Benefit-SBN Sesame Business Network Ethiopia

Sorghum Production Training Manual

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August 2017, Gondar, Ethiopia

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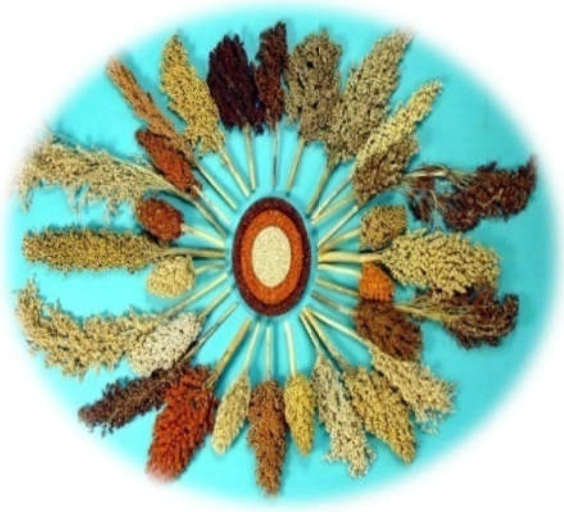
Sorghum Production Training Manual

Foreword

The purpose of this Sorghum Production Manual is to assist government agricultural extension workers to plan and carry sorghum crop production and management training sessions effectively to farmers at the community. Ideally the use of improved sorghum crop production training techniques will increase the volume of land cultivated and boost productivity. This training manual is meant to complement and supported agricultural guide, and to help farmers acquire additional knowledge and experience during participatory and practical training exercises. Subsequent to training, it is anticipated that extension staff in cooperation with BENEFIT-SBN will conduct follow up visits to growers; to ensure they are actively able to adapt the improved/ best practice in their field.

This training manual was adapted by BENEFIT-SBN staff members at Lalibela workshop from a previously utilized training manual to suit ecological and growing conditions specifically. It is hoped that this manual will be useful, and that it will be further adapted to include lessons emerging from field experiences in order to enhance the work already being performed by state extension service officials in north western Ethiopia farmers.



Introduction

Understanding the existing sorghum crop production situation and conditions in the areas where training will take place is extremely important. This knowledge is critical to ensure that farmers move successfully from the known to the unknown – that is, as they adapt and build upon their knowledge as indigenous growers to acquire more modern agriculture production-skills-and-techniques.

At the start of training, consensus should be reached by trainees on prevailing, existing sorghum production systems in the area, including a review of agricultural production methods and in this session farmers will discuss their current agricultural (food) production situation in relation to traditional farming practices, current socio-economic conditions and environmental concerns such as droughts, floods and insecurity. The goal is to enable farmers to identify major production constraints (including technical, social and economic challenges.) existing farming constraints and challenges.

The plant sorghum [*Sorghum bicolour* (L.) Moench] is an indigenous crop to Africa, and though commercial needs and uses may change over time, sorghum will remain a basic staple food and is both a food and cash crop for many rural communities. Sorghum is mainly cultivated in drier areas, especially on shallow and heavy clay soils. It is an important crop for areas with low rainfall and low soil fertility. Research efforts have produced technologies that can be applied to increase the crop's production and productivity. These technologies are affordable and easy to use by farmers and this flyer highlights some of them. Therefore this Agronomic Guide is to provide growers, agents, advisers and other interested parties with information on maximizing returns from the grain sorghum crop. In order to grow optimum yielding crops many things have to be considered and this is best explained by relating the crop growth stage to enhanced management of the plant. These factors range from soil moisture, temperature and nutrition to the effect of weeds, insects and disease at each growth stage of the grain sorghum crop. In the Grain Sorghum Agronomic Guide we will look at each of the three/vegetative stage, reproductive stage, grain filling and physiological maturity stage/ major growth stages and once understood we can use our best management, cultural and agronomic

practices to optimize a grain sorghum crop return. In general sorghum is nature cared crop means that:

- It has strong resistance to harsh environments such as dry weather and high temperature in comparison with other crops.
- It is usually grown as a low-level chemical treatment crop with limited use of pesticides.
- It has the potential to adapt itself to the given natural environment, crop" as it requires little artificial care such as irrigation and insect removal, therefore it can be called "Nature-cared crop.

Therefore in facilitating training it is essential to understand how adults learn, the role of the facilitator and participatory learning techniques that can be applied. Facilitators have an important task to deliver key messages which must excite interest and enthusiasm among the target group to learn and make decisions that lead to positive actions. The Agriculture Extension Worker and the Lead Farmers are central to the Farmer to Farmer Extension approach, their role as Trainers/Facilitators is critical in enhancing access to technical support to smallholder farmers to increase sorghum production and productivity. The following highlights are a guide for these facilitators to deliver trainings that lead to positive change in farming practices and improve farmers' livelihoods.

1.1. Adult learning

"When you hear you forget; when you see you remember and, when you discover it is for life."

The target audience (farmers) in trainings is adults and has experience, knowledge and skills. Each adult brings to the learning experience, preconceived thoughts and feelings that will be influenced by motivation, the amount of previous experience, the level of engagement in the learning process, and how the learning is applied. Learning something new is not just achieved in an instant. Referring back and making use of the knowledge and skill is the basis of the adult learning process. The new learning will have to be internalized (processing) by making it relevant to one's self. Only after this can the learning is applied when confronted with a similar situation. Remember the 20.40.80 principle of adult learning: Adults remember 20% of what they hear, 40% of what they hear and see, and 80% of what they hear, see, and do. It is advisable to use as much creativeness as possible.

