



RESEARCH  
PROGRAM ON  
Roots, Tubers  
and Bananas



# Sweetpotato Silage Making Manual

*Expanding Utilization of Roots, Tubers and Bananas and Reducing Their Postharvest Losses*

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Center of  
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*The CGIAR Research Program on Roots, Tubers and Bananas (RTB) is a broad alliance led by the International Potato Center (CIP) jointly with Bioversity International, the International Center for Tropical Agriculture (CIAT), the International Institute for Tropical Agriculture (IITA), and CIRAD in collaboration with research and development partners. Our shared purpose is to tap the*



*underutilized potential of root, tuber and banana crops for improving nutrition and food security, increasing incomes and fostering greater gender equity, especially among the world's poorest and most vulnerable populations.*



# Table of Contents

---

I. Introduction.....	2
II. Sweetpotato crop production and management.....	4
III. Harvesting, consumption, storage and marketing.....	9
IV. Sweetpotato as a livestock feed.....	10
Challenges to use of sweetpotato residues as livestock feed .....	10
Methods used to make silage: types of silos .....	12
(1) Stack silo .....	12
(2) Trench silo .....	13
(3) Plastic bag silo.....	14
(4) Improved plastic tube silage.....	16
Feeding silage to livestock .....	24



## LIST OF ACRONYMS

CIAT	International Center for Tropical Agriculture
CIP	International Potato Center
IFAD	International Fund for Agricultural Development
IITA	International Institute for Tropical Agriculture
ILRI	International Livestock Research Institute
KARLO	Kenya Agricultural and Livestock Research Organization
NALIRRI	National Livestock Resources Research Institute
NARO	National Agricultural Research Organization
OFSP	Orange Fleshed Sweetpotato
RTB	CGIAR Research Program on Roots, Tubers and Bananas
UGX	Ugandan Shillings



## I. Introduction

Sweetpotato is the third most important food crop after cassava and bananas in Uganda. Currently, sweetpotato is number one food crop in the Lake Victoria region. Uganda is now the leading producer of sweetpotato in Africa, and second only to China in the world. Increased production has been achieved more from area under cultivation than from increased yields, which over the past decade have remained fairly consistent at a national average of approximately 4.5 tons per hectare. The crop has potential benefits to poor farm households and urban consumers especially when other crops fail or in specific seasons before the main harvest.

### Importance of sweetpotato

- Sweetpotato is currently being developed as a means to address one of the most serious health and nutrition problems of Uganda, Vitamin A deficiency which is a major risk factor for pregnant and lactating women. The Orange Fleshed Sweetpotato (OFSP) cultivars contain particularly high levels of carotenoids and are equaled only by carrot as a source of pro-vitamin A. Sweetpotato tubers provide a source of carbohydrates, calcium, ascorbic acid (vitamin C).
- Sweetpotato roots may be eaten boiled, steamed or processed into simple products such as chips, bread, local brew/drink, juice, pancakes and composite flour (mixed with maize, millet and soya flour).



*SP vine-based partial milk diets as substitute to reduce the cost of rearing calves*



## Some of the products from sweetpotatoes

- In some communities, tender (young) sweetpotato leaves are consumed as a vegetable.
- Food security crop and cash crop in urban markets in other districts.
- Sweetpotato contributes about 20% of total crop residues provided by vines, non-commercial sweetpotato roots, peels which are very good source of livestock feed.
- Sweetpotato residues (small roots and vines) can be fed to livestock (pigs, goats, sheep, rabbits and cattle) and in the processed vines and roots can be chopped into small pieces made into silage to feed livestock.
- Studies conducted at the National Livestock Resources Research Institute showed that sweet potato vine-based partial milk diets can be used as substitutes to reduce the cost of rearing a calf without adversely affecting its health and yet save more milk for consumption and processing.

