

# Variety Characteristics and Production Guidelines of Traditional Food Crops



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Ministry of Agriculture

*Compiled and Edited by:  
D. R. Karanja, C.M. Githunguri, L. M'Ragwa, D. Mulwa and S. Mwiti*

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Variety, Characteristics and Production Guidelines of Traditional Food Crops  
KARI Katumani Research Centre

Photos on the cover page represent some of the major traditional food crops common in the semi-arid areas of Eastern Kenya

Photos in this document are courtesy of D.R. Karanja and L. M'Ragwa of KSU Katumani

With compliments from the Centre Director, KARI Katumani, P.O. Box 340, Machakos  
Tel. 044-21122; Fax: 21122; E-mail: [karikat@wananchi.com](mailto:karikat@wananchi.com) or [ksukatu@wananchi.com](mailto:ksukatu@wananchi.com)

Produced by: KARI Katumani and Eastern Province Horticulture and Traditional Food Crops Project  
Compiled and Edited by: D.R. Karanja, C.M. Githunguri, L. M'Ragwa and D. Mulwa

Typesetting, Layout and Design by: J.O. Abok

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## List of Acronyms

AEZ	-	Agro-ecological zone
ASALs	-	Arid and Semi-arid Lands
CAN	-	Calcium ammonium nitrate fertilizer
CBMV	-	Common bean mosaic virus
CIAT	-	Centro Internacional de Agricultura Tropical
CIP	-	El Centro Internacional de la Papa (International Potato Centre)
EARNET	-	East Africa Research Network
ECABREN	-	East and Central Africa Bean Research Network
ECAMAW	-	East and Central Africa Maize and wheat Network
FAO	-	Food and Agriculture of the United Nations
GoK	-	Government of Kenya
ICRISAT	-	International Crop Research Institute for Semi-Arid and Arid Tropics
IFAD	-	International Fund for Agricultural Development
IITA	-	International Institute of Tropical Agriculture
INTSORMIL	-	International Sorghum and Millet Organization
KARI	-	Kenya Agricultural Research Institute
NPK	-	Nitrogen, phosphorus and potassium fertilizer
PRAPACE	-	Regional Potato and Sweetpotato Improvement Network in Central and Eastern Africa (Programme Regional d'Amelioration de la Culture de Pomme de Terre en Afrique Centrale)
UNDP	-	United Nations Development Programme
USAID	-	United States Agency for International Development

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## Foreword

Agricultural growth and development is crucial to Kenya's overall economic and social development. The sector directly contributes about 26% of Gross Domestic Product (GDP) and a further 27% through linkages with manufacturing, distribution and service-related sectors. About 80% of the population lives in the rural areas and depends mainly on agriculture and fisheries for livelihood. In addition, 87% of all poor households live in rural areas where their main activities are agriculture and many of them grow one of the many traditional food crops for subsistence.

Traditional food crops such as beans, pigeonpeas, cowpeas, dolichos, sweetpotato, cassava, sorghum and millet have been pivotal in ensuring self-sufficiency in food despite being outside the brackets of other more recognized crops in the agricultural system. They have, however, suffered from recognition problem for a long time thus resulting in relegation to the undeserved category of "minor crops" with little support for their research and development. This attitude is changing rapidly with the realization that these crops have been key to the food security to millions of people especially in arid and semi-arid lands (ASALs) that are characterized by recurrent drought, poor soils and general lack of resources for meaningful agricultural production.

Besides meeting the daily subsistence food requirement, these crops can also be transformed into broad-based commodity for sustained food security, better nutrition and income generation. With the recognition of the key roles of these crops in the food systems, the government with the support of several collaborators and development partners has provided increased support for their development and propagation. This is paying dividends when one considers the production of such an important manual by scientists from Kenya Agricultural Research Institute (KARI) that is availing yet more useful and relevant information in production of these crops.

This manual has been compiled to provide guidelines on all aspects of traditional food crops being grown in the semi-arid areas of Kenya. In compiling this manual, reference was made to past work done by various KARI centers located in the arid and semi-arid areas. The work of KARI and other stakeholders involved in the development and production of traditional food crops for the semi-arid areas is greatly appreciated.

Efforts have been made to ensure that the information in this manual is accurate. However, there is room for suggestions that could be included in future editions. Agriculture, which feeds our nation, needs to be nourished with quality digestible information on improved technologies; otherwise it is likely to remain less productive. All stakeholders in agriculture need access to any information that would lead to increased agricultural productivity. This information must be easy to understand and apply. This manual precisely attempts to achieve that with a view to upgrading traditional food crops farming techniques and utilization in the ASALs of Kenya. It is worthy noting that hardcore scientific details have been deliberately avoided in the manual as these can be obtained from various KARI technical reports and other agricultural publications.

It is our sincere hope that this manual will be of assistance to many research and extension workers involved in food security programmes. Research on traditional food crops continues and future results may modify the recommendations contained here-in. Any information that is beyond the scope of this manual can be obtained from the Centre Director, KARI Katumani, P.O. Box 340, Machakos.

I take this opportunity to express my sincere gratitude to the many organizations that have supported research and development projects pertaining to these crops from 1956.

Dr C. W. Kariuki  
Centre Director KARI Katumani

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## 1.0 Introduction

Eastern, parts of Rift Valley and North Eastern are the main provinces constantly threatened by famine. Onyango *et.al.* (2006) have estimated that at any given time of the year 300,000 to 2,000,000 residents in these two provinces are receiving famine relief food. Unfortunately, Eastern and North Eastern provinces are major consumers of maize, which is not drought tolerant *per se* and hence does not perform well in these regions. About 80% of famine alarms are frequently raised in the arid and semi-arid lands (ASALs) of Kenya. Unfortunately, these famines are ignored and frequent need for food relief occurs despite the fact that these regions can support the growth of drought tolerant traditional food crops such as sorghum, millet, beans, cowpeas, pigeon peas, mungbeans, cassava and sweetpotatoes. In addition, most traditional food crops, especially sorghum, millets, cassava and sweetpotatoes are perceived as poor people's food. This has frustrated the national efforts to promote these crops as viable, commercially marketable foods. Hence, it is not a wonder that products from these crops are hardly stocked in major supermarkets. There should be deliberate and concerted efforts by all stakeholders involved in food production to promote the production of traditional food crops in the ASALs and their utilization nationally if the humiliating famine and relief are to become a thing of the past.

### 1.1 Technologies

#### 1.1.1 Sorghum and millets

Sorghum and pearl millets are important food security crops especially in semi-arid lands of Kenya. They have a wide agro-ecological adaptation. They require less water than maize thus offering great potential for supplementing food and feed resources (KARI Proceedings, 2000). They produce a crop in areas where maize crops often fail to reach physiological maturity in 5 out of 8 seasons because of erratic rainfall. Although sorghum and millet varieties with a yield potential of 2 to 5t/ha are available (M'Ragwa *et. al.*, 1997), their productivity has remained low, at 0.7/ha for sorghum and 0.5t/ha for pearl millets (GoK, 1996).

Sorghum and millets can be consumed as "ugali", "uji" fermented porridge and beer. Sorghum flour can be blended with wheat in confectioneries. In particular, 85% wheat flour can be blended with 15% fine sorghum flour to make acceptable bread. Several recipes of sorghum and millets have been developed. However, the popularity of sorghum and millets in Kenya has declined in recent years due to the introduction of maize, wheat and rice. Frequent maize crop failures have led the government to recognize their value as food security-drought tolerant cereal crops. KARI has released four sorghums, three pearl millet and one finger millet varieties.

#### 1.1.2 Grain legumes

Research on the improvement of grain legumes adapted to semi-arid areas was initiated at Katumani in 1979 with the assistance of the FAO/UNDP. The crops referred to as grain legumes or pulses are beans, cowpeas, pigeon peas, mung beans and dolichos. These crops are grown in semi-arid Eastern Kenya in varying hectareage, depending on preferences and adaptation to agro-ecological zones. Cowpeas, dolichos and mung beans are grown in lower, drier and warmer areas.

Grain legumes are a major source of proteins in the cereal-based diets, and also a source of income.



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Large amounts of grain legumes are sold locally in urban centres and are also exported in green, dried and processed forms. Majority of grain legumes fix nitrogen from the atmosphere, thus contributing significantly to the sustainability of soil fertility in the dryland cropping systems and hence reduce the requirements for inorganic commercial fertilizers.

### **1.1.3 Cassava**

Cassava is important in the economy of households, and is a major source of subsistence and cash income to farmers. The crop can adapt to adverse and diverse agro-ecological zones, qualifying it as a food security crop. Apart from labour, cassava requires minimal inputs and is thus inexpensive to produce. Cassava can produce fresh tuberous roots yield of 5 to 6t/ha on low-fertility soils.

Its genetic potential is large and untapped. The adoption of improved varieties could make cheaper calories available per hectare to resource-poor farmers in semi-arid Kenya. In the eastern region, though there are a few incidences of African cassava mosaic virus, the major biological stresses are the cassava green mites and cassava scales. The problem of mammalian pests like moles, porcupines and pigs, and lack of sufficient healthy planting materials is important.

