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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 on the ENTERPRIZE project and their role as Training facilitators is critical in enhancing access to technical support to smallholder farmers for increased 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.

**Adult learning**
The target audience (farmers) in trainings are adults and have, 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 be 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.

**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 engages the participants as much as possible. The main features of the attitude and role of a facilitator:

- To listen to farmers and respect their knowledge, experiences and perceptions,
- To give farmers the confidence to share their knowledge and experiences,
- To create suitable conditions and activities from which farmers can learn,
- To be responsive to farmers’ needs and flexible in organizing the course,
- 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:

*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.

**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.

**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 Materials**
The materials needed for each session of the training such as markers, flip charts, masking tape, training manual, and a session guide for guidance during the training. Facts sheets are also important especially if they are written in vernacular. The use of visual training aids such as pictures is also encouraged.

**Training Evaluation Method**
In each training it is important to make an effort of evaluating the trainings so that the trainer is are 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
Preparation for the training: The trainer should take time to read and understand the training content.

Learning outcomes
By the end of the session farmers should be able to:
1. Understand the importance of soyabeans and its uses.
2. Appreciate and understand gaps in production and productivity of soyabeans
3. Understand how soyabeans production constraints in Zimbabwe can be addressed.

Duration: 1 hour
Methodology: presentation/group discussion/brainstorming

Materials required
1. Flip chart and markers.
2. Fact sheets in vernacular language.
3. Posters with pictures of the soyabeans crop.

Discussion points: - Include the information below as you discuss with the farmers, to open up for discussion.

IMPORTANCE OF SOYABEAN
Soyabeans is an important crop in Zimbabwe and is popular among many farmers in high rainfall areas especially in Mashonaland provinces.

ACTIVITY 1.1
Brainstorming
Ask participants why they think soyabean is such an important crop.

- Soyabean is an important cash crop
- Soyabean can be used for food in the household. It can be processed into, soya flour, soya milk, soya chunks and can also be cooked and consumed as a snack (eats).
- Soyabean has high nutritional value: It contains more than 36% protein, 30% carbohydrates, and excellent amounts of dietary fibre, vitamins, and minerals.
- It can be processed into edible oil (contains 20% oil.
- It can also be used as a source of crude protein for home-made animal feeds.
- The crop residues are rich in protein and are good feed for livestock, or form a good basis for compost manure.

It improves soil fertility through nitrogen fixation. This makes it a good crop to grow as an intercrop or in rotation with other crops. It also helps control the parasitic weed striga.

SOYABEAN PRODUCTION
With good agronomic practices and the right varieties grain yield can be as high as 3,5-4 tonnes/ha. Smallholder farmers are attaining yields of 0.6 tonnes/ha
The current production levels cannot sustain the country’s needs as soyabean demand is about 125,000 tonnes yet production is less than 50,000 tonnes in a good year. Zimbabwe relies on imports from South Africa and Zambia.

**ADDRESSING PRODUCTION CONSTRAINTS IN ZIMBABWE**

Constraints on small holder soyabean producers include:

- Poor agronomic practices which include:
  - Use of retained seed,
  - Poor weed management;
  - Low plant population,
  - Inadequate plant protection (pest and disease management),
  - Poor soil fertility management (improper use of fertilisers)
  - Late planting.
- Poor postharvest practices leading to high losses
- Labour shortages at the critical harvesting period.

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

- Good agronomic practices such as effective weed management (including use of herbicides), planting certified seed, chemical soil amelioration based on soil testing recommendations and effective pest and disease management. Most of these practices and technologies will be discussed in this manual under various sections.
- Making affordable lines of credit available to farmers to enable them to access the required inputs.

**Closing the session**

- Give farmers 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 worker and give feedback in the next session.
- Go back to the objectives and ask farmers to explain what they have understood on each of the objectives, and close the session by asking these questions. This will go a long way in assessing the effectiveness of this session.

---

**ACTIVITY 1.2**

*Group Discussion and Presentation*

Ask the participants to break into groups and analyse why most farmers are not able to produce enough soyabean to meet country’s needs and what they think can be done to...
Preparation for the training: The trainer should take time to read and understand the training content.

Learning outcomes
By the end of the session they should be able to:
   1) Know and understand the soyabean growth habit/cycle
   2) Appreciate agro climatic and soil requirements
   3) Identify appropriate varieties to suit their environment.

