# From Roots to Riches

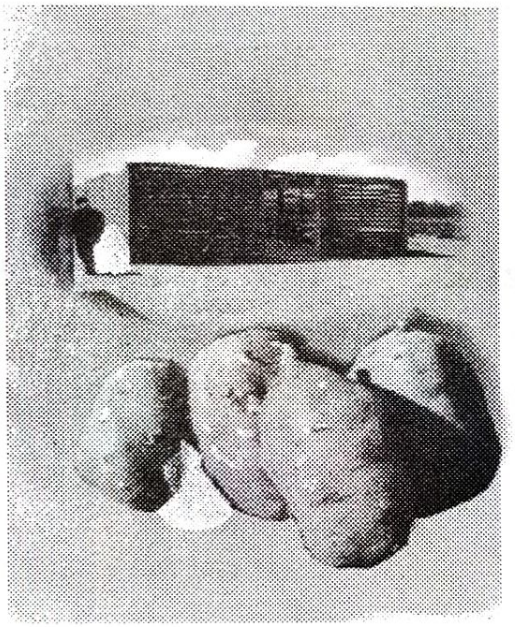
## A guide to profitable production of Sweetpotatoes

BIOTECHNOLOGY TRUST OF ZIMBABWE

BTZ

# From Roots to Riches

## A GUIDE TO PROFITABLE PRODUCTION OF SWEETPOTATOES



BIOTECHNOLOGY TRUST OF ZIMBABWE

BTZ

Published by:
Biotechnology Trust of Zimbabwe
151 Sam Nujoma Street
Harare
Zimbabwe.

ISBN - 0-7974-2887-9

| | |
|---|---|
| Written by: | Patient D. Dhliwayo-Chiunzi |
| Edited by: | A. Chinyemba, D. Hikwa, N. Rufu, D. Shumba Mnyulwa, J.T Mugwagwa |
| Special thanks: | K. Kapayapundo |
| Design: | Creative Images |
| Printed by: | Creative Images, 753736/7/50, 091 305 757 |

**Citation:**
**P. D. Dhliwayo-Chiunzi 2004. From roots to riches: a guide to profitable production of sweetpotatoes. Harare: Biotechnology Trust of Zimbabwe**

Funding for this work was generously provided by the Netherlands Government through the Directorate General International Cooperation as part of the Agricultural Biotechnology Programme for Resource-Poor Farmers in Zimbabwe. This support is acknowledged with great appreciation by all the beneficiaries of the programme.

## Contents


| | |
|---|---|
| Foreword | v |
| 1.0 Introduction | 1 |
| 2.0 Successful sweetpotato production Climate | 3 |
| 3.0 Commercial sweetpotato production | 8 |
| 4.0 Sweetpotato production techniques | 9 |
| 5.0 Sweetpotato pests and disease | 20 |
| 6.0 Nutritional disorders | 23 |
| 7.0 Marketing | 27 |
| 8.0 Storage | 30 |
| 9.0 Cost of production and yields | 34 |
| 10 References | 37 |

## Acknowledgements

This book is a partial output of a project entitled "Production and provision of pathogen-free, high quality sweet potato seed-stock for small holder farmers in Hwedza and Buhera Districts" (ZBF 0009815) funded by the Biotechnology Trust of Zimbabwe (BTZ). Project Key Players: Dr A. Matibiri, Mr N. Rufu, Mr E T. Chivero, Mrs T. Chirara, Mrs P. Dhliwayo-Chiunzi, Mrs V. Mandishona, Mr. K. Mazivazvose. The project players are highly indebted to some of the pioneer researchers among them, Dr M.D.S. Nzima, the late Dr J.M. Gopo and the late Mr H.H Dhliwayo. We will also forever cherish the irreplaceable role played by Mr P. Mazaiwana and Mr J.R Mushayapokuvaka and their teams of extension staff in Hwedza and Buhera respectively. And to the Hwedza and Buhera farmers "heanoyi mapudzi edikita renyu" (" here are the products of your efforts"). To our employers-the Tobacco Reseach Board, Biotechnology Research Inistitute, Horticultural Research Inistitute and Zimbabwe Farmers' Union and our Founders- the BTZ and the DGIS- we remain externally grateful, and may your noble missions continue.

## Foreword

Sweetpotato is fast becoming a valuable crop for income generation and household food security in Zimbabwe. The crop is widely cultivated in the country at communal and commercial levels under both rainfed and irrigated conditions. Sweetpotato has mostly been grown as a minor crop but a rise in consumer demand is leading to an expansion in production. Increasing interest in sweetpotato as a cash crop and its untapped potential in processing and utilization have stimulated research and development projects aimed at realizing the full potential of the crop. This guide presents agronomic recommendations for improved production of sweetpotato for maximum yields and benefit to the grower. The interested reader will be able to update the information, when needed, through the Horticultural Research Institute, Biotechnology Trust of Zimbabwe, Scientific and Industrial Research and Development Centre, Zimbabwe Farmers' Union, AREX Hwedza and Buhera and Farmers in the two districts.

## 1.0 Introduction

Sweetpotato (*Ipomoea batatas*) is a very important crop in many parts of the world. It is cultivated more than 100 countries and ranks seventh as a world crop (**Woolfe.1992**) In monetary terms, it ranks thirteenth. Sweetpotato is fifth on the list of the most valuable crops in developing countries. It is unquestionably one of the most important food crops in the developing world. It is, however, not easy to get accurate data and production statistics on sweetpotato for several reasons. For example, the crop is seldom traced on formal markets and, therefore, may not appear in local or international trade information.

Sweetpotato belongs to the *Convolvulaceae* or morning glory family and is the only economically important plant in the family. It is a perennial plant normally grown as an annual crop. It should be noted that, unlike the Irish Potato, the sweetpotato is a root and not a tuber as many people tend to think of it. In this book it will thus be referred to as a storage root. Sweetpotato is believed to have originated from Central or South America. In most parts of Africa, sweetpoptato is considered a minor or secondary crop. However, due to the recent resurgence of interest in sweetpotato, it is increasing in importance and its production and consumption levels may rise.

Sweetpotato has several positive attributes probably accounting for the increasing interest in the crop. It grows well under marginal environmental conditions such as low rainfall and relatively poor soils. The crop grows quickly covering the ground thereby reducing the need for weeding. Sweetpotato has low requirements for fertilisers, pesticides and disease control chemicals. Compared with other commonly cultivated crops, sweetpotato is a high-energy food. For example, it provides more calories than the Irish potato. It is rich in vitamins and carbohydrates. It provides an excellent source of provitamin A. It is also carotenoid but the level of carotene depends on the variety. The orange and yellow sweetpotatoes have considerably more carotene than white varieties (FAO 1990). The crop plays a major role in fighting food shortages, malnutrition and vitamin deficiency related illnesses.

Sweetpotato is a very versatile crop. Varieties can be selected according to use and consumer preference. The storage roots and leaves are edible. They can also be fed to farm animals. In Zimbabwe, sweetpotato is produced mainly for human consumption. The storage roots can be boiled, fried or roasted and

served as a major meal, part of a major meal, or as an anytime energy-giving snack. The role of sweetpotato as a raw material for industrial processing has not, however, been fully exploited. There is huge potential for use of sweetpotato as a raw material in several manufacturing industries such as starch production, alcohol production, bakery and confectionery industries.

Sweetpotato is a very important root crop cultivated in almost all parts of Zimbabwe for commercial purposes and for household consumption. About 85% of rural households grow the crop under both rainfed and irrigated agricultural conditions(ARA-TECHTOP,1996; Mazhangara et,al, 1996; Mharapara and Nzima 1995). Although most smallholder farmers have always grown sweetpotato as a minor or secondary crop, increasing consumer demand is gradually changing the attitudes of farmers towards this crop resulting in expansion in production. The importance of sweetpotato as a food cannot be overemphasized. In this country, the potential of sweetpotato far exceeds its current production and utilization status. Productivity is still underdeveloped because growers do not utilize appropriate production techniques. It has been observed that the current yields of most smallholder farmers can be raised by about 150% with the use of improved sweetpotato varieties and an improvement in the methods of cultivation. Swelling interest in sweetpotato as a cash crop and its untapped potential in processing and utilization have stimulated research and development projects to realize the full potential of this crop.

## 2.0 Successful sweetpotato production

### Climate

Sweetpotato is a tropical root crop that requires long periods of sunshine, a liberal amount of rainfall and warm temperatures throughout the production period. Although sweetpotato may be produced under a wide range of temperatures, it grows best at 24°C or above. Sweetpotato is extremely sensitive to frost and growth is noticeably retarded at temperatures below 10°C. Satisfactory yields can be obtained under several climatic conditions but sweetpotato should be considered a summer crop growing best during the warmest part of the year. A growing season of 120 to150 frost-free days is ideal for optimum yields. The crop should therefore be established early enough in the year to avoid the cold winter months.

About 500mm to 1000mm of rainfall is required per season for optimum productivity. Large amounts of rainfall are necessary to ensure vigorous growth and high yields but considerably less rain is required as the time of harvest approaches. A large quantity of rain towards or during harvesting may result in storage roots with an inferior taste and flavour. This condition further exposes the storage roots to disease and reduces their keeping quality. With some varieties, heavy late rains may increase the tendency of cracking or splitting in storage roots. The crop does not tolerate waterlogging therefore areas prone to waterlogging should always be avoided. Continuous humid conditions usually retard formation and development of storage roots. They also encourage the formation of soil cracks that allow easy entry of weevils. Although sweeetpotato tolerates reasonably long dry periods, beyond a certain limit it will actually wilt. Sweetpotato is considered drought tolerant but the yield can be reduced considerably especially if the crop fails to get sufficient water within the first six weeks of planting. If available, irrigation must be applied during long dry spells.

