KALRO
Kenya Agricultural & Livestock Research Organization

KCSAP
Kenya Climate Smart Agriculture Project

Sweet Potato Vines
Seed production manual

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Acknowledgement

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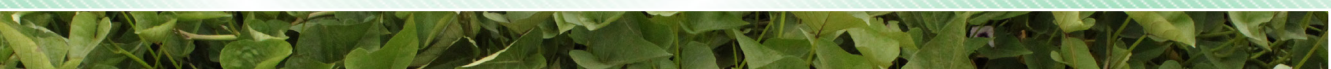
We are also grateful to the contributors of this manual who include KALRO scientists and extension agents.



Preface

Sweet potato vines (SPV) is an important fodder which is palatable and highly digestible. However, reduced access to vines limits the growing of the forage. Development of alternative forage seed distribution system is key in upscaling SPV among dairy farmers. The manual provides information on how to strengthen farmer groups to produce clean planting materials for sale and utilize SPV to improve livestock production. The Kenya Agricultural and Livestock Research Organization (KALRO) has developed a number of SPV varieties which include Kemb10, KSB 20, Ex-Mukurweini, Saparo and Ex Musinya varieties which prefers deep, fertile loam soils and do well in different Agro ecological zones.

The price for a vine ranges from Kes.3 to 5 and can even go higher depending on location, cost of production among other factors. Computations show that cost per unit vine is Kes. 0.94.

The varieties have been developed and promoted by Kenya Agricultural and Livestock Research Organisation (KALRO) under KCSAP Common Interest Group (CIGs), Vulnerable and Marginalized Groups (VMGs) and Producer Organizations (POs) for seed production as a business. This work was piloted in KCSAP Counties of Nyeri, Kericho, Bomet and Kakamega.

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SWEET POTATO VINES (*Ipomoea batatas)*

1.0 Introduction

Sweet potato vines (SPV) is one of the popular fodder crops grown in Kenya. Presently there are sweet potato varieties developed by KALRO for livestock feeding that are drought tolerant. However, the crop is affected and yields drastically reduce if drought comes during first 6 weeks after planting when roots are forming.

Due to its high crude protein (CP), palatability and digestibility, the fodder is mainly used as a supplement for dairy animals. Early maturing SPV varieties can be harvested 3 to 4.5 months after planting. Among the sweet potato varieties developed and grown for livestock are Maroko, Wagabolige, Ex. Mukurweini, Saparo, Kemb10 and KSB 20.

SPV are ready for harvesting between 3-5 months depending on the variety. Fodder sweet potato yields 12- 20 tons of fresh vines /acre (30 -50 tons/Ha.), with a cutting interval of 2-3 months depending on the weather and the level of management. The vines are chopped into small pieces and mixed with Napier grass, Maize stover or other grasses up to 50% inclusion to form a ration. The nutritive value for the vines is CP 12.5 -15% and DM 22 %.

1.1 General Agro-ecological requirements

- Minimum rainfall: 750 – 1250 mm
- Altitude: 8 - >2,000 m ASL

- A soil pH of 5.6 - 6.5 is ideal
- Optimum temperature 20°C to 25°C

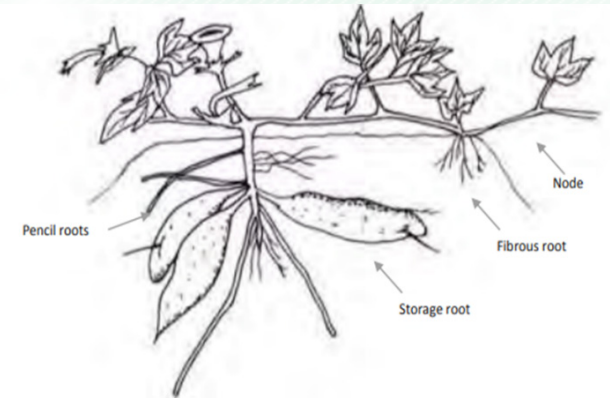
1.2 Varieties of Sweet Potato Vines (SPV)

Ex-Mukurweini

Wagabolige

Saparo

Maroko



The sweet potato plant with tubers

2.0 FIELD ESTABLISHMENT

2.1 Land preparation

Manual land preparation

Sweet potato crop requires a moderately deep, fine sandy loam soil with adequate drainage. Avoid planting on areas prone to flooding since excess soil moisture may result in vine and tuber rot.