## Constraints to production and marketing of sweet potatoes

### *(a) Production constraints:*

- sweet potato weevils
- drought
- lack of planting materials
- labour shortage
- lack of farm implements
- land scarcity
- low soil fertility
- vertebrate pests of moles, rats and pigs

### *(b) Marketing and post-harvesting handling constraints:*

- low price
- lack of market
- high labour costs
- unavailability of transport
- information on processing
- weather fluctuations
- inadequate marketing system
- labour shortage in processing



## II. Sweetpotato crop production and management

### Sweetpotato varieties

Major sweetpotato varieties in Uganda include Orange Fleshed Sweet Potatoes, Ejumule, NASPOT, Dimbuka, Rangira, Bwanjule, New Kawogo, Tanzania, and Wagabolige. Preference depends on sweetness, lack of fibres, in-ground storability, early maturing, drought tolerance and tolerance to diseases. Table 1 shows average tuber yield of some of the varieties in Uganda.

**Table 1: Average tuber yield (kg/acre) of some of the sweet potato varieties in Uganda**

Variety	Popular name	Mean yield (tons/acre)
SPK 004	Kakamega	9.5
Ejumula	Ejumula	6.0
NASPOT 9-O	VITA	10.4
NASPOT 10-O	Kabode	8.5
Vitamin A sweet potato	Orange fleshed sweet potato	12.0



*Orange Fleshed Sweet Potato*

### Soil requirements

- The crop grows on a variety of soils, but well drained light and medium textured soils with a pH range of 5.5-7.0 are more favorable.
- A well distributed rainfall of 750–1000 mm per year is considered most suitable for the crop with a minimum of 500 mm in the growing season.
- The site should be at least 50 meters away from old sweetpotato crop to minimize spread of pests and diseases from old to new crop.



- Sandy loam soils give the best yields. In a proper crop rotation, sweet potato can follow either cereals such as maize, sorghum, rice, finger millet or legumes such as beans.

### **Land preparation**

- Land preparation is done using either a hand hoe or oxen/tractor drawn plough. The operation aims at turning over the topsoil so that plant residues are incorporated in the soil.
- Deep cultivation (at least 15cm) improves the oxygen supply in the soil, thus favoring the growth of bacteria that help in decomposing organic matter.
- The compacted parts that have been trampled by humans, animals and tractor become loose again, thus increasing aeration, water infiltration and good drainage.

### **Selection of planting material**

- Sweetpotatoes are grown from vines which are normally cut from a sweetpotato garden or sprouts from old sweetpotato gardens.
- It is recommended to select planting material from healthy vigorous crop (2-3 months old), vines from old crop produce a less vigorous crop and poor yield.
- Cut the top 30cm of the vine for best results. The middle part of the stem can also be used if there is shortage of planting material.
- Plant the vines within 7 days after cutting to avoid loss in quality.
- If not planted on time, cuttings can be stored under shade or in a cool well aerated place. During storage roots develop at the base of the cuttings, the vines harden and establishment becomes faster.

### **Fertilizer application**

- Organic fertilizers (composted manure, green manure) releases nutrients slowly and therefore should be applied as a basal fertilizer (incorporated when making mounds or ridges).
- During growing period, the plants form dense foliage with rapid vine growth. .

### **Planting time, methods and plant population**

- Sweetpotatoes are planted at the beginning of the rain season to get best results,
- The vines are grown on mounds and ridges of varying sizes. A mound should be 100cm wide and 60cm high, the distance between mounds should be 1m. Ridges are spaced at 0.5m from each other.



*Ridges*



*Mounds*

- The planting operation involves pushing the lower part of the vine cuttings into the soil, such that they are nearly horizontal. Three vines are planted per mound (4-5 vines can be planted on extremely large mounds like in Buganda). Vines are spaced 30cm from each other on mounds or ridges.

### **Weeding**

- With adequate soil moisture and good soil fertility, sweetpotato vines will cover a large area within one month.
- Thoroughly weed your sweetpotatoes twice; within one month after planting and two months after planting by pulling them gently; if possible avoid deep digging with a hoe or other tool that disturbs the feeder roots that quickly spread throughout the bed.
- Water is especially important as plants grow and roots spread.

### **Sweetpotato pests**

- Sweetpotato production can be constrained by pests and viral diseases that cause yield reductions, potentially from about 50 percent to even as much as seventy percent.

#### *(a) Sweetpotato weevil*

The sweetpotato weevil is the most serious insect pest of sweetpotatoes worldwide.