### **1.1.4 Sweetpotato**

The Eastern province of Kenya, accounts for about 10% production in Kenya. The cultivation of crop is on the increase in the semi-arid lands due to its high adaptability and utilization. The crop is mainly grown by small-scale resource-poor farmers, with minimal inputs. The average sweetpotato holding in most farms is 0.2ha and is often regarded an insurance crop. Significant productions are in a subsistence basis. Its production is constrained by the sweet potato weevil virus complex. The other problems include large mammalian pests like moles and pigs. Lack of adequate disease and pest free planting materials, appropriate storage, and processing technologies hinders the production of the crop. Poor market infrastructure is also not well developed.

### **1.1.5 Soil and Water Conservation**

Management of soil and water is important for successful crop growth. This entails bench terracing, cultivation techniques that conserve water and effective weed control. Most farmers in the drier areas of Kitui, Makueni, Tharaka, Mbeere and Mwingi have minimal soil and water conservation structures. Farmers need to be sensitized on the importance of using appropriate soil and water conservation technologies and increased soil depth, water preservation and reduced loss of nutrients. Soil characteristics as well as soil water management to a great extent determine the amount of yield a farmer would get in ASAL's. In most farms, it has been noted that farmers do not have adequate skills of laying of terraces whether constructed, trash or stone lines. Extensive soil erosion is therefore a common feature in the farms. Sustainable crop production cannot be achieved with continued soil loss.



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### 1.1.6 Planting large areas

Most small-scale farmers in the drier parts of Kitui Machakos, Mbeere, Tharaka, Makueni and Mwingi Districts own large tracts of land with an average of 30 acres per farmer. They farm an average of 4-12 acres although most of them are not aware of these sizes. The plant population in the farms is usually lower than recommended. This drastically reduces the yield. In most cases, farmers are unable to cope effectively with the areas they plant crops. Farmers in most cases are overwhelmed by weeds and abandon some crops to the mercy of the weeds. Yields average 6-20 bags of grain per farmer, which translates to about 1 bag of grain per acre. Farmers are therefore losing seed, time and money in cropping areas they cannot manage effectively.

It is necessary to sensitize farmers on the need to reduce areas they are currently cropping so that they can:

- i) Achieve effective soil and water conservation practices,
- ii) Plant on time,
- iii) Weed effectively,
- iv) Attain the recommended plant population
- v) Attain increased yields per acre and
- vi) Achieve advantages of using improved food crops

### 1.1.7 Thinning

Thinning is especially important for sorghums and millet production. Most cases farmers do not thin these 2 crops that, leads to more plants per unit area than recommended. The plants compete for water, nutrients and space leading to weak plants that cannot survive water stress and consequently reduced yields. Weak plants are also not ideal for ratooning. Thinning should be done at first weeding or after first weeding. Thinning under moisture stressed dry soils affects the root system of the remaining plants. Thus, it is recommended that thinning should be done when the soil is moist. Leaving 2 plants adjacent to it compensates for a gap within the row. Gapping by transplanting is encouraged when thinning is done within 2 weeks after emergence and when the soil is moist.

### 1.1.8 Spatial Planting

Spatial planting is a system where half the field is planted while the other half is planted at the onset of rains. Farmer in semi-arid and other areas where the onset of rains is uncertain, spatial planting is recommended. Spatial planting has the following advantages:

- Risk management: Planting at two different times increases, the farmer chances of harvesting a crop.
- Weed control: The that were dry-planted will be weeded first, followed by the areas planted during the rains, leading to a more effective control regime than in the system where there is only one planting.

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## **2.0 Dry land Farming: Recommendations for Smallholder Farmers**

### **2.1.1 Cereal Crops**

### **2.1.2 Sorghum**

#### **2.1.2.1 Varieties and their characteristics**

##### **2.1.2.1.1 Serena**

- The mature plant leaf and mid rib has tainted red coloration
- The plant height ranges from 150 to 160cm depending on the altitude
- The variety has a thinner stem, many straight erect tillers and smaller compact head type when compared with Seredo
- Flowers in 69-78 days
- Matures in 110-120 days
- Grain color is brown with a testa flourly and endosperm
- Potential grain yield of 1800-2300 kg/ha or 1700-900 kg/acre
- It is tolerant to striga weed and grain mould
- It does well in wetter semi arid areas

##### **2.1.2.1.2 Seredo**

- The plant is of medium height (150-160cm).
- It produces more outward spreading tillers and has thicker stem than Serena.
- The head is large and oval at the base and tip
- Tillers mature later than the main stem.
- Flowers in 65-77 days and matures in 110-120 days
- Grain colour is brown with a testa and soft floury endosperm
- Potential grain yield is 4000 kg/ha with average yields of 1000-2800kg/ha or 400-1,100 kg/acre
- It is not cold tolerant and is cultivated in areas of 1300 to 1700m above sea level

##### **2.1.2.1.3 KARI Mtama-1**

- The plant height ranges from 50 to 170cm tall depending on the altitude
- It has one main erect tiller and sometimes has 2-3 straight tillers
- Grain colour is white with a hard endosperm and has no testa
- It flowers in 58-65 days and matures in 95-100 days
- It has a potential yield of 4,000kg/ha with an average yield of 2500kg/ha or 1000 kg/acre
- KARI Mtama-1 is highly tolerant to stalk borers and aphids
- It recovers from drought very fast
- It is highly palatable and sweet making it attractive to birds
- In order to minimize the losses due to birds, a cluster of farmers should plant or cultivate the variety to increase the acreage in a location

#### 2.1.2.1.4 Gadam

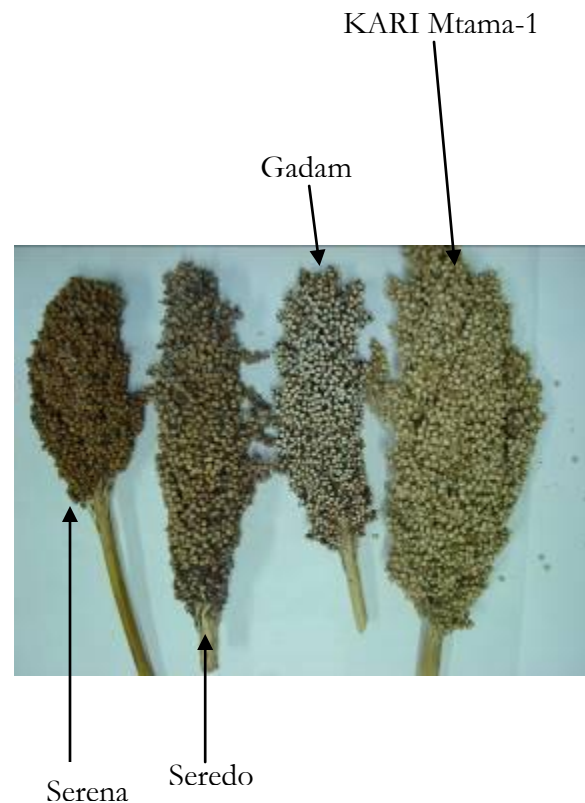
- It has semi-dwarf small plants that grow 100-130 cm tall with a very uniform plant population
- It is early maturing variety flowering in 45-52 days
- Matures in 85-95 days depending on altitude
- Its grain is grey tending towards chalky with semi hard endosperm
- The potential yield ranges from 1,700 to 4,500kg/ha or 680-1,800 kg/acre or (8-20 bags/acre)
- This variety matures earlier than the other sorghum varieties making it an ideal variety for food deficient areas
- It does well in low rainfall semi-arid areas and dry warm mid-highlands
- It is tolerant to insect pests, especially the stem borer, shootfly and leaf diseases



KARI Mtama-1 in the field



Gadam in the field



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#### 2.1.2.1.5 Target Areas of Production

Serena and seredo varieties perform well in agro-ecological zones III and IV especially in the hilly masses and wetter areas of the semi arid lands between 1150m and 1750m above sea level and receiving 250-500mm rainfall per season. These varieties are less prone to bird damage than the others because of the bitter taste.

Gadam and KARI/Mtama I varieties are suitable for cultivation in the drier lowlands of Machakos, Kitui, Mwingi, Makueni, Tharaka, Mbeere, Kilifi, Tana river, Marsabit, Moyale and Kajiado districts. The two varieties grow well in areas with an elevation of 50-1800m above sea level and receiving about 250mm of rainfall per season. The varieties recover fast from a drought.

#### 2.1.2.1.6 Crop Management

##### Land preparation

Sorghum requires a fine seedbed. Ploughing can be done either by hoeing, tractor or oxen. It is advisable to harrow in case the field has big soil clods. The planting field should be prepared very early. It is recommended that land be ploughed immediately after harvesting the previous crop.

##### Planting

**Time of planting:** Practice spatial planting. Drill or plant in hills half of the field before the rains and plant the remaining half at the onset of rains.

**Seed rate:** 7-10kg/ha or 3-4kg/acre.

**Sole Crop:** 60cm X 20cm

**Intercrop:** 120cm X 15cm and 1 row of legume between

**Method of planting:** Drill in furrows or plant in hills

**Thinning:** Leave one seedling per hill 3 weeks after emergence or when plants are 6 inches high. Thinning should be done during the first weeding when the soil is moist.

**Depth of planting:** When dry planted, the depth should be 5.0cm but in moist soils plant at a depth of 2.5cm - 4.0cm.

##### Fertilizer Application

Apply 2 bags per hectare or 1 bag per acre of NPK (20:20:0) during planting and when necessary top-dress with one bag (50kg) of CAN per acre.