1.2. The role of the Facilitator

A facilitator is not an instructor and creates conditions for farmers to learn by arranging opportunities for the farmers to observe and interpret differences, to carry out simple tests and exercises, and through discussions. The facilitator encourages farmers to adopt an active role in the learning process through making use of participatory approaches which engage the participants as much as possible.

The main features of the attitude and role of a facilitator:

o To listen to farmers and respect their knowledge, experiences and perceptions,
o To give farmers the confidence to share their knowledge and experiences,
o To create suitable conditions and activities from which farmers can learn,
o To be responsive to farmers' needs and flexible in organizing the course,
o To increase farmers' knowledge, skills and problem-solving ability

Facilitation & Learning techniques

Facilitation is a process which is driven by a Facilitator who manages a learning environment (conducive atmosphere); through exchange of ideas; which involves ANALYSIS (detailed scrutiny or examination of an issue of common interest); which should lead to change or development, facilitation may include the following activities:

1.3. Plenary Introduction

A plenary introduction is normally the first activity to start a new training session. Its' main objective is to introduce the subject and to familiarize the participants to some basic concepts by referring to familiar and related topics.

1.4. A guide to the Trainer

Brainstorming

The main objective of a brainstorming session is to introduce new topics and to discover new ideas and responses very quickly by having the group describing the topic or idea by listing an exhaustive list of related characteristics and conditions.

Small group discussions

Instead of discussing one subject with the whole group, more subjects can be discussed by using small groups. The main objective is to give every participant a way to actively participate in the discussion.

Practical (field) activities

To give participants the opportunity to go to the field and experience a new technology by watching and doing. The objective is to learn through practicing new practice.

1.5.Plenary discussion / presentation

The plenary discussion can follow directly after small group discussions, but does not need to do so. The objective of the plenary discussion/presentation is to synthesize the ideas of the participants about a (new) topic or information that is discussed within the group. A training session using the method of plenary discussion may split up in small groups.

Training Evaluation Method

It is important to evaluate the training so that the trainer is informed about the impact of the training in terms of knowledge retention. Different training evaluation methods can be used e.g.:

- Pre- and post-tests
- Participants' feedback: through recaps.
- Final training evaluation checklist

Session I: Introducing the training

Preparation for the training: The trainer should take time to read and understand the training content. Interactive engagement with trainees should be encouraged throughout the session.

Learning outcomes

By the end of the session trainees should be able to:

1. Understand the importance of sorghum, its uses and production levels in the region.
2. Appreciate and understand improved production methods/practices to address constraints in sorghum production.

Duration: 2 days

Methodology: Plenary/Presentation/Discussion/Brainstorming

Training Materials

Training materials are limitations factors for the implementation of the trainings so that as mentioned below such as:

1. Training hall and good training environments with accommodations.
2. Flip charts, markers and Note books.
3. Fact sheets and Manuals in vernacular language
4. Pictures/illustrations of the sorghum crop showing the morphology.
5. Electric power
6. Computer and LCD

7. Practical training preparations/measuring tape, strings, pegs, seed, fertiliser, chemicals and sprayer, row making implements, oxen plow, insect pests, diseased plants, parasitic and no parasitic weeds which is available, and others/should be ready.
8. Time table and action plan preparations.

Discussion points: -

Include the information below as you discuss with the trainees, ask as much as you can to open up for discussion.

Break participants into groups and ask them to indicate the highest, average and lowest sorghum yields in their area. Ask them to analyse the causes of low sorghum yields and production, and what can be done to improve the yields and production.

Addressing Sorghum Production Constraints in the Region

Sorghum yields in Africa tend to be low as cultivation is still mainly characterized by traditional farming practices with low input levels (low or no inorganic fertiliser or pesticides) and use of traditional varieties or landraces. Often there is no surplus sorghum production, without which processing industries cannot be vibrant. Traditional grain processing is labor-intensive and research and technical support are lacking.

Some of the constraints in sorghum production can be addressed through the following:

- Addressing negative perceptions on the consumption of sorghum (and other small grains). Raise awareness on dietary diversity, value addition and processing of sorghum through food fairs and other such as:

- Ensuring farmers have high yielding varieties (improved seed interventions) *(Ask farmers to name some of the improved sorghum varieties they are aware of)*

- Good agronomic practices including use of herbicides, lime and fertilizer application based on soil testing recommendations, pest and disease management. Most of these practices and technologies will be discussed in this manual under various sections.

Closing the session

- Give trainees time to ask questions and respond to the questions. In the event that there are some questions you cannot answer write down and refer to Extension Officers and give feedback in the next session.

- Go back to the learning outcomes and ask farmers to explain what they have understood on each of the outcomes.

