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CROP MANAGEMENT
Roots and tubers

Trainer's guideline

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Cassava production

What is cassava?

Cassava (Manihot esculente Crantz) is a perennial crop, although farmers harvest it during the first or second year. It is propagated from stem cuttings. Under natural conditions, as well as in the plant breeding process, propagation by seeds is quite common. When cuttings are planted in moist soil under favorable conditions, they produce sprouts and adventitious roots within a week.

The importance of cassava in Malawi as a food and cash crop has steadily increased in recent years. Cassava once regarded as a "primitive crop", "food for the poor" and having poor nutritional values was neglected for a long time. This image ha changed as a result of rapid population growth, urbanization and persistent unfavorable climate conditions for the main staple food: maize.
Cassava is a "low risk crop" that adapts readily to a wide range of agro ecological conditions, utilizes efficiently mineral reserves or marginal soils, can withstand climatic variations and is highly efficient in conversion of solar energy to starch.

Site selection

The site for cassava production should be:

-well drained, preferably with deep sandy loams which are fertile and ideal for roots development.
-ideally not on steep slopes to minimize soil loss and water run off.
-Easy to access for delivery of planting materials and harvesting.
-Protected from livestock and wild life damages.
-Where possible crop rotation can be practiced since cassava is a heavy feeder and no fertilizer is applied.

Land preparation

Land should be prepared early to enable planting with the first rains. Early planting enables the crop to establish well while there is still adequate moisture in the soil. In well drained soils, ridges should be made at 75 to 90 cm apart and 30 cm high. In dambos (low-lying area), which get flooded during the rainy season, ridges should be made at 100 to 120 cm apart and 50 to 60 cm high. Big ridges and mounds enable the plant to grow above water in saturated soil.

Soil improvement

-During land preparation, add organic manure to the soil to increase soil nutrients and improve soil structure and water holding capacity.
-Where necessary, plant cassava in association with leguminous crops such as phaseolus beans, soya beans, pigeon pea, agroforestry tree species and groundnuts. Intercrops improve soil properties in a manner to live mulch.
-Where possible, cassava should be rotated with other crops such as maize, groundnuts, pigeon pea, phaseolus beans, and soya beans.

Selection of varieties

Grow varieties that are in demand for household use and the market. Good varieties should be high in dry mater content (at least 30%), early bulking, high yielding, tolerant to pests and diseases, suitable to prevailing cropping systems and utilization modes and good in-ground storability.

Recommended varieties in Malawi

There are several recommended cassava varieties. These are Manyokola, Mbundumali, Mkondzi, Maunjili, Silira, Sauti, Yizaso and Gomani.

Selection of planting materials

Good quality planting material should be able to sprout and grow into a healthy crop once planted. Selection of planting material should be done when the plant still has leaves on for easy identification of diseases and insect pests. Selection should not be based on good appearance of the stem. Good quality planting material should:

1. be mature (8-15 months old)
2. be thick (ideally, 1.5-2.5 cm in diameter)
3. have 6-8 nodes per 20-30 cm length
4. be fresh, with no bruises or wounds
5. come from clean and healthy plants

Preparation of planting material

Stem cuttings should be 20-30 cm long for longer cuttings with 6-8 nodes per cutting. Use of shorter cuttings (15-20 cm) encourages the risk of drying under poor soil moisture conditions.

Care should be taken not to bruise or damage the buds during preparation. Sometimes stem cuttings are slightly infested with cassava mealy bug, cassava green mite and other stem-born pests. Immersing the cuttings in hot water (about 60°C) for 5-10 minutes or treating with 1% solution of Rogor should control the pests. Fungal diseases, such as anthracnose, can be controlled using Benlate or Decis.

Planting

Plant cassava with the first effective planting rains. This will enable the plants to establish before the rains end and benefit from the entire rainy season.
Stem cuttings should be planted at 90cm x 90cm or 90cm x 75cm (12,400 or 17,800 plants/ha) for root production. Where the aim is to produce small medium roots for the fresh market, cassava should be planted at 45cm-60cm (18,000 to 24,000 plants/ha) within row. However, in dambo areas cassava should be planted at 120cm x 75cm to allow good drainage. About 65 to 80 bundles of 50 one meter long stems are required to plant one hectare of cassava for root production.

At planting, insert at least two thirds of cutting into the soil at an angle of about 46°-60° from the soil surface and firm it up.

Weeding

Keep the fields weed free at all times, especially in 3-4 months of growth when the canopy is not fully developed. Weeds rob plants of nutrients, water, light and space. They also harbour pests/disease causing agents.

