SOYBEAN

TRAINING MANUAL

For Subject Matter Specialists (SMS)

January 2019
The production of this training document has been made possible by the generous support of the Government of Canada through Global Affairs Canada (GAC)
Acknowledgement

This training manual was developed by Agricultural Growth Program-2 Capacity Development Support Facility (AGP2 CDSF), with the financial support from Global Affairs Canada (GAC). The CDSF team would like to thank the following partners for their crucial contribution to this manual: CASCAPE, Oromia AGP CU, Oromia Bureau of Agriculture and Natural Resources, and Melkasa Research Center. Special thanks goes to woreda experts, development agents and farmers who contributed to the improvement of the material during the pretesting period.
Contents

1. Introduction .......................................................................................................................................... 5
2. Training Objective ................................................................................................................................. 6
3. Suitable Agro ecology for Soybean production .................................................................................... 7
   3.1. Overview ....................................................................................................................................... 7
   3.2. Session Objective .......................................................................................................................... 7
   3.3. Basic concepts ............................................................................................................................... 7
   3.4. Altitude .......................................................................................................................................... 7
   3.5. Rain fall .......................................................................................................................................... 7
   3.6. Soil type ......................................................................................................................................... 8
   3.7. Summary ....................................................................................................................................... 8
4. Seed Variety, Land preparation and Planting ....................................................................................... 9
   4.1. Overview ........................................................................................................................................... 9
   4.2. Session Objective .......................................................................................................................... 9
   4.3. Basic Concepts .............................................................................................................................. 9
   4.4. Seed Varieties ............................................................................................................................... 9
   4.5. Land Preparation .......................................................................................................................... 10
   4.6. Planting ....................................................................................................................................... 11
      4.6.1. Seed cleaning and preparation ........................................................................................... 11
      4.6.2. Planting time ....................................................................................................................... 11
      4.6.3. Seed rate and planting methods .......................................................................................... 12
   4.7. Summary ..................................................................................................................................... 13
5. Soil Fertility Management ................................................................................................................... 14
   5.1. Overview ..................................................................................................................................... 14
   5.2. Session Objective ........................................................................................................................ 14
   5.3. Basic Concepts ............................................................................................................................ 14
   5.4. Fertilizers application .................................................................................................................. 14
      5.4.1. Application of Bio fertilizer ................................................................................................. 14
      5.4.2. Application of Chemical Fertilizer ....................................................................................... 17
   5.5. Soil Acidity Management ............................................................................................................ 18
1. Introduction

This manual outlines crop production practices that farmers may use to grow soya bean efficiently and profitably in South Western Ethiopia. The manual was prepared based on the experience of the farmers and experiment conducted by CASCAPE in Bedele and Limu Seka woredas. During the commencement of the CASCAPE project the participatory rural appraisal (PRA) was conducted to identify constraints and opportunities, and priority of intervention areas. In this PRA and scoping study, monotonous feeding habit (maize and sorghum based diet) and soil nutrient depletion were among problems identified by the community for intervention. The soya bean crop was selected as a single most important crop to tackle both poor dietary diversity and to use as a rotational crop to address soil fertility problems prevailed in the areas. Recent research results have shown that maize yields increase when grown in crop rotation with soy bean compared to maize grown after maize Savanna (Carsky et al., 1997). On top of this, It is enhanced N availability following soya bean and other rotational effects such as a reduction of diseases and higher mycorrhizal colonization rate and diversity (Sanginga et al., 1999). Soya bean is an alternative protein source to the rural families and can be utilized at home in various forms and the surplus can be sold to other consumers and manufacturers for income. One of the greatest health benefits of soya beans is the fact that they provide a “complete protein”. This is a protein which includes all of those amino acids which are essential in a human diet. This is part of the reason that soya is used as the basis for meat substitute products (Henkel, 2000).

Soya bean is among the major industrial and food crops grown in most parts of Ethiopia. Particularly, the crop can be successfully grown in Western Ethiopia using low agricultural input. Soya bean cultivation in Ethiopia has expanded as a result of its nutritive and economic importance for processors and exporters. It is also a prime source of vegetable oil in the domestic and international market. Soya bean has an average protein content of 40% and is more protein-rich than any of the common vegetable or animal food sources found in Ethiopia. Soya bean seeds also contain about 20% oil on a dry matter basis, and this is 85% unsaturated and cholesterol-free. The rapid growth in the poultry sector in the past five years has also
increased demand for soya bean meal in Ethiopia. It is believed that soya bean production will increase as more farmers become aware of the potential of the crop, not only for cash/food but also for soil fertility improvement and Striga control. The market for soya bean in Ethiopia is growing very fast with opportunities for improving the income of farmers. Currently, Alema Koudijis Feed Plc, Tasty soya, Fafa food Share Company, Seka business group PLC, and Healthy Foods Plc were among the few foods and feed processing companies which utilize soya bean as an input for processing.