2. Importance of Sorghum

Sorghum is a traditionally important crop in Ethiopia that can be grown in marginal areas where other crops may not thrive. Sorghum is more nutritious than maize and is rich in carbohydrates, vitamins and minerals. It contains dietary fiber and has higher protein, calcium and iron content. Sorghum is rich in iron and zinc and it is processed into a variety of nutritious foods

There are basically two types of sorghum, that is, the white grained, normally used as meal used to make Injera and other foods. The brown or red grained sorghum primarily used for brewing of traditional fermented drink as Tela. Sorghum has been proven to be the best alternative to barley for lager beer brewing. The sorghum Stover is suitable for livestock feeding and the grain can be used in formulations of livestock feed. In general

- Has good amounts of several B complex vitamins like niacin, thiamine, pantothenic acid, riboflavin & vitamin B6. It also contains some vitamin E.
- Has excellent levels of magnesium and manganese and good levels of copper, iron, phosphorus, zinc and potassium.
- Supplies 21% of the daily protein needs in 100 grams of the grain.
- Is sodium and cholesterol free. Has high levels of fiber.
- Supplies almost 1/4 of the daily requirement of carbohydrates in 100 grams and
- has health benefits in improving digestive health, inhabit cancer, gluten free, currently is non- genetically modified and versatile crop.

2.1. Sorghum development stages

Stage 0. Emergence

Emergence generally occurs 3 to 10 days after planting. During emergence, growth is dependent upon soil temperature and moisture, planting depth, and seed ability to germinate.

Stage 1. Three–Leaf Stage

The three–leaf stage occurs when the collars of three leaves can be seen without dissecting the plant. Depending on the temperature, this stage may occur approximately 10 days after emergence.

Stage 2. Five–Leaf Stage

The five–leaf stage occurs when the collars of five leaves can be seen without dissecting the plant and occurs about three weeks after emergence. The root system develops rapidly at this stage. Stresses at this stage from weed competition, nutrients deficiencies, drought, or insect damage can dramatically reduce yields if not corrected.

Stage 3. Growing Point Differentiation

At this stage the growing point of the sorghum plant changes from vegetative to reproductive. Nutrient uptake is rapid and adequate supplies of nutrients and water are necessary to achieve maximum growth. This stage occurs approximately 30 days after emergence and is about one third of the time from planting to physiological maturity.

Stage4. Boot Stage

At this stage all the leaves are fully expanded, providing maximum leaf area and light interception. The head has reached full size and is encompassed by the flag-leaf sheath. Rapid growth and nutrient uptake continue. Stress from lack of moisture or via herbicide injury may prevent the head from emerging completely from the flag-leaf sheath preventing complete pollination at flowering.

Stage 5. Half Bloom

This stage is defined as when half of the plants in a field have started to bloom. Flowering progresses from the tip of the head downward over a period of 4 to 9 days. Severe moisture stress can result in poor head filling.

Stage 6. Soft Dough

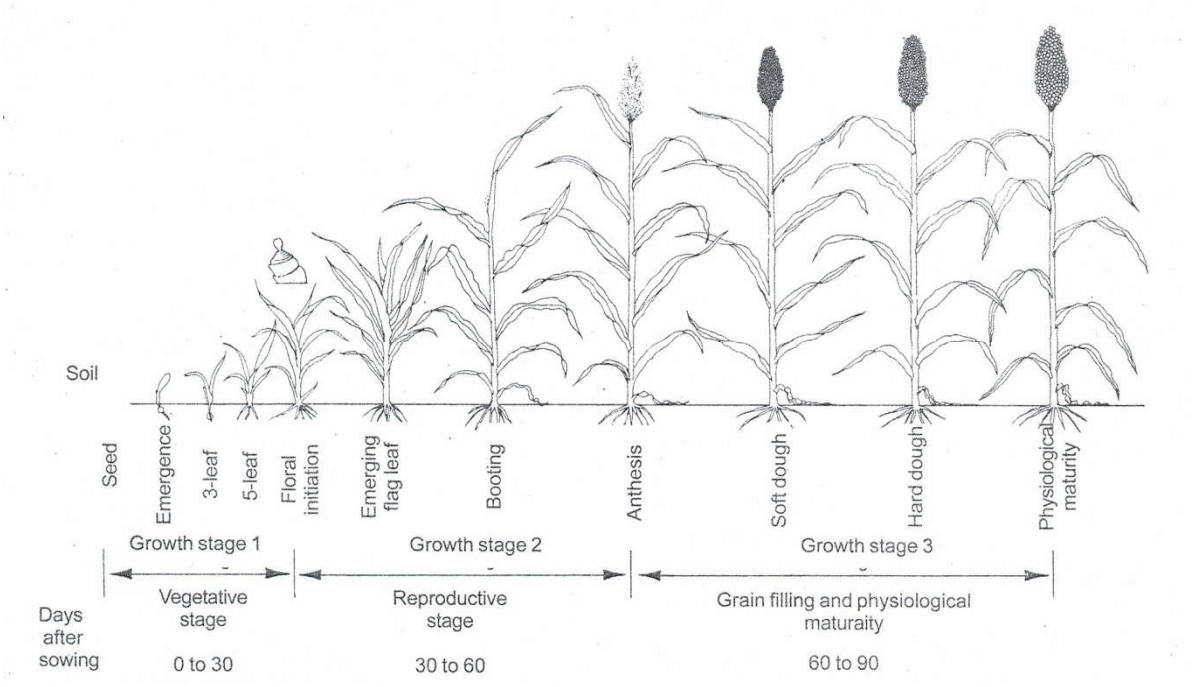
At this stage the grain has a dough-like consistency and grain fill is occurring rapidly. The lower leaves continue to senesce with 8 to 12 leaves remaining at this stage.

Stage 7. Hard Dough

By this stage approximately three-fourths of the grain dry weight has been attained. Nutrient uptake at this point is essentially complete. Severe moisture stress caused by an early freeze at this growth stage can result in light, chaffy grain.