Pests and diseases

The best way to control major diseases and pest is the use of resistant or tolerant varieties. These are made available to the farmers through the extension service as they become available from research.

The use of disease or pest free planting material helps in reducing the primary infection or infestation of the crop in the field. Rouging at early stage of cassava diseased plants reduces the spread of the disease in the field.

The main pests of cassava are:

-The elegant grasshopper : can be treated by killing physically the pests or by using pesticides

-The mealy bug: can be avoided by using tolerant varieties, with natural enemies (E. Lopezi, Dioms sp.), early planting and crop rotation.

-Termites

-Scales: can be avoided with a good planting material selection, crop rotation and pesticides.

The main diseases of cassava are:

-Cassava mosaic disease: can be avoided by using disease free planting materials.

-Cassava brown streak disease: can be avoid by using tolerant varieties and treated by rouging infested plants.

-Cassava bacterial blight: can be treated as for the cassava brown streak disease and with crop rotation.

Harvesting

The exact maturity period for cassava depends on a number of factors such as variety, rainfall, soil fertility and temperature. The crop has the advantage of in-ground storability which allows flexibility of harvesting. However, cassava should not be kept in the field for too long to avoid roots becoming woody and fibrous. Harvesting should be done piece meal (harvesting only enough for immediate needs), leaving the remaining crop in the field until required. This is because once harvested, cassava roots are highly perishable and can not be kept in good condition for more than 2 days. Care should be exercised not to bruise or cut the roots at harvesting. Harvesting should be done using a hoe when the soil is dry and should be uprooted when the soil is wet.

Uses of cassava

Much of cassava harvested along the lakeshore areas is processed into Kadonosya or Kanyakasya and used as Nsima. Makaka are very popular in Zomba, Mulanje, Phalombe and Thyolo district. On the other hand, most of the cassava being grown in the central region finds its way in Salima and Lilongwe markets and that grown in parts of Southern region finds itself in Zomba, Blantyre and other local markets being sold for snacks.

Apart from home consumptions and sales for cash, there is a very big demand for cassava by several industries in Malawi. Universal Industries process cassava in cassava crisps, K.K Millers need cassava for milling into floor while Bakhresa Milling Company need cassava for blending with maize and for animal feed formulations. Cassava can be processed into various industrial and medicinal products. Food products such as bread, cakes, donate, etc. can be made from cassava floor. Up to 10,000,000 tonnes of fresh cassava are required annually for various uses in Malawi but this is very far from being reached at the moment.

Cassava seed multiplication

There are various techniques and methodologies through which cassava and sweet potato planting material can be multiplied, which include:

-*Conventional multiplication method :*

Conventional means of cassava planting materials multiplication is achieved by preserving/using to plant planting materials from cropping field, where ridges spaced at 90 cm apart and the 25 – 30 cm long cuttings are planted at an angle of 45 degrees at a spacing of 90 cm apart. In this field the main aim is to harvest roots but after harvest the stems are also used as planting material provided they are clean.

-*Use of multiplication plots :*

Use of shorter cuttings and closer spacing

Apparently clean cuttings of 15 cm long are planted on ridges spaced at 90 cm apart and 45 cm apart between stations. If the land is well drained and flat, the 15 cm stakes can be planted on flat at a spacing of 50 cm x 50 cm. The stakes should be planted vertically where two-thirds of the length of the cutting should be in the soil and leave only one or two nodes above the soil.

Rogue out diseased plants and supply where necessary. This is the most recommended method of multiplication of cassava planting material. The cuttings are prepared using shears, secateurs, pangas or knives. These must be sharp for the cleanliness of the cut ends.

Sweet potato production

What is sweet potato?

Sweet potato (Ipomoea batatas Lam) is an annual crop and can be ready for harvest in 4-5 months after palnting. Although botanical seed germinate, their use in production is limited due to the high segregation of resulting progeny; difficulties in germination; and the poor establishment that results from planting botanical seed.

The importance of sweet potato in Malawi as a food and cash crop has steadly increased in recent years. The increase is attributed to the recent current drought and escalating prices of farm inputs especially for maize, the staple crop. Sweet potato is a "low risk crop" that adapts readily to a wide range of agro ecological conditions, utilizes efficiently mineral reserve and marginal soils, can withstand climatic variations and is highly efficient in the conversion of solar energy to carbohydrates.

Site selection

The site for sweet potato production should be:

-well drained, preferably with deep sandy loams which are fertile and ideal for roots development.
-ideally not on steep slopes to minimize soil loss and water run off.
-Easy to access for delivery of planting materials and harvesting.
-Protected from livestock and wild life damages and thieves.