2. Training Objective

At the end of this training, participants will be able to:

- Explain the technical aspects required for scaling up of soybean.
- Train development agents by using this manual.
- Achieve mainstream crosscutting issues to achieve positive change in the production of soybean.
3. Suitable Agro ecology for Soybean production

3.1. Overview
Agro ecology has crucial role in increasing production and productivity. The release of improved seed variety doesn’t guarantee the benefit out of it. As a major issue, it is important to know for which agro ecology the seed is released. In this session, we will discuss on suitable agro ecologies for soybean production.

3.2. Session Objective
At the end of this session, participants will be able to:

- Explain the suitable agro-ecology for soybean production.

3.3. Basic concepts
- Altitude is the vertical distance of a specific location from sea level.
- Annual rainfall is the amount of moisture needed for the whole life of the plant up to harvesting.
- Soil acidity means when the soil H+ (hydrogen ion) in the soil solution is lower (less than 6).

3.4. Altitude
Soybean is grown in an area of mid-altitude like Bedele and Limu Seka woredas with enough amount of rainfall that laps up to four and half months. It gives high production on altitude ranging from 750 to 1800 meters above sea level. Regarding temperature requirement 25 °C can be considered the overall optimum temperature for all growth stages, the response of the soya bean differs at various growth stages. At planting time, soil temperatures must preferably be in the region of 15 °C in order to stimulate germination.

3.5. Rain fall
Soybean is drought resistant crop. It can grow and give enough yields with the rainfall amount of 460-1500 mm with even distribution. Even though soybean is resistant to moisture stress from germination to flowering, it requires enough moisture during germination, pod formation and grain filling.
3.6. Soil type

Soybean can be grown on varying soil types with PH ranging from 4.5 to 8.5. Acidic soils (soil with low PH) can reduce soybean production by inhibiting soil bacteria which convert air nitrogen to soil Nitrogen (NO₃). Heavy soil with water logging capacity is not suitable for soybean production, because it affects germination.

Sandy loam soil is suitable for soybean production, because it enables easy circulation of air in the soil and drainage; Nitrogen fixing bacteria can easily live in the soil; it infiltrates rain water; it doesn’t cause severe erosion; it has no weed infestation; it is easy for hand weeding; soil minerals can easily approach the crop roots; etc.

3.7. Summary

Identifying suitable agro ecology including altitude, amount of rainfall and soil type, helps us to know where to plant a specific crop, when to saw a crop, and which soil type is suitable for which crop. Hence, the above session clearly tells us the suitable agro ecologies for soybean.
4. Seed Variety, Land preparation and Planting

4.1. Overview

Selection of improved seed variety is important for increasing production and productivity. Clark-63 is one of the released varieties of soybean. In this session, the selection criteria of Clark-63, land preparation and planting methods will be discussed.

4.2. Session Objective

At the end of this session, participants will be able to

✓ Describe the characteristics of Clark-63 soybean variety,
✓ Explain the land preparation and planting methods of Clark-63 variety.

4.3. Basic Concepts

➢ Improved seed is a seed that excels local variety in productivity and other factors; and is preferred for food, marketing etc.
➢ Productivity means the amount of yield from one hectare of land; productivity of improved seed should excel that of local variety.

4.4. Seed Varieties

Making proper variety selection is extremely important to the overall success of a soya bean crop production. Variety selection is a process, and growers need to seek out varieties which have high yielding potential and consistent yielding. It is also important not to forget the characteristics of varieties which can and often do impact the total yield and productivity at the end of the season. The maturity period should be the first consideration when choosing a variety suited to your geographical zone. Ethio-Ug is late maturing variety and needs more than 120 days while Clark-63 is medium maturing that needs 100-120 days. At the beginning of June, Ethio-Ug is more recommended while at the middle to end of June it is better to plant Clark-63. Ethio-Ug need long rain duration. Farmers evaluate seed based on early maturity, size grain and grain colour.
The existing released few improved soya bean varieties were tested by CASCAPE-JU in Dora kebele of Limu Seka woreda. Among the tested varieties the average grain yield of Clark-63 obtained from adaptation and demonstration trail treated with two type of fertilizers (DAP and Tale + DAP) was 28Qun/ha and 35Q/ha respectively during the growing period of 2012 and 2013. Clark-63 has been promoted for scaling up/out based on the combined evaluation made on potential branch production, big seed size, production of high biomass that increase soil fertility by dropping their leaves when it was ripening and senescence, high total grain yield, no or little shattering capacity and production of white seed color. Understanding the characteristics and type of variety which are needed in a particular situation can greatly impact overall production and assist in making this difficult task more manageable.

