

A photograph of two men standing in a lush green sorghum field. The man on the left is wearing a plaid shirt and is gesturing towards the plants. The man on the right is wearing a white shirt and is holding a small plant specimen. The background shows more sorghum plants and some trees under a bright sky.

Technical Manual on Production of:

- ▶ Sorghum
- ▶ Cowpeas
- ▶ Green Grams



INADES FORMATION
INTERNATIONAL
KENYA OFFICE

TABLE OF CONTENTS

1. Executive summary.....	1
2. Sorghum.....	1
3. Land preparation:.....	2
4. Planting:.....	2
5. Mono cropping/sole cropping:	2
6. Intercropping.....	2
7. Fertilizer application rate.....	2
8. Manure application	2
9. Weeding and thinning.....	3
10. harvesting.....	3
11. drying and storage.....	3
12. sorghum ratooning	3
13. pest control in sorghum.....	4
14. cow peas.....	5
15. ests control in cowpeas.....	8
16. green grams.....	9
17. Insects pests and their control:.....	10

EXECUTIVE SUMMARY

This training manual has been developed to give relevant technical guidance on production of Sorghum, Green grams and Cowpeas. These crops help provide better food security areas in Kenya where rainfall is limited and these are also crops among drought tolerant crops which do extremely well in regions requiring minimal amounts of rainfall approximately 200-400mm per year. This manual gives technical input on the crops husbandry focusing on land preparation, planting, spacing, weeding fertilizers and manure application, harvesting and storage. In sorghum production, the practice of Ratooning is also discussed as one of the key areas in which majority of the farmers rarely put into practice. A guideline on pests and disease control in these crops is also shared which plays a very vital role and if not put into consideration may have negative impact positively to projected yields per harvest.

There is a growing recognition that sorghum has great advantage in providing for food security. Sorghum is indigenous to Kenya, but it lost favour with farmers when maize became the preferred food crop. Now, sorghum, green grams and cowpeas are becoming suitable alternative in many places where maize fails. With increased production of these drought tolerant crops farmers in semi arid areas may in future have crops that they can reckon with since they will have capacity to feed their families and the country at large and also make a living from them since there are a couple of food recipes and products that can be made from these crops including selling them as a grain to earn income from them.

SORGHUM (*Sorghum vulgare*)

Sorghum plays an important role as a food security crop especially in semi-arid lands of Kenya. It can survive drought conditions by some weeks by rolling up its leaves and thus decreasing transpiration. It requires a rainfall from a minimum of 250mm per year, but does best above 900mm per year. Minimum temperatures are 10°C, very cold temperatures interfere with the physiology of the crop

Sorghum grows in wide range of soil types, but will grow best on clay loam, clay and silt soils.

Varieties recommended for cultivation include:

? KARI/MTAMA 1 ? Seredo ? Serena ? Gadam

All these varieties are improved/developed by Kenya Agricultural Research Institute (KARI). Their maturity duration is 3 to 3.5 months in Moist-Mid Altitude i.e. Busia, Kuria, Kakamega, Homabay, Siaya, Migori, coffee zones of Meru and Embu and Nyeri; Semi-Arid Low lands i.e. Machakos, Makueni, Kitui, Mwingi, Tharaka, lower Embu, Kajiado, parts of rift valley and north eastern provinces and in Humid Coast regions i.e. Lamu, Kilifi, Taita Taveta, Kwala and Mombasa. In Cold Semi-Arid Highlands i.e. Nakuru, Baringo, Laikipia, Naivasha, Narok, parts of Koibatek and Taita Taveta they mature in 7 - 8 months.

The average potential yields of these varieties are 12 bags per acre.

Land preparation: All sorghum requires a fine seedbed for better seedling establishment. It tractor or oxen plough is used to open up the shamba; it is advisable to harrow after the first ploughing. When jembes are used, for land preparation, farmers are advised to ensure that large clods are reduced by breaking them to provide a smooth seed bed.

Planting field should be prepared well in advance and is recommended that land be ploughed immediately after harvesting the previous crop.