##### Weeding

First weeding should be done within two to three weeks after emergence. The second weeding should be done two weeks after the first weeding.

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## **Crop Protection**

Insect pests include the shootfly and stem borer. The major diseases include smut, charcoal rot, anthracnose, stem and leaf rust. Marshall or Dipterex should be used to control stem borers and shootfly at 3kg/ha. Seed should be dressed with a combination of fungicide and insecticide to control most of the diseases. Use scaring devices to control birds. It is advisable to have several farmers in a locality growing sorghum in order to share out the bird damage.

## **Harvesting**

Harvest the crop when the grain is hard and does not produce milk when crushed between the fingers. The heads are harvested, threshed and stored in cool dry conditions. To control storage pests the grain should be dusted with super actellic at 50g per bag or any other effective storage chemical.

## **Ratooning**

Ratooning ensures a farmer gets more than one harvest from a single crop. Two ratooning systems have been identified. One is in the bimodal rainfall zone in the semi-arid lowlands and the other one in the mid-altitude coffee zones. A ratooned crop has an established root system, which utilizes the available water much earlier in the season than a new sown crop, reduces ploughing and planting labour. Ratooning also avoids migratory quelea birds in May and June. Ratooned sorghum avoids male sterility that is caused by cold temperatures by flowering in April rather than in cold month of July.

In bimodal rainfall zones of semi-arid lowlands of eastern province, sorghum is planted during the short rains (October-November). On maturity, sorghum is harvested in February and immediately ratooned to take advantage of the long rain season, which starts in mid-March in order to achieve good yields; the crop is thinned two to three tillers per hill. Weeding and other management practices are similar to those of a newly sown crop. Stalkborer attack can be a big problem in a ratoon crop. It is recommended that dipterex or marshal 250 EG be applied in the plant funnel to control stalkborer. Aphids can infest the crop during a short dry spell between rains. They should be sprayed with Ambush or Thiondan at the rate of 1.5 litres per hectare.

## **Utilization**

Sorghum grain can be utilized either whole, dehusked or as flour. Sorghum flour makes a wide range of products. These include chapattis, bread, biscuits and cakes. Both opaque and clear bear can be made from it. Utilization and recipes are available from KARI Katumani. KARI has developed .... Recipes (Sorghums/Millet Utilization Guidelines).

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## **2.1.3 Millets**

### **2.1.3.1 Varieties and their characteristics**

#### **2.1.3.1.1 Pearl Millet**

##### **2.1.3.1.2 KAT/PM-1 (Katumani Pearl Millet-1)**

- It is an open pollinated variety
- Flowers in 48-59 days
- Matures in 80-100 days
- Seed shape is obviated and grey in colour.
- Potential grain yield is 2800kg/ha with a mean of 1900kg/ha or 760 kg/acre
- Eighty percent of the ear heads have bristles, which is a desirable bird-scaring trait
- Tolerant to rust and leaf blight

##### **2.1.3.1.3 KAT/PM-2 (Katumani Pearl Millet-2)**

- It is an open pollinated variety
- Flowers in 52 days
- Matures in 80-90 days, a week earlier than KAT/PM-1
- Seed shape is obviated and grey in colour
- Potential grain yield is 2500kg/ha with a mean of 1800kg/ha or 720 kg/acre
- Only 10% of the ear heads have bristles
- Tolerant to rust and leaf blight

##### **2.1.3.1.4 KAT/PM-3 (Katumani Pearl Millet-3)**

- KAT/PM3 is open-pollinated
- Plant height ranges from 140 to 160cm
- Have 1-6 erect synchronous maturing tillers and thickness of tillers ranges from 2.5–4.5cm
- Its ear heads are compact and cylindrical (12-27cm long, 6-9cm thick) with a limited bear tip
- Flowers in approximately 45-55 days depending on altitude
- Matures in 75-90 days
- Seeds are obviating in shape, bold in colour and have a soft endosperm.
- Has mean grain yield potential of 2,400kg/ha or 960 kg/acre
- Can be grown between 50 and 1500m altitude in the semiarid areas of Kenya

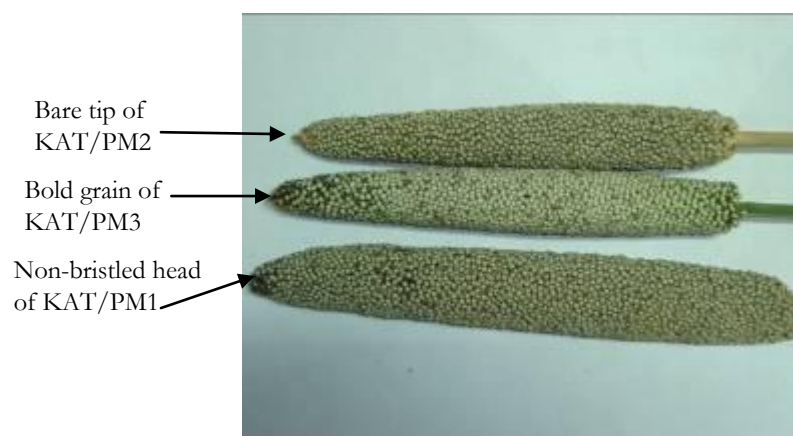




Pearl Millet (KAT/PM 1)



Pearl Millet (KAT/PM 2)



Pearl Millet Heads



Pearl millet head showing sterility due to cold stress



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### 2.1.4.1 Finger Millet

#### 2.1.4.1.1 KAT/FM-1 (Katumani Finger Millet-1)

- The variety is self-pollinated and grows upto 6cm tall
- Flowers in 75 days
- Matures in 90-115 days
- Mature ear glumes are straw in colour
- The seed colour is brown
- Potential yield grain yield is 1400kg/ha or 560 kg/ha
- The variety is tolerant to blast and resistant to lodging
- Can grow from sea level to 2000m above sea level
- It is high in calcium



Finger millet (KAT/FM 1)

#### 2.1.4.1.2 Proso Millet

#### 2.1.4.1.3 KAT/PRO-I (Katumani Proso Millet 1)

- Self-pollinated and grows upto to 80cm tall depending on the altitude
- The panicle is open and has cream coloured grains
- Flowers in 40-50 days
- Matures in 65-80 days
- Has an average yield of 1400 kg/ha or 560kg/acre
- Has the ability to stop growing during severe water stress and resumes growth quickly when the stress is broken.
- Can be grown between sea level and 2000m

### Target areas of production

The millet varieties grow well in agro-ecological zones IV and V of Eastern and North Eastern provinces. They also do well in the semi-arid districts of Rift valley and Western Provinces that receive about 150mm of rain per season. The varieties can be grown from 50m to 2000m above sea level.

### Crop Management

#### Land preparation

Millet requires a fine seedbed. Ploughing can be done using a hoe, tractor or oxen. Fields with big soil clods should be harrowed. Planting fields should be prepared early. Land should be ploughed immediately after harvesting the previous crop.

#### Planting

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Spatial planting is recommended. Drill or plant in hills half the field before the rains and plant the other half at the onset of rains.

**Seed rate in furrows:** - Pearl millet - 5kg/ha or 2 kg/acre  
- Finger millet - 3kg/ha or 1.2 kg/acre  
- Proso millet - 4kg/ha or 1.6 kg/acre

**Method of planting** - Drill and thin 2 weeks after emergence when plants are about 6 inches tall.

**Depth of planting** - All varieties should be planted at a depth of 2 inches (5cm)

**Thinning:** Thin to one seedling per hill. This results in strong plants that produce the required yields.

**Spacing:** (Sole cropping):

- i). Pearl millet varieties (Kat/PM I, Kat/PM2 and KAT PM3):
  - Distance between rows - 60cm
  - Distance between plants - 15cm
  - Intercrop: Pearl millet: 120cm X 15cm and 1 row of grain legume between
- ii). Finger millet, Foxtail and proso millet (Kat/FM-1, Kat/Pro I): -
  - Distance between rows - 30cm
  - Distance between plants - 10cm

### **Fertilizer Application**

All millets respond well to fertilizers. Apply 50kg per hectare of NPK (20:20:0) when necessary. Farmyard manure is recommended at 8-12 tons/ha.

### **Weeding**

The first weeding should be done within 2-3 weeks after emergence and the second 2-3 weeks thereafter. In the case of Proso millet, the first weeding should be done within 2 weeks of emergence.