4.5. Land Preparation

Before land preparation, appropriate site for soy bean production should be selected. When the slope is high, it is important to put in place the soil erosion control system. It grows well on deep, rich and aerated soils. It does not perform well in swampy areas. It is not recommended to plant soya bean in sandy, gravelly, or shallow soils to avoid drought stress. It should not be grown in water logged soils or soils with surfaces that can crust, as this will lead to poor seedling emergence.

Land preparation for soya beans should provide for deep rooting and a moist seedbed for planting. Clear all vegetation before land preparation. The seedbed may be prepared manually with a hoe or animal-drawn implement. Well-prepared land ensures good germination and reduces weed infestation. To expose insect and their larvae and harmful organisms to sunlight, first ploughing should be made from January to February. Though the frequency of ploughing depends on previous land history, whether it has been used for crop cultivation or not, the farm should be ploughed 3 to 4 times. The last ploughing should be used for making rows used for sowing at the spacing interval of 50cm. The optimum planting depth for soya bean seeds is to 2.5, no more than 5 cm in sandy soils.
4.6. **Planting**

4.6.1. **Seed cleaning and preparation**

Soya bean seeds are extremely fragile and subject to damage by handling, auguring, and transporting. Seed moisture influences the extent of damage; dried seed is more easily damaged than seed with higher moisture content. The recommended moisture content is less than or equal to 11% for food use or seed, whereas average moisture above 13% can lead to quality deterioration in relatively short time span. Splits and cracks in seed can be seen easily, but considerable internal injury can go undetected. The only way to determine seed viability is to have a germination test run. The germination rate should be 85 per cent or greater.

![Soya bean Seed](image)

Figure 1: Soya bean Seed

Unless, we use high quality seeds of the selected variety (Fig. 2), soya bean seeds easily lose their viability. Therefore, use seeds that are not more than 12 months old to ensure good germination. Sort out the good seeds for planting to ensure that they are free from insects, disease infestation, and weed seeds. Do not purchase seeds from the open market as the germination potential is not guaranteed. Planting poor quality seeds will not produce a good yield. Always buy seeds from seed companies (seed producers cooperatives and seed enterprises) or agricultural research centers nearest to farmers.

4.6.2. **Planting time**

Soya bean produces well over a wide range of planting dates, if moisture is available. Do not plant too early because a prolonged dry spell after planting may result in permanent wilting of
the crop and the need for replanting. Late planting, on the other hand, may expose the crop to attack by some late season pests and also deprive the crop of sufficient moisture if the rains stop early. Plant soya bean as soon as the rains are well established. With early plantings, slightly shallower seed placement will speed emergence, and with late plantings in dry soil, slightly deeper placement may be necessary to put the seed in contact with moisture. The optimum period for planting soya beans in Western Ethiopia is from June 1 to June 15. Planting can begin in the last week of May based on the condition of rainfall which varies from year to year. Very early-maturing soya bean varieties tend to have a more narrow range of favorable planting dates than do late-maturing varieties. CASCAPE used planting calendar: from early June to Mid-June in Bedelle and from mid-June to early July in Limu Seka where the plant performed well. This can be used in those areas and similar agro ecologies.

4.6.3. Seed rate and planting methods

With conventional varieties, remember the eye cannot detect seed viability; therefore, germination tests are essential. Germination test can be done in less sophisticated laboratory and with easy metrics. Germination should be at least 80 percent. Plump seed with high percent germination, good color, and no visible damage will generally develop into good stands. Consider soil temperature and recognize that higher soil temperatures (dry soil) may lower overall germination. Consider seedbed condition and increase the seeding rate by 10 to 20% if planting late, or in a dry or trashy seedbed. Also consider soil moisture and crusting potential when making seeding rate decisions and alter accordingly. Overall, the amount of seed used for sowing depends on the size of seed. Generally, soya bean was planted at the rate of 80 kg/ha at spacing interval of 10cm x 50cm between plants and rows respectively.

Moreover, the narrow rows at above mentioned spacing help to ensure full canopy development which can reduce soil moisture loss and suppress late emerging weeds. Do not sow seeds more than 2–5 cm deep. Deeper planting may result in loss of vigour or failure of seedlings to grow. It makes the seed buried deep down and make the seed spoil and unable to grow.
4.7. **Summary**

Clark-63 variety of soybean was selected based on farmers’ preference in terms of productivity, soil fertility improvement and grain size. Clark-63 was compared with other varieties in CASCAPE JU woredas and selected based on the mentioned criteria. Therefore, it is possible to scale up the variety to western Oromia woredas which have similar agro ecology to Limu Seka and Bedele.
5. Soil Fertility Management

5.1. Overview
Fertilizer application should be based on soil test. Bio fertilizers and chemical fertilizers can be used for soybean. This session describes the use of fertilizers for soybean production.