Land preparation

Land should be prepared early to enable planting with the first effective rains. Early planting enables the crop to establish well while there is still adequate moisture in the soil. In well drained soils, ridges should be made at 75 to 90 cm apart and 30 cm high. In dambos (low-lying area), which get flooded during the rainy season, ridges should be made at 100 to 120 cm apart and 50 to 60 cm high.

Soil improvement

-During land preparation, add organic manure to the soil to increase soil nutrients and improve soil structure and water holding capacity.
-Where possible, sweet potato should be rotated with other crops such as maize, groundnuts and pigeon pea.

Selection of varieties

Sweet potato varieties to grow should be those in demand by the farmers and the market. These should be high yielding, early maturing high in dry matter content, of acceptable taste and of low fiber content, good storability and tolerant to pests and diseases.

Recommended varieties in Malawi

There are several recommended varieties of sweet potato in Malawi. These include Kenya, Semusa, Mugamba, Kakoma, Tainoni, Selera, Lunyangwa, Kamchiputu, Yoyera and Babache.

Selection of planting materials

Good quality of planting material is the one that will be able to sprout and grow into a healthy crop once planted. Selection of planting materials should be done when the plant still has leaves on for easy identification of diseases. The first 2/3 from tips are the best-actively growing, less infested with sweet potato weevil (SPW) and stem-borer. The vines should be fresh and without bruises. They should come from mother plants free from pests and diseases.

Preparation of planting materials

Vine cuttings should be 20-30cm long. Use of shorter cuttings (15-20cm) increases the risk of drying under poor soil moisture conditions. Care should be taken not to bruise or damage the buds during preparation. This normally happens if planting is done when the soil is dry and when preparing cuttings.

Planting

Plant sweet potato with the first planting rains. This will enable the plants to establish before the rains tail-off. Insert 2/3 of cutting in the soil with buds facing upwards. Care should be taken not to bruise or damage the buds during planting. This may happen if planting is done when the soil is dry.

Vine cuttings should be planted at 90cm x 30cm (32,000 plants/ha). About 75 to 100 bundles of 50 Kg bags of sweet potato vines will be required to plant one hectare of sweet potato for tuber production.

Weeding

Keep the fields weed free, especially in the first 6 weeks of growth before the canopy fully develops. Weeds rob plants of nutrients, water, light and space and also act as alternative sources of hosts to diseases and pests.

Pests and diseases

1. Insect pests

Sweet potato Weevil (Cylas formicarius)

This is the most destructive insect pest of sweet potato. Even very low populations reduce quality of tubers. In response to weevil feeding, the crop produces bitter tasting and toxic substance which render stored roots unfit for human consumption. The problem is more prevalent during the dry season. Control is by practicing crop rotation and use of resistant varieties namely: Yoyera, Babache, Kenya, Kakoma, Semusa, Mugamba and Tainoni. The epical end of planting material is relatively free from eggs and could be used to reduce the infestation.

White grubs

White grubs cause serious damage to roots and tubers of sweet potato. Where they are a problem, do not plant on soils rich in organic matter.

2.Disease control

Sweet potato virus disease (SPD)

The disease is characterized by mottled and curled leaves and is transmitted by aphids and white flies. Control is by use of SPD clean planting material, rouging of infested plats and use of resistant varieties namely Yoyera, Babache, Kenya, Kakoma, Semusa, Mugamba and Tainoni.

Harvesting

The exact time for harvesting a sweet potato crop depends on several factors some of which are variety, rainfall, soil fertility and temperature. Normally, sweet potato should be harvested at 4-5 months after planting.

Harvesting should be done when the crop is fully mature. Never leave the crop in the field for a longer time otherwise the sweet potato weevils will heavily attack the tubers hence reducing the quality and quantity of usable tubers. Care should be exercised not to bruise or cut the tubers to avoid storage problems.

Storage of sweet potato fresh tubers

Sweet potato can be stored both in the fresh and processed form. The most common storage method is storage of fresh tubers in the pits. In-ground storage of tubers is not common due to the problem of weevil attack. Normally farmers store fresh tubers in the pits treated with ash. This has proven to store sweet potato tubers for a limited period. The following practices should be followed to store sweet potato tubers for a long period:

1.Harvest the sweet potato tubers on time (when they reach physiological maturity). Delayed harvesting will encourage weevil attack and rotting of tubers

2.Care should be taken when harvesting to avoid unnecessary damage to tubers.

3.Harvested tubers should be graded to isolate small and damaged tubers from good ones.

4.Only clean tubers of good size should be taken for storage.

Good storage of tubers requires low temperatures and reasonable humidity. The following storage method has been described for appropriate storage of fresh sweet potato tubers:

Mjinge Storage Method of Sweet potato

Preparation of the storage pit.