(b) *Sweetpotato hornworm*



### Sweetpotato diseases

Several viruses currently recognized as significant constraints to sweet potato (SP) in Uganda, listed roughly by their frequency of occurrence, include:

(a) *Black rot*

Black rot is caused by the seed-borne fungus *Ceratocystis fimbriata*. Symptoms include large circular, brownish to black, firm, dry rots on sweet potatoes.



- Stunted plants;
- wilting plants;
- yellowing plants;
- dropping leaves;
- plant death;
- circular brown-black patches of rot on tubers

In plant beds symptoms include plant stunting, wilting, yellowing, leaf drop, and plant death. Rots may continue developing in storage. Infected roots have a bitter taste. Management: Avoid infected seed roots. Cut transplants above the soil line. Rotate with other crops in a 2 to 3 year rotation. Treat seed roots with a fungicide.



(b) *Ring rot*

Ring rot is caused by the common, soil-borne fungus *Pythium* spp., which also parasitizes many other plants. Infected roots have sunken, chocolate colored lesions that tend to extend laterally and often form a ring around the sweet potato.



*Ring rot*

The soft rot extends into the interior as illustrated. Losses generally occur late in the season during cool, rainy periods. Symptoms may be confused with *Rhizopus* and bacterial soft rots and souring. Ring rot usually does not spread in storage. The disease can be managed by harvesting prior to cool, wet periods.

(c) *Fusarium root and stem rot*

*Fusarium* root and stem rot, caused by the fungus *Fusarium solani*, is a common field and storage rot. The rot extends deep into the sweetpotato and is firm and dark tan in color. Internally, elliptical cavities form in which a white mold develops.



*Fusarium root and stem rot*

The soil-borne disease may be spread by infected transplants. The base of mature stems may become swollen and distorted.

Generally, pests and diseases can be managed by applying integrated pest management (IPM) methods. These include: (a) planting healthy vines, (b) planting a new crop 50m away from the old field, (c) early planting, crop rotation, (d) destruction of infested plant parts and (e) destroy volunteer crops.



### III. Harvesting, consumption, storage and marketing

#### Harvesting for quality

Sweetpotatoes are usually ready to harvest just as the ends of the vines begin to turn yellow, or about 4-5 months after planting depending on variety. To avoid injuring roots, find the primary crown of the plant you want to dig, and then use a digging fork to loosen an 18-inch wide circle around the plant. Pull up the crown and use your hands to gather your sweetpotatoes. To make digging easier and get the vines out of your way, you can cut some of them away before digging.

Harvesting the roots in piecemeal (removing big roots and creating room for small ones) can start at 3 to 4 months. Wholesale harvesting takes place when the crop is mature (4-6 months)

#### Consumption

Sweetpotato is generally consumed in fresh form, but where weevil attacks limit the length of time that roots can be kept underground prior to harvesting, they can be harvested, chipped, and sun-dried to make products such as inginyo and amukek. Sweetpotatoes can be baked, roasted processed into dry chips, pounded into powder to make other delicacies like cakes, cookies, pancakes, etc.

#### Storage and marketing

Sweetpotato roots are bulky and perishable unless cured. This limits the distance over which sweetpotato can be economically transported. Production areas capable of generating surpluses tend to be relatively localized but dispersed, which leads to a lack of market integration and limits market size. Moreover, production is highly seasonal leading to marked variation in the quantity, and quality, of roots in markets and associated price swings. There is little commercial processing into chips or flour, which could be stored for year round consumption for use in ugali, bread and cakes, or processing into fermented and dried products like fufu. Sweetpotato consumption tends to decline as incomes rise, a change often linked with urbanization, partly because it is perceived as a “poor man’s food” but mostly because of the change in relative prices of root crops compared to grains in urban areas due to transport cost differentials.