5.2. Session Objective
At the end of this session, participants will be able to:
• Explain the importance of soil fertility management.
• Describe the type, method, amount and time of fertilizer application.

5.3. Basic Concepts
• Bio fertilizer means a natural fertilizer in a form of Nitrogen (No3) fixed by rhizobium bacteria from atmospheric Nitrogen. Rhizobium bacteria are available in the root nodules of legume crops.
• Chemical fertilizers are the mixture of the required amount of Nitrogen, Phosphorus, Sulfur and Boron; and farmers purchase it from suppliers.
• Soil acidity means when the soil H+ (hydrogen ion) in the soil solution is lower (less than 6).

5.4. Fertilizers application

5.4.1. Application of Bio fertilizer
A good fertilizer recommendation for soya bean production depends on a good soil test. The soya bean plant is a legume, so nitrogen can be supplied by nitrogen-fixing bacteria contained in nodules located in the plant roots. Under normal conditions, soya bean as a legume should provide itself nitrogen through biological nitrogen fixation under ploughed. Until nodulation occurs, the soya bean plant depends on soil nitrogen for growth. 100 kg DAP was applied as a source of 46 kg P2O5 and 18 kg N during sowing. To increase atmospheric nitrogen fixation 400gm of tale rhizobium bacteria was inoculated with 80 kg seed.
For soils where soya beans have not been successfully grown within three years, inoculants containing nitrogen-fixing bacteria should be applied at planting. To increase the capacity of the plant using the atmospheric nitrogen to usable form two strains of rhizobium bacteria (tale and legume fix) were collected from national soil laboratory and Holeta agricultural research Centre. The adaptation experiment and demonstration of inoculants were conducted during the adaptation trials. The highest grain yield was obtained when soya varieties were inoculated with legume fix followed by inoculated by tale with that of control.

To be able to form nodules and fix nitrogen, soybean seeds need to be inoculated with rhizobia. Each legume crop needs a different type of rhizobium bacteria, so always check you have the right inoculant for soybean. Directions for using inoculants can be found on the package.

Fig 3: Nodules of soybean

How to inoculate soybean seeds:

1. Measure 15 kg of legume seed, this will be approximately 15 litres. Place in any container that will accommodate the seeds.

2. Measure one soda bottle (300 ml) of clean lukewarm water.

3. Pour the water into a larger bottle (500 ml plastic bottle) so that it is easier to mix the sugar.

4. Add 2 tablespoons of sugar to the water.
5. Mix thoroughly to get an even solution of sugar. This solution is called the sticker.

6. Add the sticker to the seed.

7. Mix the seed with sticker solution until all the seeds are evenly coated with the sticker.

8. Add the rhizobium inoculant onto the seeds and sticker. The inoculant is the 125 g black powder contained in the pack.

9. Mix the seeds and the inoculant thoroughly but gently until all seeds are uniformly covered with the inoculant.

10. Protect the inoculated seed from direct sunlight by covering the container with paper, cloth or gunny bag and keep under a shade until planted.

For smaller amounts of seed, use 4 teaspoons or soda bottle-tops (20 ml) of the sticker solution, and 2 heaped teaspoons or soda bottle-tops (10 g) of inoculant for every 1 kg of seed.

Fig 4: Seed inoculation with rhizobium bacteria, Source: N2 Africa how to inoculate legume fix
Benefits of inoculation:

- Inoculation ensures good nodulation.
- With good nodulation, the legume can fix its own nitrogen.
- When more nitrogen is fixed, legume yields increase.
- Following crops or crops intercropped with the legume also benefit from the fixed nitrogen.
- Inoculants are much cheaper than nitrogen fertilizers.

Some helpful hints concerning soya bean inoculation include:

- Purchase proven soya bean inoculants from a reputable dealer or research centre.
- Check the expiration date to assure viability at planting.
- Store inoculants in a cool, dry place prior to planting.
- Do not buy inoculants that are pre-packaged with fungicide treatments.
- Do not mix inoculants and seeds treatments far in advance of planting.
- Apply inoculants at rates and in the manner according to manufacturer recommendations.
- Many producers use small amounts of nitrogen fertilizer for soya beans.

5.4.2. **Application of Chemical Fertilizer**

Total nitrogen needs can be supplied through the symbiotic nitrogen-fixation process. Nitrogen in excess of 20 kg per ha can seriously inhibit the symbiotic nitrogen-fixation process. Phosphorus is often the most deficient nutrient; therefore, apply optimum phosphorous fertilizer for good yield. The plant could utilize Phosphorus from NPSB fertilizer which is available in the domestic market. Until nodulation occurs, the soya bean plant depends on soil nitrogen for growth. 100 kg NPSB was applied as a source of 37.2% P2O5 and 18.6% N during sowing.
5.5. **Soil Acidity Management**

Wide part of Western Ethiopian soil (more than 80%) is Nitisol. This type of soil is known for its acidity. Soil acidity inhibits plants from absorbing minerals like Nitrogen and Phosphorus.