This method involves storage of fresh tubers in the pits.

Pits are dug with a maximum depth of 1-2m. Width and length of the pit depends on the quantity to be stored. The storage pit should be prepared well in advance before the sweet potato tubers are harvested. A hut is constructed on top of the pit. The hut should have a leak-proof roof, should be mudded and well ventilated to allow free circulation of air. The hut should have a secure door.

The storage process

- Once sweet potato tubers have been harvested, they should be cleaned and graded (damaged and rotten tubers should be discarded or be taken for immediate use)
- Tubers should be stored while very fresh (curing of tubers is not encouraged).
- Medium to big tubers should be selected for storage as small ones dry faster during storage.

- Apply dambo sand at the base of the pit before placing the sweet potato tubers. This will prevent tubers from sprouting resulting from nutrient absorption.
- Sprinkle some water to the dambo sand at the base of the pit (care should be taken not to make the conditions too wet as it will encourage rooting of tubers).
- Place the selected sweet potato tubers in layers of 12-15cm each. Apply a layer of dambo sand and sprinkle some water after every subsequent layer of sweet potato tubers.
- This process should be repeated until all the tubers have been stored or until the pit is filled.
- Apply a thick layer of dambo sand of 2-3cm on top of the last layer.
- Sprinkle some water on the dambo sand and on the walls of the hut to maintain cool conditions inside the storage structure.

Management of tubers and storage structure

- Frequent visits should be made to check the storage structure and condition of the tubers.
- If temperatures inside the storage house are high, water should be sprinkled on the walls of the storage hut to reduce the temperature.
- Special attention should be put on the condition of the tubers.
- All tubers observed to be rotting inside the storage pit should be removed.
- Some tubers may start sprouting during the storage period. All sprouts should be removed to avoid loosing quality of tubers.
- Tubers should be taken from one corner of the pit as required.
- The pit should not be covered. Only the door to the storage structure should be locked to control theft and livestock damage.

This method can store fresh sweet potato tubers for over 8 months while maintaining quality. Some varieties have been re-known to be stored for over 12 months using this storage method.

Caution

- Use of ash for storage of sweet potato tubers especially the improved varieties does not work well.
- Some varieties store better than others.
- Varieties such as Kenya, Kakoma and Lunyangwa should not be selected for storage.
- Varieties such as Semusa, Mugamba, Tainoni, Kamchiputu, Yoyera and Babache should be considered for storage

Sweet potato seed multiplication

Multiplication plots can be establish through various ways:

Rapid multiplication

- Use of vines

Apparently clean vines of 10-15cm long are planted on beds of any length but 1m wide and spaced at 10cm x 10cm. The field should not be prone to water logging as these conditions have poor aeration and hamper root development. The vines should be planted

vertically where 2/3 of the length of the vine should be in the soil and leave only one or two nodes above the soil.

Unlike in cassava, in sweet potato, the tips are the best planting material both in multiplication of planting material as well as in root production. This is because the meristematic cells are still dividing actively. After planting, the plants must be watered.

The field should be well demarcated and each plot/bed should be provided with labels indicating variety and date of planting. As you plant, make sure that each plot is pure (each plot contains only one variety which is true to that type).

As the plants sprout be on the lookout for mixtures or off-types that need to be removed and be replaced with the correct variety. Diseased plants should be removed and need to be either buried outside the field or burnt.

Keep the field weed free. At the above spacing, weeds are suppressed early because of early foliage cover and vines creep extensively because of completion for sunlight. Long vines are an advantage for seed production. Although it is unlikely that weeds will be a big problem at this spacing due to quick coverage of the ground, it is still important to ensure that the field is kept weed free. Hand pulling of weeds should be done where necessary.

- Use of tubers

2/3 of the tuber is buried in the ground (soil), and the exposing part produces shoots which are later split and multiplied further following the above method (use of vines).

Management of nurseries
Watering is a must. Nursery sites should be near a water source or perennial streams, boreholes, etc.

Harvesting of vines
As soon as the vines are long enough (commonly 2 months after planting), some vines can be harvested either for further multiplication or planting in a production field. The vines should be cut 25 to 30 cm above the ground. Cutting of tips will promote side growth, as the epical dominance will be removed. This will give rise to more vines. A sweet potato nursery can be rationed three times or more.
Fertilizer may be applied to boost up growth but should not be too much to avoid rankness (tenderness of vines), which results in weak vines due to lack of hardening.

References: Inter Aide – Agriculture training guidelines – in collaboration with the Ministry of Agriculture of Malawi – March 2006

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