When sweetpotato is grown under irrigation, most of the water should be applied from planting up to the time when the vein canopy fully covers the ground. About 30mm to 50mm of water can be applied each week during this period. The amount should gradually be decreased as harvesting approaches. Sweetpotato is commonly grown under sprinkler or flood irrigation systems. When grown under flood systems, the crop should be planted on a flat surface to ensure efficient irrigation.

## Soils

Sweetpotato can be grown successful on various types of soils provided they are fertile enough, well drained and free of pests and diseases. A fairly good yield can be obtained on soils considered too poor for the production of most crops. Sweetpotatoes, however, grow best in sandy loams with a high organic matter content or with a clay subsoil. When grown under such soil conditions the yields can be high and the quality and appearance of the crop is appealing.

Sandy soils should be avoided whenever possible. They promote excessive leaching of soil nutrients. Such conditions produce long stringy roots which are unmarketable. An ideal soil should provide good drainage with minimum leaching. Heavy clay soils promote heavy vine growth and the development of rough irregular roots, which are inclined to be watery and therefore difficult to cure and store. Harvesting from clay soils can be particularly difficult.

The addition of cattle manure compost and fertilizers may be necessary for improving infertile soils. Leguminous crops ploughed in as green manure also serve a similar purpose. Sweetpotato grows well over a wide range of soil pH (4.5 to7.5). The crop is sensitive to alkaline and saline soils. Adjustments of pH may be required in some cases and should be based on recommendations from chemical soil analysis.

## Soil improvement

Sweetpotatoes, like other crops, remove certain nutrients from the soil. Consequently these nutrients need to be replaced through the application of either chemical fertilizers and or suitable organic matter. It is difficult to give specific fertilizer recommendations to use on sweetpotatoes. A chemical analysis of a specific soil assists in determining the type and quantity of fertilizer to use for that soil. However, every grower must study individual soil requirements by monitoring crop performance rather than by just relying on theoretical calculations. For this reason, only a general recommendation on the use of fertilizers is given in this guide.

### *Use of chemical fertilizers*

The major nutrients, namely, nitrogen, phosphorus and potassium, can be supplied to the crop by applying chemical or mineral fertilizers to the soil. The

type and quantity to use largely depend on the soil requirements, climatic conditions and the crop rotation used. A soil analysis is important in determining which fertilizers to use and how much to apply.

Sweetpotatoes need potassium during the period of storage root growth. Fertilizers with a high potash ratio are recommended for the production of good quality and high yields of sweetpotatoes. Heavy applications of nitrogenous fertilizers such as ammonium nitrate (AN) usually result in vigorous growth of vines with practically no production of roots. A balanced use of fertilizers will therefore give increased yields at an optimum economic return. Fertilizers may be a necessity in commercial production of sweetpotaotes but their use should be properly planned and rationalized. Excessive fertilizer application may result in the production of undesirably big storage roots with inferior taste and poor keeping quality.

**Basal fertilizer application**

D or M or C per hectare

**Top dressing**

MOH or AN per Hectare

***Fig 1 Recommended quantity of fertilisers***

Generally, 300kg/ha of Compound D (N8: P14: K7) can be used as a basal fertilizer application in the production of sweetpotatoes. Other fertilizers like Compound C (N6: P18: K15) or Compound M (N10: P10: K10) or any other fertilizer with a high potash or "$K_2O$" ratio can applied. These fertilizers are usually very expensive and sometimes unavailable in most rural areas. It has been observed that compound fertilizers are more effective when applied together with cattle or green manure in which case the rate of mineral fertilizers may be reduced. A single application of AN (34.5% N) at 120kg/ha and 250kg/ha. Muriate of Potash (MOP) (60% $K_2O$) is used for top dressing plants as soon as they are established in the field.

Some smallholder farmers use gypsum (CaSO4 17.5%S) for top-dressing their crop to improve the quality of the storage roots. Research carried out by

Horticultural Research Centre (HRC) in collaboration with other institutions and farmers in Hwedza and Buhera under the Biotechnology Trust of Zimbabwe ( BTZ) programme has shown that the use of gypsum enhances quality parameters like taste, texture and shelf life.

### *Use of cattle and green manure*

Green manuring involves growing a crop, preferably a leguminous crop, and ploughing it down. Legumes such as cowpeas, soyabeans (Will farmers be willing to plough these under as green manure? How about substituting these with sun hemp?) and velvet beans make ideal green manures that result in an increase in soil nitrogen. Many of the so – called "poor" fields could produce high yields of good quality sweetpotatoes with green manuring. Cattle manure is another source of organic matter and is known to give a heavy crop of both vines and roots. **Fresh cattle manure should never be applied direct during planting.** This will increase the need for weeding and in the dry periods the plants may get stressed and wilt. Use of fresh cattle manure also results in immobilization of nitrogen deficiency in the early stages of growth and this may affect final root yield.

Well-composted cattle manure should be applied to the previous crop or at least four to six months before planting sweetpotato. A rate of 20 to 30 cubic metres (200 to 400 x 50kg bags) of well-composted manure is adequate for one hectare of land. Although sweetpotato responds readily to addition of organic matter to the soil (such as the liberal use of green manure and kraal manure), these organic fertilizers cannot be applied directly to the crop without compromising on the quality and selling value of the sweetpotatoes. They should be applied to the crop immediately preceding the sweetpotatoes.

### *Use of lime*

Agricultural lime is applied to sweetpotato fields to correct soil acidity by raising pH to the required range of between 4.5 and 7.5. Liming is also required when a large amount of green material has been incorporated into the soil as organic manure. It neutralizes the acidity that is often caused by the green crop. To obtain best results, lime should be used indirectly and preferably in a three year rotation. It is best applied after ploughing under a green crop or to the crop before the sweetpotatoes.

***Use of crop rotation***

For purposes of controlling diseases, pests, raising yields and improving the soil, a careful system of rotation should be followed. Use of disease free planting material and a rotation where sweetpotato will only be grown on the same piece of land after three or four years will eliminate most serious soil diseases and improve the soil nutrient status. In planning a sweetpotato crop rotation, the importance of ploughing under a soil-improving crop on every two to three years should be seriously considered. Whenever possible, a leguminous crop such as cowpeas, soyabeans, sugar beans or velvet beans should be ploughed in to supply nitrogen as well as maintain a reasonable level of organic carbon.

The grower should decide on which crop rotation system to follow. The soil, the prevailing climatic conditions, the demand for a particular crop and the size of land available will influence choice of system of rotation. No hard and fast rule can be made as to the system of rotation to follow, but advice can be obtained from researchers and extension workers. The following are four year rotations which may be suitable for most smallholder farmers in Zimbabwe:

These rotations are only suggestions that may be changed according to the farmers' preference another factors mentioned at the beginning of this section.

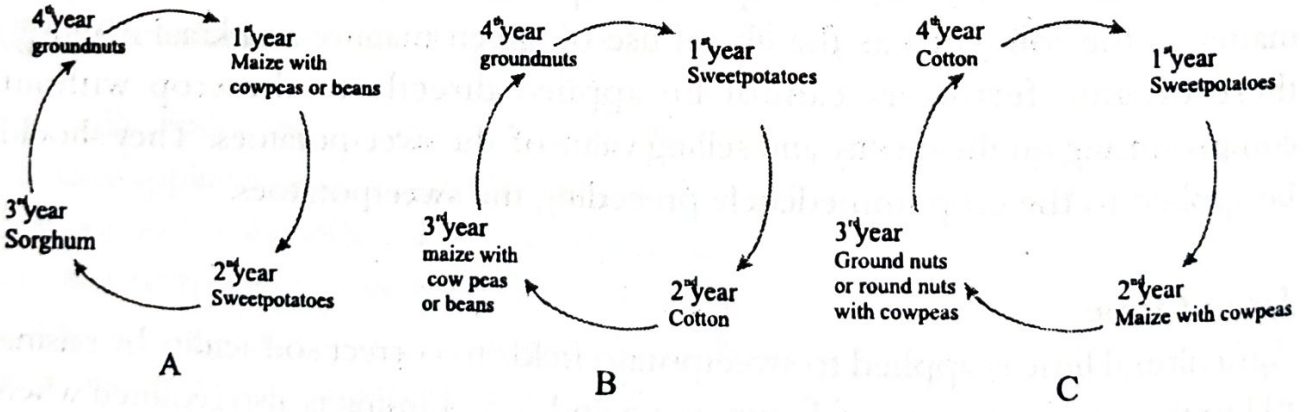



Fig.2 Suggested three year rotation for improving soil nutrients status

## 3.0 Commercial sweetpotato production

For success in commercial production of sweetpotato the following important requirements must be met:

### Planning

The grower must be able to plan all production activities well ahead of the planting season. All major activities namely land preparation, application of fertilizers or manure must be performed correctly and at the right time. Careful planning ensures efficient operations, higher yields and therefore more profits.

### Marketing

Producing large amounts of sweetpotatoes is of no use if there is no market for them. Fortunately, most areas in Zimbabwe, especially urban areas, are good marketing locations. A grower, producing sweetpotatoes for income generation, must first identify market outlets. The grower must them produce enough sweetpotatoes to satisfy the known market. More customers will be attracted if the grower is capable of producing good quality sweetpotatoes of the most popular varieties. The grower must be aware of the fact that market preferences and trends vary and change from time to time. It is therefore wise to make a survey of market requirements at the beginning of each season. The grower must then proceed to plan and make all the necessary adjustment for the target market.

### Labour

The availability of adequate labour for all production activities is essential. The size of the production area should be determined by the amount of labour available. A lot of manpower is needed for land preparation, planting and harvesting. Maintenance of the crop does not require much labour.