- Roots can be stored in the ground for an additional period but they are attacked by weevils when soil is dry and cracked. This leads to a marked seasonality of supply with substantial price variability and deterioration in quality as the dry season progresses. Seasonality of supply creates a barrier to increasing per capita consumption and income earning possibilities both for fresh sales and for processing.
- Farmers have developed “In ground storage and piecemeal harvesting” technology to maintain the supply of fresh sweetpotato for as long as possible. In Uganda this involves staggered planting, so that crop will not all mature simultaneously, and in ground storage of roots after maturity, for up to six months. Piecemeal harvesting is an indigenous practice which may reduce weevil losses as more superficial and potentially damaged roots are harvested first.
- Farmers in areas with marked dry seasons in Uganda sun dry sweetpotato to extend the period when it may be consumed. In Uganda, roots are sliced (amokeke) or crushed (inginyo) before drying. Amokeke is reconstituted whole as a breakfast food and inginyo used for flour to produce atapa, a starchy staple.



- In Tanzania roots are sliced fresh or after boiling before drying. These products can be stored for six months.
- Dried products are mostly used for home consumption with limited commercialization, probably because they are not competitive with dried cassava chips. Slicing and drying by hand is labor intensive for processing large quantities when fresh storage would be preferable, but is an option for dealing with small quantities at a time. If farmers could store fresh roots they could benefit from higher prices at the end of the harvest season.
- Sweetpotato can be chipped and dried. At the village level, women slice the sweetpotato into thin round chips by hand. Commercially oriented operations require an investment in chippers, with manual, bicycle driven and motorized versions available, and drying racks.
- Dried chips can be milled to make sweetpotato flour. This adds more value for farmers, and reduces volume for transportation, and was financially viable in a pilot trial. But it is difficult for farmers to maintain quality (a) because they cannot determine moisture content and may mill chips which are not properly dried and (b) it may contain impurities as farmers use public mills.
- The largest flour market is for staples such as ugali. White fleshed sweetpotato flour would have to compete on price and quality with cassava and maize flour in this market. Since fresh sweetpotato tends to sell at a higher price than cassava this could be difficult.
- The best market for sweetpotato flour would be as a substitute for wheat flour in the production of the snack foods, chapattis (flat unleavened bread) and mandazi (doughnuts) and porridge, where sweetness is not an issue.

## IV. Sweetpotato as a livestock feed

### CHALLENGES TO USE OF SWEETPOTATO RESIDUES AS LIVESTOCK FEED

Although sweetpotatoes are a good source of energy (roots) and protein (vines), they are highly perishable. In order to make good use of sweetpotato residues (vines and roots) there is need to conserve them in form of silage which has the potential to mitigate seasonal feed shortages and help cope with seasonal feed prices fluctuations that many smallholder livestock farmers experience. It also provides opportunity to reduce waste in urban market and at household level as well as it can open up business opportunities for youth and women

Sweetpotato silage is a method for preserving vines and roots in a succulent condition in a silo. Well-made sweetpotato silage is a wholesome and nutritious feed for all classes of cattle and pigs. Sweetpotato silage is made by fermenting chopped vines and roots of non-commercial value in the absence of air and can be stored for up to a year. Its protein content and digestibility makes it an excellent complement to grass feeds (Table 2).



*Making high quality sweet potato silage*

**Table 2: Nutrient value of sweetpotato vines and silage compared to Napier grass\***

	Moisture content (%)	Crude protein content (%)	Neutral Detergent Fibre (%)	Metabolizable energy (MJ/kg)	Digestibility (%)
Sweetpotato vines (fresh)	87	16.0	46	8.3	60
Sweetpotato silage; vine and roots	72	16.2	20	13.3	69
Napier grass (fresh)	82	10	60	8.5	57
Napier grass (Silage)	80	9.5	56	7.8	66

*\*Values on dry matter basis at 6-8 weeks old*

Silage can be made with only chopped vines or combined chopped vines with roots (at a ratio of 70:30) or with a grass like napier. The use of a ferment starter, like molasses, improves the process of fermentation and nutrient content. Use of sweetpotato silage can significantly reduce feeding costs. However, sweetpotato silage is underutilized in Sub-Saharan Africa because it is largely unknown. The best use of sweetpotato silage is during periods of feed scarcity. Vines and roots can be chopped either manually (panga) or with a motorized forage chopper. The former is recommend for small scale producers while a motorized chopper (costing about UGX 2 to 3 million depending on the capacity) is more suitable for large scale producers or farmers' groups.