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## 3.0 Grain Legumes

### 3.1.1 Common Bean

#### 3.1.1.2 Varieties and their characteristics

##### 3.1.1.2.1 KAT/B-1 (Katumani Bean 1)

- A determinate plant with an average height of 35-40cm
- Has light pink flowers
- Flowers within 30-31 days
- Matures in 60-65 days
- Seeds are round, have a black hilum and greenish pericarp, which changes to cream/straw with age
- Potential yield ranges from 1400-1900 kg/ha or 7-9 bags/acre
- Grains taste sweet and less flatulence than Mwezi moja and Rosecoco.
- Tolerant to rust (*Uromyces* sp.), common bean mosaic virus (CBMV), angular leaf spot and bacterial blight
- Highly tolerant to heat and grows well under tree/banana shades

##### 3.1.1.2.2 KAT/B-9 (Katumani Bean 9)

- A determinate plant with an average height of 35-40cm
- Flowers in 30-40 days
- Flower colour is light pink.
- Has a uniform flowering period.
- Matures within 60-65 days
- Grain is brilliant red and gives an Irish brown colour when cooked with maize, a quality preferred by farmers
- Potential yield is 1400-1900kg/ha or 7-9 bags/acre
- More drought tolerant than Katumani Bean 1
- Tolerant to CBMV and rust; and has field tolerance to several fungal diseases

##### 3.1.1.2.3 KAT X56

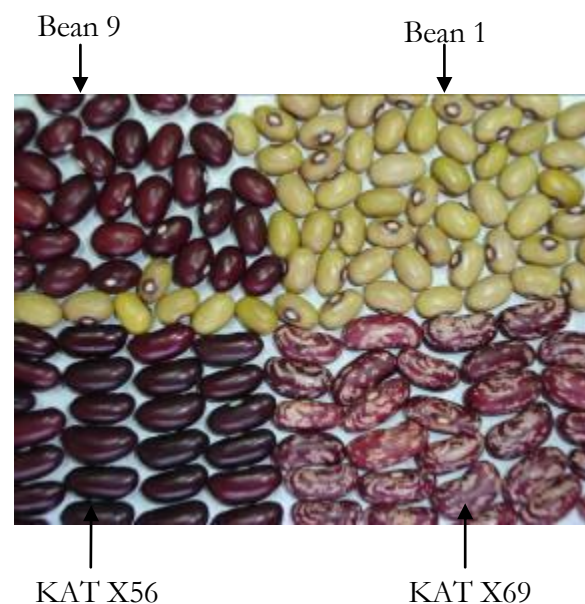
- A determinate plant with an average height of 35-40cm
- Flowers in 30-35 days
- Flowers are light pink
- Has uniform flowering and maturity
- Matures within 60-65 days
- Grains are brilliant dark red, long, oblong and round
- Potential yields are 1400-2000kg/ha or 7-10 bags/acre
- Under good growing conditions, the variety yields more than KAT/B-1 and KAT/B-9.
- Has tolerance to rust, charcoal rot, CBMV and tolerance to angular leaf spot.
- Mature pods ready for harvest are not damaged by heavy rains.
- The grains cook fast and tastes sweet.

#### 3.1.1.2.4 KAT X69

- A determinate plant with an average height of 40-50cm
- Flowers in 30-35 days
- Has white flowers
- Matures within 60-65 days
- Grains are long, oblong and rosecoco type in colour but with dark red background
- Potential yields are 1400-2000kg/ha or 7-10 bags/acre
- It is resistant to rust (*Uromyces* sp.) common bean mosaic virus (CBMV)
- Tolerant to angular leaf spot and charcoal rot
- Susceptible to lodging due to heavy bearing and tall plants
- Cooks fast, producing large, brownish and sweet tasting grains.



Bean (KAT X69)



#### 3.1.1.2.5 Target Areas of production

All the varieties can be grown in various agro-ecological zones of semi-arid areas, as they are fairly more drought tolerant than mwezi moja (GLP 1004). Katumani Bean 1 performs well in areas between 900-1600m above sea level, but at elevations higher than 1600m above sea level, angular leaf spot and halo blight may seriously affect its yields. KAT Bean 1 does not do well in areas with high rainfall.

Katumani Bean 9 is suitable for cultivation in lower altitude areas of 1000m and below where the average rainfall season is more than 200mm. The four varieties are sensitive to waterlogging and acidic soils. Their optimum temperatures range from 15°C - 27°C. KATX69 also do well in cold dry highland areas especially in Nanyuki. Reduced growth is observed with low temperatures and very high rainfall. KAT X56 does well in ASAL areas of Nyanza (Bondo and Siaya).

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### 3.1.1.2.6 Crop Management

#### Land preparation

The field should be well prepared without big soil clods and have a fine filth. Hoes, oxen plough and tractors can be used for ploughing.

**Time of planting:** Sow at the onset of the rains after a minimum of 30mm of rainfall has been received.

**Seed rate:** 40-50kg/ha (16-20kg/acre)

**Number of seeds/hill:** Sow at least 2 seeds per hill

**Depth of planting:** Plant at a depth of 4-5cm

**Spacing: Sole crop:** The distance between rows is 45cm and 20cm between plants for sole crop. However, if an oxen plough is used during planting, the distance between furrows is fixed at 60cm and the distance between plants should be kept at 15cm.

**Intercrop:** Maize: 150cm X 30 cm and 2 rows of bean (legumes)

Maize 120cm X 30cm and 1 row of beans, legumes

Sorghum: 150cm X 15cm (2 rows)

120cm X 15cm (1 row) oxen 1 row of beans

#### Fertilizer

DAP fertilizer should be applied at the rate of 1 bag/ha (50kg/ha) or about half a bag (25kg) per acre during planting. If applied in furrows or planting holes, mix the fertilizer and the soil thoroughly before covering the seed.

#### Weeding

The first weeding should be done two weeks after emergence and the second one must be done before flowering.

#### Crop Protection

Insect pests include:

- i). Bean fly - usually observed at seedling stage
- ii). Black ban aphid - common during cool dry periods
- iii). Bean leafhopper - found during vegetative stages
- iv). Bean weevil - common during storage
- v). Pod borers

#### Control

The Katumani bean varieties have been screened for tolerance to insect pests. Furthermore, being early maturing, these varieties escape the attack by these insects. Use dimethoate, duduthrin or other insecticides for control of beanfly, black aphid and leafhopper. Rogue plant early to avoid infestation or land rogue/affected plants. Do not use the same insecticide all the time repeatedly to avoid creating resistance in insects.

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Major diseases include:

- i). Anthracnose
- ii). Angular leaf spot
- iii). Charcoal rot
- iv). Bean common mosaic virus
- v). Halo blight
- vi). Rust

### **Control**

Use Binomial and copper oxychloride as recommended by manufacturer. Rotating bean fields with cereals is recommended.

### **Harvesting and storage**

Harvest when all pods turn brown and hard. Weevils are major storage pests. During storage, dust with super actellic (50g per bag) or with neem tree leaves or treat with wood ash (4-6kg of ash per bag).

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### **3.2.1.1 Cowpeas**

### **3.2.1.2 Varieties and their characteristics**

#### **3.2.2.3.1 M66 (Machakos 66)**

- M66 is a bushy semi-spreading plant with an indeterminate growth habit
- It is a dual-purpose variety grown for both leaves and grain
- The leaves and midribs are dark green
- It flowers within 55-60 days
- Flowers are purple with a white corolla
- Matures within 80-90 days
- The pods are green when young, turn bright red during grain filling and brown purple when dry
- It has smooth creamy brown seeds having a small eye
- The yields range from 800-1700 kg/ha or 320-680 kg/acre
- M66 is tolerant to yellow mottle virus and scab moderately tolerant to septoria leaf spot and powdery mildew
- It has some field tolerance to aphids and thrips.
- M66 may mutate to various forms during the growing period

#### **3.2.2.3.2 Katumani 80 (K80)**

- K80 is a dual-purpose, M66 spontaneous mutant variety and may still mutate to other forms
- It is suitable for both grain and leaf production
- It has a semi-spreading habit and indeterminate flowering pattern
- Leaves are lanceolate with a distinctive silvery midrib
- The flowers are purple blue and the corollas are pigmented ivory white
- Immature pods are green and turn white brown with interspersed faint red brown spots at maturity
- Seeds are smooth and creamy brown in colour with a small eye
- Potential yields range from 800-1800kg/ha or 320-720 kg/acre
- It is resistant to aphids, moderately tolerant to thrips, pod borers and leafhopper
- Moderately tolerant to foliar fungal diseases and mosaic virus
- K80 may mutate to various forms during the growing period

#### **3.2.2.3.3 KVVU-419**

- It has a semi-spreading habit and grows to a height of 18-35cm
- Spreads and produces tendrils
- It is a grain variety and has small shiny leaves with an obscure midrib.
- The pods and peduncles are green when young but develop shades of red brown coloration when dry
- The peduncles are erect and stand over the canopy
- Flowers in 41-49 days
- Matures in 65-72 days (early maturing)
- Has lower yield than K80 or M66
- Potential yield is 1000-1500kg/ha or 400-600 kg/ha
- Has smaller grains than both Machakos 66 and Katumani 80



- It is more of grain than leaf type
- Tolerant to cold and recovers from drought very fast

#### 3.2.2.3.4 KVU 27-1

- A dual-purpose variety suitable for both grain and leaf production with a semi-spreading habit and indeterminate flowering pattern.
- Leaves are lanceolate with a distinctive silvery midrib and have purple blue flowers
- The main difference between K80 and KVU 27-1 is in the grain color
- Grains are dark red in colour
- Potential yields range from 800-1800 kg/ha or 320-720 kg/acre
- Moderately tolerant to aphids and thrips, pod borers, leaf hoppers and is moderately resistant to foliar fungal disease and mosaic virus.



Cowpea K80 (straw coloured pods)



KVU 419 grains



Cowpea M66 (purple pods)



KVU 27-1 grains

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### 3.2.2.3.5 Target areas of production

Machakos 66 is recommended for medium and higher altitudes of between 1200-1500 above sea level in agro-ecological zone III and IV. KVVU 27-1 performs well in similar agro-ecological zones as Machakos 66. Katumani 80 is recommended for drier agro-ecological zones IV and V or areas below (1500m above sea level receiving an average of 200mm rainfall per season.