## 4.0 Sweetpotato production techniques

### Planting material

Propagation of healthy planting material is the first essential step in sweetpotato production. A number of pests and diseases can affect sweetpotato and **care should be taken in selecting disease free healthy planting material, so that diseases are not multiplied and transmitted to the field crop and into storage.** Growers can obtain material from reputable nurseries or they can produce their own. Planting material should be ordered from sweetpotato nurseries well ahead of the production season so that the nurseries can supply enough material. This ensures that the grower has the required amount of material at the onset of the rainy season. For growers producing their own planting material, the nursery should be established early enough material for sufficient planting material to be readily available at the time of planting. It is important to note that planting material propagated using farmers' traditional methods may not have the best "health status". For a high yielding vigorous crop, disease free planting material should be obtained from HRC and from maintained nurseries such as those in Hwedza and Buhera. A wide range of varieties is available from these nurseries and the grower can order the varieties preferred. **It is recommended that the grower obtains new planting stock from these nurseries after every two-years or as soon as yield decline becomes apparent.**

### Sweetpotato sprouts

Sweetpotato roots can be sprouted in well-drained soil beds under warm moist conditions to give rise to plantlets that can be transplanted into the field. . The sprouts can also be further multiplied as cuttings to give more planting material. The use of sprouts is not a very common practice in Zimbabwe, but is useful especially in the propagation of planting material after the hill selection process. Researchers have realized that the basis for improvement of sweetpotato quality in terms of yield; root shape and root size is hill selection. In this technique, storage roots with desired morphological qualities are selected from appropriate sweetpotato hills or plants in the field. **As a general recommendation, planting material of satisfactory performance may be regenerated from roots on hills showing about eight or more marketable sweetpotatoes of the desired**

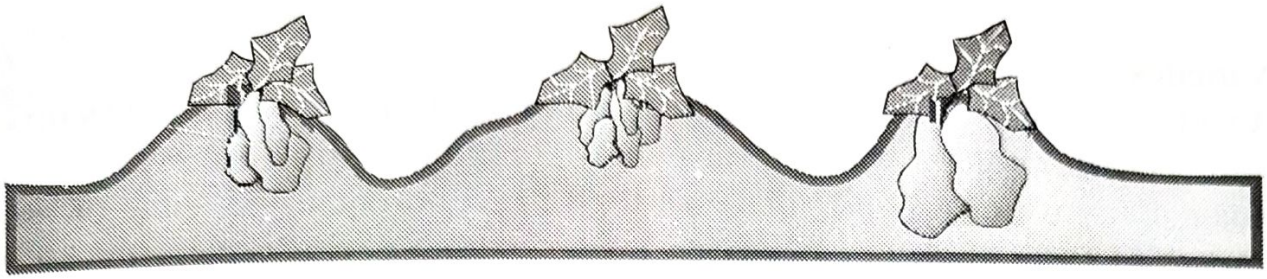


*Fig 3. Selection criteria for planting material*

shape and size. The regenerated material should give rise to a crop of similar performance and root quality.

Sweetpotato vine cuttings

The most common method of producing planting materials is the use of vine cuttings obtained from the previous crop or from nursery plants. When vines are obtained from disease free plants, the field plants will also be disease free.

Propagation from vines involves continual collection and rooting of the cuttings from sweetpotato plants. The method employs a high density planting system where cuttings are closely spaced at about 25 plants per square metre and maintained under hygienic and intensive agronomic management. The use of vines is more economical than raising plants from roots.

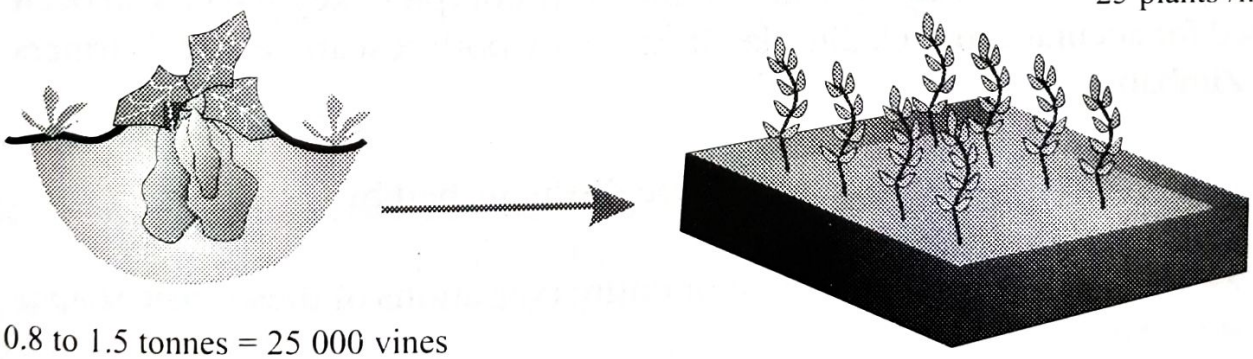



***Fig 4 Use of vines more economical than raising plants from roots***

About 25 000 vines are required to plant a hectare whilst approximately 0.8 to 1.5t of roots are required to produce enough material for the same piece of land. It is possible for growers to propagate their own sweetpotato planting material. However, for large-scale production, buying planting material from sweetpotato nurseries becomes more cost effective. Details on the multiplication of high quality planting material are extensively covered in a guide to successful establishment and management of sweetpotato nurseries.

## Varieties

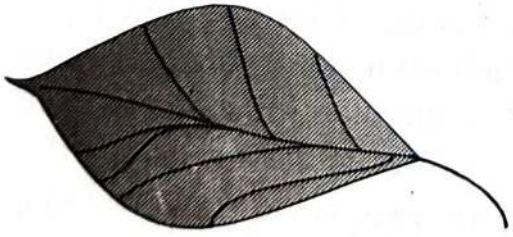
A wide range of varieties is grown in different locations. A number of factors influence the choice of varieties grown by communal farmers in Zimbabwe. Adaptability to local conditions and high yield potential are some of the important factors. Other desirable qualities include early maturity, long storability, high starch and sugar levels as well as taste. In some cases varieties favoured for household consumption may not be grown for marketing or large-scale commercial purposes. For commercial production, high yield, earliness in maturing, storability, root shape and root skin colour influence the choice of varieties.

Usually, the local name of a variety may vary from place to place. For instance the variety "Tanzania" parades under the following different names in Zimbabwe: "Chizambia", "Murambinda", "Ngoronhatu" and "Chingovha". Sometimes even the name for the most common variety from farmer to farmer. This is probably the reason why there seems to be a large number of sweetpotato varieties that have been recorded in this country.

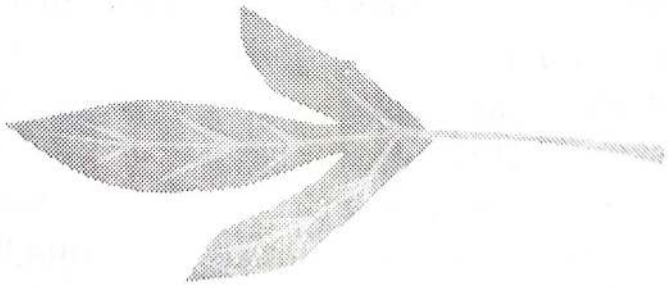
Descriptors of sweetpotatoes have been documented but these are mostly suitable for researchers and scientists in the field of sweetpotato research. Tentative classifications for local varieties have been suggested and developed by the Horticultural Research Institute, but more information is being compiled so as to come up with a sufficiently complete key which can been used for accurate and reliable classification by both researchers and farmers in Zimbabwe.

Generally, sweetpotato varieties can be distinguished by:

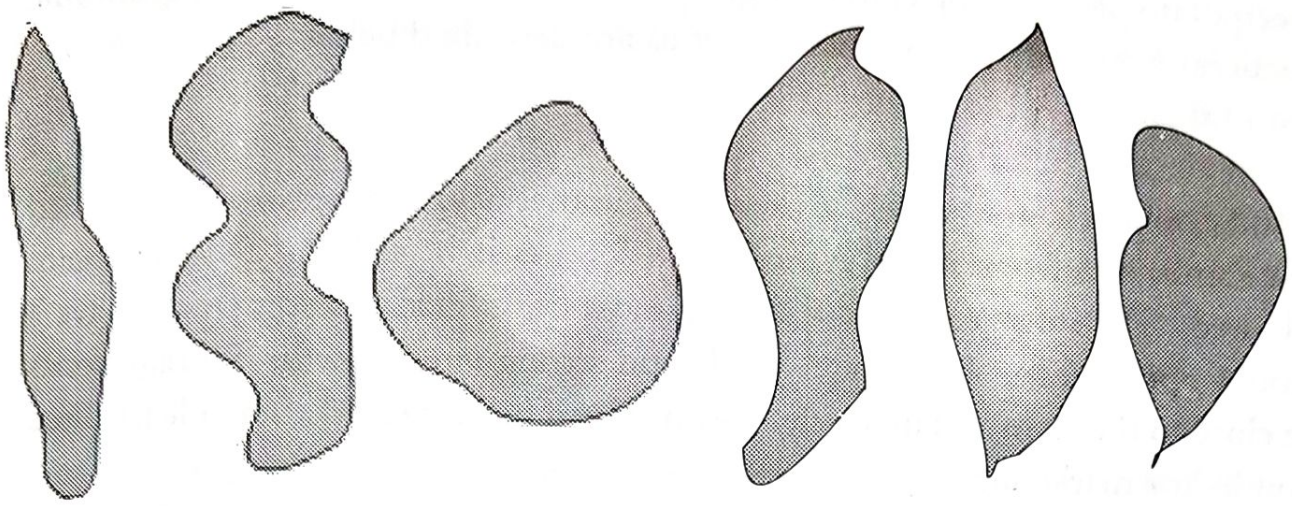
- leaf shape, which can be lobed or entire (variations of these basic shapes are expected).
- root shape, which can be round, long or irregular (variations of these basic shapes are expected)