Stage 8. Physiological Maturity

At this stage the maximum total dry weight of the plant has been reached. This stage is marked by the appearance of a dark spot on the opposite side of the kernel from the embryo. Grain moisture at physiological maturity depends on the improved, with typical moisture ranging from 25% to 35%.



2.2. Agro-climatic and soil Requirements

- The best time to plant is when there is sufficient water in the soil and the soil temperature is 15 °C or higher at a depth of 10 cm. Temperature plays an important role in growth and development after germination. A temperature of 27 to 30 °C is required for optimum growth and development.

- Sorghum is grown mostly in areas with an annual rainfall range of 300 to 750 mm. It is grown in areas which are too dry for maize as crop is drought tolerant.

- Sorghum can be grown on many different soils but best yields are obtained on deep, fertile, well-drained loamy soils. However, it is quite tolerant of shallow soil and droughty conditions.

- Sorghum grows poorly on sandy soils, except where heavy textured subsoil is present.
- The crop is more tolerant of alkaline salts than other grain crops and can therefore be cultivated successfully on soils with a pH between 5.5 and 8.5.

- Sorghum can better tolerate short periods of water logging compared to maize. Soils with a clay percentage of between 10 and 30 % are optimal for sorghum production.

2.3. The Sorghum Varieties

Ask participants to name the types of sorghum commonly grown in the area. What do they consider when choosing type/ variety to plant?

Factors to consider when selecting varieties

When choosing a variety to grow in your particular farming area some of the factors to consider include:

- The growing period (days to maturity),
- Yield potential,
- Susceptibility to bird damage/losses,
- Pest and disease resistance. See table 4.at the end of the manual.

Session II : Site selection and Clearing

Site selection and clearance is one of the first activities necessary when preparing a plot for agricultural use. For new land it can be an extremely laborious exercise. This session will discuss the importance of land clearance and different techniques used. The session aims to create understanding of the negative effects of traditional selection and clearance techniques such as topography, altitude, grass burning, and emphasizes alternative practices that maintain soil fertility should be considered.

Time of Site Clearing

Traditionally, land clearance is conducted prior to the onset of rains, between the months of January and March, depending on the land to be cleared. However, it is generally advisable to clear land immediately after harvesting. This provides time for crop residues to decompose over time, prior to the next cultivating season, making nutrients available for the coming season.

Summary of Main Points of Site Clearing

1. If plant residues are not burned in the field, advantages include:

♣ Improved soil fertility

♣ Increased water holding capacity of soils

♣ Protection from soil erosion.

2. Where stalks are collected and used for fencing and cooking, farmers should collect the largest stalks and leave behind the small ones and remaining residues to cover/re-fertilize the soil.

3. Farmers should be aware of alternative land clearance methods including being more selective when cutting down of trees (instead of felling all trees in the area to be cultivated), and using fuel-efficient mud stoves to conserve firewood consumption.

4. Land clearance is highly recommended immediately after harvesting.

Session III : Land Preparation

Land preparation is one of the most laborious activities performed during crop husbandry. Different methods and tools are used to prepare the land. This session will discuss the various methods and tools being used to prepare land for crop production. The aim in this session is to ensure that participants understand good land preparation methods and their advantages, compared to traditional methods which often result in significantly lower yields. The importance of timely land preparation also will be discussed.

Advantages of Good Land Preparation

1. Kills harmful insects inhabiting in the soil,by digging into the soil, some harmful insects and/or eggs that normally live inside the soil will be exposed to the sun and either weakened or killed by the heat and/or by birds that feed on insects;
2. Kills weeds and weed seeds, some weeds that have deep roots and/or remain under the soil will be brought to surface and will be killed by sun/heat;

3. Seeds will germinate evenly and quickly;
4. Young plants will have good growing conditions, enabling their roots to grow deeper into the soil, to draw more water and absorb plant foods.

If the land is new, it should be prepared on two or three separate occasions prior to planting. Ideally, the first preparation would occur after land clearance (following the previous harvesting, or around January to February. The second preparation should occur in March, and then again, prior to planting. If land has been used previously (i.e., is not newly cultivated), two preparation periods may suffice, depending on soil type.

Summary of Main Points on Land Preparation:

1. The use of improved tools, including hoes or ox-plowing can increase the volume of land available for cultivation;
2. Timely preparation can help improve the volume and fertility of land for cultivation;
3. Good land preparation techniques should be practiced (For example, not preparing land when wet.)

Session IV: Fertiliser Application and Planting of sorghum crop.

The time of planting and methods used are very important. Delays in planting can cause farmers to have poor harvests. Different methods used in planting have advantages and disadvantages. The aim of this session is to ensure that farmers understand the importance of timely planting and to compare different methods of planting. Farmers are encouraged to continue to practice mixed cropping, while giving increased consideration to inter-cropping patterns and optimum spacing.

4.1. Seed characteristics

The other major factor in optimum plant establishment is the seed itself. In ideal conditions most seed will germinate and establish adequately. However in marginal conditions the quality and germination of the seed will affect seedling vigour and establishment. Seed with a germination of over 90% is the optimum and it will have the best possibility of establishing in marginal conditions. Seed between 80-90% can still be good seed depending on its vigour and density. Even seed as low as 70% (minimum germination) can still be good seed if the vigour is high. However planting rates should be increased and plant establishment could be less even in these lower germination lines.

Growers should use known seed and which is tested for vigourity, yield capacity and adaptable to the area.