To control the effect of soil acidity,

- Applying lime to the soil
- Using biological fertilizers (compost, manure, etc)

To determine the amount of lime per hectare, soil sample should be taken from the depth of 20 cm and analyzed in soil laboratory. If the PH is less than 5.5, the following formula should be used based on the soil exchangeable acidity.

\[
\text{Lime Requirement} = \text{Exchangeable acidity} \times 1.5 \times 10 \text{ qt/ha}
\]

After determining the amount of lime to the soil, we should apply the required amount of lime to soil and mixed to the depth of 5 cm one month before sawing.
In order to obtain high production, it is important to manage soil fertility based on soil test. In soybean production, we can use soil management methods including the use of bio fertilizer and chemical fertilizers. In the Western part of Ethiopia, soil acidity is one of the bottlenecks of agricultural production. We can control soil acidity by applying the required amount of lime and by using natural fertilizers.
6. Crop protection

6.1. Overview
Major yield reducing factors of soya bean includes weeds, insect pest and disease. Usually farmers in Western Ethiopia produced soya bean through mono cropping which creates suitable condition for different crop pests. In addition, when a given farm field is used to grow only one crop season after season it has several disadvantages: it is difficult to maintain cover on the soil; it encourages pests, diseases and weeds; and it can reduce the soil fertility and damage the soil structure. As a result, it is advisable to use soya bean as rotational crop and or as row intercropping to mitigate the aforementioned negative impact of mono cropping. In addition to control different crop pests it is highly advisable to use integrated pest management (IPM) approaches.

6.2. Session Objective
At the end of this section the participants will:

- Identify and describe the type and control methods of common weeds of soya bean
- Identify and describe the type and control methods of common diseases of soya bean
- Identify and describe the type and control methods of common insect pests of soya bean

6.3. Basic concepts
- Plant protection is the practice of managing crop field from yield reducing factors that includes: insect pests, plant diseases, weeds and other pest organisms that damage agricultural crops using traditional practices, chemicals and integrated approaches.

6.4. Weed control
Weed computes the plant for nutrients, water, sunlight and space. Weed control can be accomplished by manual or chemical, or both.

6.4.1. Manual weed control
- First round: Weed about one time hoeing was made at 20 to 25 days of sowing
• Second round: hand weeding the first few days before hoeing and second before flowering.

6.4.2. Chemical weed control

There are different types of herbicides. The type of herbicide used depends on the predominant weed species and availability of legally registered herbicides. Herbicides are available for pre-emergence or post-emergence weed control. If pre-emergence herbicide is applied at planting, one weeding may be required at 5-6 weeks after planting. During those of our trials and scaling pilot no chemical weed used. As a last option to use, you can apply the following herbicides presented in the table below as their recommendation domain.

Table 1: Soya bean herbicide type and their usage

<table>
<thead>
<tr>
<th>Brand or common name</th>
<th>Name of active ingredient</th>
<th>Use rate (L/ha)</th>
<th>Time of application</th>
<th>For which type of weeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fusilade</td>
<td>Fluzifop-p-butyl</td>
<td>0.25 kg a.i. ha⁻¹</td>
<td>Pre-emergence</td>
<td>grass weeds</td>
</tr>
<tr>
<td>Lasso</td>
<td>Alachlor 480 EC</td>
<td>4 l ha⁻¹</td>
<td>Pre-emergence</td>
<td>broad leaf weeds</td>
</tr>
<tr>
<td>Dual Gold</td>
<td>S-metolachlor 960 EC</td>
<td>1 l ha⁻¹</td>
<td>Pre-emergence</td>
<td>broad leaf weeds</td>
</tr>
</tbody>
</table>

Source: 362-N2 Africa-Ethiopia-soya bean booklet

6.5. Insect pest control

Common pests affecting soya bean in Ethiopia are; African bollworm, cut worm, green stink bug, and the aphid. If the damage level observed on the leaves of soya bean doesn’t lead to the critical yield damage, spraying chemicals for insect pest control is not economical. From flowering onwards, soya bean becomes attractive to pod-sucking bugs, then can seriously reduce seed quality. If pests are damaging pods, control the pest by spraying with insecticides. Be aware of aphids, as they can transmit viruses to soya bean. Always follow the manufacturer’s recommendations or seek advice from an extension agent. Safety clothing should be used during chemical application.