Entire

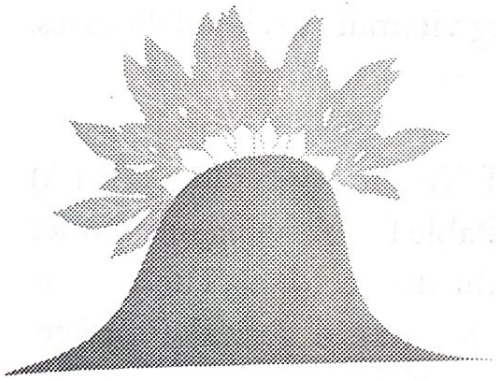


Lobbed

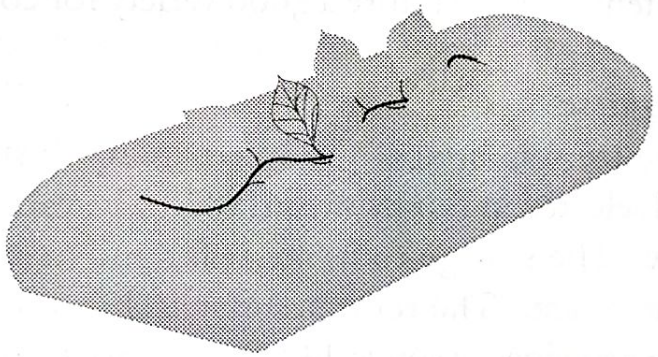


- root skin colour, which can be different shades or red or purple and different shades of white or cream
- the texture of the cooked sweetpotatoes, which is either soft, intermediate or mealy
- the growth habit of the plant, which may either be long or bunchy.

Bunchy



Long



Other minor characteristics that may be noted include leaf colour, vine thickness and extent of hairiness. This guide gives information on the most common varieties. The descriptors given are as observed by the author, researchers at Horticultural Research Institute, collaborators in the Sweetpotato Microprogation Project and farmers in Hwedza and Buhera. The author acknowledges that although the descriptors presented may not be complete if required for advanced scientific study the information is quite reliable and accurate for the purposes of this guide.

It is also important to realize that standard varietal characterization requires intensive study which takes a considerably long time. At the same time, the

sweetpotato plant is subject to change by climate, mutation, soils and agronomic practices. Some of the common varieties are described below.

**Brondal**

Brondal, which is now widely grown for commercial purposes, was introduced into Zimbabwe from South Africa. The skin is light red and flesh is cream coloured. The storage roots are large, almost cylindrical and sometimes have a knobby appearance. It has high yields and strong vine growth. Storage roots are close to the stem and tilt easily. Brondal can be harvested after at least three months for marketing.

**Cordner**

The variety was developed in America and matures in about four months. The storage roots are long and slightly tapered at each end. The flesh is orange and the skin is bronze. Cordner is a sweet tasting variety with high susceptibility to weevil attack. It is, however, tolerant to fusarium wilt (or stem rot) and the root knot nematode. Cordner is high yielding and has a very high provitamin A content. It is therefore a good variety for combating vitamin A related illnesses.

***Magutse***

Magutse was bred at the International Institute of Tropic Agriculture (IITA) and selected in Zimbabwe in1987. The variety is suitable for growing in summer only. The storage roots are bulky and have a khakhi skin colour. The flesh is light cream. The roots are easy to harvest as they are found near the surface. The growing season is 140 to 160 days (three and a half to five months).

***Chingovha***

A very popular variety with Harare's Mbare commercial vegetable market, Chingovha, is a high yielding variety developed in Kenya and released by the International Potato Center (CIP). Chingovha has a very vigorous vine growth, with a bushy habit. The leaves are deeply lobed, and when still tender, suitable for cooking as a vegetable. The roots are long and have a tendency to be very big. The skin and flesh colour are both cream. Chingovha is a very tasty variety with a desirable texture and it requires at least four months to reach full maturity.

*Chizayi*

Chizayi is one of the most popular "traditional" varieties and tends to be a favourite with many people especially for household consumption. Like most traditional varieties, Chizayi may be harvested after at least six months. The variety has round storage roots whose skin colour is deep red and almost purple. The flesh colour is yellow. The flesh texture is very firm with a mealy center. Chizayi is another renowned tasty variety.

*Kori*

Kori is a popular variety in the eastern districts especially in Chipinge. Kori is considered a traditional variety, and as such, it is also normally harvested after at least six months. It is grown mainly for marketing. Kori, a high yielder, bears uniformly shaped roots with a red skin colour and a pale yellow flesh and high in provitamin A. It has very attractive long shape and may grow big in rich soils. The texture is firm with the tendency to have a mealy center.

## Land preparation

The success of the sweetpotato crop depends to a large extent on the soil in which it will grow and the methods of preparing the filed.

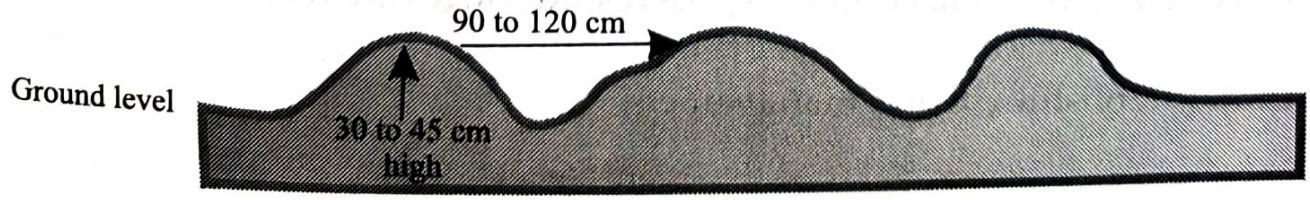
## Ploughing

Ploughing the field is necessary in order to produce a friable medium for planting the crop.

- Rich sandy loams can be ploughed to a shallower depth.
- Heavier soils should be ploughed deeper to break the clod and encourage root penetration.

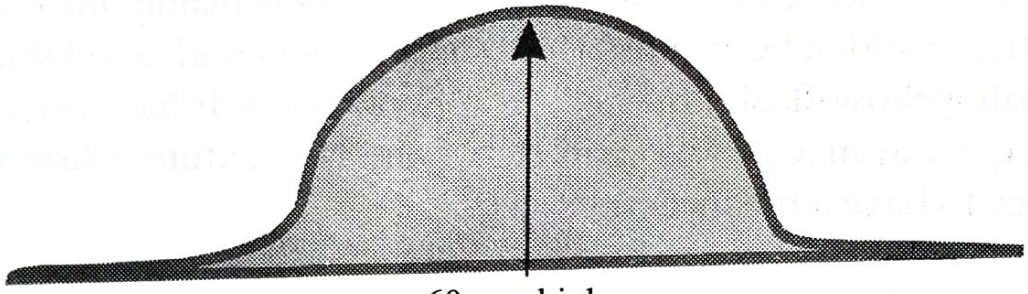
## Planting bed preparation

Sweetpotato can be grown on raised beds, flat ground, mounds or



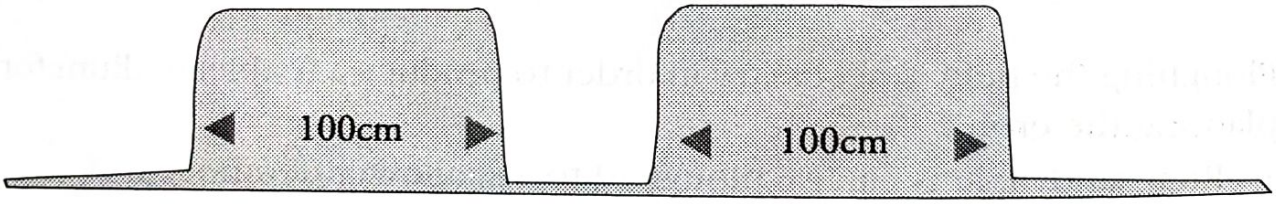
water logging and it is usually grown on mounds, beds or ridges by farmers.

- Ridges 30 to 45cm high and about 90 to120cm apart are normally used. This type of culture improves the drainage capacity of the soil and is therefore mostly desirable where the rainfall is high. Where the rainfall is erratic, low ridges are recommended as they conserve moisture. High ridges result in moisture loss. Ridge construction can be mechanized making the process of land preparation less labour intensive.
- Mounds of up to 60 cm high also improve drainage where the water table is high. Preparation of mounds is time consuming and the methods cannot be mechanized. Several plants can be planted on a single mound. This however, makes the harvesting process very difficult.



60 cm high

- Raised beds of up to 60cm in height and up to 10cm in width are commonly used in very wet areas. They also improve the drainage capacity if the soil. With raised beds two rows of plants can be planted but this also makes harvesting difficult.




- Planting on flat surfaces is preferred for purposes of conserving moisture where the rainfall is low. Growing on the flat surface is recommended in loose friable soils where mounds and ridges are unnecessary. Deep ploughing is required for loosening the soil in order to allow the development of storage roots of an attractive shape and size.
- For efficient drainage and easy harvesting, ridges are recommended.

**Crop establishment and management**

## Planting

### *Time of planting*

No set rules can be laid down as to the best date of planting in the field. In Zimbabwe, planting usually begins at the onset of the rains, which is usually in the month of October.

- Planting can start as soon as the temperatures have gone up (that is, above 10°C) and danger from frost is over.
- The sweetpotato crop requires at least 120 warm days. Growth is best at or above 24°C and is severely retarded when temperatures fall below 10°C. Plants should be established early enough to avoid the cold months.
- Early planting is desirable for early marketing when prices are higher
- Planting should be done at the onset of the rainy season for a rainfed crop. Where irrigation facilities are available, planting can be done all year round provided the temperatures in the area do not go below 10°C. For the irrigated crop, production can start as early as August in the warmer areas of the country but the rainfed crop can be established as early as October.