KVVU 419 is recommended for cultivation in areas below 1200m above sea level receiving less than 200mm of rainfall per season. These are agro-ecological zones IV and V in lower Kitui, Mwingi, Makueni, Tharaka, Tana River districts, and Yatta plateau in Machakos district.s.

### 3.2.2.3.6 Crop Management

#### Land preparation

The field should be well prepared without big soil clods and have a fine filth. Hand, oxen plough, tractor can be used for ploughing.

**Time of planting:** Early planting is recommended but not before 30mm of rainfall is received. Spatial planting is also recommended.

**Seed rate:** 20-25kg/ha (8-10kg per acre)

**Number of plant/hill:** Sow 3-4 seeds/hill and thin 2 weeks after emergence to one seedling per hole.

**Depth of planting:** Seed should be placed between 4-5cm deep and covered properly.

**Spacing:** Machakos 66, Katumani 80 and KVVU 27-1: The distance between rows is 60cm and between plants 20cm. KVVU 419: The distance between rows is 50cm and between plants 20cm.

Intercrop: Maize: 150cm X 30 cm, 2 rows, 120cm X 30cm, 1 row

Sorghum: 150cm X 15cm, 2 rows

#### Fertilizer

Cowpeas require nitrogen and phosphate fertilizer application. However, where the soils are highly eroded and very deficient in these nutrients, a basal dose of 10-15kg/ha of nitrogen and 20-25kg/ha of single or triple super phosphate fertilizers may be broadcasted. Cowpeas not pod if a lot of nitrogen is applied and remains very leafy.

#### Weeding

The first weeding should be done two weeks after emergence and the second one must be done before flowering.

#### Crop Protection

##### Insect pests:

Before flowering aphids, thrips, leafhoppers

After flowering - aphids, pod borers, pod sucking bug, apion beetle

During storage - Bruchids

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## **Chemical control**

Aphids: Thiodan, Duduthrin, Karate or Sherpa plus

Thrips: Sherpa plus, Karate, and Duduthrin

Leafhoppers: Thiodan

Pod borers: Thiodan, Sherpa plus, Decis, Thiodan

Pod sucking bugs: Dimethoate, Sherpa plus, and Karate

Apion beetle: Super Actellic

## **Harvesting and storage**

Time of harvesting - harvest when all the pods have turned brown and are dropping. Weevils are major storage pests. To store, dust the grain with super actellic (50g per bag) or with neem tree leaves or treat with wood-ash (4-6 kg of ash per bag). The grains should be well dried before being stored.

### 3.3.3.1 Mung Beans

#### 3.3.3.1.1 Varieties and their characteristics

##### 3.3.3.1.2 Yellow Grams: Variety N22 or KVR 22 (KAT/MB22 Katumani mung bean 22)

- It is a semi-determinate plant.
- Grains have golden yellow colour.
- Flowers in 55-60 days
- Matures in 80-90 days
- Potential yield range from 1000-1300kg/ha or 400-500 kg/acre
- Tolerant to aphids, resistant to yellow mosaic and moderately resistant to powdery mildew
- Cool conditions in May to July predispose the variety to powdery mildew attack

##### 3.3.3.1.3 Green Gram: Variety: N26 or KVR 26 (KAT/MB26 Katumani mung Bean 26)

Has a determinate growth habit

Flowers are auxiliary on short penduncles and purple in colour

Pods are black and contain shiny green grains

85% of the grains are shiny green and bold

Flowers in 40-45 days

Matures in 60-65 days

Potential yields range from 300-1500kg/ha or 520-600 kg/acre



Green Grams (Green pods)



N26 Grains

#### 3.3.3.1.4 Target areas of production

The two varieties of mungbean are recommended for cultivation in both semi-arid and well-watered areas of between 50-1600m above sea level. N22 thrives best in well-drained sandy loamy soils and because of its lateness and performance in the drier areas is relatively poor. N26 is suited to well-drained sandy loams and because of its earliness it has proved more successful in the drier areas of

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lower Machakos, Kitui, Mwingi, Tharaka, Mbeere and Makueni districts. At elevations of more than 1800m above sea level, it has very poor pod set.

### **3.3.3.1.5 Crop Management**

#### **Land preparation**

The field should be well prepared without big soil clods and have a fine filth. Hoe, oxen and tractor can be used for ploughing.

**Time of planting:** Early planting is recommended but not before 30mm of rainfall is received. Spatial planting is also recommended.

**Method of planting:** When using oxen plough for planting, place the seed at the side of the furrow.

**Seed rate:** 10-15kg/ha (4-6kg/acre)

**Number of plants per hill:** At least 2

**Depth of planting:** The depth should be kept at 4-5cm.

**Sole cropping spacing:** The distance between rows should be 45cm and between plants 15cm

#### **Weeding**

The first weeding should be done 2 weeks after emergence and the second weeding before flowering.

#### **Fertilizer**

Mung beans do not respond well to nitrogen and phosphate fertilizer application. In most cases it is not necessary to apply them. However, where the soils are highly eroded and very deficient in these nutrients, a basal dose of 10-15kg/ha of nitrogen and 20-25kg/ha of single or triple super phosphate fertilizers may be broadcasted.

#### **Crop Protection**

Insect pests of economic importance include thrips, aphids, and pod sucking bugs, apion beetle and bruchids.

#### **Chemical Control**

Insect pests

- i). Thrips - Thiodan, sherpa plus, duduthrin
- ii). Aphids - Thiodan, sherpa plus, Karate
- iii). Pod sucking bugs - Dimethoate sherpa plus
- iv). Apion beetle - Thiodan and Karate
- v). Bruchids - Super Actellic

Apply at manufactures' recommended rates.



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## Diseases

Diseases include powdery mildew and yellow mosaic virus. Powdery mildew is prevalent during the long rains whereas yellow mosaic occurs in both seasons. Use Benomyl and Copper oxychloride to control the diseases.

## Harvesting

Time of harvesting - Harvest when 95% of the pods have turned black. When pods do not mature at the same time uproot the entire plant and dry in the sun before threshing.

## Storage

The mung beans should be dried well before storage because grains that are not well dried are prone to weevil attack. It is recommended to store the dry grain in covered tins, drums, pots, sealed containers or bags. When stored in bags, the grain should be protected from weevils. Add ash or neem leaves to the dried grain, or mix with actellic at 50g per 90 kg bag.

### 3.4.4.1 Pigeonpea

#### 3.4.4.2.1 Varieties and their characteristics

##### 3.4.4.2.1 KAT 60/8 (KAT/PP 60/8)

- Plant height ranges from 85-130cm depending on the altitude and season
- Shorter when planted in the long rains (March-May) than in short rains (October-December)
- Taller at lower altitudes (less than 1000m) than in higher altitudes
- Has a spreading growth habit
- Flower in 95-120 days
- Both unopened and opened flowers are yellow in color with no streaks
- Flowering is indeterminate. The plant will keep on producing flowers and pods enabling multiple harvests if there is adequate soil moisture
- A medium maturity variety in 136-150 days
- Grains are white in colour with brown spots and smaller than long duration local landraces (Tunyai0
- Potential grain yields range from 1200-1500kg/ha or 480-600 kg/acre in one season and in two seasons it yields 3000kg/ha or 1200 kg/acre
- Susceptible to insect pests mainly pod sucking bugs and pod borers
- Tolerance to wilt and leaf spot diseases

##### 3.4.4.2.2 Mbaazi-1

- A determinate variety that grows 80-120cm high depending on season and altitude
- Shorter when grown at higher altitudes and taller at lower altitudes
- The plant is compact and is normally grown as a sole crop
- A short duration variety with a semi spreading growth habit and an indeterminate flowering pattern

- Flowers in 55-70 days
- Unopened flower is red in colour while the open flower is yellow
- The pods are green with purple streaks
- Matures in 105-120 days producing greyish grain (short duration)
- Has a potential yields of 1000kg/ha or 400 kg/acre in one season and 2000kg/ha or 800 kg/acre in two seasons



Mbaazi-1

#### 3.4.4.2.3 Mbaazi-2

- Has spreading growth habit and plant height ranges from 120 to 240cm depending on season and altitude
- Normally planted in the short rain season (October-November) – mainly two season variety
- The plant is taller and stronger at lower altitudes (less than 1000 m) than at higher altitudes
- Flowers in 60-90 days
- Has indeterminate flowering pattern. In favourable weather conditions, can continue producing flowers and pods.
- Flowers are yellow in colour while the pods are green with dark stripes.
- Matures in 150-180 days (long duration)
- Potential grain yield of 1300 kg/ha or 520 kg/acre
- Grain colour is greyish

#### 3.4.4.2.4 Target areas of production

Pigeonpea varieties are sensitive to differences in temperature. With late maturing types, high temperatures (greater than 20°C) delay maturity whereas in the early types higher temperatures (20-30°C) hasten maturity. Kat 60/8 can be grown between 50-1800m above sea level and performs well in lower Makueni, Kitui, Mwingi, Mbeere, Tharaka, Meru and Machakos where temperatures are high.