Planting:

- ? Dry planting is highly recommended. Thus, plant before or at the onset of rains by either drilling in the furrows made by oxen plough or tractor, or hill plant in the holes made by jembe or panga.
- ? Seed rate 7-10 kgs/ha or 3-4 kgs/acre
- ? Depth of planting: when dry planted, the depth should be 5cm but in most soils, plant at a depth of 2.5cm to 4.0 cm.

Mono Cropping/sole cropping:

Row spacing is 75 cm and between plants is 20 cm in semi-arid lowlands and humid coastal strip and hinterland, or row spacing of 60 cm and between plants at 20 cm in coffee zones AEZ in and also when planting using wheat driller. In semi and lowlands, where the ox-plough yoke is fixed at 90 cm, especially in Machakos, Makueni, Kitui and Mwingi districts, the recommended spacing between plants is 15 cm.

Intercropping

Intercrop sorghum with legumes (beans, pigeon peas, cowpeas, and green grams): alternate single row of legume between 2 sorghum rows at 90 cm and legume row at the centre. This is recommended in areas where ox-plough yokes are fixed at a distance of 90 cm. When intercropping in semi and areas, sow two rows of legume between two rows of sorghum spaced at 150 cm and between plants spacing is 20cm.

Fertilizer application rate

Apply fertilizer along the furrows and thoroughly mix with soil before placing seed. In moist mid altitude zones of western Kenya and coffee zones of Central and Eastern provinces, apply two (50 kg) bags of NPK (20:20:0) per acre at planting and top dress with two (50 Kg) bags of CAN per acre if the rainfall is sufficient.

In Semi arid, lowlands, apply two (50kg) bags of NPK (20:20:0) per acre at planting. Top dress sorghum with two (50 Kg) bags of CAN per acre if the rainfall is sufficient.

In cold semi-arid highlands (Nakuru, Laikipia and Narok), apply two (50 kg) bags of DAP per acre at planting and top dress with two (50 kg) bags per acre of CAN if necessary. When applying -, at low rate, use one 50 Kg bag of 20:20:0 and if there is sufficient moisture, top dress with 1 bag of CAN after first weeding and thinning.

Manure application

Manure improves the organic matter content of the soil, soil moisture retention ability and soil structure. Manure can be broadcasted in the field and mixed with soil during ploughing. It can also be spread in bands along the planting furrows and mixed with soil before seeds are placed...

The standard farm wheelbarrow when full holds approximately 25kgs of dry manure. At a low rate, 2 wheel barrows are enough for 10m by 10m area. This translates to 200 wheel barrows or 5 tonnes/ha or 80 wheel barrows per acre. When aiming for high rate apply 400 wheel barrows or 10 tons per hectare.

Weeding and Thinning

First weeding should be done within two to three weeks after germination. Two weeding are recommended and the first weeding must be done within three weeks after germination, because sink capacity of sorghum plant is determined within 45 days after emergence. Thin sorghum seedlings to one plant per hill, three weeks after germination in semi arid lowlands or four weeks in cold semi and highlands where the growth rate is low; or/ and when the plants are 45 cm or 11/2ft high. Thinning should be done after the first weeding or when the plants are 2 to 3 leaf stage. If hill planted at the recommended spacing, thin to one plant per hill. Thinning is recommended to be done when the soil is moist to minimize moisture stress.

Harvesting

Harvest sorghum when it has reached physiological maturity, when the grain is hard and does not produce milk when crushed. Cut the heads with sickles or a sharp knife from either plants already cut to the ground or still standing.

Drying and storage

Sun dry or use a dryer to dry the harvested panicles to moisture of 12.5% or 13% and store the grain. Dust the grain with super Actellic at 50g per 90kg bag before storing. The store should be cleaned before putting in the grain. Every two to three months of storage, it is necessary to remove the heads or the grain from the store and sun dry for a day or two, re-clean and re-dust the store before restoring.

