KALRO
Kenya Agricultural & Livestock Research Organization

KCSAP
Kenya Climate Smart Agriculture Project

Sorghum (*Sorghum bicolor*) (Variety: E1291)

Seed Production Manual

W. Ayako, J. Nguru, N. Mathai, E. Chelimo and D. Mbugua

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Acknowledgement

Compilation of this Sorghum seed production manual has been made possible through support of the World Bank funded Kenya Climate Smart Agriculture Project (KCSAP). We are grateful for the support of KCSAP National Project Coordination (NPC) and Kenya Agricultural and Livestock Research Organisation (KALRO) for coordination and oversight.

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

Preface

Sorghum has shown great potential in improving livestock productivity in Kenya. However, reduced access to seed limits the growing of the fodder. Development of alternative forage seed distribution system is key in upscaling the production of the fodder among dairy farmers. This manual provides information on how to strengthen Common Interest Group (CIGs), Vulnerable and Marginalized Groups (VMGs), Producer Organizations (POs) and other farmer groups to produce clean planting material for sale and utilization of Sorghum to improve livestock production. E1291 dual purpose sorghum has been developed and promoted by Kenya Agricultural and Livestock Research Organisation (KALRO). The variety is drought tolerant, has high grain yield, suitable for cold semi-arid highlands and good for silage making. It is propagated through seed and sold at approximately Kes. 250 per Kilo.

This manual provides information on how to produce, manage and utilize Sorghum E1291 among dairy farmers. It emphasizes the growing of the fodder targeting Common Interest Group (CIGs), Vulnerable and Marginalized Groups (VMGs) and Producer Organizations (POs) for seed production as a business.

This work is being piloted in KCSAP Counties of Nyeri, Kericho, Bomet and Kakamega.

1.0 Introduction

Sorghum (*Sorghum bicolor*)

Sorghum is a coarse perennial grass, adapted widely to various Agro-Ecological Zones (AEZs). It is drought tolerant, requires relatively little fertilizer and its yield potential in the semi-arid tropics is high. It is an indigenous crop to East Africa. It serves as a basic staple food for many rural households and is an important livestock feed. Several varieties of sorghum have been developed and promoted by KALRO such as E1291, Ikinyaruka, BJ28 and BM30.

1.1 E1291 variety

E1291 is a dual-purpose sorghum being promoted by KALRO under KCSAP to smallholder dairy farmers because it is suitable for silage making and highly digestible. It is propagated through seed and sold at approximately Kes. 350 per Kilo. There is need to train farmers on how to grow and commercialize sorghum E1291 using seed. The average seed production is 6 tons per Ha. per year (2.4 tons per acre). With good management, the crop can give three re-growths (ratoons) before re-establishment. As a result, farmers enjoy added economic benefits through saving on subsequent seed purchases and land preparation expenses.

E1291 Sorghum Seed

Sorghum re-growth (ratoon)

1.2 General Agro-ecological requirements for E1291 sorghum

- Minimum rainfall: 650mm
- Altitude: 1500 – 2000m ASL
- Soil pH: 4–8 (Acidic/Slightly Acidic/ Neutral)
- Drought tolerant

2.0 FIELD ESTABLISHMENT

2.1 Land preparation

Prepare the land at the end of the rains following a cropping season. Ensure fine tilth or alternatively practice zero tillage using non-selective herbicides.

Primary and secondary land preparation

2.2 Fertilizer and manure application

At planting use Diammonium Phosphate (DAP) or Compound fertilizer (NPK) at the rate of 62.5 kg/ha (25.3 kg/acre), together with manure at the rate of 17.3 t/ha (7 t/ acre).

Seek advice from your extension officer on which fertilizer is suitable for your region.

Top dress at knee high with 200 kg/ha (4 bags) of CAN. Foliar fertilizers can also be used at the recommended rates to supply the necessary nutrients.

2.3 Spacing and seed rate

The seed rate is 6 to 8 kg/Ha (2.5 to 3 per acre). A planting depth of 25 mm (1 inch) is satisfactory.

