NARO

Republic of Uganda

Adaptation for Smallholder Agriculture Programme
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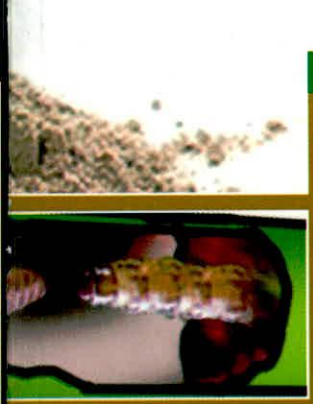
Investing in rural people

PRELNOR

Sorghum

Curriculum and Technical Guide for Farmer Field and Business School Facilitators











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SORGHUM

INTRODUCTION

Sorghum is an important income and food security crop for those living in drought-prone regions of Uganda. It is widely grown in the country but the northern region leads both in production and area covered, followed by the eastern region and then the western region where both brown and white seeded types are grown. The white seeded specialty sorghum used for lager beer making is the leading commercial type while the brown sorghum is used for food and confectionery. The brown sorghum is used as sole grain to produce beverages or blended with cassava flour and wheat to make food products. Despite the importance of sorghum, the productivity is still low especially in the northern region which is the highest producer. This is due to numerous constraints that affect the crop in addition to lack of information and training materials. Constraints include; drought, striga weed especially Striga hermontheca; diseases such as anthracnose, ergot and covered kernel smut; insect pests such as shoot fly, midge and stem borers and birds which affect mainly the white sorghum in addition to market demands for specialty sorghum. This is compounded by lack of training guide for extension workers and other stake holders such as the farmers on how to produce sorghum and manage its production constraints. Some of these constraints are addressed by developing varieties that are resistant or tolerant. NAROSORG 2 and NAROSORG 4 are tolerant to striga, while SESO-1 and NAROSORG-1 were produced to meet specialty demand for lager beer production. SESO-3 and NAROSORG-4 were developed for food specialty needs.

The varieties NAROSORG-2 and NAROSORG-3 were developed for the control of birds and sorghum midge respectively. The curriculum will thus enable stakeholders to follow the recommended agronomic practices which normally lead to high productivity.

Contents of the Curriculum

The curriculum consists of training modules divided into units indicating the topics, objectives, contents, methods of delivery and training materials required. A time schedule is allocated for each topic to enable the facilitator to plan appropriately for each session.

Sorghum Production: Course content

TIME (HOURS)		TOPIC	OBJECTIVE	CONTENT	METHOD	MATERIAL
THEORY	PRACTICAL					
30 min	1hr	Introduction	To enable farmers appreciate sorghum production	The Economic importance of sorghum	• Sharing • Group discussion	• Flip chart • Markers • Pens • Notebooks • Print out • Brochures
30 mins	45 mins	Record keeping	To be able to keep proper records	Importance of record keeping	• Brainstorming • Group discussion • Demonstration	• Samples of records
15 mins	45 mins	Constraints in sorghum production	To enable farmers identify constraints in sorghum production	Constraints in sorghum production	• Brain storming • Sharing • Group discussio	• Flip chart • Markers • Pens • Notebooks

15min	15min	Varieties of sorghum	To be able to identify different sorghum varieties with their attributes	Identification of sorghum varieties and their attributes	• Brainstorming • Group discussion • Practical • Demonstration	• Variety samples of sorghum seeds • Note books • Pens • Flip charts • Markers
15mins	20 mins	Seed selection	To be able to select good quality sorghum seeds for planting.	Attributes of good sorghum seeds for planting	• Discovery • Group discussion • Practical • Demonstration	• Demo plot • Different sorghum seed samples. • Flip charts • Markers • Masking tape • Pens • Notebook

20 min	30 mins	Seed rates	To be able to determine appropriate seed rates and spacing for sorghum.	Determining the quantity of sorghum seed per plot size	• Discovery • Practical • Demonstration	• Demo plot • Sorghum seeds • Note books • Strings • Measuring tape • Farm tools
30 min	45mins	Site selection	To be able to select suitable sites for planting sorghum	Selection of suitable sites for sorghum production	• Brainstorming • Practical • Demonstration	• Demo plot • Farm tools • Note books • Pens
30 min	1hr	Land preparation	To be able to prepare land suitable for planting sorghum	Different methods of land preparation for sorghum	• Brainstorming • Practical • Group discussion • Demonstration • Group discussion • Sharing	• Hand tools, • Ox plough • Tractors • Demo plot • Note books • Pens • Flip charts • Markers • Masking tape