Duration: 2 hours
Methodology: Plenary/Presentation/Discussion
Materials required
   1. Flip chart and markers.
   2. Fact sheets in vernacular language.

Discussion points: - Include the information below as you discuss with the farmers, ask as much as you can to open up discussions.

THE SOYABEAN CROP

Soya bean grown is an annual plant normally bushy and erect (upright growth habit), usually plant height varies from 40 to 100 cm.

The plants are categorised into determinate and indeterminate types:
   - The determinate types are of short and terminate growth with the onset of flowering and the growth tips end in a pod-bearing raceme. The harvesting can be done in one round because all pods usually ripen at the same time.
   - The indeterminate types can grow to a height of about 70 cm. They continue to grow vegetatively, they flower and they form pods resulting in seeds or pods of different sizes that require manual harvesting at different times

AGROCLIMATIC REQUIREMENTS
   - Soyabean thrives in warm weather.
   - Rainfall above 450mm is required for good yields. High moisture requirement is critical at germination, flowering and pod forming stages. However dry weather is necessary for ripening.
   - Loamy soils are best for soyabean production. The crop performs badly in poor sandy soils with low organic matter content but can do well in these soils with good soil management. Soya bean grown in sandy soils are very sensitive to drought.
   - It does well in free draining soils and pH of 5-7. Soils with a pH below 5 adversely affect Rhizobium survival.
   - Soils that easily compact and form a crust must be avoided for growing soybean because the protruding soybean seedling (hypocotyl) breaks easily under resistance.
   - Soybeans can tolerate brief water logging
Can be rotated with maize, cotton and wheat.

**THE SOYABEAN VARIETIES**

**ACTIVITY 2.1**

*ASK the participants to: Name the soybean varieties that they know. Indicate the types that are commonly grown in the area. State and explain the factors they consider when choosing bean varieties to plant.*

In your discussion include the following points:

**Factors to consider when selecting varieties**

When choosing a variety to grow in your particular farming area the following points are very important:

- The variety must fit in a growing season of 4 to 4 ½ months.
- The variety should give the highest yield for that particular area.
- The variety must be resistant to lodging especially where combine harvesters are used.
- The variety should have a longer period between physiological maturity (time when no more dry matter is added to seed) and pod shattering.
- High pod clearance to reduce losses when harvesting with a combine harvester.
- Resistance to diseases, especially red leaf blotch, frogeye and soyabean rust.
The following varieties highlighted in table 2.1 can be considered:

**Table 2.1: Some of the characteristics of common soyabean varieties grown in Zimbabwe**

<table>
<thead>
<tr>
<th>Variety</th>
<th>Days to maturity</th>
<th>Growth habits</th>
<th>Disease susceptibility</th>
<th>Pest/diseases resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC Squire</td>
<td>125</td>
<td></td>
<td>Susceptible to downy mildew, bacterial pustule, wildfire and frogeye</td>
<td>Highly resistant to rust, tolerant to red leaf blotch</td>
</tr>
<tr>
<td>SC Saga</td>
<td>126</td>
<td>Indeterminate</td>
<td></td>
<td>Highly tolerant to frogeye leaf spot and rust</td>
</tr>
<tr>
<td>SC Serenade</td>
<td>126</td>
<td></td>
<td>Susceptible to rust</td>
<td>Very good tolerance to frogeye leaf spot</td>
</tr>
<tr>
<td>Safari</td>
<td>128</td>
<td></td>
<td>Highly susceptible to rust</td>
<td>High resistance to frogeye leaf spot, wildfire and downy mildew</td>
</tr>
<tr>
<td>Santa</td>
<td>126</td>
<td></td>
<td></td>
<td>High tolerance to bacterial blight and red leaf spot</td>
</tr>
<tr>
<td>Siesta</td>
<td>125</td>
<td>Determinate</td>
<td>Susceptible to red leaf blotch</td>
<td>Highly resistant to wildfire, downy mildew and frogeye leaf spot</td>
</tr>
<tr>
<td>Sequel</td>
<td>125</td>
<td></td>
<td></td>
<td>Highly tolerant to rust</td>
</tr>
</tbody>
</table>

**Closing the session**

- Give farmers 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 worker and give feedback in the next session.
- Go back to the objectives and ask farmers to explain what they have understood on each of the objectives, and close the session by asking these questions. This will go a long way in assessing the effectiveness of this session.
Preparation for the training: The trainer should take time to read and understand the training content.