2.2 Fertilizer and manure application

Where soil is low in nutrients, add a handful of manure per hill/ hole at planting. For vegetative growth, apply compound fertilizer at the rate of 60 Kgs/Ha (24 kgs/ acre) after root establishment to avoid scorching. A soil test is recommended to determine the soil pH and the amount of lime and fertilizer needed for optimum crop growth.

2.3 Propagation of SPV

Vegetative propagation can be done on a small scale through stem cutting while in large scale establishment, tubers can also be used.

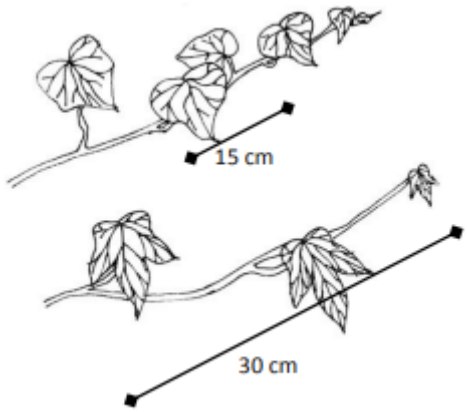
2.3.1 Propagation of SPV using tubers and stem cuttings

Sprouted sweet potato storage root

- Small tubers can be used to produce nursery plants from which cuttings are also harvested
- Stored tubers can be cut into sections and established close together but not touching in the nursery bed
- Cover with about 5 cm (2 inches) of soil and then a layer of mulch added to retain moisture. Afterwards the seedling can be transplanted in the field

Cuttings showing nodular roots

- Sweet potatoes are propagated from stem cuttings which can be obtained from the previous mature crop (2-3 months old)
- Use the tips of the plants, vigorously growing and free from pest and disease
- To establish an acre of SPV, 22,000 vines (55,000 vines/Ha) are required



Internode lengths may differ between varieties, in some varieties 3 nodes =15 cms, in others 3 nodes =30cm length

Sweet potato cuttings with short internodes

Sweet potato cuttings with long internodes

2.3.2 Planting and Spacing

SPV can be planted on hills, ridges or flat seed bed. Make holes 15 cm deep at a spacing of 45 x 45 cm. For faster ground cover formation, closer spacing is recommended. Plant when the soils are moist. Cut vines of 30 – 60 cm long and cover 3/4 in the soil.

Sweet potato being planted on ridges

2.3.3 Weed Control

Control weeds as necessary since they compete with the growing plants for moisture, nutrients and harbour pests and diseases. Once the crop is established it is able to suppress emerging weeds.

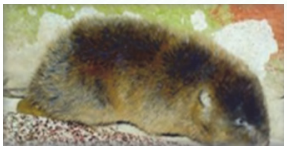
3.0 NUTRITIONAL DEFICIENCIES, PESTS AND DISEASES

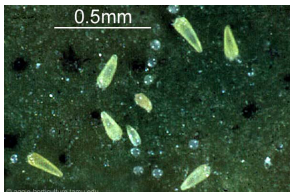
3.1 Nutrient Deficiencies in SPV

Nutrient Deficiencies	Key symptoms and control
 **Potassium (K) deficiency**	• Short vines with short internodes and small leaves are the first symptoms • Small, shiny brown spots emerge on the leaves, first on the bottom of the leaves and on old leaves • For control, add fertilizers rich in Potassium
 **Nitrogen (N) deficiency**	• Old leaves become yellowish or reddish • Plants wilt fast and leaves easily fall off • When experiencing heavy deficiency, the whole leaf becomes yellow except the leaf base • For control, add nitrogenous fertilizer
 **Phosphorous (P) deficiency**	• Reduced vine growth with purple discoloration which then turns yellow • Leaves become dark green to bluish with purple veins • Small storage roots of irregular shape and purple colour • For control, add phosphatic fertilizer

3.2 Pests

Most common pests attacking SPV are mole rats, Sweet Potato Weevil, Sweet Potato Stem Borer, Sweet potato butterfly and Eriophyid mites.