4.2. Plant populations

In dryland plant populations range from 30,000 – 90,000 plants/ha. Populations above 100,000 plants/ha even in the most favorable environments are rare. Normal recommendations fall into the range as follows:

- Lower rainfall 30-60,000 plants/ha
- Higher rainfall 55-70,000 plants/ha
- Averagely spacing of 75 cm by 15 cm= 88,889 plants/ha is promising.
- For taller varieties spacing of 75 cm by 20 cm = 66,667 plants/ha

Seed Rate

Seed rate depends on the size, wt of each variety in general for row and broadcast the recommended seed rate is 10-12 kg/ha.

4.3. Methods of Planting

There are two main methods of planting: row planting and broadcasting. In broadcasting, seeds are not planted in rows but instead are scattered at random.

Row planting

Sorghum is row planted between rows 75 cm and between plants 15 cm for short varieties and for tall local and other varieties is 20 cm distance at a depth of 4-5 cm is planted and after 18-20 days of age at every plant should be thinned to 15 cm distance space.

Advantages of Row Planting

♣ Optimum plant population per unit of area is achieved;

♣ Subsequent agronomical practices such as planting, fertilizing, weeding, thinning, harvesting are more easily carried out;

♣ Fewer seeds required than in broadcasting.

Disadvantages of Row Planting

♣ Requires more labor and skills than broadcast method.

Planting Broadcast

♣ It is especially convenient with small seeds.

♣ It also requires less labor.

Disadvantages of Broadcasting

♣ Many seeds are wasted;

♣ Uneven plant populations;

♣ Impossible to use machinery to facilitate weeding or harvesting;

♣ High plant nutrient computation and less production

4.4. Fertiliser Application

Soil Fertility in crop production, soil is the topmost portion of cultivated land on which plants grow. Like human beings, plants need water, food, air, light and support. The soils provide everything needed for plant growth. This session aims to ensure trainees to understand the importance of maintaining soil fertility for sustainable productivity, and the different methods that will restore soil fertility. Farmers are encouraged to continue their use of traditional methods to increase soil fertility and to improve upon them. There are different methods to improve soil fertility/adding compost, manure, using organic and inorganic fertilisers, crop rotations, intercropping with legume crops, soil conservation, fallowing and planting nitrogen fixing plants and improving cultural farming practices.

Symptoms of nutrient deficiencies on sorghum plant

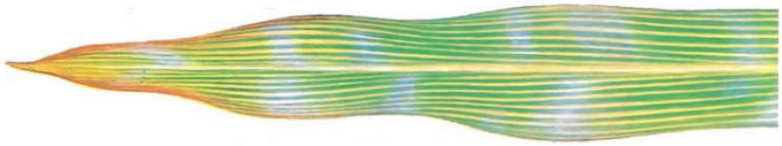
Normal Sorghum leaf

Phosphorus deficient sorghum leaf

Potash deficient sorghum leaf

Nitrogen deficient sorghum leaf

Magnesium deficient sorghum leaf.



Moisture deficient sorghum leaf

Fertiliser rate and types.

- Currently fertiliser recommendation and fertiliser rate for sorghum is prepared, that is for all soil types DAP/NPS/NPSB/NPSZnB is 100 kg and Urea 50 kg/ha.
- At planting 100 kg of DAP/NPS/NPSB/ NPSZnB is recommended, for one row every hundred meter length 0.75 kg is used or (for one meter length 7.5 gm or 2 cups of beer covers) is used and should be covered in the soil.
- The remaining 50 kg Urea is applied at the plant age of 35-40 days after planting and for every hundred meter length 0.375 kg is used or for a meter length 3.75 gm or one beer cup full is used near to the plant at distance of 5-10 cm and then cover in the soil.

•Place the top dressing fertilizer 5-10 cm from the plant and avoid getting the fertilizer into contact with the plant to avoid fertilizer burn.

•Top dressing must be done when the soil is moist, preferably soon after raining.
•Split application is recommended at 4 weeks and second application at 6 weeks from planting date.

Losses of Plant Food from the Soil

1. Plant foods can be leached away (washed down) by rains to a deeper level that crop roots may be unable to reach;
2. Weeds can consume a great quantity of available soil nutrients;
3. Crop plants also consume considerable quantities of available nutrients;
4. Growing one type of crop year after year in the same piece of land (mono-cropping) will deplete nutrients;
5. Wind can remove top soil from the land if left bare (without any cover from crop residues, trees etc.);
6. Heavy rains can wash away the top soil (soil erosion);
7. Trees also use up food and water for crops;
8. Burning of land can cause loss of soil fertility.

Lost Plant Food can be Replaced Using the Following Practices

1. By cutting leaves and small branches of trees, chopping and leaving them in the field to decompose instead of cutting down whole trees;
2. Plowing under or leaving crop residues lying at the field to decompose most clever, hardworking farmers plow their land early, before the last rains, leaving the grasses to decompose inside his fields to enrich the soil with fertilizer;
3. Add animal manure;
4. Add composted manure;
5. Add crop by-products after threshing;
6. Mulching (spreading especially dry grasses on top of the soil);
7. By growing selected trees and shrubs in the field which can increase the soil fertility either through their roots or leaves;
8. By protecting the farm from burning;
9. Leaving the garden fallow;
10. Practicing crop rotation with plants that can add soil fertility/legume crops/;
11. Practicing to use chemical fertilizers that contain plant foods that can be applied to enrich the soil.