Sorghum should be spaced at 60cm by drill between rows (approximately 84,000 plants per Ha. or 33,600 plants per acre). Compact the soil for moisture retention to enhance germination. Germination occurs within 5 to 7 days after sowing.

2.4 Thinning

Thin when crop is 30 cm high or 30 days after germination, whichever comes first, to achieve spacing within rows of 10 cm to 20 cm.

2.5 Weeding

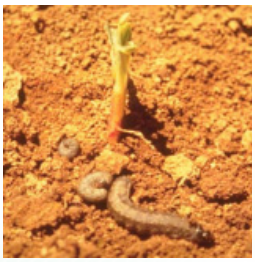
Sorghum field should be kept weed free especially during the early growth stages (before tussling). This is done to minimize competition for nutrients, moisture and space. Weeding can be done manually or by use of selective herbicides.

E1291 Sorghum at different physiological stages of growth		
		
Young sorghum crop	***E1291 dough stage of growth***	***Sorghum at physiological maturity***

3.0 COMMON PESTS AND DISEASES

Main pests affecting Sorghum include cut worms, sorghum shoot flies, chafer grubs, army worms, stem borers and aphids. The main diseases affecting the fodder are leaf bright, top downy mildew, leaf rust and head smut

3.1 Common Pests

Pest	**Symptoms**	**Control Method**
 **Cutworm larvae**	Cutting off young plants at or slightly below the soil level. Attacked plants die.	Dress seeds with insecticide or apply at planting.

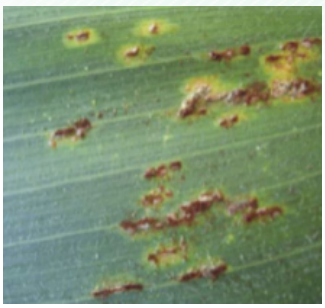
 **Chafer grubs**	Feed on the roots and may kill young seedlings.	Dress seeds with insecticide or apply at planting
 **Sorghum shoot fly**	Feed on the young shoot killing the growing point and the youngest leaf which turns brownish and withers (dead heart)	Apply recommended insecticides at the early stages of growth.
 **Stem borer**	The young plants are more susceptible to attack by stem borers. The pest bore holes straight into the centre of the stem.	Apply recommended insecticides at the early stages of growth. Integrated pest Management (insects, beetles)
 **Armyworm**	Causes serious damage mostly to young plants by eating the leaves	Use the recommended pesticide at the right stage.
 **Sorghum aphid**s	They suck sap on the ear heads or on the undersides of the leaves and produce honeydew which encourages formation of sooty mold. Infested plants become stunted, leaves dry up and yield is considerably reduced.	Use the recommended pesticide at the right stage Integrated pest Management (insects, beetles)

 **Stink bug**	Start infestation immediately after flowering of sorghum. They lay eggs in clusters and nymphs complete their maturity before sorghum matures. Stink bugs feed on sorghum kernel at milk and dough stages making the seeds shrivel and reduce their size and quality.	Use the recommended pesticide at the right stage Integrated pest Management (insects, beetles)
 **Birds (*Quelea quelea* Birds)**	Feed on the seeds causing heavy yield losses.	Scare them away and destroy their nests.

NB: Use pesticides/insecticides as recommended by extension officers

3.2 Common diseases

Disease	Symptoms	Control Method
 **Leaf blight**	Small reddish purple or yellow-brown spots develop on the leaves of the infected plants. In severe cases, these spots combine, covering the entire leaf. This makes the leaf appear to be burnt.	Use the right spacing. Use fungicide where possible.
 **Top downy mildew**	Infected plants develop thick, stiff, twisted, pale green leaves with bumpy surfaces. The plants do not produce heads in severe cases of infection.	Uproot the affected plants Use certified seeds Use fungicide where possible