### *Planting material*

The following are tips for obtaining the best yields with sweetpotato planting material;

- ***Use planting material from young plants, which are two to three months old. This material is more vigorous and gives higher yields.***
- ***Cuttings from the tips of the vines give the best yields. Those obtained from the middle and the base give lower yields and may also carry weevils.***
- ***Long cuttings tend to give higher yields that shorter ones, but cuttings of 30 to 40cm long are recommended. If the internodes, that is the distance between the leaves are short, cuttings should be about 30cm long. If the internodes are long, cuttings should be about 40cm long.***

### *The planting process*

Planting techniques can influence yield. Careful consideration should be given to the selection of the method of use.

- There are several methods of planting sweet potato cuttings on the flat ground, ridges, raised beds or mounds but there may be a specific basis for all of them:

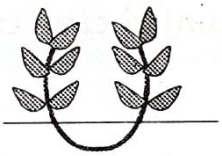
a. The cutting may be positioned vertically.

⅔ in the soil

b. The cutting may be planted slightly inclined at 45 degrees angle.

⅔ in the soil

c. The central portion of the cutting may be buried in the soil leaving a node exposed at either end.



⅔ in the soil

d. The cutting may be laid horizontally on the ridge or bed leaving a few nodes exposed to one end.

⅔ in the soil

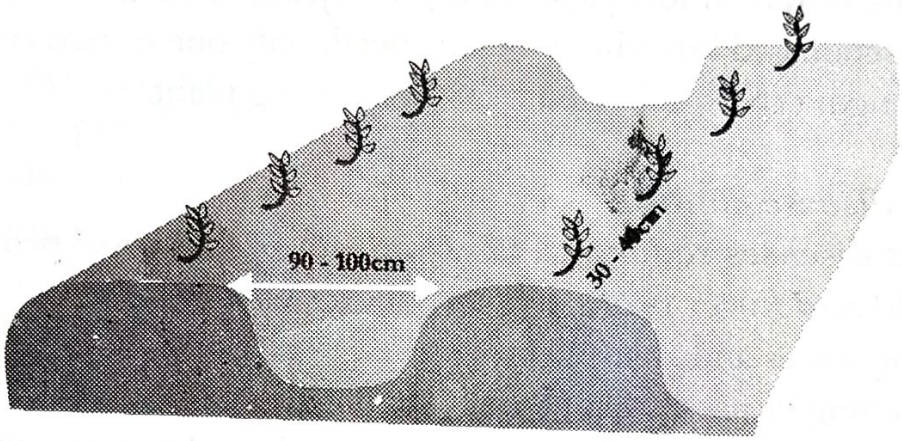
- In the first two methods half to two-thirds of the cuttings is buried in the soil taking care to firm the soil around the cutting.
- It is encouraged to plant cuttings slightly inclined. The angled planting results in larger storage roots developing close to the soil surface because the soil area is more likely to be moist most of the times. This method is less time consuming and ensures better yields.

***The best time to plant is when the soil is moist. Irrigating after planting also ensures good crop establishment.***

*Plant spacing*

The soil type should be considered when determining the plant spacing

- In rich soils plants may be closely spaced but n poor plants may be widely spaced
- Generally ridges and beds are spaced by 90 to100cm and plants on the ridges or in the beds are spaced at 30 to 40cm apart.




*Recommended plant spacing*

With the recommended spacing, the grower needs about 20 000 cuttings per hectare.

Sweetpotato crop management

After planting, there are other operations that are necessary in order to produce a good crop.

*Weeding*

- *Weeding is important for good sanitation.*
- Weeds should not be allowed to grow in the sweetpotato field. They compete with the crop for water, nutrients and sunlight. Weeds may even harbour pests and disease that affect the sweetpotato crop. Weeds should be pulled out by hand or removed using hoes. Care should be taken not to destroy the ridges or beds during the process.
- A single weeding may be carried out about four weeks after planting. The sweetpotato plant grows rapidly completely covering the ground within six to eight weeks. This removes the necessity for weeding during the later stages of crop development.

***Pinching off of vines***

Growers may collect vines from their sweetpotato crop for the following purposes:

- to feed their animals
- to sell as planting material to fellow growers.

The cutting of vines must be minimized because removal of many cuttings from plants results in low yields and poor quality sweetpotatoes. Pinching of vines is discouraged but where there is need, only one or two cuttings of 30 to 40cm in length can be collected from each young plant.

***Pest and disease control***

***Pests and diseases reduce yields resulting in less food produced for the household and lower profits.*** Pests reduce yields by:

- chewing leaves and stems causing wilting and death of the plant
- transmitting viruses, which reduce crop vigour and yield
- damaging the roots resulting in unmarketable and poor quality roots.

Disease reduce yield by:

- causing leaf and stem blights, scab and scurf resulting in less vigour, wilting and death of the plants
  causing root rots in the field and in storage, thus decreasing the amount of consumable and marketable roots

Methods of effective and sustainable pest and disease control include:

- regular scouting for pests and disease to establish the levels of infestation
- use of disease free planting material
- use of hygienic practices like weeding and rouging (uprooting) infected material
- practicing a crop rotation system where sweetpotato is grown on the same land once after three years
- covering up of cracks on ridges and beds to prevent entry of the sweetpotato weevil.
- use of pest and disease resistant varieties where they are available
- picking and destroying other pests by hand e.g. white grubs, caterpillars and leafhoppers
- setting traps to catch rodents like mole rats (nhuta)
- selection of weevil free and nematode free land for production of sweetpotatoes.

## 5.0 Sweetpotato pests and disease

Sweetpotato can give satisfactory yields even under adverse climatic conditions. In contrast to most crops grown in Zimbabwe, sweetpotato has low requirements for fertilizer and chemical. Despite these attractive features about sweetpotato production, there are also some problems with a number of pests, diseases and nutritional disorders affecting the crop.

A general knowledge of pests and diseases affecting this crop is very valuable to any sweetpotato grower so that losses in the field and in storage can be minimized. It is also important, however, to note that identification of pests, diseases and nutritional disorders is a specialist field that requires a considerable amount of experience. Emphasis must be placed on good sanitation, hygienic measures, rotation and the use of disease free planting material to achieve an integrated approach towards the control of pests and diseases in sweetpotato production. Whenever possible the use of chemicals should be avoided.

In Zimbabwe, sweetpotato weevils and viral diseases probably contribute the most to yield losses. Insect pests such as the armyworm and hornworm can also cause significant losses during outbreaks. Some common chemicals that can be used for controlling pests and diseases are presented in Table 1.

### Storage root feeders

### Sweetpotato weevils

*Damage caused and symptoms*

Adult weevils feed on the vines, leaves and storage roots. Feeding inside the vines results in malformation, thickening and cracking of the affected vine. Roots affected by the weevil are bitter and inedible. The sweetpotato weevil is considered as one of the most economically important pests of sweetpotato.

There are several species of the sweetpotato weevil but all of them have a similar life cycle. Basic knowledge on the life cycle of the weevil helps in developing strategies that successfully control infestation.The female weevil cannot dig, it therefore finds storage roots in which to lay eggs by entering through soil cracks.

Table1:Some of the common pests and disease of sweetiepotato and chemical used for their control

| Pest/Disease | Chemical | Application rate |
|---|---|---|
| Nematodes | Basamid | 5g/ $m^2$ (worked into soil before planting) |
| | | 10ml/ $m^2$ (used as a gas fumigant) |
| | Methylbromide<br>Ethyl dibromide (EDB) | 10/30l (injected into the soil at land preparation) |
| White grubs | Dursban | 30ml/15l (drench application) |
| Leaf eaters | Carbaryl<br>Malathion<br>Tamaron | 20g/10l<br>30g/10l<br>10ml/10l |
| Aphids | Dimethoate<br>Malathion<br>Tamaron<br>Cabaryl | 7.5ml/10l<br>30g/10/b<br>10ml/10l<br>20g/10l |
| Spider mites | Mitec<br>Temik<br>Parathion<br>Fenvelerate | 10ml/10l<br>2g/10 $m^2$<br>10ml/10l<br>10ml/10l |
| Blight<br>Wilting<br>Stem rot<br>weavil | Bravo<br>Copper Oxychloride<br>Spoton<br>Dithane M45<br>Captan | 20ml/10l<br>50g/10l<br>30g/10l<br>30g/10l<br>30g/10l |

Notes

1. Use of chemicals should be minimal
2. It is very important to follow the manufacturer's recommendations when using chemicals
3. Chemicals should be applied only when necessary and when other methods of control have failed
4. Advice on the use of chemicals should be obtained from extension workers, researchers and the suppliers of the chemicals
5. Application of chemicals should be as a full cover spray unless other wise stated
6. Rotation of chemicals is needed in order to discourage the development of resistance and diseases

The adult female weevil lays eggs in cavities in the vines or storage roots. These egg cavities are normally sealed with weevil faecal plug. In most cases, eggs are deposited at the base of the vine. The developing larvae (which look like tiny white grubs) tunnel into the vines and storage roots damaging them. The vines and the roots become filled with the excreta imparting a bitter unacceptable taste. After hatching, the larvae can completely destroy the plant. A few days after pupation, adult weevils develop in the vines or storage roots.

***Control***

***Sweetpotato weevils are difficult to control.*** The following agricultural practices are effective in controlling the weevil:

- use of disease free planting material
- removal of volunteer sweetpotato plants from previous crops
- where water is readily available flooding the field for 24 hours after harvesting
- timely planting and early harvesting to avoid a dry period which encourages development of cracks and entry of the weevil
- avoiding planting in or near infested fields
- hilling up of soil around the base of plants and filling in cracks in the soil
- irrigating sufficiently to prevent or reduce cracking
- soaking cuttings in an insecticide solution before planting. This treatment will continue to protect the crop in the field for up to one month from any new weevil infestation
- use of an efficient crop rotation system.