15 min	40 mins	Crop rotation	To be able to design a crop rotation program for sorghum	Planning crop rotation for sorghum	• Discovery • Practical • Demonstration • Group discussion	• Demo plot • Note books • Pens • Flip chart • Markers
15 mins	30mins	Planting sorghum	To be able to plant sorghum using different methods and recommended depth	Different methods of planting sorghum using suitable planting depth	• Discovery • Practical • Demonstration	• Demo plot • Sorghum seeds • Strings
40 mins	1 hr	Soil fertility management and fertilizer requirements for sorghum	To be able to manage soil fertility in sorghum field.	Soil fertility requirements for sorghum	• Brainstorming • Group discussion • Practical • Demonstration	• Demo plot • Organic fertilizers • Inorganic fertilizer
	15 mins		To be able to identify suitable fertilizers for planting sorghum	Types and rates of fertilizers required in sorghum production	• Brainstorming • Group discussion • Practical • Demonstratio	• Demo plot • Organic and inorganic fertilizer samples • AESA sheet • Pens • Notebooks

30 mins	1 hr	Weed management in sorghum fields	To be able to manage weed infestations in sorghum.	• Methods of weed management in sorghum	• Brainstorming • Practical • Demonstration	• Demo plot • Weed specimens • AESA sheet • Pens • Notebooks • Flip charts • Markers • Masking tapes • Farm tools
20 mins	1 hr	Disease management in sorghum fields	To be able to manage the different diseases in sorghum.	• Methods of disease management in sorghum	• Brainstorming • Practical • Demonstration	• Demo plot • Diseased samples in the field • Spray pump • Protective gear • Fungicides • AESA sheet • Pens • Notebooks

20 mins	1 hr	Pest management	To be able to identify and control different pests of sorghum.	• Identification of different pests of sorghum • Methods of pest management in sorghum	• Brainstorming • Practical • Demonstration	• Demo plot • Insect box • Spray pumps • Samples of chemicals for pest control • Pens • Note books • Flip charts • Attendance sheets • AESA sheet
20 mins	1 hr	Harvesting sorghum	To be able to determine time of harvesting sorghum.	• Time of harvesting sorghum	• Discovery • Sharing • Practical • Demonstration	• Demo plot • Harvesting tools • Transport
15 mins	30 mins	Post-harvest handling	To be able to handle sorghum after harvesting.	• Post-harvest handling methods in sorghum	• Discussion • Practical • Demonstration	• Tarpaulin • Transport • Bags

20 mins	1 hr	Drying sorghum	To be able to determine the appropriate moisture content for sorghum.	• Methods of drying sorghum • Determination of the required moisture content of sorghum	• Brainstorming • Practical • Demonstration	• Drying yard • Tarpaulins
30 mins	1 hr	Threshing and cleaning sorghum	To be able to thresh and clean sorghum appropriately.	• Methods of threshing and cleaning sorghum	• Discussion • Practical • Demonstration	• Dry sorghum • Threshing and cleaning machine • Winnower / blower • Tarpaulin • Mats • Packing bags
25 mins	30 mins	Packaging	To be able to package sorghum appropriately.	• Suitable methods of packaging sorghum	• Discussion Practical Demonstration	• Samples of packaging materials

30 mins	1 hr	Storage	To be able to store sorghum appropriately.	• Different methods of storing sorghum	• Discussion • Practical • Demonstration	• Stores • Silos • Sorghum • Pallets • Bags
30 mins	1 hr	Marketing sorghum	To be able to market sorghum profitably	• Marketing sorghum • Profitability analysis for sorghum	• Discussion • Practical • Demonstration	• Flip charts • Markers • Pens • Notebooks