Mbaazi-1 can be grown in the same range of altitude and temperature as Kat/60/8 but is better suited to the more humid coastal zone. Mbaazi-1 is better adapted to medium and higher altitude (over 900m above sea level). If grown in altitude lower than 900m above sea level, they produce excessive growth and may not flower.



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#### 3.4.4.2.5 Crop Management

**Land preparation:** Requires a fine tilth like other grain legumes. Avoid soils with huge soil clods

**Planting:** Practice spatial planting, that is plant half the crop and plant the rest at rain onset

**Seed rate:** 20-25kg/ha (8-10kg/acre)

**Method of planting:** Plant in furrow or holes but place at least 5 seeds per hole

**Depth of planting:** Place at a depth of 4-5cm and cover properly if there is little moisture

**Thinning:** Thin to 2 seedlings per hole two weeks after emergence

**Spacing:**

##### i). Sole cropping

Mbaazi-1: Plant at 50cm between rows and 10cm between plants if using plough, skip one furrow.

Kat 60/8: Plant 75cm between rows and 50cm between plants. When using oxen for ploughing and planting, sow after every other two furrows.

Mbaazi-2: Plant 100cm between the rows and 50cm between the plants at lower altitude where temperatures are warmer. At higher altitudes these spacings should be reduced by 20-30cm.

##### ii). Intercropping

Kat 60/8 and Mbaazi-2 can be intercropped with maize, sorghum or millet during the first season, which are normally the short rains (October). If intercropped with maize, sow either one row of pigeonpea after one row of maize or one row of pigeonpea followed by two rows of maize at a distance of 90cm between maize/sorghum and pigeon pea rows. Mbaazi-1 should always be planted as a pure stand.

#### Fertilizer

Fertilizer is not recommended. However, in extremely poor soils, a basal application of one bag of NPK fertilizer (20:20:0) could be applied.

#### Weeding

The slow initial growth of pigeonpea seedlings makes the crop vulnerable to weed competition in the first six weeks of growth. During this period, keep the crop free from weeds. For short duration pigeonpea varieties such as Mbaazi-1, weed twice, for medium and late types weed three times in the first season. The first weeding of all varieties must be done within the first 2-3 weeks whereas the second weeding should be done two weeks after the first one. Subsequent weeding will depend on the growth of weeds and amount of rainfall.

#### Crop Protection

##### Insect pests and their control methods

Pod sucking bugs, pod borers and thrips are major pigeon pea pests. Mbaazi-1 and KAT 60/8 normally flower coinciding with peak periods of the insect pests infestations. Insect pests are best

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controlled in the following stages:

- i). Before flowering - Thrips and aphids
- ii). After flowering - Pod fly, pod borers, pod suckings bugs
- iii). Storage - Bruchids

General recommendation - spray once before flowering and twice after flowering. The following is recommended at various phases of plant growth:

- i). Before flowering to control thrips and aphids, spray Sherpa plus, Karate or Thiodan when flowers are forming.
- ii). During and after flowering - the common insects include thrips, pod fly, pod borers and pod sucking bug. Spray with Sherpa plus, thiodan, Karate, Decis or Thiodan.
- iii). Storage - During storage, control bruchids through use of super actellic (50g/90kg bag), ash or neem leaves (4-5 kg/ton)

### **Diseases and their control methods**

Fusarium wilt - Rogue and destroy infected plants  
- Crop rotation - successive pigeon pea sole crops should not be planted in the same field after 3 years. In the meantime rotate with cereal crops.

### **Harvesting**

Green mature pods may be harvested for grain food. Harvest dry grains when most of the pods are dry and have turned brown.

**Storage:** Dry grain in the sun before sorting and dust with super actellic at 50g/90kg bag.

### **3.4.4.2.6 Utilization and Marketing**

Pigeonpea can be consumed in form of whole grain or split pea (dehulled). There is market within and export for green pods, whole dry grain and split pea (dehulled).

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### 3.5.1.1 Dolichos Lablab Bean

#### 3.5.1.2 Varieties and their Characteristics

##### 3.5.1.2.1 DL1002 (KAT/DL-1)

- The plant has a determinate growth habit in areas of upto 2000m above sea level
- Flowers between 65-75 days
- Have purple flowers and a definite indeterminate flowering period
- Matures between 80-90 days
- The grain is black with a white hilum
- Has a yield potential of 3000-4000kg/ha or 1200-1600kg/acre
- The crop can be ratooned giving a second crop that is 80% more grain than the first crop
- It is mainly a grain type but at higher elevation it can also be used as fodder
- It is attacked by pod borers. The diseases are of no economic importance



##### 3.5.1.2.2 DL1009

- Has a semi-climbing growth habit and has purple flowers
- Grains are dirty or cream white with a white hilum
- Flowers in 68-80 days
- Matures in 95-115 days
- Has yield potential between 2500-3000kg/ha or 1000-1200kg/acre
- It is both a seed and fodder type
- Pod borers can attack it. Diseases are of no economic importance.

##### 3.5.1.2.3 Target areas of production

DL1002 can be grown between 5-1800m above sea level. When grown in altitudes higher than 1800m above sea levels, it can become a vegetative climber that may not yield much grain. It is recommended for cultivation in the lower and more marginal areas of Machakos, Kitui, Makueni, Mwingi, and Tharaka-Nithi and Laikipia district.

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DL-1009 is suitably grown in semi-arid areas between 50-100m above sea level. In more fertile and wetter parts, the variety may become a vegetative climber particularly in the cooler high altitude masses of Machakos, Kitui, Makueni, Mwingi, Mer and Laikipia. Both varieties can tolerate a wide range of soils including acidic and vertisol (black cotton) soils.

#### **3.5.1.2.4 Crop Management Practices**

##### **Land preparation**

The field should be well prepared without big soil clods and have a fine filth. Hoe, oxen and tractor can be used for ploughing.

##### **Planting**

Plant early: before the onset of the rains since Dolichos seeds take longer than common beans or cowpea to germinate and emerge. If oxen plough is used for planting, place seed in the furrows and cover gently.

##### **Plant depth**

Place seed at a depth 5-7cm (or middle finger length) and cover gently and properly if erratic showers occur.

##### **Number of seeds per Hill/Thinning**

Sow three seeds per hole and thin to one plant per hole three (3) weeks after emergence.

##### **Seed Rate**

For both varieties use a seed rate of 8-12 kg/ha or 3-5 kg/acre.

##### **Spacing**

The distance between rows for both varieties is 100cm between plants at 50cm when planted as a pure crop. If intercropped with maize or sorghum after every row. Plant dolichos at a distance of 90cm or two row of dolichos after every two rows of maize or sorghum. Keep the distance between dolichos and cereals at 90cm and that between the two rows of dolichos at 75cm. When using an oxen drawn plough, keep the distance between the two rows of Dolichos at 60cm.

##### **Weeding**

The first weeding must be done within 2 weeks after emergence while the second one must take place at least 3 weeks after the first.

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## **Fertilizer**

Dolichos Lablab does not require any fertilizers and can be grown in very poor soils.

## **Crop Protection Measures**

Dolichos lablab is attacked by a number of insects including:

Aphids	- Mainly during flowering and podding
Thrimbs	- Before and during flowering
Pod borers	- During flowering and podding
Pod bugs	- During podding
Bruchids	- At storage

## **Insect pests control methods**

At least three insecticide sprays, one before flowering and two at flowering and grain filling growth stages are necessary for the farmers to realize the potential yields of the varieties. The chemicals listed down here applied at manufacture are recommended rates should be used to control the respective insects.

Aphids	- Thiodan, dimethoate 1l/ha
Thumps	- Dimethoate, Sherpa plus, Thiodan, Karate – 1l/ha
Pod borers	- Decis, Thiodan + Sherpa plus 1l/ha
Pod sucking bugs	- Sherpa plus, Karate, dimethoate 1l/ha
Bruchids	- Actellic super (50g/90kg bag)

Dolichos lablab has no known serious diseases.

## **Harvesting**

The pods are harvested when dry and have turned brown. It is very easy to confuse pods damaged by insects as being mature. In the two varieties, the pods start drying at the base of the fruiting branch rather than on the top. Harvest the dry brown pods first as they are likely to be damaged by weather and insects if left in the field for too long. Harvest the dry, hard grains only. Dry the grains and apply actellic super for storage.



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## 4.0 Roots and Tuber Crops

### 4.1.1 Cassava

#### 4.1.2.1 Varieties and their characteristics

##### 4.1.2.1.1 KME 1

- Matures in 16 months
- Potential yield ranging between 20 and 28 tons/ha or 8-11 tons/acre
- The variety is sweet and less fibrous and low cyanide content
- Tolerant to the cassava mosaic virus and scales

##### 4.1.2.1.2 KME 61

- Matures in 14 months
- Yield potential of 20-30 tons/ha or 8-12 tons/acre
- It is bitter and more fibrous than KME 1
- The variety is tolerant to cassava mosaic virus and scales



##### 4.1.2.1.2 Mucericeri

- Matures in 16 months
- Yield potential of 20-28 tons/ha or 8-11 tons/acre
- The variety is sweet and tolerant to cassava mosaic virus and scales.

##### 4.1.2.1.2 Target Areas of Production

The three varieties can be grown in all agro-ecological zones in the semi-arid areas except in black cotton soils. The crop is normally sown during the short rains (October/November) but may be planted during the long rains in areas below 1000m above sea level with adequate rainfall.