**Virus transmitters and viral diseases**

**Transmitters or vectors**

This class of insects transmits viruses as they feed and move from plant to plant. Viruses reduce plant vigour and yields. Apart from spreading viruses these insects also cause damage by their feeding activities. Virus transmitters can be a common problem in sweetpotato nurseries. Measures to improve hygiene in the field and nursery should be taken to prevent their spread.

**Important tips for virus infection and symptom identification**

- ***Virus identification is best carried out by an expert*** because sometimes

physiological and nutritional disorders are mistaken for virus infection.

- Symptom visibility on plants is influenced by susceptibility of the variety, degree of stress, stage of growth and strain virulence.
- Increased stress, like drought and inadequate nutrients, can enhance the expression of symptoms in affected plants.
- Rapid growth under favorable conditions may result in masking of symptoms in affected plants.
- Viruses are not only transmitted by insect vectors like aphids and whiteflies but are commonly spread through the use of cuttings.
- Very high vector populations in major sweetpotato growing areas increase the chances of virus infection and transmission.
- In areas where there is minimal production of sweetpotatoes, incidences of vectors and virus infection are low.

## 6.0 Nutritional disorders

The sweetpotato requires adequate and balanced supply of several important chemical elements in the soil for satisfactory development. A deficiency of any particular nutrient results in reduced growth. Nutritional disorders cause a range of problems that can result in high yield loss and can be the major limiting factor for most unfertilized crops. They also reduce tolerance to pests and diseases. This guide will focus on the most important nutritional disorders affecting production of sweetpotatoes in this country.

### Facts to remember about nutritional disorders

- Sweetpotato is generally regarded as a crop which tolerates low soil fertility levels. This means that the sweetpotato crop can yield satisfactorily where other crops fail.
- However, for optimum and profitable production, all the nutrient requirements need to be there.
- Diagnosis of nutrient disorders is a specialist area which requires knowledge and experience.
- Symptoms described in this guide should alert the grower to the problem of nutritional disorders in the crop, but in some cases chemical analysis of the soil and the plants themselves may be required to confirm the condition. Chemical tests assist in determining the type and quantities of fertilising elements needed to correct a deficiency.

## Table 2. Virus transmmiters and viral diseases

| Pest/disease | Damage caused/symptom | Control |
|---|---|---|
| **Aphids**<br><br>Aphids damage plants by sucking sap from growing shoots | . Signs of aphid attack are wrinklmg. cupping and downward curling of young leaves. During heavy infestatio n, plant vigour is reduced. | Control is rarely necessary. Predators such as lac'ybird beetles reduce the population of the aphids. In cases of heavy outbreaks insecticides may be applied but these should be sparingly as they may reduce the population of nat ural enemies of aphids. |
| **Whiteflies** | Whiteflies cause yellowing and necrosis of infested leaves | Appropriate measures to control these include:<br>use of insect proof screen material in the construction of nursery structures<br>use of appropriate insecticides. |
| **Spidermites** | Symptoms are dependent on the spidermite species. With some species, vines and leaves become excessively hairy starting from the shoot tip. Other species cause pocket like green galls on the leaves, petioles and stems. The galls later turn brown. When heavy infestation occurs, the leaves become crinkled and lose their shape. | Spidermites can be controlled by the use of:<br>mite free planting material<br>appropriate chemicals or acaricides |
| **Viral diseases**<br>Virus infection also results in reduced y ield and plant vigour | . The following symptoms are those transmitted or vectored by aphids and whiteflies:<br>faint irregular chlotic spots bordered by purplish colouration<br>chlorosis along the midrib<br>stunted growth<br>mild vein yellowing<br>small and narrow trap like leaves often with a distorted edge<br>puckering, vein clearing and mottling<br>leaf distortion | Viral infections can be controlled through such measures as the:<br>use of disease free planting material<br>use of tolerant varieties<br>control of virus vectors<br>removal of weeds. |

## Table 3.Bacterial, fungal disease and soil pests

| Disease/Pest | Damage caused | Symptoms | Control |
|---|---|---|---|
| **Bacterial diseases** | Bacterial diseases cause wilting as well as stem and root rots | -lesions of fibrous roots<br>-localized lesions with black margins on the surface of the storage roots<br>-wilting, that is, disease starts at the base of the stem as yellowish or brown to black water soaked lesions that soon turn brown<br>-roots can rot and develop distinctive odours. | - cuttings to be used for transplanting should be collected above the soil line<br>- use of tolerant varieties<br>- avoiding wounding storage roots during harvesting and handling<br>- use of disease free planting material<br>- practicing a good rotation system<br>- curing of roots before putting in storage. |
| **Fungal diseases** (Sometimes these fungal diseases are termed blights) | Fungi cause foliar and stem diseases at different stages of plant development. Fungi also cause root rots in the field and in storage. | - brown to tan corky lesions with purple to brown centers on the stems<br>- lesions on leaf veins, making them shrink and causing the leaves to curl<br>- black lesions on petioles and stems death of vines can occur and the ground under affected vines is often carpeted with blackened leaf debris<br>- whitish to brown lesions on both surfaces of leaves usually with a dark brown or purple margin - commonly referred to as leaf spot<br>- dullness and yellowing of the leaves followed by wilting and death of the vines<br>- dark and sunken cankers in the lower part of the stem<br>- severe infection causes yellowing, wilting and even plant death<br>- roots develop black to gray sunken areas rotting of storage roots. | - the use of disease free plating material careful crop rotation<br>- crushing of roots to drive out excess moisture and heal cut surfaces<br>- the use of tolerant varieties<br>- hygiene and sanitation |
| **Soil pests**<br><br>Nematodes (Nematodes are tiny soil borne pests and are sometimes referred to as eelworm.) | Nematodes are some of the most important pests causing considerable yield loss in sweetpotato production. | - stunted growth in plants<br>- yellowing of leaves and abnormal flower production<br>- galls on fibrous roots<br>- longitudinal cracking on storage roots<br>- blisters on the surface of roots<br>- small brown necrotic lesions on the fibrous roots and in the flesh of the storage roots | - use of resistant varieties<br>- crop rotation<br>use of nematode free planting material |

## Table 4. Common nutritional disorders

| Nutritional disorder | Signs of deficiency | Correction |
|---|---|---|
| Nitrogen deficiency (common on sandy soils with little organic matter) | Nitrogen deficient plants grow slowly and have small dull green leaves. Older leaves may die prematurely and they usually turn uniformly yellow before wilting and dying. | Nitrogen may be added in the form of mineral fertilizers, animal manure, plant compost, and mulch or by growing leguminous |
| **Phosphorus deficiency** -can reduce growth considerably without showing visible symptoms. This disorder is difficult to identify until it is quite severe | - first visible symptom is the development of red brown or purple pigmentation on the older leaves.<br>- Yellowing may then develop unevenly.<br>- This deficiency may develop bright colours for example yellow and orange combining with purple pigmentation.<br>- Purple pigmentation may appear on or may spread to the young leaves | Apply phosphorus such as super phosphate (single super phosphate or triple super phosphate) fertilizer or compound fertilizer at planting. |
| **Potassium deficiency**<br><br>Potassium deficiency common on sandy soils | - mature leaves develop a light green chlorosis between the fine veins.<br>- leaves become yellow particularly around the margin and in areas between the main veins.<br>- yellow tissue eventually dies usually turning dark brown and brittle. | Potassium may be supplied in organic material or as mineral fertilizer e.g. Muriate of Potash (MOP) or combined NPK fertilizers<br>Plant material can be applied as compost or as surface mulch |
| **Magnesium deficiency**<br><br>Magnesium deficiency is most likely to occur on sandy soils and on soils with high potassium content | - crop tends to have a generally pale colour with vines that become thin twining.<br>- Older leaves develop pale green to yellow interveinal chlorosis.<br>- Affected leaves are often slightly wilted and drooping.<br>- Red or purple colouration may appear on the upper surface of older leaves over interveinal patches.<br>- On older leaves, yellow areas become brown and necrotic but usually remain soft.<br>- entire leaf the turns yellow and wilts. | Dolomitic lime or magnesium oxide may be added to the soil. Magnesium sulphate as a band application or as foliar spray may be used to correct symptoms on existing crops. |
| **Boron deficiency**<br><br>Boron deficiency usually occurs on clay soils and under dry or cold conditions that restrict root development | - Young leaves become small thickened and brittle and are often puckered.<br>- Tips or lobes may curl under and petioles may twist.<br>- Internodes length may re reduced.<br>- the shoot tip shrivels and dies.<br>- Storage roots are often shorter than normal, blunt ended and may split resulting in deformities.<br>- Some portions of the flesh may be mottled and corky there by becoming less sweet or even bitter. | Deficiency is controlled by application of borate fertilisers |
| **Iron deficiency**<br>Over liming or excessive use of phosphate fertilizers may induce iron deficiency. | - Young leaves become yellow or almost white, with sharply contrasting green veins.<br>- In severe cases the young leaves become necrotic and the tip and auxiliary buds may die | Foliar sprays of iron sulphate are recommended. |

## 7.0 Marketing

The subject on marketing of any crop is a very important one. Marketing and selling begins with the first harvest and continues throughout the season until after the winter months. In large scale commercial production, sweetpotatoes can be marketed directly from the field or they can be put in storage to supply the off season market. In marketing directly from the field, the general process is to harvest, grade and market the sweetpotatoes on the same day. Sweetpotatoes can also be stored and sold for a larger profit later in the season. For this purpose, only the best sweetpotatoes are selected. Markets change from time to time and the grower has to understand and study the trends in the market. However, the secret to successful selling is to create a desire for the product to be purchased by consumers.