 **Leaf rust**	Rust appears on the leaves as small raised spots which rapture releasing reddish brown spores. These occur on both sides of the leaf.	Use fungicide where possible Use certified seeds Crop rotation
 **Head smut**	Large dark brown sooty balls emerge in the place of the tussles (panicles)	Crop rotation with leguminous crops. Use clean seed

NB: Use recommended fungicides as advised by extension officer or agrodealers

3.3 Nutrient Deficiencies in sorghum	
 **Nitrogen Deficiency**	Nitrogen deficiency in sorghum is characterized by; • Reduced dry matter and head number • A light green to yellow colouration • Yellowing of lower leaves beginning at the tip • Delayed flowering of the primary tillers Top dress as required to correct the deficiency

 **Phosphorus (P) deficiency**	• Phosphorus deficiency is usually visible on young plants • Deficient plants are dark green with reddish-purplish leaf tips and margins on older leaves • Phosphorus-deficient plants are retarded in growth compared to plants with adequate phosphorus Apply NPK to correct the deficiency
 **Potassium (K) deficiency**	• Potassium deficiency is not common in most Kenyan soils. Where present, deficiency is characterized by yellowing and necrosis of the leaf margins, beginning on the lowest leaves. • When potassium deficiency is severe, older leaves turn yellow with tissue necrosis along leaf margins, but upper new leaves may remain green. Apply recommended compound fertilizers

4.0 HARVESTING OF SORGHUM GRAIN FOR SEED PRODUCTION

Harvesting of sorghum with a knife

- Sorghum grain is ready for harvesting in 7 months and grows to a height of about 1.7 metres
- The dry mature heads are harvested with a knife or sickle, sun dried, threshed, and cleaned by winnowing to separate the chaff from the grains

Winnowing of sorghum

Sorghum E1291 variety produces 77*90kg bags of sorghum grain per Ha. (31*90kg) bags per acre).

4.1 Postharvest management

This is aimed at minimizing losses attributed to the following ;

- Improper handling predisposes the harvest to insects (e.g. weevils and moths), birds and rodents, which negatively affect yields and seed quality
- Improper storage leads to moulding and aflatoxin infestation which is harmful to both human and livestock

Recommended practices to minimize storage losses are:

- Seed-dress to increase shelf life. Seed dusting and dressing with appropriate insecticides is highly recommended to prevent losses arising from insect infestation and damage. e.g. actelic dust® and supa skana® for grain storage and fanasan-D®, Furaha® for seed dressing
- Store seeds in treated gunny bags placed on pallets, not directly on the floor
- Storage environment should be clean, dry and well ventilated

4.2 Utilization

- E1291 Sorghum seed is an important component in livestock feed
- Much of the sorghum in the country is imported from the neighbouring countries of Uganda and Tanzania. There is need to develop alternative seed distribution outlets among dairy farmers which necessitates farmer training

on aspects involving production for commercial gains through the sale of the harvest to their fellow farmers and the milling industry

4.3 Seed business analysis

Gross Margin analysis of sorghum seed (Basic costs/Estimated returns)

The price of sorghum seed is between Kes 225 and 250 per kilo but can be higher depending on demand and supply dynamics, location, cost of production among other factors. From the Gross margin computations, the cost of producing one acre of sorghum seed with an expected yield of 2000 kgs is 157,850. This translates to a production of cost Kes 78.92 per kilo of sorghum seed. The gross profit margin is 68.4%.