Table 2: Soya bean pesticide and their usage
<table>
<thead>
<tr>
<th>№</th>
<th>Product Name of active ingredient</th>
<th>Use rate (L/ha)</th>
<th>For which pest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Primor 50%WP</td>
<td>0.5kg a.i./ha</td>
<td>Aphids</td>
</tr>
<tr>
<td>2</td>
<td>Cymbush10%EC</td>
<td>150 a.i./ha</td>
<td>African ball worm</td>
</tr>
<tr>
<td>3</td>
<td>Dimethoate40%EC</td>
<td>1lt/ha</td>
<td>Beanfly, bean aphid, thrips, African ball worm</td>
</tr>
</tbody>
</table>

Source: 362-N2 Africa-Ethiopia- Soya bean booklet

Fig 7: Aphids
Fig 8: Triphs
Fig 9: African bollworm
6.6. Disease control

Soya bean diseases can be caused by fungi, bacteria or viruses and can result in major yield losses. The major disease infected soya bean in Ethiopia is brown spot, downy mildew, anthracnose, leaf blotch, and bacteria blight and mosaic virus (Moges M. and Zinaw D., 2014). Infection takes place at different growth stage and time, some diseases appeared during vegetative stage whiles other at pod setting growth stage and scouting. The symptoms various according to disease type; so seek advice from crop protection professionals when disease symptoms observed on the crop.

Table 3: disease types and control methods in western Ethiopia

<table>
<thead>
<tr>
<th>Name of the disease</th>
<th>Symptoms of the disease</th>
<th>Control methods</th>
</tr>
</thead>
</table>
| **Rust** | • First symptoms of soybean rust caused by *Phakopsora pachyrhizi* begin as very small brown or brick-red spots on leaves  
   • This symptoms may be more prevalent and more severe on the lower leaf surface showing powdery darken and may range from dark brown or reddish brown to tan or gray-green in color. | • Using disease resistant varieties  
   • Sowing clean seeds  
   • Using crop rotation  
   • Using chemical called “Opra-max” 1lit/ha |
| **Bacterial blight** | Initially yellowish dots/spots appear on the leaves and finally appearance of brown spots on the leaves | • Sowing disease free seeds  
   • Crop rotation  
   • Burning residues and other host plants on the field after harvest  
   • Avoid hoeing when there is dew/moist |
6.7. **Summary**

To increase productivity of soya bean crop protection activities are crucial. Starting from land preparation to harvesting crop protection activities: weed, disease and insect pest prevention and control needs due attention. Integrated pest management (IPM) is the best strategic approach for the control of pests and use of chemical should be the last option.
7. Harvesting, threshing and post-harvest handling

7.1. Overview
Among yield reducing factors losses related to harvesting and post-harvest handlings are very huge. To prevent yield loss during harvesting and post-harvest handlings creating knowledge on optimum harvesting stages (maturity stage for harvesting), methods of harvesting and storage mechanisms after harvest is very important. In addition to methods of improving feeding habits of the community and soya bean market related issues will be assessed under this section.

7.2. Session Objectives
At the end of this section the participants will:
- Explain methods and procedures to be followed during harvesting and after harvesting soya bean
- Describe soya bean market related issues and value additions on soya bean.

7.3. Basic concepts
- Harvesting is the process of gathering/collecting a ripe/mature crop from the fields.
- Postharvest handling is the stage of crop production immediately following harvest, including cooling, cleaning, sorting, packing and storing.
- A value-addition on soya bean simply means any action that helps you to raise the value of soya bean products or something you can add to a soya bean product that enables you to increase the profit margin. E.g. soya bean grain to powder, soya milk etc.

7.4. Harvesting soya bean
Two ways of predicting harvesting time were used:

i. Counting crop calendar (harvested 100-120days after sown) and

ii. Observing when the lower leaves started defoliating, when the color of pods changed to straw-color (pale yellow) and pods show symptom of shattering during the mid-days.

Generally, the varieties were harvested early in the morning or late afternoon to avoid loss from shattering.
Soya bean matures within 100-120 days after planting and requires timely harvesting to check excessive yield losses. At maturity, the pod is straw-colored (pale yellow). It is recommended that soya bean be harvested when about 85% of the pods have turned brown for a non-shattering variety such as Clark- 63k (but 80% for shattering varieties such as CS1). Alternatively, the crop can be harvested when the seeds are at the hard-dough stage, when the seed moisture content is between 14 and 16%. For the varieties which are relatively resistant to shattering the losses in yield may occur from other causes such as delay in harvesting. Harvesting can be done using sickles. Cut the mature plants at ground level. Stack them loosely on tarpaulin and allow them to dry in the open for 2 weeks before threshing. Do not harvest by hand pulling because this may remove the nutrient that the soya bean has added to the soil.

7.5. Threshing
Thresh manually or mechanically when the plants are properly dry and as soon as possible. Manual threshing is mainly recommended for small-scale production. It involves piling soya bean plants on tarpaulin or putting dry soya bean pods in sacks and beating them with a stick. The material is then winnowed to remove the seeds from the debris.