### Varieties

The issue of varieties is largely dependent on the requirements of the market to which the produce is sold. Preference trends also change from time to time. Although confusion still exists with reference to names of varieties, a few have become so prominent and well known that these may well be considered standard varieties. These standard varieties such as Chizambia, Kori, Brondal and Mozambique White are usually the most profitable for the local market and for household purposes. Individual growers and co-operatives stand to benefit more if they select one popular variety and produce that one exclusively. Specialization tends to attract the attention of consumers who would not be interested otherwise. However, the market demands will always decide which variety to produce. Currently the Harare Mbare market gives preference to white skinned varieties, whilst the Bulawayo markets favour the red skinned varieties.

### Time of harvesting

Sweetpotato can be harvested three to six months after planting depending on the variety and the intended usage. The ideal time is during dry, warm weather. Harvesting during wet spells should be avoided because it encourages rapid rotting of bruised sweetpotatoes. Furthermore, during such weather, the sweetpotatoes will naturally be more watery and require longer curing. Traditionally, roots can be harvested as required for household purposes. Most growers prefer to harvest when the sweetpotatoes are fully mature. On the

other hand, when sweetpotatoes are grown for the early market, maturity is not a major concern as roots are dug when they are of marketable size. For storage purposes the crop must be harvested at full maturity since immature roots do not keep well.

Factors that influence maturity include climate, growing season, soil, fertilizers and variety. Some growing conditions favour rapid development and therefore early maturing of the crop. When the sweetpotatoes are fully mature and ready for harvest, a light yellowish color is observed on the leaves. At this stage the plant does not show any new growth. There is also another way of checking for full maturity. If the crop is fully matured, a broken sweetpotato will harden within a few minutes of being exposed. When the crop is immature the cut surface will remain sticky and milky. This means that cuts and bruises on immature roots will remain as open as wounds and this condition may encourage the entrance of bacterial and fungi, which cause rots. Although sweetpotatoes harvested earlier for the market can fetch a higher price, their quality may not be pleasing. In most cases the sweetpotatoes may not have reached full maturity. Immature roots have less weight and they do not store well, which results in comparatively lower profits. For purposes of early marketing, it is more economical to plant a definite size of land with early maturing varieties that will be dug for the early market. Alternatively, an early crop may have to be established for the early market.

**Implements for harvesting**

In small and backyard fields, where sweetpotatoes are grown for home consumption, harvesting can be done using a hoe or a garden fork. When the garden fork is used the work will be easier and more efficient. In commercial situations harvesting is usually performed with ox drawn or tractor drawn implements such as ploughs or rippers. Proper implements for harvesting sweetpotatoes have not been designed so far. The ordinary plough may not accomplish the task of harvesting If not properly and carefully used. There is a tendency to damage and bruise a considerable quantity of the rots resulting in reduced marketable roots and lower profits.

It is desirable that the soil be comparatively dry at harvesting. Relatively dry soils result in drier, cleaner and smoother sweetpotatoes that can be properly handled. All the soil should be removed from the sweetpotato and it is preferable that they be graded and packed in the field to avoid unnecessary handling. The

less handling there is the less likely they are to become bruised, damaged and to rot. Whether the sweetpotatoes are for storage, marketing or home consumption, they should be cured, graded and packaged in the field, thus eliminating numerous handling stages.

## Grading

Sweetpotatoes may be separated into two major grades, the marketable and the unmarketable. Currently in this country, only these two major grades exist. Distinct grades in terms of size have not bee developed yet although different growers and traders may use their own individual system.

The grading system is usually based on size, pest and disease infestation and on whether the sweetpotatoes sustained damage during harvesting. The best quality sweetpotatoes in the marketable grade, those of a regular shape and medium size, are marketed first. The "not so good" sweetpotatoes, which may include the extra large ones and probably some small ones, will then be sold later. The best plan is to go over one row at a time and picking up all the marketable sweetpotatoes first then the bruised roots and finally the pest and disease infested ones. It is advisable to store the grades separately. As more farmers get to produce sweetpotatoes, more defined grades may be suggested.

## 8.0 Storage

Of all field crops grown on the farm, sweetpotato is the most perishable. The grower must practice good harvesting and storage techniques in order to have fresh sweetpotatoes for sale and for household use for a longer period. A major benefit of storage is that when sweetpotatoes are sold off-season the grower will realize higher profits. The lack of proper storage facilities has, however, been the greatest drawback for growers who may want to go into production of sweetpotatoes for marketing over a longer period. The first important stage in storage of sweetpotatoes is the curing process followed by the construction of properly constructed storage facilities.

### Essential requirements for keeping sweetpotatoes

Some essential principles must be observed to successfully keep sweetpotatoes without decay. Precautions should be taken to prevent the development of diseases, starting from propagation of planting material, the production phase right through to storage. The time of harvesting, the extent of curing and the techniques of storage influence the keeping quality of the sweetpotatoes. Extreme care should be taken during harvesting to minimize bruises, which encourage rotting or decaying in storage. The requirements for successful storage of sweetpotatoes are discussed below.

### Use of disease free planting material

A good sweetpotato crop of satisfactory performance, even in storage, begins with disease free planting material. Infected plants transmit disease to the field, and subsequently to the roots in storage.

### Timely harvesting

To secure maximum yield and develop the highest quality, sweetpotatoes should be allowed to mature before they are harvested. Immature roots have a tendency to rot and decay faster. Once mature they should be left in the ground for too long. Delayed harvesting exposes them to several types of pests and diseases. Weevil attack and rotting usually occur at this stage.

## Careful handling techniques

Proper harvesting techniques must be practiced. Care must be taken not to bruise, cut or break the sweetpotatoes during the process. Most good quality roots are lost through careless handling resulting in bruises. Whatever system of handling used, sweetpotaoes should never be thrown in heaps in the field or handled in sacks. A large percentage of the sweetpotatoes handled in these ways will surely become bruised. This allows the entrance of spoilage microorganisms. Sweetpotatoes should be handled as little as possible, graded and carefully placed in boxes, crates, baskets or any other suitable containers while still in the field. The sweetpotatoes should be transported in the same containers thus minimizing bruising and rotting. For storage purposes, only the best roots without damage or disease must be selected and kept in proper storage facilities.

## Sufficient curing

The sweetpotato must be properly cured in order to reduce the chances of spoiling in storage.

## Suitable varieties

Some varieties store better than others. It may be a good idea to do a small test to find out which variety keeps best. The grower who is familiar with the varieties grown will know which varieties to keep and which to sell immediately.

## Curing

When sweetpotatoes are harvested, they contain excess moisture, which is given off. If sweetpotato roots with excess moisture are carried into storage, moisture is released and may even collect on the surfaces of the sweetpotatoes thus causing wet and humid conditions that favour the spread of storage diseases. To prevent this condition, the sweetpotatoes should be well cured. Curing sweetpotatoes is meant to drive out excess moisture from the roots as soon as they are harvested from the field. Curing also dries off or seals cuts and bruises on the surfaces of roots and improves the condition of skin making it tougher for better handling and storage. This ensures that they keep better and for a longer time than they otherwise would.

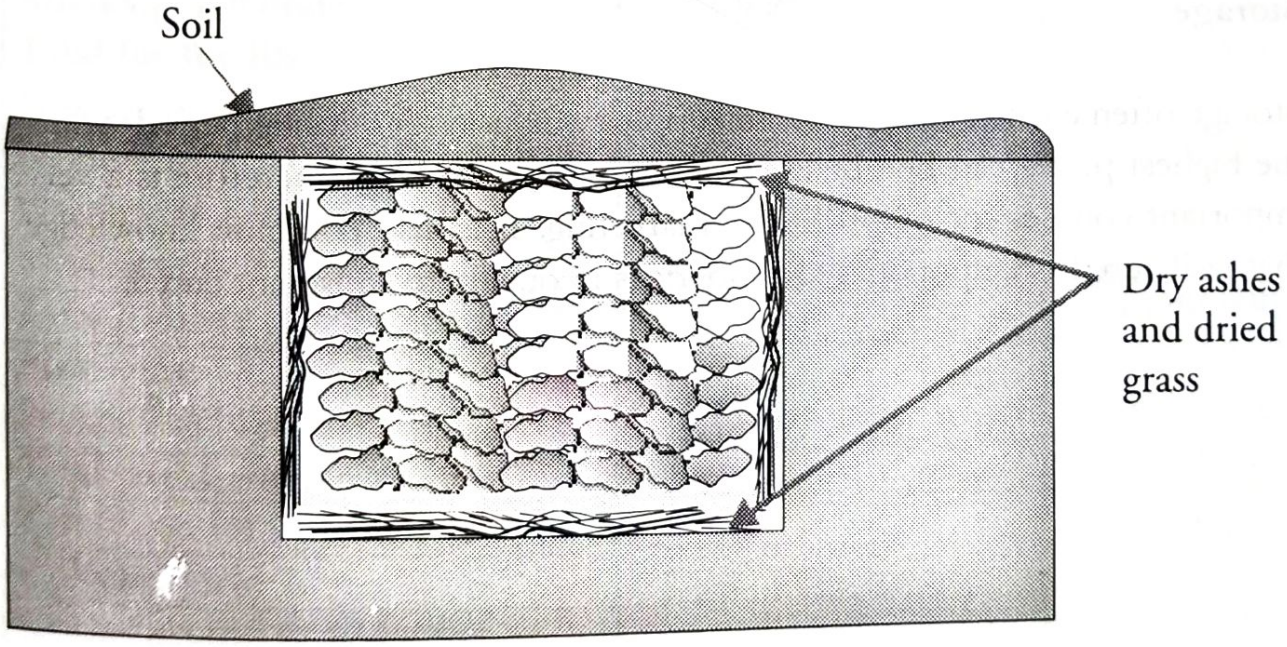
Growers cure sweetpotatoes by drying them in the sun for a few days. It is relatively easy to tell when the sweetpotato is cured. The test is conducted by rubbing the skin of the sweetpotato. When the skin clings firmly to the flesh it indicates that it has been properly cured but if the skin rubs off it indicates that the sweetpotatoes are still not cured.