SORGHUM (E1291) SEED				
1 acre sorghum (E1291)	**Units**	**No. of units**	**Cost of units**	**Totals**
Land Hire	Acre	1	10,000	10,000
Non-selective herbicide	lts	2	1,000	2,000
Ploughing Tractor hire	Acre	1	4,000	4,000
Heavy Harrowing Tractor hire	Acre	1	3,000	3,000
Light Harrowing Tractor hire	Acre	1	1,500	1,500
D.A.P Fertilizer	bags	2	6,000	12,000
Sorghum seeds	kgs	5	350	1,750
Insecticide	lts	3	2,000	6,000
Fungicide	lts	4	1,500	6,000
Planting labour	m/days	30	400	12,000
1st weeding labour	m/days	25	400	10,000
2nd Weeding Labour	m/days	25	400	10,000
Chemical application labour	m/days	10	400	4,000
Harvesting labour	m/days	40	400	16,000
Cleaning and processing labour	m/days	60	400	24,000
Dressing chemical	lts	8	1,500	12,000
Dressing labour	m/days	10	400	4,000
Packaging labour	m/days	4	400	1,600
Packages	pcs	1200	15	18,000
Sub total				**157,850**

Gross margin analysis for 1 acre of sorghum seed			
	Kgs	**Cost**	**Total**
Expected revenue (TR)	2,000	250	500,000
Cost of production (TC)			**157,850**
Gross profit (GP= TR-TC)			**342,150**
Gross profit margin % (GPM = GP/TR*100)			**68.4%**
Cost of production per kilo (Kes)			**78.92%**

4.5 Marketing of sorghum seed

For successful marketing of sorghum seed, farmers and farmer groups need to focus on some basic marketing principles which include Product, price, place and promotion. This helps farmers decide on the product and its characteristics, set the price, and decide how to distribute and promote it. This is based on the following marketing principles;

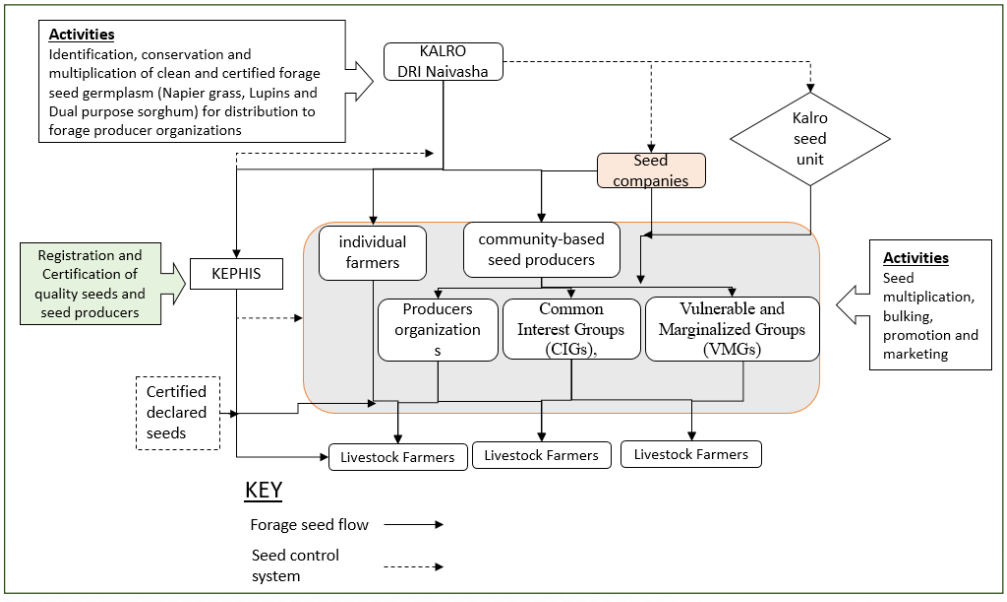
Product: what to produce? Sorghum Seed

Price: at what price to sell? Between Ksh. 220 to 250

Place: where to sell it? Individual farmers and farmer groups

Promotion: how to promote the product? Producer organizations, farmer to farmer linkages and extension agents.

4.6 Business Model



5.0 FURTHER READING

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5. Enhancing Sorghum Production and Marketing in Semi-Arid Kenya Authors: Karanja, D.R., Kisilu, R.K., Kathuli, P., Mutisya, D.L., Njaimwe, A.N., Keya, G., Ouda, J., and Ayemba, J. KALRO AMRI Katumani P.O. Box 340. 90100. Machakos. Kenya.

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