Photos courtesy of Dr. J.G. Gethi of Root and Tuber Programme, Katumani

##### 4.1.2.1.3 Crop Management

#### Soils

Cassava is grown on a wide range of soil types, but being a root crop, does best on soils of a friable

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nature, which permit expansion of the tubers. Fertile sandy soils with adequate rainfall are most suitable for growing cassava. However, cassava can be grown on almost all soil types provided they are not water-logged, too shallow and stony. Cassava is exhaustive of potassium. Too high fertility may result in excessive vegetative growth at the expense of tuber and starch formation. The important soil physical and cultural factors that affect cassava production include soil temperature, rooting depth, method of seedbed preparation and soil erosion, which may result in loss of soil fertility. Cassava is considered a drought tolerant crop but that does not imply that it cannot do without water. Ease of harvest depends on various soil factors such as texture and soil moisture content at the time of harvest. Cassava by virtue of its low and slow growth of canopy cover is an erosion-promoting crop. Intercropping cassava with maize decreases erosion by a half and mulching can even minimize the erosion losses to zero.

### **Land preparation**

Cassava production requires good soil preparation. Land preparation varies considerably, depending mainly on climate, soil type, vegetation, topography and other agronomic practices. Grow in fine tilth and avoid huge soil clods. When planting on the flat, deep plough to allow for root establishment. An alternative method of preparing planting field is to make mounds or hills and ridges using a hoe or plough.

**Seed rate:** 10,000 cuttings per hectare (4,000 cutting per acre). The size of the cutting is 8-12 inches long

### **Planting**

The most common planting time for cassava is at the beginning of the rainy season. In areas with adequate temperature and soil moisture, planting can be done almost at any time. It is recommended to plant after the first well-defined rains to avoid losing the plants and to ensure that they are exposed to as many months of rain as possible.

### **Planting stock**

Use 20-30cm long mature cuttings with 5-7 nodes. The quality of cassava cuttings depends on stem age, thickness, number of nodes per cutting and size. Control of these factors is essential for the sprouting of vigorous plants capable of producing a good number of roots. Although cuttings from the green stems will sprout, they are extremely susceptible to attack by soil-borne pathogens and sucking insects and tend to dehydrate rapidly. It is recommended that cuttings can be taken from plants ranging from 8 to 18 months old.

### **Placement**

There are three different orientations in which cassava is usually planted. It may be planted upright in a vertical position, upright at an angle or horizontally beneath the soil. For planting on the vertical position, the cutting is inserted so that about two thirds of its length is within the soil, while the remaining one third is exposed. For planting at an angle, the cutting is also inserted with about two-thirds of its length in the soil. The exact angle of planted cutting to the soil surface varies from 70 to



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about 10 degrees. For horizontal planting, the cutting is inserted horizontally so that the entire cutting lies beneath the soil.

### **Depth of planting**

Depth of insertion is usually about 10 cm, but may vary from 5 to 20cm.

### **Spacing**

Spacing varies but to realize optimum yields, a spacing of 1M between rows and 1M between plants is recommended.

### **Intercropping**

Intercropping with short duration grain legumes such as beans, cowpeas and mung bean is recommended. Two rows of legume should be planted between cassava rows.

### **Weeding**

Weed control is one of the most important factors in obtaining high yields in cassava. Hand weeding is the most common practice in most cassava growing areas. Cassava requires at least two properly timed hands weeding especially with cultivars that branch at heights not less than one metre. Most farmers, however, grow cassava at a lower plant population than it is necessary to provide effective ground cover. Under these conditions, three weeding are necessary for a good crop yield.

### **Fertilizer**

Cassava cultivation in traditional agriculture is usually without any applied fertilizer. Manures may occasionally be used, but their use is not widespread. Cassava has high nutrient requirements and very rapidly exhausts the soil unless provision is made for the replacement of the nutrients removed. It is important to replenish phosphorus and potassium regularly.

### **Crop Protection**

Fungal, bacterial, viral or viral-like mycoplasmal agents affect cassava. These diseases can affect plant vigour, inhibit photosynthetic efficiency, or cause pre-harvest or post harvest deterioration. Some of these diseases and pests and their control are:

- i). Cassava mosaic disease: Several control measures are available for cassava mosaic disease. The most promising control measure is the use of resistant varieties. Use of healthy planting material is also recommended.
- ii). Cassava brown streak: Control measures are similar to those outlined for cassava mosaic disease. Cassava bacterial blight. Planting disease free cuttings is the most recommended control measure. Using resistant cultivar is also recommended.
- iii). Cassava green mite. Planting resistant varieties is the most appropriate control measure.
- iv). Cassava mealy bug: Planting resistant varieties is the most appropriate control measure. Use of biological control agents is recommended.

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v). Termites: Control involves discovering the home of the termites and destroying it.

## **Harvesting**

Late maturing cassava cultivars are ready for harvesting from 12 months after planting while some early maturing cultivars are ready for harvesting at 7 months. The exact time of harvesting is dependent upon cultivars, rainfall, soil conditions and temperature regime. It is best to harvest cassava when the tubers are old enough to have stored sufficient starch, but not too old to have become woody and fibrous. In practice, cassava fields are hardly harvested at once, or at the recommended time of harvesting. The main reason for this is that the tubers deteriorate rapidly when harvested. Therefore the farmer harvests what he needs for the time being, leaving the remaining tubers unharvested until they too are needed.

## **Post Harvest Technology**

Cassava deteriorates quickly after harvest, and storage methods have not been very effective in enabling farmers to store their roots after harvest. Ideally, cassava should be stored in the dry form, which involves peeling, chipping and drying under the sun or in an oven. After drying, cassava chips can either be stored in that form or milled into flour. Cassava can also be peeled, grated and processed into a fermented product known as “gari”. Both flour and “gari” have a shelf life of two years.

## **Utilization**

KARI has developed over 30 cassava recipes. Tubers may be consumed fresh, dried or cooked. Dry tubers can be ground or milled into flour which can be used either as pure flour or mixed with flour from cereals to make a wide range of preparations such as biscuits, bread, cakes, chapatis and cookies and other preparations. Industrial uses include various products such as starch, alcohol and glue.

## **Marketing**

There are few biscuits, bread and cookies industries that use cassava flour. The only cassava starch processing factory in Kenya is Tropica Company in Mazaras, Mombasa. Cassava is mainly marketed in its fresh form in most cassava producing areas.



## 4.2.1 Sweetpotatoes

### 4.2.1.1 Varieties and their characteristics

#### 4.2.1.2 KSP 20 “Wanjugu”

- Matures in 3½ - 4 months
- Potential yield of 22-25 or 8-10 t/acre
- Its skin colour is red and the flesh is white

#### 4.2.1.3 Kemb 10

- Matures in 4-5 months
- Yield potential ranges from 20-30 or 7-12 t/acre
- Its skin colour is red and the flesh is cream
- It is more drought tolerant than other varieties



Different Sweetpotato varieties in the field

#### 4.2.1.4 K04-013

- Matures in 4-5 months
- Yield potential range of 30-38 t/ha or 12-15 t/acre
- Skin colour is pink and orange-fleshed

#### 4.2.1.5 SPK004

- Matures in 4-5 months
- Yield potential of 15-30 t/ha or 6-12 t/acre
- The tuber and flesh is light orange
- High in Vitamin A



Sweetpotato tubers

Photos courtesy of Dr. J.G. Gethi of Root and Tuber Programme, Katumani

### 4.2.1.5 Target Areas of Production

The varieties can be grown from the sea level to 2000m above sea level. They perform well in wetter areas of zone III and IV of Machakos, Kitui, Makueni, Tharaka, Mbeere, Meru and Mwingi, hilly masses, swamps, riverbeds and irrigated areas. They do not perform well in waterlogged soils.

### 4.2.1.5 Crop Management

Sweetpotato is grown on a wide range of soil types, but being a root crop, does best on soils of a

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friable nature, which permit expansion of the tubers. Fertile sandy soils with adequate rainfall are most suitable for growing sweetpotato. However, sweetpotato can be grown on almost all soil types provided they are not water-logged, too shallow and stony. Sweetpotato is exhaustive of potassium. Too high fertility may result in excessive vegetative growth at the expense of tuber and starch formation. The important soil physical and cultural factors that affect sweetpotato production include soil temperature, rooting depth, method of seedbed preparation and soil erosion, which may result in loss of soil fertility. Sweetpotato is considered a drought tolerant crop but that does not imply that it cannot do without water. Ease of harvest depends on various soil factors such as texture and soil moisture content at the time of harvest. Sweetpotato by virtue of its low and slow growth of canopy cover is an erosion-promoting crop. Intercropping sweetpotato with maize decreases erosion by a half and mulching can even minimize the erosion losses to zero.

### **Planting**

Time of planting: At the onset of both short and long rains.

Planting stock: Long vines, one foot long and disease free

Methods of planting: cover half of the vine in the ground and expose the other.

Seed rate: 27,000 vines per hectare (11,000 vines per acre)

Depth of planting: Bury half of the vine 4-6cm deep

### **Spacing**

Sole cropping: Plant in rows at a distance of 75cm and 50cm within the rows

Intercrop: Some farmers do

### **Weeding**

The first weeding must be done within two weeks after planting and the second two weeks later when earthing-up is recommended.