7.6. Storage
Soya bean should be stored at a moisture content of 10% or less. A soya bean seed is sufficiently dry when it cannot be dented with the teeth or fingernails. At harvest, the grains usually contain about 14% moisture. Dry to 13% moisture for storage of 6–12 months and to 10–11% for longer storage. Open-air drying is the most practical way to protect soya bean in storage. Place 50-kg or 100-kg bags of clean soya bean on a rack in the cold room or in shade. High moisture content in stored soya bean encourages the development of various agents of deterioration, such as insects and microorganisms. Good storage management can greatly influence the storability of soya bean and subsequent germination when planted in the field. Do not leave soybean exposed to high temperatures, as it will increase deterioration and reduce seed viability.
7.7. **Value addition**

In Ethiopia value addition activities on soya bean need to be done that will help to get soya bean products mainly: soya oil, soya milk, animal feeds etc. Now a days soya bean processing factories are producing fortified children foods, animal feeds, soya bean milk and other products (soya sauce, soya oil, soya powder, etc.). In addition, groups of producer farmers can also easily produce soy milk and different types of foods from soya bean grain for home consumption and local market (for example Urji-Chewaka Farmers’ cooperative union processing soya bean grain to produce soya milk and other products for local market). This will encourage farmers to allocate more lands for soya bean production.

7.8. **Soya bean marketing**

Existence of good market opportunity for soya bean product is important to promote or scale up/out soya bean production technologies to the wider farmers.

Major actors in soya bean value chain and their roles:

- **Input suppliers** (Oromia research institute, primary cooperatives, seed enterprises, private companies engaged in improved seed multiplication): play their role in improving the availability of quality seed as per the farmers demand and suitability of agro ecology, promote improved soybean seed multiplication in the target areas

- **Producers** (farmers), play role in applying proper agronomic practice, harvesting and post-harvest handling

- **Soya bean grain Collectors** (traders at woreda and Addis Ababa level),

- **Processors I & II** – companies producing human animal feeds, play role in price negotiation and contractual farming invest on farmers to produce quality soya promote product standards

- **Wholesalers & Retailers**,  

- **Exporters**,  

- **Consumers**.
In improving the soya bean value chain if those value chain actors cooperate accordingly and play their own crucial role the benefit margin of each actor will improve. Prior to producing soya bean awareness on the existence of market opportunity will help producers to get advantages. Creating linkage between farmers (producers) and processors (local and external) encourage farmers to allocate more land and produce high volume of soya bean in required quality standard.

7.9. **Summary**

As specified in the above sections to get high grain yield from soya bean production harvesting, threshing and post-harvest handling activities need due attention. Specially in producing standard quality of soya bean grain harvesting, threshing and postharvest handling have to be accomplished following recommended procedures. Extension agents at every level should give attention in raising farmer’s awareness on this regard.

8. **Cross cutting issues**

8.1. **Overview**

In soya bean production activities considering cross-cutting issues like gender, nutrition and climate smart agriculture is very important. This section illustrates gender, nutrition and climate smart agriculture issues in soya bean production.

8.2. **Session Objectives**

At the end of this section participants will: -

- Identify the role of men and women in soya bean production,
- Describe the contribution of soya bean production for women,
- By understanding the nutritional content of soya bean the describe the role of making soya bean part of their daily food/dish,
- Describe the role of soya bean in managing and improving soil fertility,
8.3. **Basic concepts**

- **Malnutrition** – is a condition that results from eating a diet in which one or more nutrients are either not enough or are too much that diet cause’s health problems. It may involve calories, protein, carbohydrate, vitamins or minerals. Not enough nutrients are called under nutrition or under nourishment while too much is called over nutrition.

- **Gender:** - is the range of characteristics pertaining to, and differentiating between masculinity and femininity. Depending on the context this characteristics may include biological sex (being male or female), sex based social structure (i.e. gender role).

- **Nutrition** is the intake of food, considered in relation to the body’s dietary needs. Good nutrition – an adequate, well balanced diet combined with regular physical activity – is a cornerstone of good health. Poor nutrition can lead to reduced immunity, increased susceptibility to disease, impaired physical and mental development, and reduced productivity.