SUMMARY INFORMATION ON SORGHUM TECHNOLOGIES

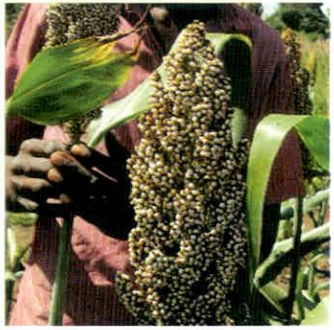
Importance of sorghum

- Source of food and food security
- Drought tolerant crop
- Raw material for brewery
- Source of household income when sold
- Fodder (seeds, silage)
- Green manure and cover crop

Challenges in sorghum production

- Field insects e.g shootfly, midge, stem borer, false army worms
- Storage insects e.g., Indian meal moth, red flour beetle, weevil
- Diseases e.g., ergot, smuts, anthracnose
- Climatic changes
- Declining soil fertility
- Knowledge gaps in production
- Post -harvest losses
- Limited access to quality seed

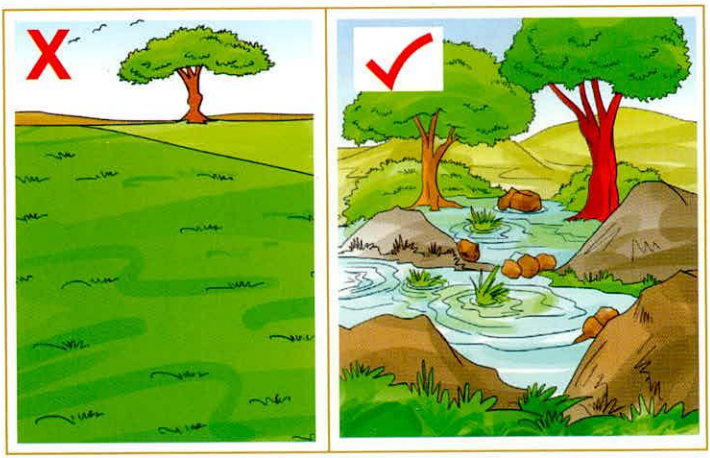
Sorghum varieties

	Brief Attributes			
	Seso 1		**Seso 3**	
Yield	900-950 kg/acre		900-950kg/acre	
Maturity	85-90 days		90-100 days Tolerant to striga	
Grain color	(Cream white ,early maturity)		Brown	
Other varieties	Brief attributes			
	NAROSORG 1 	Cream white, dual purpose, free from tannins	**NAROSORG 3** 	Chalky white and resistant to midge, minimal bird damage

	NAROSORG2 	Red and tolerant to striga,	**NAROSORG 4** 	Brown and tolerant to striga, good for beverage making

SITE SELECTION

- The best soils are deep well drained sandy loams or loamy sandy soils and moist throughout the growing season, and with reasonable fertility levels
- Avoid soils in areas that keep standing water for long periods.



- Free from humidity and strong winds during ripening period.
- In swampy sites, sorghum should be planted on ridges to avoid water logging.
- Sites with fewer trees to minimize bird damage

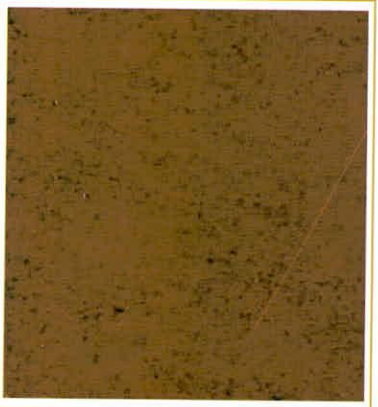
LAND PREPARATION

- Sorghum requires a fairly fine seed bed.
- Plough land twice in readiness for planting when rains start
- Ridge construction by hand hoes, oxen or tractors.