### **Fertilizer**

Sweetpotato cultivation in traditional agriculture is usually without any applied fertilizer. Manures may occasionally be used, but their use is not widespread. Sweetpotato has high nutrient requirement and very rapidly exhausts the soil unless provision is made for the replacement of the nutrients removed. It is important to replenish potassium and phosphorus regularly.

### **Crop Protection**

Insect pests:

The most important pest of the crop is the sweetpotato weevil. Plant sweetpotato on land where the crop has not been grown in the past 2 years.

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## **Control Measures**

Sweet potato weevil and moth: keep earthing the crown and exposed roots regularly and breeding for tolerance. Practice crop rotation. Plant sweetpotato on land where the crop has not been grown in the past 2 years.

### **Diseases**

Sweetpotato virus is the most important disease affecting sweetpotato.

Control: use disease free vines for planting and breed for resistance.

## **Harvesting**

### **Time of harvesting**

KSP 20 should be harvested within 4 months but piecemeal harvesting can start when the crop is 3 months old. Piecemeal harvesting of KSP II should be done 5 months after planting. Young leaves can be harvested for vegetables use 2 months after planting. SPK004 should be harvested 4-5 months after planting. Locate the large tubers by cracks in the ground. Loosen the soil around the tuber with a sharp tool like a fork and lift the tuber from the ground. Use a jembe if you want to harvest the whole plot at once.

## **Storage**

Sweetpotato can be stored in the field in fresh form and harvested as needed. Tubers stored for long periods in the field are usually attacked by weevils and large mammalian pests. Fresh tubers can also be stored in covered pits under shade. Before being placed in the pit the tubers are covered with banana leaves to avoid contact with soil. This practice is common in western Kenya. Sweetpotato tubers can also be stored as dry chips. Harvest, wash, peel and cut into chips and dry in the sun. Dried sweet potatoes store much longer than those left in the field.

## **Utilization**

Sweetpotato can be consumed whole, or made into chips or flour. The flour can be used to make composite flour with wheat, maize and sorghum for preparation of biscuits, bread, cakes and other cookies.

## **Marketing**

High bread prices have triggered the increase in the utilization of sweetpotatoes. It is marketed both in rural and urban areas.



### 4.3 Utilization of Traditional Food Crops

Farmers in arid and semi-arid ASAL areas have been utilizing traditional food crops in one way or another. Traditional methods of utilization are limited by the negative psychological attitude towards the traditional food crops hence hampering adoption. Traditional food crops are used in making uji, ugali and various traditional dishes. The potential for use of traditional food crops has not been fully optimized. Thus it has become necessary to establish processing and utilization units at research centers and universities to enhance and optimize the post harvest activities output. These units seek to develop/ improve the processing and utilization of traditional food crops such as sorghum, millets, pigeon pea, cow pea, cassava and sweet potatoes to add value to them in order to be more acceptable by the target end-users. In doing this, crops that are enriched with essential micro food nutrients and also blended at various rates to cater for broad spectrum of consumers depending on their tastes and preferences.

The main objectives of processing and utilizing the traditional food crops are to promote their consumption for economic empowerment to the farmers/stakeholders. This also enhances the post-harvest qualities and preserves both food crop and animal resources. Supporting breeding programmes in selection of food crops materials that are nutritionally and chemically suitable for consumption as food base is also the role of these units. From activities of these units new and improved recipes are available.

Table 1: Range of new and improved recipes based on traditional food crops

Crop (s) Resource used	Product form available	Other potential related products
Sorghum, finger millet, pearl millet, green gram, cassava, sweetpotato, Pigeon pea, cowpea, Dolichos, soya bean Composite flours from these crops	<b>Flour used for:</b> Light porridge Thick porridge Make variety of these porridges	Glue, pasta and noodles
Sorghum, finger millet, pearl millet, green gram, cassava, sweetpotato, Pigeon pea Composite flours from these crops	Variety of Non-alcoholic beverages	Clear alcoholic beverages from cassava, sorghum, millet, sweetpotato Instant beverages
Sorghum, finger millet, pearl millet, cassava, sweetpotato, pigeon pea	Flour used for Confectionaries like cakes, cookies,	Bread, Scones
Sweetpotato, cassava, Sorghum and millets	Juices	Sauces, jams
Sweetpotato and cassava	Chips, dice	Gari, starch
Sorghum, finger millet, pearl millet, cassava, sweetpotato,	Flavour/preservative substances glucose syrup	Dextrin, sugar
Cowpea, amaranthus, stinging nettle, African nightshade, pumpkin, cassava and sweetpotato leaves	Vegetables for human consumption	Rations for making animal feed Cassava leaves for medicine
Sorghum, finger millet, pearl millet, cassava, sweetpotato,	Snacks like- crankies, Sorghum pop	Sorghum and millets (crisps&flakes)
Bean, pigeonpea, cowpea	Eaten as stews	Canned legume products
Beans (KAT B1)	Stews for diabetic people	



### 4.3.1 Product Development

There has been a push to get entrepreneurs to develop and market products of traditional food crops. What has been lacking is information on the nutritional value of the materials being used. It's essential in product formulation to know accurately the proportions of each material to be used. Mixing of various materials in certain proportions will achieve the suitable levels of nutrients components required to satisfy target end-users. The composition of the various elements contained in each traditional food crop can only be

determined through analysis. The following table gives the composition of elements of selected traditional food crops courtesy of the Food Utilization team at KARI Katumani with funding from USAID. Farmers, Home economics officers, Ministry of Agriculture and entrepreneurs can use this information in formulation of various products.



Photos courtesy of S. Mwiti of Food Utilization Programme, Katumani

Table 2: Nutritive value of some traditional food crops

Food	Moisture g	Energy Calories	Protein g	Dietary Fibre g	Lipid g	Total Carb. g	Total sugars g	Total Ash g	Fe mg	Ca mg	Zn mg	P mg
Sweetpotato KSP20 (flour)	11.3	360	3.4	2.6	1.3	76.7	2.8	1.9	3.1	69	1.7	97.8
Sorghum flour KARI Mtama- 1	11.0	348	11.3	2.0	1.9	70.0	0.43	1.6	14.0	27	2.2	23
Seredo flour	12.0	347	11.0	2.4	2.5	69.6	0.41	1.5	14.8	26	2.8	24
Cassava flour KME 1	12.0	343	1.2	2.7	0.4	79.2	0.78	1.8	33	99	1.1	92
Cassava flour Mucericeri	12.4	343	1.3	2.6	0.3	80.9	0.80	2.0	32	98	1.1	91
Cowpea flour M66	11.0	338	22.3	4.0	1.1	59.5	2.4	1.4	13.6	158	5.1	104
Pigeon pea Flour	9.9	339	20.6	5.3	1.3	60.5	0.46	2.0	15	161	2.8	300
Pearl millet	8.8	349	10.4	1.7	4.0	70.8	0.32	1.7	20.7	258	2.8	22
Finger millet	12.0	348	10.8	1.2	1.3	70.4	1.8	1.5	19.4	250	1.7	220

Table 3: Nutritional Composition of some traditional leafy Vegetables

Food	Moisture g	Energy Calories	Protein g	Dietary Fibre (g)	Total Carb. (g)	Total Ash (g)	Fe (mg)	Ca (mg)	P (mg)
Sweetpotato KSP 20 leaves	12.0	303	20.3	14	60.2	6.1	1.8	155	150
Amaranth Leaves	12.0	302	30.8	12.6	58.0	5.8	62.3	410	103
Cowpea Leaves	12.0	302	32.9	13.3	58.1	6.2	5.7	256	440
African nightshade (Mavu)	12.4	266	30.1	9.1	39.9	-	7.0	3094	525
Spider plant (Mwangani)	12.3	238	33.6	9.8	36.4	-	42	2016	777

Courtesy of USAID Nutribusiness Project

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## 5.0 References

- L. M'Ragwa, B. Bugusu, C. Mburu, M. Wanjohi, R. Hudgens, G. Ashiono, B. Kanyenji and J. Malinga (Eds). 1987. Sorghum and Millet Production and Utilization Guidelines, Nairobi, KARI Headquarters.
- N.J. Grundon, D.G. Edwards, P.N. Takkar, C.J. Asher and R.B. Clark (1987). Nutritional Disorders of grain sorghum.
- H.J. Ensink, 1995. Sorghum Agronomy in West Africa. Investigations from a Farming Systems Perspective.
- L. M'Ragwa, 2001. Application for Plant breeders' Right.
- D.R. Karanja, 2003. Food security Training and Recommendations for Diocese of Kitui. KARI Katumani
- GoK, 2004. Strategy for Revitalizing Agriculture. Ministry of Agriculture, Ministry of Livestock and Fisheries Development and Ministry of Cooperative Development and Marketing. February 2005, Nairobi, Kenya
- J.M. Kavoi, D.R. Karanja, D.M. Mulwa and C. Mugo, 2004. Enhancing Food Security in Semi-arid Eastern Kenya through Promotion and Uptake of Crop Protection Research Output. Machakos. KARI Katumani Research Centre.
- C. Onyango, P.W. Ngunjiri, T.J. Oguta and S.M. Wambugu, 2006. Small-scale Processing technologies for selected traditional and horticultural food crops in Kenya. Kenya Industrial Research Development Institute (KIRDI), 166PP. KIRDI, Nairobi.