SORGHUM RATOONING

Ratooning is a practice of getting more than one harvest from a single sowing.

There are two ratooning systems that have been identified. In the bimodal rainfall zones in semi arid lowlands giving two crops, and the other in the moist altitude coffee zones where the local varieties are two seasons rationing type.

A ratoon crop compared to a newly sown crop has an established root system which will utilize the available water in the soil for crop growth early in the season; reduce ploughing and planting labour; and avoid migratory quelea birds in August by maturing early.

In bimodal rainfall zones of semi-arid lowlands in Eastern province, sorghum is planted in short rains (October - December). When the crop is mature, it is harvested in February and immediately rationed to take advantage of the long rain season which starts in mid-March. To achieve good yields, the crop is thinned to 2-3 tillers per hill. Weeding and other management practices are done as for newly sown crop.

Stalkborer can be a big problem in ratoon crop, it is recommended to apply Dipterex or Marshal 250EG in the plant funnels to control Stalkborer. Aphids may infest the crop especially during the dry spell between rains and should be sprayed with Ambush or Thiodan at the rate of 1.5 litres per hectare.

PEST CONTROL IN SORGHUM

Pest	Symptom	Control
Shoot fly (Atherigona soccata)	The yellowish or white maggots bores into the hearts of the shoot causing drying of the central growing shoot (dead heart)	i) Early uniform planting(avoid staggered planting) ii) Apply systemic insecticides at planting ii) If attacked apply insecticides like Dipterex or Thiodan
Stem or stalk borers	Caterpillar feed inside the stalks causing a stunted plant growth windowing of leaves, withering shoots and often poorly developed heads	i) Early planting ii) Field sanitation iii) Apply insecticides in funnels e.g. Ambush, Dipterex, Thiodan
Head bugs	Feed and punctures the grain. Shrivelled chaffy grain. Presence of bugs on panicles at milky stage	i) Use variety with semi-loose to lose panicles ii) Spray with insecticides e.g. Diazinon, Ambush or Karate
Sorghum midge	Reddish fly lays eggs in the floret at flowering and the maggot feeds on and destroys the developing seed	i) Apply insecticides like Thiodan, ambush, or Karate ii) Early planting ii) Use early maturing varieties
Chafer grabs	Wilted or dried plants encrusted with earthen, tunnels Lodging of plants	i) Use well decomposed manure ii) Avoid manure heaps near field iii) Early and deep land preparation iv) Seed dressing with systemic insecticides / V) Rotation of sorghum with cowpeas, pearl millet and/or cotton
Storage pests	Holes in the grain Flour and caking of the grain	i) Early harvesting ii) Clean and disinfect store at least 6 weeks before harvest
Birds	Eat the grains and can devastate crop completely	i) Use birds scaring devices ii) Early uniform planting of similar maturity crop iii) Use affordable reflectors e.g. old cassette tapes, aluminium foils iv) Timely harvesting v) Destroy roosting and nesting sites Vi) Avoid isolated production fields
Covered smut	Spores sacs on florets(instead of seeds) resulting to black powdery spores in seed	Seed dressing with fungicides e.g. Thiram
Foliar diseases Leaf blight, Anthraenose, Rust	Dry lesions on the leaf surface Elongated dark lesions alongside the midrib, rust has brown to red spots	i) Use resistant/tolerant varieties ii) Avoid late planting
Long smut	Elongated spores sacks instead of grains i.e. black masses of powdery spores: the entire head becomes black	i) Use resistant/tolerant variety grains ii) Early planting spores; the entire head iii) Treated seeds
Charcoal rot	Premature drying of the plant	i) Use of resistant/tolerant varieties ii) Avoid late planting
Grain mold	Dark sooty appearance on the grain	i) Crop must mature under low humid conditions ii) Use resistant / tolerant varieties

COWPEAS (*Vigna Unguiculata*)

Cowpeas are annual, leguminous crops grown for their leaves and seeds. Cowpeas are mainly important in the marginal rainfall areas because they are well adapted to dry climate and suitable for a variety of intercropping systems. The cowpeas seeds can be cooked to make various recipes i.e. soup, stew, or boiled together with maize among others. The leaves can be crushed and fried or boiled and sometimes dried and stored for future utilization.