Pest	Symptoms	Control
 Mole rats	Mole rats burrow through the soil and feed on the sweet potato roots and leaves. They often spoil more roots and stems than they actually eat. Signs of their damage and presence include: small mounds of freshly dug soil, sweet potato vines being pulled back down into the soil holes.	Trapping or baiting are methods of control. Control works better if done on a large scale, so farmers should work with their neighbours for effective control
 Sweet Potato Weevil	The adult female makes holes at the base of the stem or in tubers near the soil surface, in which they lay eggs. The eggs hatch into larvae (worms) which tunnel downwards and feed just below the peel layer of the tubers, causing damage	Among methods of control are: good agricultural practices, use of pesticides, Integrated Pest Management
 Sweet Potato Stem Borer	The adult moth lays eggs on the leaves and stems of the plant. The eggs hatch into larvae (worms) which burrow into the stems. They continue to feed, eventually reaching inside the tuber where they tunnel causing extensive damage.	Good agricultural practices Use of pesticides Integrated Pest Management
Butterfly eggs underleaf  Caterpillar after hatching. It eats the leaves  Sweet potato butterfly	The pest destructive stage is the caterpillar which feeds on the leaves hence defoliating the plant. This attack is seasonal and is usually at the beginning of the dry season.	Good agricultural practices Use of pesticides Integrated Pest Management

 Mite infested vines  Eriophyid mites	Sweet potato leaves and vines become covered with a dense almost velvet-like layer of white hairs caused by the mites. The leaves and plants are slightly stunted, leaves and vines thickened and the plants yield poorly.	• Good agricultural practice • Use of recommended pesticides • Integrated pest management

3.3 SPV Diseases

3.3.1 Viral diseases

Virus infested vines

There are two main viruses that affect sweet potato in Kenya (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 sweet potato plant gets infected by both the viruses, a very severe disease results which is known as sweet potato virus disease (SPVD). The insects do not spread SPVD over very long distances. But if virus infected planting materials (vines or roots) are transported over long distances, then the disease can be spread very widely.

3.3.2 Other Diseases

Fusarium wilt	Symptom	Control
 	It is caused by the fungus. The disease is also called stem rot or vine wilt. It is more severe where temperatures are above 27°C. Yellowing of the leaves, which later wilt and fall off. Stunting results and eventually the plant dies. Death of the stem vascular bundles occurs with brown to purple coloured when split. The disease may be transmitted to the next crop by infected cuttings. Dying vines often have pinkish fungal growth.	• Use resistant varieties • Avoid rotation with plants of the same family • Avoid fields with a history of wilt. • Use fungicides

3.4 Harvesting of SPV cuttings

SPV are ready for harvesting between 3-5 months depending on the variety. Fodder sweet potato yields 12-20 tons of fresh vines /acre (30 -50 tons/Ha.), with a cutting interval of 2-3 months depending on the weather and the level of management. This gives approximately 120,000 vines per acre (300,000 vines per Ha.)

Preparation of SPV cuttings

4.0 SEED BUSINESS ANALYSIS

4.1 Commercialization of Sweet Potato Vine

Sweet potato vines are common among dairy farmers for its high nutritive value and palatability. The planting material is sold as vines. The vines can be either rooted or non-rooted depending on farmer preference. The price for a vine ranges from Kes.3 to 5 and can even go higher depending on location, cost of production among other factors. Gross margin computations indicate that the cost of producing one acre of SPV vines is Kes. 113,300, while the expected returns per acre is Kes. 360,000 indicating a gross profit margin of 68.5% (360,000-113,300 divided by 360,000) %. This also translates to a cost per unit vine of Kes. 0.94.