Rough first digging

Fine second digging

ROTATION

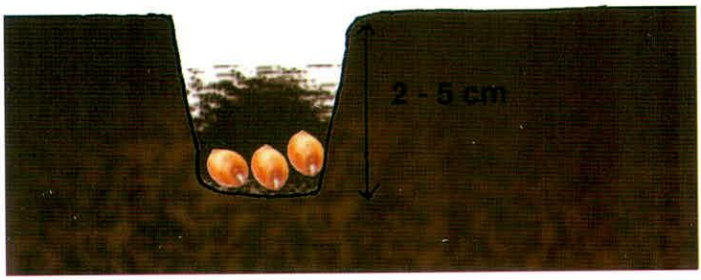
- Know history of crops grown in the field
- Cereals followed by legumes for newly opened land and fallowed and vice versa for land that has been used regularly
- Plant root crops after legumes

SEED SELECTION

- Seed viability test is highly recommended.

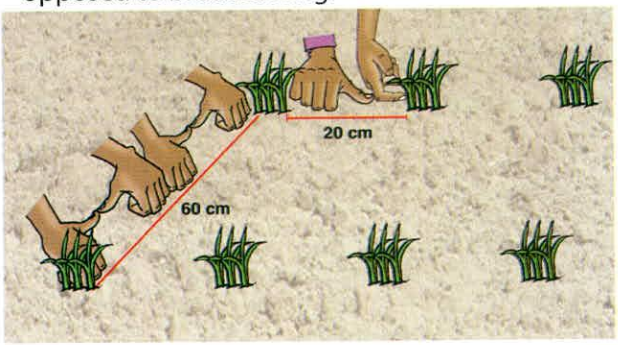
SEED RATE

- Seed rate of 5 kg/acre or 12 kg/ha where 3-5 seeds are planted per hole under row planting
- Plant seeds 2-5 cm deep.

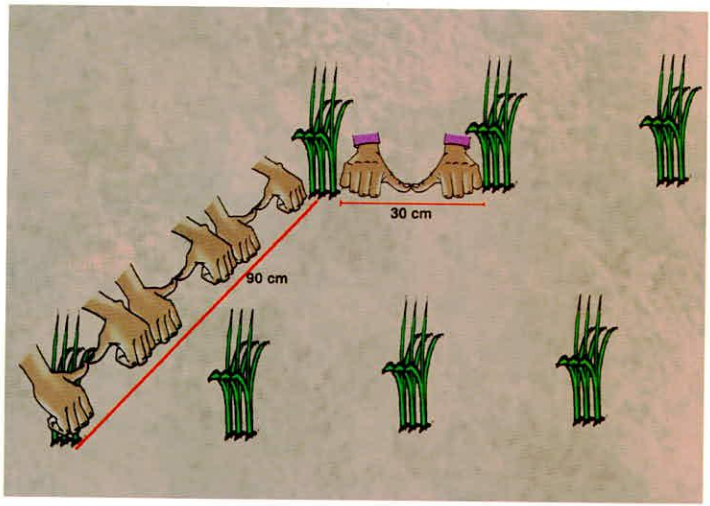


PLANTING/SPACING

- A plant spacing of (60 x 20)cm for short varieties and (90 x 30) cm for tall varieties to achieve optimum productivity -row planting is recommended for optimum yields as opposed to broadcasting.



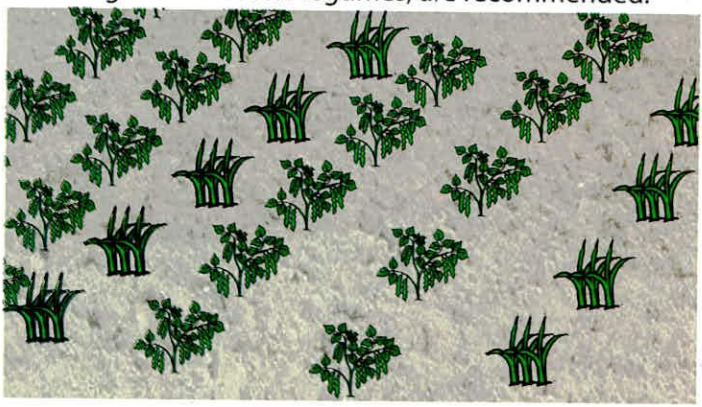
Short varieties



Tall varieties

Row planting facilitates easy field operations such as weeding, bird scaring, harvesting, use of ox drawn equipments for weeding.