**Learning outcomes**
By the end of the session they should be able to:
1. Appreciate the different methods and equipment used in land preparation for the soyabean crop.
2. Understand and appreciate importance of CA practices in land preparation
3. Practice and be able to make rip lines and furrows

**Duration:** 4 hours

**Methodology:** plenary/presentation/discussion/brainstorming and demonstration

**Materials required**
1. Flip chart and markers.
2. Fact sheets in vernacular language.
3. Rippers for demonstrating how to make rip lines.

Land preparation is a critical stage in the soyabean production cycle. Poorly prepared land may result in soil erosion, poor germination, weed infestation and harvesting losses.

**TILLAGE SYSTEMS**
Two tillage systems are normally used in soyabean production namely conventional and conservation tillage systems

- **Conventional** tillage systems aim to produce a seedbed, which is firm, deep and fairly fine. Land is ploughed, disked and harrowed if necessary to obtain a fine tilth. The tillage pulverises the soil structure, leaving the soil exposed to erosion. Over time, a plough pan (a compacted layer of soil that is difficult for roots or water to penetrate) develops. The several tillage operations and exposure of soil to erosion make conservation tillage unsustainable.

- **Nowadays** there is widespread use of conservation tillage systems with soya beans (zero tillage, reduced tillage etc.). **Conservation tillage aims to carry out tillage only to the extent that is needed to produce a crop and with the primary aim of conserving soil and water.**

- Under conservation tillage furrows are opened up for seed and fertilizer placement in land where soya bean is to be planted. To conserve water and nutrients at least 30% of the soil surface must be covered with residue after planting the next crop. Some conservation tillage methods forego traditional tillage entirely and leave 70% residue or more. This system has two important features; that crop residues are left on the soil surface and that the soil is not inverted and may not be tilled at all.

**CONSERVATION/MINIMUM TILLAGE**
Conservation tillage may also be conducted using a hoe to mark holes or farrows to which will be the planting stations. An ox-drawn ripper may also be used to mark furrows under conservation tillage. Apart from the planting station, the rest of the field is not disturbed.
Ripping

Ripping also known as Mulch ripping involves use of ripper tines to make rip lines along the intended planting row, following the contour line. Planting stations are marked out along the row with a hoe ready for hand planting, or the seed is sown directly into the furrow by hand or with a machine planter and then covered. It is useful where soils have a hard top-soil or surface crust, and/or where crops like soya beans, dry beans or groundnuts are to be grown. Ripper tines are available which fit onto the ox-plough beam after removal of the mouldboard.

Zero Tillage

Zero-tillage involves sowing the crop directly into an untilled soil. Planting stations are made with hoes, or the seed is sown with a specially made machine planter. The great benefits of zero-tillage are that it does not require draught power, while soil and water are conserved, and yields may be stabilised or enhanced.

**ACTIVITY 3.1**

*Ask the participants if they are practising reduced tillage, stating the reasons for practising or not practising it. What are the benefits and challenges associated with reduced tillage?*

**Benefits of minimum or conservation tillage**

Minimum/conservation tillage reduces soil erosion by as much as 60%-90% depending on the conservation tillage method; pieces of crop residue shield soil particles from rain and wind until new plants produce a protective canopy over the soil. Organic matter added as crop residue decomposes creates an open soil structure that lets water in more easily, reducing runoff.
Other practical benefit to the farmer

**ACTIVITY 3.2**

*In groups discuss the other practical benefits from minimum/conservation tillage outlined below and make presentations to the class.*

- CA means less work because it is not necessary to plough the soil and, once established, it is not necessary to weed as many times, thereby overcoming shortages of labour and draught power.
- Depending on gender roles, CA can reduce women’s labour and free up time for women to attend to children, other home chores, and pursue other livelihood activities. Fewer trips across the fields saves time and money (lowers fuel, labor and machinery maintenance costs) and reduces soil compaction that can interfere with plant growth.

**Closing the session**

- Give farmers 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 objectives and ask farmers to explain what they have understood on each of the objectives, and you may close the session by asking these questions, this can help to measure the effectiveness of your session.
SESSION FOUR: PLANTING

Preparation for the training: The trainer should take time to read and understand the training content.