4.5.Thinning

High plant population can lead to poor crop growth, especially under drought conditions. It is, therefore, advisable to thin out extra plants 2-3 weeks (3-4 leaf stage) after emergence to maintain a plant population in the range of 66,667-88,889 plants per hectare. Thinned plants can be transplanted on wet days to fill gaps. However, transplanted plants will not be as productive as the directly seeded plants.

4.6. Mixed Cropping/Inter-cropping

Farmers traditionally grow two, three or four different crops in the same field. This method is called inter-cropping and is not suitable for mechanized farming where most of the operations like planting, weeding, chemical spraying; harvesting, etc. are carried

out by machines. But for many farmers in the region, mixed cropping has several advantages, and it remains advisable for farmers to continue their mixed-crop farming methods. Advantages include:

1. Risk of crop failure is reduced;
2. Helps reduce and suppress weeds;
3. Improves soil fertility;
4. Higher total production from the farm.

While inter-cropping has many benefits, farmers should consider differences in plant root systems, length of time to maturity, nutrient requirements and spacing. The combinations of crops should be planned so that varying crops will have no or less competition for different nutrients. For example, groundnuts planted with long sorghum are a bad combination.

Summary of Main Points

1. Plant crops early, with the onset of rains;
2. Inter-cropping is beneficial, with consideration of some factors;
3. Planting in rows has many good benefits.

Session V: Weed controlling

5.1. Weed types

Weeds are classified in to annuals, perennials, grasses, broad leaves, parasitic and non parasitic weeds which unwanted plant in a plant which is planted by an individual for his economic and social benefits. Therefore weeding is another crucial activity in crop husbandry. To minimize competition from weeds and unwanted plants, farmers should do weeding at various stages of plant growth. The aim of this session is to help farmers appreciate and understand the importance of timely weeding. Farmers will be advised to weed at the early stage of crop development, when plants are more susceptible to competition from weeds. Discussion also will be focused on different types of parasitic and non parasitic weeds and their control methods.

5.2. Parasitic weeds

There are parasitic plants such as Striga hermonthica, Striga asiatica and *Striga aspera in Ethiopia.*

5.2.1. Striga hermonthica

- Striga Hormontica, has pink or white flower colour.
- Is cross pollinated
- It grows to a height of 0.30-1.00 meter
- The length of the leaf is 2.5-7.5 cm
- It damages Sorghum, grasses, finger millet, maize, rice and sugar cane**.**

5.2.2. Striga asiatica

- It has reddish flower colour,
- Plant height measures 10-30 cm length and is self pollinated,
- this parasitic weed fevers in sandy soils and
- Damages sorghum and others but more damages maize.

5.2.3.Striga aspera.

- Is more found in west Africa
- In Ethiopia is found in Gojam and Wolega state farm areas, but not found at farmers farm lands.

5.3. Reasons for Weeding

There are several reasons why farmers should do weeding. Weeds are unwanted plants that grow amongst crops in the field.

- The first reason for weeding is to reduce the competition for plant food, water and sunlight with our crops. The plant food and water needed for plant growth, development and maturity are found in the soil (in varying quality depending on the soil type and other factors). Like our plants, weeds use the food and water from the soil that is being used by our crops. These weeds, once removed, will in healthier plant growth and larger increases in crops yields.
- The second reason for weeding is to improve the quality of the harvest. Weeds produce a lot of seeds. If left in the field during harvest, weed seeds can mix with

produce and reduce the quality of the harvest. Some weeds arrive with seeds transported from other areas.

5.4. Methods of controlling weeds

- Field scouting remains critical for post-emergent weed control. Manage fields with heavy weed populations as soon as possible after weed emergence.

IPM control method of Parasitic weeds plants

- To control striga IPM methods, such crop rotations with other non host crops/legume crops/, soil fertility improvement using organic and inorganic fertilisers, use of resistance crop varieties/Birhan, Abshire, Gobye, Gedo and Hormat/, intercropping with other crops having different harvest time and growth stages, moisture conservation, use of chemical herbicides etc.

Manual or Mechanical methods

Weeds can be removed manually (hand weeding and use of hand tools) and mechanically (using mechanical implements).

•For sorghum effective weed control requires 2 to 3 weeding. Carry out the first weeding within 2 weeks after planting and the second as soon as weeds appear around 5–6 weeks after planting, depending on weed pressure.

Avoid weeding immediately after it has rained as this would not offer effective weed control, in general weeding should be performed:

1st weeding 20-25 days after germination.

2nd weeding 45-50 days after germination and as weeding is necessary 60-75 days after germination.

•Weeding can be done with use of implements such as ox drawn or tractor drawn cultivators.

Cultural practices

Practices that allow early establishment give the crop a competitive advantage over many weeds.

•Proper seed placement, fertility management, planting date, and seeding rates can help establish a healthy, competitive sorghum crop.

•Ploughing as required is an effective method of controlling weeds.

Chemical methods

Chemicals formulated as liquids, granules or gases can be applied to kill germinating, growing weeds or seeds. Herbicides offer a cost effective method of weed control if used

properly.

- Application should be based on correct weed identification.

- The choice of herbicide, however, depends on the predominant weed species and the availability of the herbicide.
- Herbicides are available for pre-emergence or post emergence weed control depending on time of application. If herbicide is applied at planting, one weeding may be required at 5–6 weeks after planting depending on weed presence.