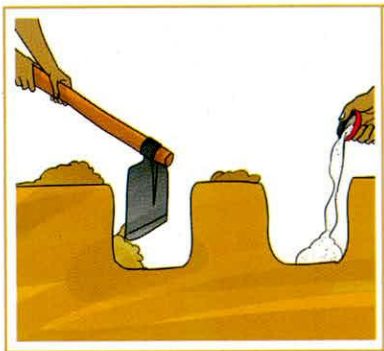
- Under mixed cropping, the sorghum-cow pea or sorghum-green gram intercropping system, in a ratio of 1 row sorghum to 2 rows legumes, are recommended.



FERTILIZERS REQUIREMENTS

Deficiency symptoms of important nutrients are:

- Nitrogen :Yellow leaves, more pronounced in older leaves
- Potassium :streaked patterns on interveinal tissue, symptoms at tips and margins more towards the base
- Phosphorus: Purpling may also be an indication of phosphorus deficiency in the plant due to an inability to uptake sufficient phosphorus.
- Micro dosing: Is highly recommended.
- Application of SSP fertilizer (Single Super Phosphate at the rate of 125 kg/ha (3 bags) or 50kg /acre (1 bag) during planting and 80 kg/ha (1.5 bags) or (0.5 kg/ acre) Calcium.



Ammonium Nitrate



SSP fertilizer application

- Calcium Ammonium Nitrate (CAN) at first weeding.

WEED MANAGEMENT

- Weed sorghum twice, 1st weeding should be done 2-3 weeks after germination and the 2nd Weeding 3 weeks later.



Weeding at three weeks



Weeding at 8

THINNING

- Thin to one plant per hill during or immediately after the first weeding
- Remove off types or poor looking plants while leaving healthy lines

SOIL NUTRIENT MANAGEMENT

- Plant in soils with adequate levels of fertility.



Retain sorghum residue for manure

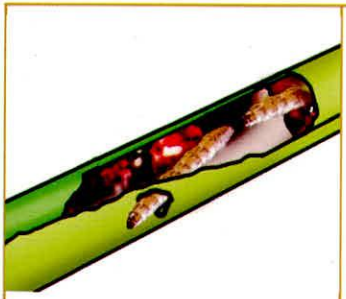
- In soils with low fertility, apply organic manure or inorganic fertilizer SSP (50 kg/acre) at planting and 30 kg/acre CAN at first weeding.

PEST AND DISEASE MANAGEMENT

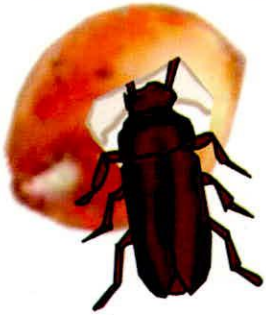
Pests

Some common pests include:

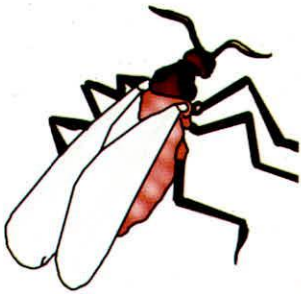
- Sorghum shoot fly, stem borer, sorghum midge and grain weevil



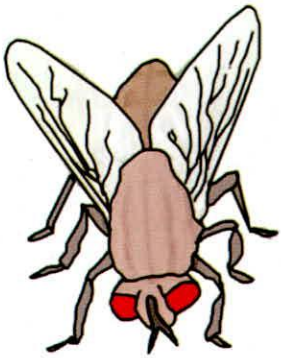
A stem borer on a sorghum plant stem



Sorghum grain weevil Flour beetle



Sorghum midge



Sorghum shoot fly

Control

- Crop rotation
- Planting resistant sorghum varieties
- Destroying sorghum stalk after harvesting

Diseases

Major diseases of sorghum include;

	
Covered kernel smut disease	*Ergot disease*

- Uprooting infected sorghum heads
- Dressing seeds to be planted

HARVESTING

- Harvest sorghum when heads are mature
- Mature sorghum heads have bold heads.



POST-HARVEST

Post harvest handling of sorghum

- Harvesting: seed/grain sorghum is harvested strictly when physiologically mature (black layer at point of attachment has developed).
- Hand harvesting is done with a knife or sickle.
- Transport: harvested panicles are packed in bags and transported on head, bicycles, ox-carts or vehicles.