Learning outcomes
By the end of the session they should be able to:
1. Explain the importance of planting early in the seasons;
2. Appreciate the different factors that should be considered when planting soyabean
3. Practice planting soyabean using available equipment

Duration: 4 hours

Methodology: Plenary/Presentation/Discussion and Demonstration

Materials required
1. Flip chart and markers.
2. Fact sheets is available
3. Direct seeders

PLANTING TIME
Planting must be undertaken when the seed bed has adequate moisture. Soyabean will fail to germinate if planted with inadequate moisture in hot soils. Please note, farmers should NEVER DRY PLANT SOYABEANS!

- Plant when the rains are well established to avoid dry spells after planting
- Plant in the morning or evening to avoid direct sunlight on the inoculated seed. Sunlight will make the inoculant ineffective

Planting time is dependent on the amount of rainfall received in both November and December. If November receives poor rains than December, yields are better on the December crop. Planting very early may result in harvesting difficulties, as rainfall is often substantial in March whereas late plantings stand the risk of running out of water during pod-fill.

General optimum planting dates are:

<table>
<thead>
<tr>
<th>Highveld</th>
<th>Mid to late November</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middleveld</td>
<td>Late November</td>
</tr>
<tr>
<td>Lowveld</td>
<td>Late November to early December</td>
</tr>
</tbody>
</table>

However, it is important to note that these are mere guidelines and the obtaining situation in any locality should inform the planting dates. This is more so under the climate change scenario. Farmers are urged to refer to weather forecast in deciding when best to plant. They should also seek the advice of their extension officers.

SEED QUALITY

- Use only high quality seed for planting (preferably certified seed)
- Make sure seed is 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 a germination test at least 10 days before planting. Plant 50 seeds. If at least 40 emerge, the seed is good for planting. If 30-40 emerge, plant more seeds than recommended. Get new seeds if less than 30 seeds emerge.

SEED RATE and PLANTING DEPTH
The recommended seed rate is 100 kg/ha. However this rate may be increased to achieve the optimal plant population if the germination percentage dictates so.

Planting depth is critical.
• Plant at 2-5 cm deep. Planting deeper than 5 cm may result in loss of vigour or failure to emerge.
• In sandy or light soils seed can be placed 4 cm deep.
• In heavy soils (high clay content) a depth of 2-3 cm is adequate.
• If it rains soon after planting, a crust may form that will hinder germination. A light spike harrowing across the rows will aid germination.

PLANT SPACING AND PLANT POPULATION
• Plant in rows. This has many advantages: you get the correct plant density, weed management is easier, and harvesting is more efficient.
• Inter and in-row spacing depends on the variety. Generally early maturity varieties need closer spacing than late maturity varieties.
  ✓ Plant early maturing varieties in rows which are 45-50 cm apart. Within rows, plant seeds at 5-7 cm apart from each other (1 seed per station)
  ✓ Plant late maturing varieties in rows which are 60 cm apart. Within rows, plant seeds at 7-10 cm apart from each other (1 seed per station)
• Populations of over 300 000 plants/ha can only be used with short statured varieties like Soma, Nyla, and possibly Storm. To obtain 300 000 plants/hectare more seeds than that must be sown to allow for germination percentage and field losses. These losses vary with soil, and weather conditions etc., but 350 000 to 400 000 seeds/ha are usually planted.

PLANTING METHOD AND BASAL FERTILIZER APPLICATION

Hand planting
1. Cut shallow (5-7 cm deep) planting furrows into moist soil. The planting furrows can be cut by hoe or by an animal drawn ripper.
2. Dribble basal compound fertilizer into the furrow at a rate of 150-200 kg/ha (ideally rate determined by soil tests). Refer to table 4.1 for fertilizer rates. In fertile soils e.g. previously well-manured, fields previously planted to a well fertilised crop like cotton or wheat, use less basal fertiliser. One handful should be dribbled on one metre length to give approximately 150 kg per ha.
3. The fertilizer placed in the furrow should be covered with 2 cm of soil. It is important that there is no direct contact between the seed and fertilizer to avoid seed “burn” and/or rendering the inoculant ineffective.
4. Follow-up immediately with placement of inoculant-dressed seed in the furrow (on top of the soil covering the fertilizer). Cover to depth of 2-3 cm immediately. A spike harrow is recommended for covering the seed. Farmers however use other methods.