Preparation of a storage pit

Although there may be more than one method of storing sweetpotatoes, the most common and efficient storage facility is the storage pit.

The process of constructing the storage pit is very simple:

- The pit must be dug in a dry termite-free area.
- The size of the storage is determined by the quantity of sweetpotatoes to be stored.
- The shape of the pit is entirely the farmer's choice. Some farmers find it easier to prepare a square shaped pit than a round one.
- After digging, the pit should be lined with dry ashes and dried grass.
- The selected sweetpotatoes are carefully put in the pit, which is then sealed with more ashes and or dry grass.
- After the ash and dry grass layer, soil used to level up the pit.
- Other growers prefer covering the storage pit with a thatched roof for shading and for preventing rain from getting in.



Research in other countries has shown that it is possible to keep sweetpotatoes in the storage pit as for as long as five months during the dry season. However, in order to achieve this, it is important to inspect the storage pit regularly. The storage pit must be inspected at one to two week intervals to check for:

- signs of rotting
- damage by rats, mice and moles and
- infestation by weevils and other insects.

If any of these problems are observed the pit should be cleared and the affected roots thrown away. Unaffected roots from the same store should not be restored. They might harbour diseases, which may initiate decaying. Such roots should be used within a short period of time. If the roots are in good condition the storage pit should be resealed.

The storage pit can be used in subsequent seasons but:

- All the remains of the old grass and soil covering should be thrown away.
- The pit must be sterilized by lighting a fire in it.
- New dry grass and fresh soil must be used for lining and covering the pit.
- If any rotting problems were encountered the pit must be relocated to a drier position.
- If problems with rodents; mice, rats and moles and insects were experienced, the storage pit should covered with a thicker layer of soil at the top.

**Storage**

Storage often enables the grower to supply sweetpotatoes during periods when the highest prices can be obtained at the market. Storage therefore is a very important component of profitable marketing. It is also common knowledge that well cured sweetpotatoes are superiors in quality to those not cured.

## 9.0 Cost of production and yields

### Cost of production

The cost of producing one hectare of a sweetpotato crop depends on the region where the crop is grown and the agronomic methods practiced. Variations in the cost of labour, planting material, fertilizers, storage and marketing infrastructure are expected from place to place. Due to these factors, no definite statement can be made to hold for every condition. A general gross margin budget for the production of sweetpotato is shown in Table 5. The cost of producing one hectare of sweetpotatoes should be reduced to a minimum.

Table 5. Cost of producing 1 hactare of sweetpotatoes, as of the 2003/2004 season

| **Item** | Quantity Required | Total Cost |
|---|---|---|
| ***Inputs*** | | |
| **Land preperation** | | |
| Ploughing | | 490 000 |
| Ridging | | 225 000 |
| **Land preperation Total Costs** | | **735 000** |
| Planting material @ 20 000/bag | 90 bags | 1 800 000 |
| **Total planting material costs** | | **1 800 000** |
| ***fertilizers*** | | |
| compound D | 300kgs | 486 000 |
| Ammonium Nitrate | 120kgs | 145 500 |
| **Total for fertilizers** | | **631 500** |
| ***Labour*** | | |
| Planting @ $10 000 | 20 man days | 200 000 |
| Weeding @ $10 000 | 30 man days | 300 000 |
| harvesting @ $10 000 | 50 man days | 500 000 |
| **Total Labour** | | **1,000,000** |
| ***Packaging*** | | |
| Pocket @ $1400 | 1500 pockets | 2 100 000 |
| **Total packaging costs** | | **2 100 000** |
| **Total Cost Of Production** | | **6,266,500** |
| Expected yield 20t/ha | | |
| **Gross Income @ $2000/kg** | | **30,000,000** |
| Gross Profit | | 23,733,500 |

The above budget makes the following assumptions:

1. The grower has free land ownership
2. The agronomic recommendations in this guide are closely followed so that satisfactory yield is obtained. Where necessary, advice should be sought from the HRC and local extension workers
3. Planting material is bought from renowned sweetpotato nurseries e.g. those in Hwedza, Buhera and the HRC
4. Labour is hired for planting, weeding and harvesting
5. Land preparation is by ploughing, discing or ridging using tractor drawn implements. Government rates have been quoted – variations are expected in different areas
6. An average yield of 20t/ha is obtained
7. The sweetpotatoes are packed in the conventional 'potato' pockets.
8. The sweetpotato are sold at a producer price of $1 500.00/kg

From a financial standpoint, success with sweetpotatoes depends on, several factors including crop rotation, which increases yield, reduces the cost of fertilizer and keeps down disease incidences. Proper storage techniques and knowledge of the best marketing conditions, including knowledge on the best selling varieties, will also help to make the sweetpotato crop profitable.

## Selling period

Selling growers have earned themselves high profits and a good name though producing and supplying high quality sweetpotatoes on the early market. Although it might be expensive to cater for the early market most growers find it largely profitable. Prices are considerably lower when the market is glutted with sweetpotatoes. Many growers should therefore prefer to store their produce until the market prices are favourable. This requires that the grower established and efficient and relatively curing and storage system that avoids unnecessary losses to rotting and pest damage. If the grower caters for the extra early market, then the earliest varieties should be grown. The time of selling, middle or late markets, should strongly influence all other operations of production and must be considered during planning in order to have a profitable marketing system.

## Quality

Consumers and growers are impressed by superior quality produce. Quality

refers to all factors that make the sweetpotatoes attractive and desirable. This includes uniformity in size or grade, shape, root skin and flesh color, texture and sweetness. The quality of sweetpotatoes is particularly influenced by the type of soil on which it is grown, the amount of rainfall, the variety, fertilizers, harvesting, curing and subsequent handling and grading. Growers should strive to produce sweetpotatoes of a certain desirable standard and work on maintaining or even improving it. In this way the grower gains a good reputation which ensures viability of the business.

## Grade

***Sweetpotatoes that attract customers and tend to fetch higher prices on the market are of medium size, smooth texture and uniform shape.*** Sweetpotatoes of different varieties and different grades should be transported and sold separately. Sweetpotatoes of a similar size are more attractive than mixed varieties and mixed grades.

## Quantity

***A grower should never produce more sweetpotatoes than he can efficiently handle or sell.*** At the same time the grower must grow enough to supply the market and generate enough income to cover all production costs. It is useful, therefore, to try and get an estimate of the quantities that can be absorbed by a particular market at different times. If all the sweetpotatoes are to be marketed at harvest the amount to grow will depend on the harvesting period, the absorption power of the market at that time and the labour available at harvest time. If adequate storage facilities are available, more sweetpotatoes can be handled immediately with little or no unnecessary losses. A grower without storage facilities is likely to experience losses when a greater crop than can be marketed is produced.

## Yields

The yield obtained per hectare depends on the season, amount of rainfall, soil type, fertilizers and the variety used. High yielding varieties and good agronomic practices normally give satisfactory yields and higher profits. The yields obtained will also vary from farmer to farmer and from region to region. The average yields obtained at sites in two different districts are shown in Table 3.

TABLE 6. Yields of selected local sweetpotato varieties grown in Hwedza and Buhera under irrigated conditions during the February to June 2002 season

| Site | Mvurachena Irrigation Scheme (Hwedza) | Murambinda Irrigation Scheme (Buhera) |
|---|---|---|
| Variety | Yield in tonnes/hectare | Yield in tonnes/hectare |
| Mupedzanzara | 26.0 | 34.4 |
| Cordiner | 24.8 | 20.8 |
| Brondal | 31.0 | 31.8 |
| Pamhayi | 26.9 | 40.4 |
| Imby | 25.0 | 25.0 |
| Muuyu | 24.5 | 37.5 |
| Bhanabhasi | 27.7 | 26.5 |
| Mai Farai B | 26.6 | 27.9 |

The results shown give a general idea of yields expected with the varieties shown in the two areas.

## References


ARA-TECHTOP, 1996. Study on the feasibility of micropropagation programme for the selected root and tuber Crops. Final report submitted to the Zimbabwe Biotechnlogy Advisory committee (ZIMBAC). Harare, Zimbabwe.

FAO, 1990. Roots, tubers plantains and bananas in human nutrition. www.fao.org/inpho/vlibrary/t0207e05.htm

Mazhangara E.P, Nyakatawa E.Z, Moyo C, Mutimutema E. Baseline study on cassava and sweetpotato production and utilization in Zimbabwe. Interim report Chiredzi, 1996.20 pp.

Mharapara I.M and MDS Nzima, 1985. Sweetpotato and cassava Survey. 27 Feb- 10 March 1985. Chiredzi research station, Department of Research and Specialist Services. Chiredzi, Zimbabwe.

Woolfe J.A Sweetpotato: An untapped food resource. Cambridge *University Press, Cambridge, 1992*

## About the book

Sweetpotato is a widely grown crop both in rural and urban Zimbabwe. Although it has largely been grown as a food crop, it has the potential to become a valuable income generator. This book provides suggestions for improved production of sweetpotatoes which can result in maximum benefit to the grower. The book was written as part of the sweet potato micropropagation project facilitated by the Biotechnology Trust of Zimbabwe (BTZ).

## BTZ

The mission of BTZ is to enhance the quality of life of marginalised people through participatory development and use of appropriate agricultural and environmental technologies. Since 1997 BTZ has facilitated the implementation of several pilot projects addressing the needs and priorities of smallholder farmers in Hwedza and Buhera using an interactive bottom up, participatory, multi-stakeholder approach.

## Contact details

For more information about the BTZ visit our website at http://www.biotechtrust.co.zw or e-mail us at: biotech@mweb.co.zw. You can also write to us at The Biotechnology Trust of Zimbabwe, P.O. Box, BW 267, Borrowdale, Harare, Zimbabwe.

BIOTECHNOLOGY TRUST OF ZIMBABWE

BTZ