## METHODS USED TO MAKE SILAGE: TYPES OF SILOS

### (1) Stack silo

- A plastic sheet (about 0.1 mm thick) is spread over the ground.
- Material for making silage is chopped using a forage chopper or a panga and placed on the sheet or cemented floor (Figure 1).



Figure 1: Stack silo

- The material is entirely covered with a plastic sheet.
- Proper tread pressure has to be applied, and complete sealing is required.
- The size of a silo depends on the number of raising animals.
- It is necessary to make steps to prevent damages on the plastic sheet by field mice or birds.

Table 3 shows estimated cost of materials required to produce 500 kgs using stack silo method. The calculations are based on the assumption that the farmer gets the vines from her/his field.

**Table 3: Estimated cost of materials required to produce 500 kgs using stack silo method**

Material	Quantity	Unit cost (UGX)	Total amount (UGX)
Fuel and oil for forage chopper	1	5,000	5,000
Polythene material (meters)	15	4,000	60,000
Chopping and ensiling process (labour)	2	20,000	40,000
Molasses (litres)	16	2,000	32,000
<b>Total</b>			<b>137,000</b>

Estimated cost of producing 1 kg of silage: UGX 274



## **(2) Trench silo**

A trench silo can be built by simply digging the ground, but it is better to place plastic sheets inside to prevent loss (Figure 2).



*A silo pit*

*Compressing the material before to keep out air*



*Covering the silo pit*

*A silo pit*

**Figure 2: A trench silo**

Proper tread pressure also has to be applied, and complete sealing is required.

Table 4 shows estimated cost of materials required to produce 500 kgs using trench silo method. The calculations are based on the assumption that the farmer gets the vines from her/his field.



**Table 4: Estimated cost of materials required to produce 500 kgs using a trench silo**

<b>Material</b>	<b>Quantity</b>	<b>Unit cost (UGX)</b>	<b>Total amount (UGX)</b>
Digging a pit	1	20,000	20,000
Fuel and oil for chopper	1	5000	5,000
Polythene material (meters)	25	4,000	100,000
Chopping and ensiling process (labour)	2	20,000	40,000
Molasses (litres)	16	2,000	32,000
<b>Total</b>			<b>197,000</b>

Estimated cost of making 1 kg of silage: UGX 394

### **(3) Plastic bag silo**

This is a plastic bag with the thickness of about 0.1 mm and silage materials are packed inside (Figure 3). Commercial imported plastic bags are available although they are very expensive. Plastic bags for fertilizer and feed may be reused for cost-cutting. There are many methods of making silage but use of **plastic tubes** is one of those suitable for smallholder dairy farmers

#### *Advantages:*

- Plastics silage bags are an economical alternative to traditional silage storage systems, such as pits and silos when related, harvest and storage losses are considered.
- It is an effective way for preserving feed with minimum nutrient loss (the anaerobic environment that is created eliminates spoilage from the growth of yeasts, moulds and adverse bacteria while maintaining essential proteins and nutrients).
- Allows farmers to store silage anywhere they need it. A well graded and well drained ground surface is all that is necessary.
- The silage is completely sealed in the bag. This means that all the acid is retained in the silage, unlike that in pit silage when it seeps out through the bottom of the pit as effluent. This compensates for the longer pieces of forage and poorer compaction than that found with silage machinery, so that the quality of the silage is just as good.
- Ensiling in a bag avoids the hard work of having to remove silage, as it has to be from a pit, when it has to be dug out every day.
- Because the whole bag is fed out to the animal, it means the rest of the silage which is in the other bags is not exposed to air at removal and is therefore unspoiled. Much of the silage in pits has been found to be spoiled due to poor sealing and exposure to air every day when the silage is removed for feeding.
- The bag is easily stored and easily portable so that any member of the family can carry it to the feed trough for the cow.

#### *Disadvantages:*

- The importance of pest control to prevent damage on the bags,
- Containment and disposal of the plastic, once silage is removed from the bag,
- The need to chop the green mass, as chopped material tends to make much better silage, because more air can be squeezed out of it during the packing process, and the small pieces cannot puncture the bag
- Most losses of silage during the process occur due to:



- Unnoticed bird/rodent damage to the bags resulting in spoilage loss.
- Too wet (gaseous/seepage losses) or too dry silage (spoilage).