4.2 Computed SPV Gross Margin analysis

1-acre fodder sweet potato vines	**Units**	**No. of units**	**Cost of units**	**Totals**
Land hire	Acre	1	10,000	10,000
Ploughing (Tractor hire)	Acre	1	4,000	3,000
Heavy Harrowing (Tractor hire)	Acre	1	3,000	3,000
Light harrowing (Tractor hire)	Acre	1	1,500	1,500
Vines	pcs	22,000	3	66,000
Non- selective herbicide	lts	1	1,000	1,000
Planting NPK	bags	1	6,000	6,000
Top dressing CAN	bags	1	4,000	4,000
Planting labour	m/days	15	400	6,000
1st weeding labour	m/days	15	400	6,000
2nd weeding labour	m/days	15	400	6,000
Top dressing labour	m/days	2	400	800
Sub total				**113,300**
Gross margin/ year				
	Vines	**Cost (Kes.)**	**Total**	
*Total Revenue (TR)	120,000	3	**360,000**	
Cost of production (TC)			**113,300**	
****Gross profit (GP= TR-TC)**			**246,700**	
Gross profit margin % (GPM = GP/TR*100)			**68.5%**	
Cost of production/vine (Kes.)			**0.94**	

Assumptions:

- Costs such as salaries, levies, insurance, marketing and promotion are not factored.

- Variable costs may change depending on the region
- Harvesting is done twice in a year
- Establishment is done as per the production recommendations
- All other risk factors such as weather uncertainties, theft, crop destruction, pests and diseases are held constant.

4.3 Marketing

For successful marketing of SPV, farmers and farmer groups need to focus on some basic marketing principles which include Product, price, place and promotion. These principles help farmers decide on the product and its characteristics, set the price, and decide how to distribute and promote it.

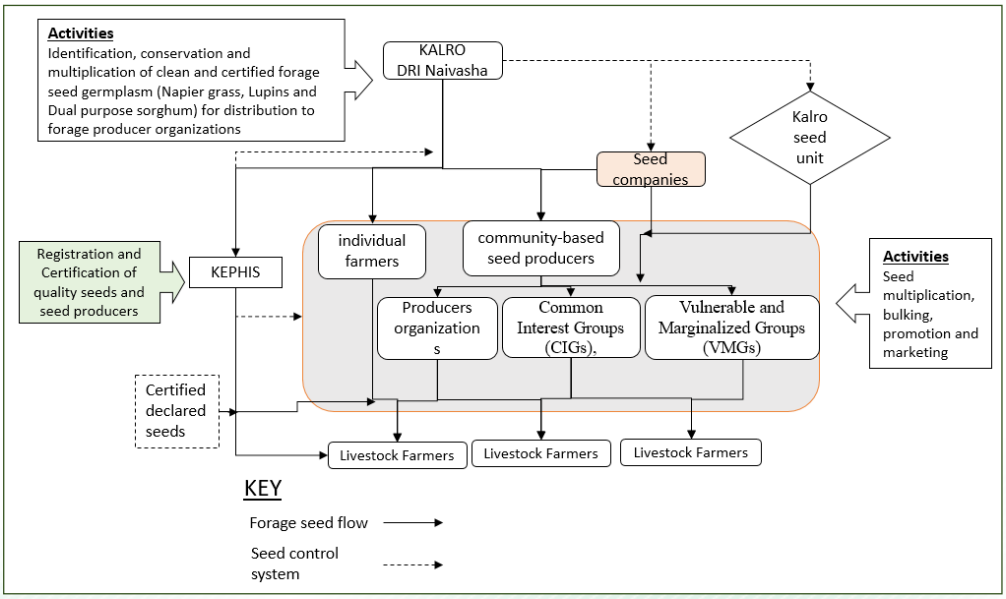
Product: what to produce? Sweet potato vines (SPVs)

Price: at what price to sell? Ksh.3 to 5

Place: where to sell it? Farmers can sell the rooted splits amongst themselves, other CIGs, VMGs, POs and other institutions.

Promotion: how to promote the product? This can be achieved using avenues such as farmer to farmer interactions, churches, schools, shows, milk collection centres and use of printed materials.

4.4 Business model



5.0 FURTHER READINGS

1. Everything You Ever Wanted to Know about Sweet potato Reaching Agents of Change ToT Training Manual © International Potato Center, Nairobi, Kenya, 2013
2. Extension Training and Information Services Division Ministry of Food Production Trinidad and Tobago December 2014
3. Sweet Potato Technical Manual-Caribbean Agricultural Research and Development Institute (CARDI) April 2010
4. Sweet potato Pest and Disease Management, Reaching Agents of Change Training of Trainers (ToT) manual October 2018
5. Everything You Ever Wanted to Know about Sweet potato Reaching Agents of Change ToT Training Manual © International Potato Center, Nairobi, Kenya, 2013

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