Drying and threshing sorghum

- Drying should be on tarpaulin



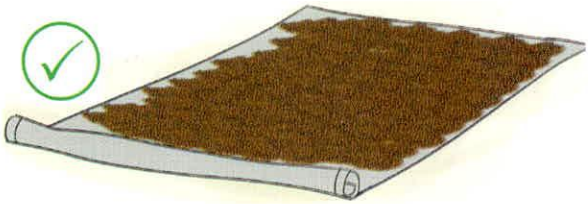
- Drying sorghum on cemented ground (recommended practice).



- Traditional method of drying sorghum on bare ground.



- Dry the seed well on a mat or tarpaulin for quality control.



THRESHING, WINNOWING AND STORAGE OF SORGHUM

- Threshing is done by beating with a stick followed by winnowing.





- Sorghum is packed in bags and put on pallets / water-proof stores.

Storage



- Store clean dry sorghum in gunny bags on raised platforms



- Avoid using plastic or polypropylene bags.

VALUE ADDED PRODUCTS FOR SORGHUM



Popped Sorghum



Sorghum flour



Industrial Beer



Sorghum Composite Flour



Sorghum Cake



Sorghum Loaf of Bread

MARKETING

- Conduct market survey to establish the market requirements in terms of quality, quantity, seasonality, price
- Provide market information and linkages
- Promote bulk marketing
- Encourage contract farming
- Promote local seed business



A farmer buying quality declared seed from local seed business

PROFITABILITY ANALYSIS FOR SORGHUM

Risks and Sensitivity Analysis for Sorghum

Example: Gross margin for sorghum per acre

Assumptions: yield of sorghum = 700kg and market price;1000 sh per kg

Item	Unit	Qty	Unit cost	Total
Cost of input				
Seeds	Kg	8	6,000	48,000
Tools (hoes)	Pieces	5	8,000	40,000
Tools (pangas)	Pieces	2	3,000	6,000
Pesticides	Litres	4	10,000	40,000
Bags	Pieces	7	1,000	7,000
Total input cost				141,000
Labour costs				
Land preparation x2	Man-day	2 x10	5,000	100,000
Planting	Man-day	5	6,000	30,000
Weeding	Man-day	2 x 6	5,000	60,000
Scaring birds	Man -day	7	5,000	35,000
Harvesting	Man -day	2 x 5	5,000	50,000
Drying	Man-day	2	5,000	10,000
Threshing	Man-day	20	3,000	60,000
Packaging	Man-days	7	2,000	14,000
Total labour cost				359,000
Cost of labour and input				500,000
Gross Margin				200,000

Note: Production cost per unit (kg) = $\frac{\text{Total cost}}{\text{Total output (yield)}}$

Profit margin per kg = sale price per unit – production cost

$= \frac{500000}{1000}$

Profit margin per kg = sale per price unit – production cost per unit

= 1000 – 500

= 500/-

Implication: a farmer is getting a profit of shs 500/- per kg produced

RISK AND SENSITIVITY ANALYSIS

Risk Analysis for Sorghum Enterprise

Scenario 1: A decrease in yield of sorghum to 650kg/acre and a rise in market price to shs 1,100 /kg

Parameter	Product	Quantity (kg)	Marketing Price (Sh.)	Total (Sh.)
Expected Revenue	Sorghum	1 acre × 650	1,100	715,000
Total Cost				500,000
Gross Margin				215,000

Scenario 2: Anincrease in yield of sorghum to 750 kg/acre and a fall in price to shs 900/kg

Parameter	Product	Quantity (kg)	Marketing Price (Sh.)	Total (Sh.)
Expected Revenue	Sorghum	1 acre × 750	1,100	675,000
Total Cost				500,000
Gross Margin				175,000

Note : a) **In scenario 1** above, the decrease in yield accompanied by a rise in price will not significantly affect profitability of the enterprise.

b) **Under scenario 2:** A fall in market price will drastically reduce profitability of the enterprise.

A fall in market price has a far reaching effect on gross margin than a fall in yield.

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