8.4. **Gender**

In soya bean production practices both male, female and children can participate. other activities like weeding, harvesting and threshing soya bean by hand is labor intensive and time consuming tasks than harvesting and threshing cereal crops; so introducing labor and time should be inconsideration including thresher, combiner and so forth. Soya bean requires three times weeding before harvesting and both weeding and planting activities are mainly accomplished by women. Other remaining activities like land preparation, threshing etc. were done by men. In addition food preparation from soya bean grain is done by women. Soya food preparation is labor intensive and time consuming since farming households in the rural area use local materials to grind soya bean. So introduction of harvester machines, thresher planter and soaked soya bean grinder etc. at household level or for group of farmer is very important.
8.5. Nutrition

The introduction of soya bean is a good answer to the problem of malnutrition to the Western Oromia farm households whom mainly depended on teff, maize, and sorghum which provide very little protein and with less quality. Given the possibility of preparing different food menu recipes using the locally available materials, the soya bean become the best candidate pulse crop used to reduce malnutrition in farm households. Soya bean has an average protein content of 40% and is more protein-rich than any of the common vegetable or animal food sources found in Ethiopia. As a result, it could be used to mitigate the in availability of protein rich diets among farm households. In average soya bean constitutes % 40 proteins. This means it has more (two-fold) protein content than meat (%19) and egg (18%) and four times than maize (%10) (IITA, 2013). In addition, soya bean is a good source of 20% cholesterol free food oil and it has lower quality carbohydrate, which means diabetic peoples can consume it easily. The presence of anti-nutritional factors and off flavoring enzymes necessitates proper processing on the product and training for the farmer. Facilitation of soya bean food recipe training made large numbers of local people benefiting from its potential advantage. Hence preparing the training by integrating with health office at woreda level who are working on malnutrition and BOA office who are working on production side has a paramount contribution to make soya bean in the list of crops commonly produced in a given target community.

Possible Food items prepared from Soybean:
- Soya milk
- Soya cheese
Soya yogurt

Food items prepared from soya bean residue/okara

- Soya “kita”
- Soya bread
- Different types of soya sos (wat) with pea or meat
- Okara with cabbage or egg
- Porridge, soup, roasted soya/kolo etc.

Fig 14: soybean dishes

The introduction of soya bean is a good answer to the problem of malnutrition to the Western Oromia farm households whom mainly depended on teff, maize, and sorghum which provide very little protein and with less quality. The presence of anti-nutritional factors and off flavoring enzymes necessitates proper processing on the product and training for the farmer. Facilitation of soya bean food recipe training made large numbers of local people benefiting from its potential advantage. Hence preparing the training by integrating with health office at woreda level who are working on malnutrition and BOA office who are working on production side has a paramount contribution to make soya bean in the list of crops commonly produced in a given target community.
8.6. Climate smart agriculture

Climate-smart agriculture is an approach for transforming and reorienting agricultural development under the new realities of climate change (Lipper et al. 2014). Climate smart agriculture is an agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces/removes GHGs (mitigation) where possible, and enhances achievement of national food security and development goals. This include use of soil improvement activities like crop rotation, intercropping, use of compost, cover crop, soil and water conservation activities etc. during soya bean production.

In addition, no or minimum use of chemicals for weeds, pests and diseases, low use of chemical fertilizers, integrated approach of pest and disease control, integrated soil fertility management approaches are important in promoting soya bean production.

Farmers experience from Limu seka and Bedelle woreda reviled that use of soya bean verities with bio-inoculant gave higher environmental and economic benefits than use of commercial fertilizer for soya bean production.

Soybean forms root nodules which contain bacteria called rhizobia. The bacteria can fix nitrogen from the air into a form that soybean can use it for growth. This is called biological nitrogen fixation. Some of the nitrogen is left behind through falling leaves and roots to improve soil fertility. This makes soybean a good crop to grow as intercropping or in rotation with other crops, because these other crops then also benefit from the nitrogen. Generally soya bean production is environmentally friend and plays crucial role in increasing agricultural productivity through improving soil quality.

8.7. Summary

In soya bean production process both male and females have their own roles. Women participated in planting, weeding and soya bean food preparation activities. Since the activities require more labor and time introduction and demonstration of labor saving technologies like combiner, thresher and soaked soya bean grinder is important.
Soya bean is important in solving problems of malnutrition in rural areas. Soya bean contains up to 40% protein and it is rich in protein, vegetable oil and essential minerals compared to animal products (meat and egg) and vegetables. So, to use it as a protein source in rural areas of Ethiopia introduction of different food items from soya bean is also important.

In Soya bean production process the use crop rotation, intercropping, compost, bio inoculants plays crucial role in increasing the productivity of soya bean by improving soil quality in environmentally friend way.

9. References


Henkel, John (May–June 2000). "Soy: Health Claims for Soy Protein, Question About Other Components". *FDA Consumer (Food and Drug Administration) 34* (3): 18-20. PMID 11521249Http://findarticles.com/p/articles/mi_m1370/is_3_34/ai_62298457/?tag=content;col1


http://dx.doi.org/10.2134/agronj1990.00021962008200060006x

Moges Mekonen and Zinaw Dilnesaw, 2014. Assessment of diseases on soya bean (Glycinmax L. merli) growing fields of Pawe and Dangur districts Metekel zone, Ethiopia


http://dx.doi.org/10.1016/S0065-2113(08)60802-0


362-N2 Africa-Ethiopia-soya bean booklet