**Figure 3: Silage making using plastic bags**

Table 5 shows estimated cost of materials required to produce 500 kgs using trench silo method. The calculations are based on the assumption that the farmer gets the vines from her/his field.

**Table 5: Estimated cost of producing 500 kg of silage using a plastic tube silo**

Material	Quantity	Unit cost (UGX)	Total amount (UGX)
Fuel and oil for chopper	1	5,000	5,000
Polythene material (meters)	5	4,000	20,000
Ensiling process (labour)	2	20,000	40,000
Sisal string (rolls)	1	5,000	5,000
Molasses (litres)	16	2,000	32,000
<b>Total</b>			<b>102,000</b>

Estimated cost of making 1 kg of silage: UGX 204



Bags must be packed with chopped raw materials, compressed as much as possible to remove the internal air and then sealed completely. The number of bags is determined freely in accordance with the operation size. It is necessary to watch out for damage on the plastic bag by field mice, birds and dogs.

#### *Silage making process using plastic bag silo*

- (a) Select a good strong plastic bag with high density (from fertilizer bags to shopping bags) with capacity from 5-50 kg of fresh chopped green fodder. Imported plastic bags used in silage making are now available
- (b) Harvest fodder at a time when the feeding value is still high (before it flowers).
- (c) Wilt the forage in the sun for about 1 hour to reduce the moisture content.
- (d) Chop the forage into small pieces of about 1-3 cm long before ensiling.
- (e) It is important to time the cutting of the forage so that the cut forage is not sitting for more than a day waiting to be chopped and ensiled, otherwise it will become mouldy or too dry.
- (f) Weigh the material.
- (g) Add fermentable substrate at ensiling e.g. molasses or maize bran. The addition of either molasses or maize bran is to act as preservative. Molasses should be mixed with water at the ratio of a 1 part molasses with 2 parts of water to make it easier to apply (Table 6).

**Table 6: Rations for molasses and maize bran used for different forages**

Forage type	Molasses (kg)	Maize bran (kg)
Chopped sweetpotato vines and roots	15-20	40
Chopped sweetpotato vines and roots and legume mixture	15-30	55-70

#### **(4) Improved plastic tube silage**

The greatest challenge that farmers face when making sweetpotato silage is how to control the high moisture content in the sweetpotato vines. Typically, vines are wilted prior to making silage to remove excess moisture. However, many farmers have found it difficult to wilt sufficiently large volumes of vines which often results in spoilage during the silage making process. The spoilage is due to excess water accumulating at the bottom of the silage container. This leaflet explains an innovative way of enhancing compaction and draining excess effluent (liquid waste) from the tube silo method of producing silage.

#### **How to make an improved plastic tube silo?**

A silo is an airtight place or receptacle for preserving green feed for future feeding on the farm. To make an improved plastic tube silo you will need:

- One 95 cm length, 4 cm diameter plastic (PVC) pipe (your drainage pipe)
- 2.5 meters of 1000 gauge silage tubing (made of polythene), sold in 1 m diameter rolls
- 230 cm of flexible rubber tubing, 2.75 cm in diameter
- One 4 cm plastic tap which should have the same diameter as the pipe or a piece of soft wood if a tap is unavailable