Summarize the Main Points

1. Weeding is important since it reduces competition from weeds against the crop plants;
2. Different methods can be used in weed control such as hand pulling, cultivation, mulching, crop rotation, good land preparation and early planting. Our aim is to give our plants the best conditions to grow vigorous and healthy for high yields;
3. For successful crop growth and production, weeding must be done early enough – ideally 2-3 weeks after germination and should be performed 2-3 times prior to harvest;
4. It is easy and cheap to reduce weeds through proper land preparation, early planting and use of clean seeds;
5. It is important not to conduct weeding when the ground is very dry.

Herbicide Application

Types of herbicides

- Pre-plant: incorporate into the soil before planting
- Pre-emergence: applied after planting before germination of the weed, e.g. roundup
- Post emergence: applied after emergence of crop and weeds-2.4.D

Session VI: Major pests of Sorghum and management

6.1. Insect pests of Sorghum and their control

Low levels of insect pests may be of little concern, but when they increase above certain limits they must be controlled otherwise economic losses may occur.

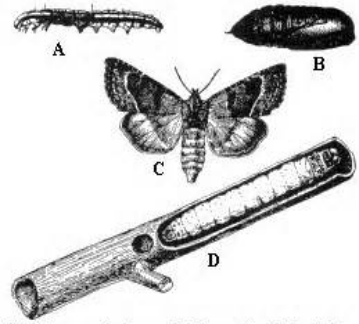
- When chemical sprays are used, safety precautions and correct application techniques must be followed.
- Integrated pest management whereby various methods are applied to protect the crop by suppressing insect populations and limiting damage. These measures include the following:

chemical control, biological control, plant resistance and cultural control.

- Application of chemicals should be done after scouting and after determination of the economic threshold (are there sufficient pests to cause economic damage)

Enquire from farmers on major sorghum pests in the area and how they manage them?

Table 6.1: Insect Pests of Economic Importance in sorghum production.

Pest	**Management**	**Chemical control and Application rates**
Stalk borer: *Stalk borers are 3 types Chilo partellus, Sesamia calamistis and Busseola fusca,which are the most important pest of sorghum. Symptoms starts with small holes in leaves then in stems. Larvae then channel through the stem eating the central part.* 	*-Cultural methods include deep ploughing and destruction of Stover to destroy overwintering larvae, rotation with legumes to interrupt the life cycle of stem borers* *and addition of nutrients to the soil.* *-Chemical control include Carbayl 5 dust; Carbaryl 85WP; Dipterex and Thionex; Kombat*  Stalk borer. A, Larva. B, Pupa. C, Adult. D, Larva and entrance hole in stem.	*Carbaryl 85%: 2kg/ha; Dipterex 2.5%: 1-2kg/ha. Carbaryl is applied as full coverafter emergence. Ensure penetration into the funnel.* *Push and pull system for controlling of stalk borer* 
African Army worm *These Pests cut and chew causing extensive damage in sorghum. They also consume the lamina leaving midribs thereby reducing the photosynthetic area.*	*Controlled by use of contact insecticides which include:* *-Carbaryl 85WP,-Karate 5EC* 	*Apply as full cover spray* 
Aphids *These usually appear during head emergence and flowering, they suck sap from*	Systematic control after head emergence with chemicals.	Malathion 85% and Dimethoate (rogor)

the leaves. 		
•	•	•
American ball worm *Chewed grain at stand and lying on the ground all fruit and seed producing crops which is evidence of attack and damage its seeds during milky stage.* 	*Use of chemicals recommended* 	*Thiodan (Endosulphan) recommended for control*

6.2. Birds and other mammal pests: There are also birds, mammals which damage sorghum crops at field and in storage, but the worst nightmare for the sorghum farmer and can cause significant damage and reduction in yield. These become a problem as the crop approaches maturity.

- Bird scaring is the only effective way of minimizing bird damage, but community cooperation in planting dates may also help to spread the risk. Red/Brown sorghum is bird resistant.
- Farmers are encouraged to harvest early to minimize bird damage.
- Clear possible habitats around the field.
- Growing of sorghum by many farmers in same locality will reduce losses.

6.3. Major diseases of Sorghum and their control

The major sorghum diseases in the region are leaf blight, covered kernel smut and charcoal rot and others. Diseases of economic importance in sorghum are shown below.

Table 6.2: Diseases of Economic importance in sorghum production.

Disease	**Picture**	**Management/ Control**
Head Smut *The entire head is replaced by a large smut gall covered by a thick white membrane. This is the most common disease in sorghum. The disease spores are easily carried by wind and rain, spreading the disease to other plants*		*-Use of resistance varieties.* *-Use of certified disease free seed.* *-Roguing smutted heads and burning them.* *-Crop rotations.*
Covered kernel Smut *Symptoms include all kernels affected smut head destroyed and replaced by a dark brown powdery mass*	 -	*-Use of resistance varieties* *-use of certified disease free seed.* *-Roguing smutted heads and burning them.* *- Practice crop rotation.*
Charcoal Rot *Symptoms include root rot, soft stalks, lodging of plants, premature drying of stalks, and poorly developed panicles with small inferior-quality grain*		*-Good management practices that reduce moisture stress e.g. proper management of crop residues, crop rotations, avoiding excessive plant population, balancing fertility levels, and growing drought tolerant varieties. lodging resistance varieties represents the best means of control.* *-Use of Apron star for seed dressings.*