Production:

Cowpeas require warm climate and only give good yields below 1500m altitude. They are well adapted to the dry climate. Rainfall of about 200-400mm per growing season distributed in some good showers around planting (to boost the vegetation growth) and around flowering (for pod setting and filling) is sufficient.

Cowpeas grow on a wide range of soils and is well adapted to light, sandy soils where most other crops produce poorly. On heavy fertile soils they grow a vigorous vegetation growth but not necessarily a good grain yield. However, cowpeas will not tolerate water logging and hence require well drained soils.



Cowpeas

Cowpeas varieties and their characteristics

Variety	Maturity (Days)	Potential Yields (Bags/Acre)	Remarks
Katumani 80 (K80)	75 - 85	5 - 7	Dual purpose variety erect, improved, reddish and good for inter-cropping
Machakos 66 (M 66)	85 - 95	5 - 7	Dual purpose variety erect, reddish colour and good for inter-cropping
KVU-419	65 - 72	5	Has a smaller seed than both M66 and K80. More of a grain than leaf/vegetable type
KVU HB 48E 10	85 - 95	5 - 7	More of vegetable type than grain type

Other known varieties are Ngombe which is semi spreading, good for green leaf production, sweet taste of grain, there are also local varieties which display different colours are either semi-spreading or spreading.

Target areas for production of various varieties

- Machakos 66 (M 66):** This is recommended for medium and higher altitudes of between 1200-1500m above sea level in agro ecological zones III and IV
- Katumani 80 (K80):** This 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
- KVU 419:** it is recommended for cultivation in areas below 1200m above sea level receiving less than 200mm of rainfall per season, agro- ecological zones IV and V.
- KVU 27-1:** This variety will perform well in similar agro-ecological zones as Machakos 66

Land preparation: Early and proper land preparation is recommended. Prepare a medium tilth for good seedling establishment. Hand, oxen plough or tractor can be used for ploughing where soil capping and sealing is a serious problem, plough immediately after harvesting the previous crop

Planting: Early planting is recommended, that is at the onset of the rains.

Seed rate: 25 35kg/ha (10-14kg/acre)

The recommended number of plants per hill is 2-3 seeds/hill and thinned 2 weeks after emergence to one seed per hole. Depth of planting is between 4 & 5 cm.

Spacing

a) *Pure stand*

Mackakos 66, K80 and KVVU 27 -1; the distance between rows should be 60 cm and between plants 20 cm that is, *60cm by 20cm*.

For KVVU 419 and KVVU HB 4810 the distance between rows is 50cm and between plants 20cm, that is *50cm by 20cm*

b) *Intercropping*

Cowpeas are often inter-sown with other crops such as maize, sorghum, millet and cotton. In maize and cowpeas intercrop, it is recommended that one row of cowpeas be sown after every row of maize. This is to mean that one row of cowpeas is mid way between 2 rows of maize.

Only erect cowpeas are suitable for intercropping. With cotton for example, spreading and semi-spreading cowpeas would entangle the cotton making normal field operations very difficult.

Fertilizers: Cowpeas do not respond well with nitrogen and phosphate fertilizers and in most cases it is not necessary to apply any.

However, where the *soils are highly eroded*, and very deficient in these nutrients, a basal dose of 10-15 kg/ha of nitrogen and 20-25kg/ha of single or Triple Super Phosphate fertilizers may be broadcasted.

Where Farm Yard Manure is used, it is recommended to apply 5t/ha of dry manure.

Weeding: Weed during early stages of crop, later the cowpeas will cover the ground and suppress weeds. Two weeding have been found satisfactory. The first weeding should be done two weeks after emergence and the second just before flowering

Harvesting

a) *Leaves harvesting:* Leaves for eating must be young and tender. Three leaf picking (starting 2.5 - 3 weeks after planting) at weekly intervals have little effect on grain yields. Don't spray chemicals within two weeks before picking leaves.

b) *Harvesting grain:* Harvest cowpeas grain when all the pods have turned brown and are dropping. This is normally 2-3 months after planting. They are dried, threshed and winnowed.