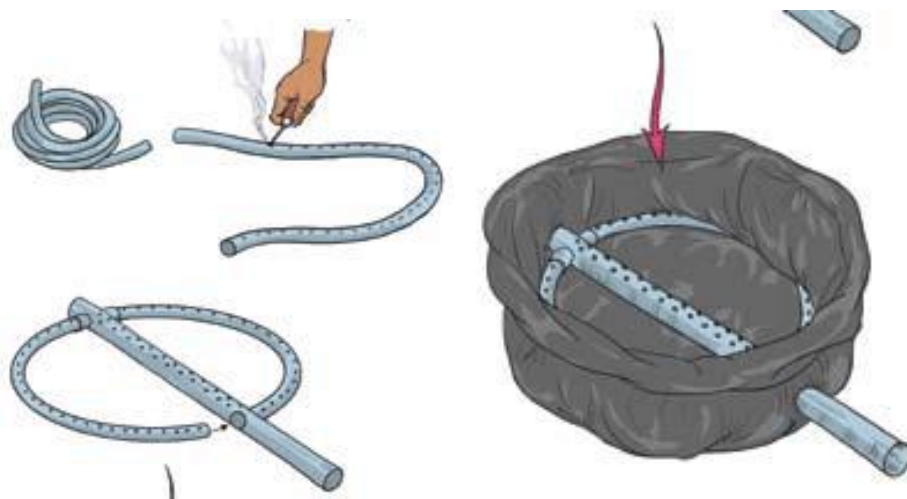


- A metal rod 0.9 cm in diameter for making holes on the PVC pipe
- 7 meters of sisal twine
- 3 wooden poles (can be cut locally), at least 1.2 m in length and 5 cm in diameter
- 1 used 200 liter empty drums
- 8 kg of molasses
- 16 to 24 litres of water (depending on the dryness of the roots and vines)
- 2 nails (length, 6cm)
- 190 kg of fresh vines and 90 kg of fresh storage roots to make 250 kg silage

### To make the tube silo:

#### Step 1

In the drainage pipe make 2 holes using a knife (4 cm from one end and 8 cm from the other end (this end will serve as the outlet), each 2.75 cm in diameter (the same as the diameter of the flexible pipe), and one on each side of the pipe as shown in Figure 4.



**Figure 4: Making the internal drainage system for the silage tube**

#### Step 2

Heat the nails with a wood or charcoal fire. Drill small holes for drainage using the hot metal rod through the PVC pipe and in the flexible rubber tubing at intervals of 1 cm throughout their entire lengths as shown in Figure 4.

#### Step 3

Pass the rubber tubing through the top holes in the drainage pipe, so that the open ends of the tubing align at the bottom of the pipe as shown in Figure 5.



**Figure 5: Assembling the internal drainage system for the silage tube**

#### **Step 4**

To make a good seal at the bottom of the silage tubing, first open up the tubing. Then on one open end (that will be the bottom of the tube), make even pleats about 20 cm long starting from the end towards the centre on each side of the tubing. Then twist the pleats together and tie off with the rope making a strong knot. Then turn the tubing inside out, so that the tied knot is on the inside (Figure 6).



**Figure 6: Sealing the bottom of the silage tube**

#### **Step 5**

Make a 3.5 cm diameter hole using a knife at the side of the tube, about 43 cm from the tied knot. Then take the joined drainage pipe and rubber tubing and fit it into the inside of the silage tubing so that the bottom of the drainage pipe goes through the newly made hole, extending about 20 cm beyond the hole. Using the twine, tighten the plastic around the drainage pipe as shown in Figure 7.



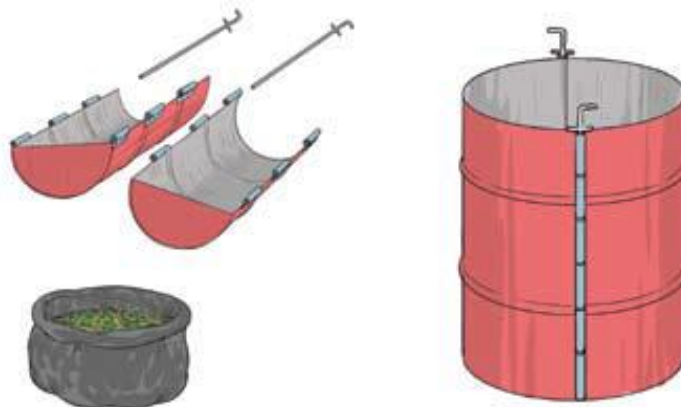
**Figure 7: Making the external drainage system of the silage tube**

### Step 6

Fit a plastic tap or a piece of soft wood to the bottom of the exposed drainage pipe so that no effluent can flow out when the tap is turned off.

### Step 7

To make a compacting drum measuring 86 cm in diameter and 120 cm in height first remove the top and bottom of each drum to make it hollow. Look for a shaded place to make and store the silage. Then cut each oil drum on one side, so that when joined the total diameter matches that of the silage tubing. To join the 2 drums together running lengthwise, have a welder make on each side 3 joints and one 75 cm long rod bent on one end to fit through the joints as shown in Figure 8.