Leaf blight *Large elliptical spots up to 20 mm wide and 100 mm long, initially water soaked, but drying to straw-coloured spots with red, purple or tan margins depending on the varieties.*		*-Rotation with non-susceptible crops.* *-Use of resistance varieties.* *-Seed dressing with Captan or Thiram.* *-Use foliar fungicide*.
Ergot *Sorghum ergot is a disease caused by a fungus that infects the ovaries of sorghum flowers and often converts them into a white, fungal mass.* *The most obvious external symptom of infection is the abundant exudation from infected flowers of an amber-coloured, sticky fluid, or "honeydew," which often drips to the leaves and the soil.*		*-Use seed treatment with fungicides such captan and Thiram.* *-prevent sorghum ratoon and sorghum volunteer development.*

Session VII: Harvesting and Drying

The final stage of crop production consists of harvesting and post-harvesting practices. The aim of farmers during these stages is to minimize losses and maintain the quality of grains for prolonged storage and future use. This session is divided between different topics, with the goal of ensuring that farmers understand the optimum time to harvest and important practices during harvesting, drying and storage.

7.1. Seeds Selection

Proficient farmers visit their fields regularly and to locate and observe plants which appear healthier than others in the plant population in the field. The farmer needs to follow the progress of these robust plants until harvest. Especially for sorghum, the farmer can see good looking heads and harvest them separately as seeds to save for the next season.

7.2. Drying

Once crops are harvested they must be dried before threshing and storage. Proper drying of harvested grains is important so that they store well over a long period. Drying prevents seeds from germination, growth of molds and diseases, and reduces conditions favorable for insect infestation. If grains are improperly dried, they can be attacked by insects and diseases while in storage, causing loss to the farmer. Drying is normally done by spreading harvested crops (heads, nuts and pods) on a clean and well-smeared ground for sun drying. While drying in the sun, the farmer should stir seeds regularly to distribute the heat equally over the bulk. For crops like sorghum, maize and millet, it is possible to let the crop dry in the field, after which it is harvested. Farmers usually check the seeds using their teeth or fingernail to see whether they are well dried or not.

7.3. Threshing

Threshing is the extraction or separation of seeds, nuts, and grains from their covering materials like shells, pods, fruits, etc. Threshing should be done on well- smeared and dry ground using sticks or other implements depending on the area. Threshing should be conducted only for crops that have been dried very well.

Summary of Main Points

1. Timely harvesting of crops is important to reduce losses which can occur as the result of delay;
2. Farmers need to select seeds before harvesting by sorting and separating the healthy and good-looking plants from the rest;
3. Well-dried grain will keep longer;
4. By-products of the plants can be used for improving soil fertility

Session: VIII: Storage

There are simple techniques of constructing small stores which can reduce grain losses so the grain will last longer with minimal losses. Proper drying followed by traditional smoking to fumigate bundles of grains should be encouraged, as this can be effective for reducing damage of grains by weevils and other pests. Local granaries can be improved by:

1. Increasing the height of the granary by 1 meter;
2. Putting metal flaps (rat guards) on the granary's posts;
3. Smearing the granary's posts with cow dung;
4. Attaching a well-thatched roof;
5. Mixing some crops together in storage.
6. Sale to market at optimum period for further use.

Summary of Main Points on Storage

1. Many simple techniques exist to store grains without problems;
2. Some traditional, low-cost techniques exist for good storage;
3. Local granaries can be improved for food storage.

IX: **References:**

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Table 4: Improved released varieties

No	varieties	year of released varieties	Days to maturity	Days to maturity	Plant height in cm	Productivity/ha		Seed coluor
						Research	Farmers site	
1.Low lands(Kola) (< 1600 masl)								
1	Teshale	2002	early	65-76	170-210	26-52		White
2	Ashebir	2000	100-120	83	110-140	15-25		
3	Gobiye	2000	100-120	80	110-140	19-27		
4	Mecha	2007	113-130	55-60	135-150	42-44	23-30	White
5	Red siwaz	2007	106-112	55-60	120-153	30-33	20-21	Red
6	Raya	2007	129	82	185.7	37.68	22.77	White
7	Misiker	2007	126	76	123-191	40.73	37	White
8	Girana	2007	122	75	135-305	40.86	38.7	White
9	yeju	2002	early	68	172	50.9		White
10	Birhan	2002	early					
11	Hormat	2005	early	71	161-171	23.3	16-22	White
12	Abuwarie	2003	early					
13	Gedo	2007	early	75	116-138	34	27-36	White
14	Melkam	2009	118	76-82	126-163	37-58	35-43	White
15	Hybrid 2	2009	120	61-75	150-192	42-60	35-43	White
16	Dekeba	2012	119	75	136	37-45	26-37	White
17	Mesay	2011	106-134	65-79	137-231	38-62		White

2.Medium altitudes (1600-1900 masl)

No	varieties	year of released varieties	Days to maturity	Days to maturity	Plant height in cm	Productivity/ha		Seed colour
						Research	Farmers site	
1	Abamelko	2001						Brown
2	Geremew	2007	150-160	103	170	49	40	Red
3	Emahoy	2007	136-142	73-78	220-300	40-45		Red
4	Dagim	2011	158	87	156	27-54	42	Brown
3.High lands (Dega) (>1900 masl)								
1	Muyira-1	2000	135-175	100-140		30-65		Red
2	Muyira-2	2000	135-140	100-140		30-65		White
3	Cheleko	2005	181-207	124-131	250-410	29-64		Red