic or less well defined mottle, or along the veins to form a chlorotic network.
- misshapen leaves with an uneven or curled appearance
- pigmented leaves, often purple or yellow generally or in spots or rings
- reduced production of sweetpotato storage roots

There are two main sweetpotato viruses that affect sweetpotato in Africa (*Sweet potato feathery mottle virus* (SPFMV)) transmitted by aphids and *Sweet potato chlorotic stunt virus* (SPCSV) transmitted by whiteflies. Each virus by itself may cause only very mild symptoms but when a sweetpotato plant gets infected by both the viruses, a very severe disease results which is known as sweetpotato virus disease (SPVD).

The insects do not spread SPVD over very long distances. But if virus infected planting materials (vines or roots) are transported long distances, then the disease can be spread very widely.

In order to reduce the chances of your crop getting infected with virus disease:

1) **Always use planting materials cut from healthy-looking plants**. In addition:

   - Try and make sure the whole field that you take your planting materials from is healthy, as this will reduce the likelihood of taking cuttings from plants that have just been infected but are not yet showing symptoms.
   - Try to collect cuttings from young or mature crops (3-4 months old), as sweetpotato virus disease symptoms are harder to see in older plants.

2) **Remove and burn or feed to livestock any diseased plants as soon as they appear in young crops**. This practice of removing diseased plants is known as roguing and is very important to reduce the spread of the virus within your sweetpotato field. Remember, if a plant becomes infected it won't yield very much anyway, so you are improving your chances of harvesting a good yield if you removed infected plants as early as possible. Otherwise, the insects can use them to spread the disease widely in your field and seriously reduce your yields. The neighbours of plants which have been rogued will soon fill up the gap and produce larger roots as a result, or you can gap fill with a new cutting.

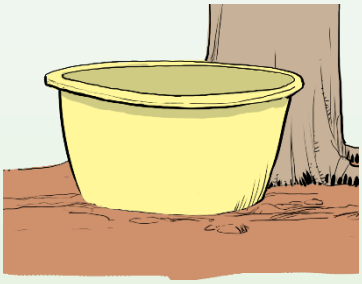
3) **Plant sweetpotato varieties that are resistant to the disease**. Some varieties are rarely affected by virus disease. You can set up a replicated trial to test which varieties seem to be resistant to virus diseases.

4) **Avoid planting new sweetpotato crops where you grew sweetpotato last season**. If there are roots or vines from old diseased plants surviving in the soil, they may sprout and produce diseased plants from which infection will easily spread to your new crop. This is also an important aspect of weevil control.

5) **Plant your new sweetpotato crop away from old sweetpotato crops**. This will make it harder for the aphids and whiteflies to reach your new crop and bring the virus disease from the old crop. This is also an important aspect of weevil control.

Remove any diseased plants as soon as they appear, as this helps to reduce the spread of the disease

Sweetpotato Triple S: Sand, Storage, Sprouting Guide for Trainers

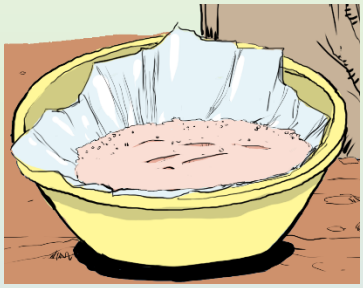


1. Gather all the necessary equipment together in a shady spot

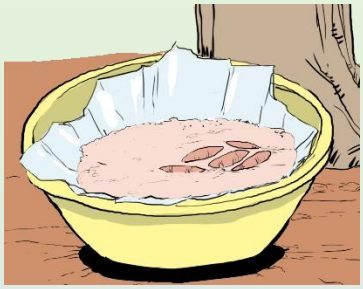
2. Place the newspaper inside the basin, to act as an absorbent layer across the bottom and sides of the basin

3. Add a layer of cool, dry, coarse sand about 2-3 cms deep

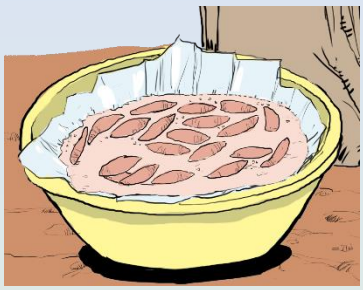
4. Then add a layer of undamaged, healthy roots. Position the roots so that none of them are touching each other, and so that they are not touching the edge or base of the container



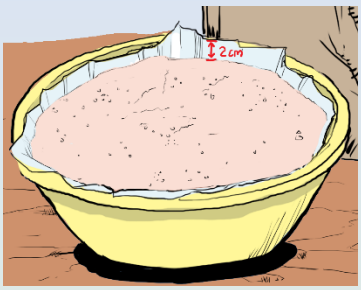
5. Cover the roots with a layer of cool, dry, coarse sand



6. Add another layer of roots, again making sure they do not touch each other or the edge of the basin. Cover them with a layer of cool, dry, coarse sand



7. If there is space in the basin, add a third layer of roots. Again make sure they do not touch each other or the edge of the basin



8. Finish with a deep layer of sand (~10 cm thick) to help prevent rodent or weevil damage and sprouting

SASHA

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