**Figure 8: Making the compacting drum silage tube inside the compacting drum**

### Step 8

Place the silage tubing inside the closed compacting drum, letting the excess tubing fold over the sides of the drum at the top. Ideally, the diameter of the tubing should be the same as or slightly larger than the drum for best results (Figure 9).



**Figure 9: Placing the silage tube inside the compacting drum**

### Step 9

To prepare the material for ensiling, chop the sweetpotato vines and roots to be ensiled into pieces not more than 2.5 cm long (Figure 10). A motorized chopper can be used



**Figure 10: Preparing sweetpotato vines and roots for ensiling**

### Step 10

Prepare the molasses and water mixture by mixing 8 kg of molasses with 2 to 3 times as much water until the mixture can flow easily (Figure 11).



**Figure 11: Preparing molasses**

### **Step 11**

Fill the tubing with alternate layers of the chopped vines and roots and the molasses/water mixture. Each layer of vines and roots should be 20 to 30 cm high; then sprinkled with the molasses mixture until it is thoroughly wet on top. Each layer must be compacted before adding the next layer. One person can compact using feet as shown in Figure 12.



**Figure 12: Compacting the sweetpotato vines and roots in the tube**



### Step 12

Bunch the excess tubing at the top together, remove all excess air so the plastic is in touch with the ensiled material and tie a tight knot, using the twine. Place heavy stones on top of the silo to ensure continued compaction during fermentation (Figure 13).



**Figure 13: Sealing the tube after ensiling**

### Step 13

Remove the rods to remove the compacting drum. Anchor the filled tube silo with three poles to prevent the silo from collapse due to drainage of excess effluent from the silo (Figure 14).



**Figure 14: Anchoring the silage tube firmly on the ground**



## Step 14

For the first five days, open the drainage tap daily and leave open until all the effluent comes out, then close (Figure 15). Then open the tap every 4 to 5 days thereafter and let any effluent come out. Fermentation is usually complete after 30 days.



**Figure 15: Removing excess effluent from the silage tube**

### How do you know silage of good quality?

Well-prepared sweetpotato silage is bright or light yellow-green in color, has a strong smell similar to that of fermented milk and has a firm texture. Poor quality silage tends to smell similar to rancid butter or ammonia. Sweetpotato tube silage should be stored under shade, for example in a store. Rodents like rats that could tear the tube need to be controlled. When feeding, open the tube and after removing the amount needed, remember to re-tie without trapping air inside.

### How much does it cost to make sweet potato silage?

One tube holds about 250 kg chopped, well compacted silage. An example of the average cost of making one sweetpotato silage tube is indicated in Table 7.



**Table 7: Average cost of making one improved sweetpotato silage tube (250Kg)**

Material	Quantity	Unit cost (UGX)	Total amount (UGX)
Fuel and oil for chopper	0.5	5,000	2,500
1000-gauge polythene tube (meters)	2.5	6,000	15,000
Chopping and ensiling process (labour)	1	20,000	20,000
Molasses (litres)	8	2,000	16,000
Cost of making the drum and the drainage pipes (these are made once and can be used many times)	1	180,000	180,000
<b>Total cost of making one tube of silage</b> (excluding the drum and the materials used to make the drum)			<b>53,500</b>

Estimated cost of making 1 kg of silage: UGX 214 (full costing of the polythene tube included. However, if carefully used it is possible to reuse the polythene tube up to 4 times, thus reducing the cost of making silage).

## FEEDING SILAGE TO LIVESTOCK

Silage is ready for feeding at least 30 days after making it. Silage should be fed as soon as possible, preferably within a few hours after opening the silos. After feeding, the feed troughs must be cleaned out to prevent any remaining silage, which will spoil, contaminating the next feed out. Silage can be provided to animals in number of different recipes based on its composition and the breed and use of the animals. In general silage should be used up to 25 kg per day for 550 kg animal and up to 5 kg for sheep, pigs and goats (Table 8).

**Table 8: Utilization of silage for different types of stock**

Stock	Quantity (kg/day)
Lactating dairy cow	10-20
Dry cows	10-15
Dairy heifers	5-8
Beef breeding cows	12-20
Pigs (Sows)	2-5

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