Store grains when thoroughly dried, dress with Actellic if stored for longer periods or keep in air tight drums. If seeds are to be used for planting, do not put into an air-tight containers as seeds need oxygen to breath. Keep dressed seeds in gunny bags.

Pests control in Cowpeas

Pests	Symptoms	Control
Cowpeas Aphid	Shiny black aphid, feeds on under surface of young leaves causing distortion & stunting	Spray with- Thiodan, Karate or Sherpa plus
Flower Tarips	Shiny black insects, which cause early fall of lowers or no flowering at all	If heavily attacked, spray with Sherpa plus, Karate (Lambda)
Leaf Hoppers	Adult and nymphs infest leaves and suck the plant sap from the underside causing yellowing and cupping of leaves	Spray with Thiodan 35% E.C
Pods sucking bugs	Adult and nymphs such the sap from developing pods causing premature drying of pods and lack of normal seed formation	Spray with Dimethoate, Sherpa plus, Karate
Pod Borers	Yellowish-white greenish-white or reddish white caterpillar feed on flower buds and seeds (after penetrating the pods)	Spray with Thiodan, Sherpa plus, Decis
Bruchids	Thin tunnel beneath the seed coating and circular holes on the surface of the grain	<ul style="list-style-type: none"> - Clean stores before storing new grain - Mix cowpeas grain with Super Actellic thoroughly
African boll worm	Feeds on flowers and pods	Spray with Thiodan or Ambush CV
Diseases	Symptoms	Control
Anthrachose	Sunken, dark brown sports on the pods, having black sometimes an orange boarder	<ul style="list-style-type: none"> - Use clean seed - Practice crop rotation and field sanitation - Use Benomyl
Powdery mildew	White, external mildew visible on lower surface of the leaves	<ul style="list-style-type: none"> - Use resistant varieties - Can spray with Bayleton or Antracol
Bacteria blight	Tiny, water soaked dots on the under surface of the leaves, the surrounding tissue becomes necrotic and turn to orange with a yellow halo. Also causes water soaking of pods from which it enters the seed	<ul style="list-style-type: none"> - Crop rotation - Field sanitation - Use of certified seeds
Brown rust	Slightly raised postules on the leaves. In severe cases cause leaves to shrivel and fall	<ul style="list-style-type: none"> - Crop rotation - Field sanitation - If necessary spray with Bayleton, Benomyl
Brown Botch	Causes wilting and death of the plant. On flowers causes brown necrosis that cause either complete floral abortion or distortion and shivering of immature pods	<ul style="list-style-type: none"> - Use certified seeds - Practice crop rotation and field sanitation

GREEN GRAMS (VIGNA AUREUS)

Green gram is an annual leguminous crop. They do well in marginal rainfall areas and play an important role as relay crop and short rain crop. Grams in general can be green, black or yellow in colour. The green grams are the most commonly grown in Kenya.



They do best at altitude between 0 1600m above sea level. They do well under warm climatic condition. They are drought tolerant and will give reasonable yields with as little as 650mm of annual rainfall. Heavy rains and cool temperatures result in increased vegetative growth with reduced pod setting and development. They do well on fertile red loam soils, but grow reasonably as well on not too exhausted sandy soils.

Varieties of green grams and their characteristics

- i) The local green gram variety
 - Has small seeds which ripen unevenly.
 - Plants mature at different times.
 - Matures late.
 - Has a lot of stony seeds, which makes green gram meal difficult to eat.
- ii) The improved variety K26
 - Has bright green and large seeds.
 - Gives high yields and plants ripen at the same time.
 - Matures early.
 - Does well in dry areas.

Land Preparation and Planting

Prepare land early enough so that planting can start when the rains begin. They should be planted 1-2 weeks before the rains or at the onset of rains. When using oxen plough for planting, place seeds at the side of the furrow.

Sole cropping: when planting seeds, the distance between rows should be 45cm and between plants 15cm, that is 45cm by 15cm. The recommended depth of planting is 4-5cm.

Intercropping: When green grams are planted at the end of the long rains are normally inter cropped into other major crops. If they are inter cropped with maize, the maize spacing is the same way as in pure stand, but the grams are inter planted mid-way between the maize rows.

Weeding: Early weeding is recommended. The first weeding should be done 2-3 weeks after the seeds have emerged followed by the second weeding 6 weeks later and must be done before flowering.

Fertilizers: Fertilizer may not be necessary. However, when the soils are highly eroded and are very deficient in nutrients especially nitrogen and phosphate, a basal dose of 10-15 kg nitrogen and 20-25 kg/ha of single or TSP fertilizers may be broadcasted. If the soils are poor, you can also apply up to 12 gorgoros or 1/2 bag of DAP per acre.

Harvesting: Harvest green gram when 95% or most of the pods have turned black. In some cases, you can pick and dry individual pods or uproot the whole plant and dry it for about 2 days, then thresh and winnow/clean it.

Storage: Green grams must be dried well before storing because Bruchid weevils attack the stored grain. It is best to store the grain in covered tins, drums, pots or sealed containers.

N.B If you store it in bags; Add the ash of neem leaves or buy Super Actellic and add 2 matchboxes full (50 gm) to one 90 kg bag of green grams for protection against the Bruchid. Mix the actellic or ash well with green grams before storage.

Yields: Average yields range from 1 to 2 bags (90 -180 kg) per acre. If you follow the above steps you can get up to 4 bags (360 kg) per acre. The Stover is good livestock feed. You can get a return of 5 times your investment if you follow the steps in this leaflet.

Insects Pests and their Control:

Pest	Symptoms	Control
Bean fly	Attacked plants are yellow and may wilt. The base of the stem is swollen and numerous cracks can be seen, as a result of feeding activities of the maggot	- Early planting - Avoid overlapping of grain crops - Remove volunteer plants - Dress the seed with Carbosulfan or - 1 or 2 sprayings with Diazinon in the seedling stage
Bean Aphid	Feeds on foliage and pods causing distortion of leaves, stunting of plants and poor nodulation of the root system	- Early planting - Spray with Thiodan, Sherpa plus or Karate
Thrips	Shiny black insects which cause early fall of flowering or failure	- In severe attacks , spray with Thiodan or Sherpa plus
Sucking bugs	Adults and nymphs suck the sap from the developing pods causing premature drying of the pods and lack of normal seed formation	- Timely planting - Removal of debris - Use chemicals like Dimethoate, Sherpa plus
Bruchids (a pest)	Infested crops show the well known and much defested holes in the seeds. Inside the seed, a whitish larva or pupa can be found	- Use clean seeds - Treatment with cheap sunflower oil - Use Super Actellic dust

Diseases: Diseases of economic importance include Powdery mildew and yellow mosaic virus. Powdery mildew is prevalent during the long rains whereas yellow mosaic virus occurs in both seasons

Disease	Symptoms	Control
Powdery Mildew	White external mildew on the lower surface of the leaves	- Use certified seeds - Crop rotation - Spray with Benomyl or copper oxychlorid
Yellow Mosaic virus	It's a viral disease. The affected plants show mosaic and plants stunting	- Use certified / clean seeds - Control insect vector - Plant resistant varieties



Designed & Printed by: Maxamen Enterprises. 0722 864668



INADES FORMATION

**I
N
T
E
R
N
A
T
I
O
N
A
L

K
E
N
Y
A

O
F
F
I
C
E**

P. O. Box 1905 - 90100 - Machakos,
Inades bldg., Opp. Century Park College, Mks - Wote Rd,
Tel: 254 4421595 Fax: 254 4420319 Email: inadesk@jambo.co.ke