**Using a planter**

The direct seeder can be used for soyabean planting with the relevant adjustments. The direct seeder will also apply fertilizer at the calibrated rates. Ensure that dry seed is placed in the seeder/planter by drying it in the shade after inoculation.

**Note:**

- Planting furrows must be fertilised, planted and covered as soon as possible. If left open soil dries out and inoculant may be killed by the high drying temperatures.
- If dressed seed is left uncovered, the bacteria are exposed to sunlight and ultra-violet light and are killed.
- Whatever method is used it is essential not to plant too deep.
- If surface crusting has occurred before emergence, dampening the soil with irrigation or breaking the crest with a millipede can be very useful.

![Figure 4.1: Use of direct seeder for soyabean planting](image)
Table 4.1 shows the practical application of recommended fertilizer rates under soya. Use a teaspoon or beer/soft drink cap to measure the amount of fertilizer and apply it in the furrows, according to the distances in the table.

Table 4.1: Fertilizer application rates under soyabean

<table>
<thead>
<tr>
<th>Fertilizer type</th>
<th>Rate (kg/ha)</th>
<th>Row spacing: 50 cm in a furrow, spread 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Teaspoon</td>
</tr>
<tr>
<td>SSP</td>
<td>225</td>
<td>Beer/soft drink bottle top/cap</td>
</tr>
<tr>
<td>Compound L</td>
<td>150-200</td>
<td>Every 40 cm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Every 30 cm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Every 40 cm – 30 cm</td>
</tr>
</tbody>
</table>

Closing the session
- Give farmers 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 objectives and ask farmers to explain what they have understood on each of the objectives, and you may close the session by asking these questions, this can help to measure the effectiveness of your session.
Preparation for the training: The trainer should take time to read and understand the training content.

Learning outcomes
By the end of the session they should be able to:

1. Understand the importance of rhizobium and its application.
2. Understand when and how the different fertilizers should be applied.
3. Practice correct application of rhizobium.

Duration: 4 hours
Methodology: Plenary/Presentation/Discussion and Demonstration

Materials required
1. Flip chart and markers.
2. Fact sheets
3. Rhizobium, sugar and water

Discussion Points: Discuss with farmers some of the best practices in soyabean soil fertility management and if possible use examples and guided by the notes below.

Fertilizer and lime rates should be informed by soil analysis recommendations. When recommended, lime should be applied to bring the soil pH to around 5.3.

INOCULATION
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. Farmers are cautioned against the use of toxic seed dressings, which will kill the bacteria. Of the commonly used dressings, Thiram is considered to be safe to use with inoculant provided that the seed is planted soon after inoculation.

How to inoculate soybean with rhizobia

1. Spread 100 kg of soybean seed on a clean plastic sheet or in a large container.
2. Mix 100 g of inoculant and 1 litre of water in a clean bucket.
3. Add 50 grams of sugar into the solution. The sugar acts as an adhesive between the seed and the inoculant.
4. Stir the solution for 30 seconds.
5. Sprinkle the inoculant mix onto the seed.
6. As you sprinkle the inoculant onto the seed, turn the seed gently to ensure that all seeds are coated with the inoculant. The coated seeds should look shiny wet.
7. After thorough mixing of the seed with inoculant spread the inoculated seed on a tarpaulin or other clean surface under a shade (a tree) and leave for about 30 minutes to dry.
8. Plant immediately after inoculation and protect the inoculated seed from direct sunlight by covering the container with paper, cloth or hessian bag placing under a shade (tree). The inoculated seed should be planted within 24 hours of inoculation.

9. Sow the seeds in moist soil and cover immediately afterwards to protect the rhizobia from sunlight.

Each inoculant packet is sufficient for 100 kg of seed. For smaller amounts of seeds, use 10 g inoculant (2 heaped teaspoons), 5 g sugar (1 teaspoon) and 100 ml water per 10 kg seed.

Important:

- The right inoculant must be used with the right legume. You should not apply, for instance, a bean inoculant on soybean seed.
- Inoculant contains living organisms that must be protected from heat and sun. Therefore always store the package in a cool place away from direct sunlight (for example, in a clay pot in the coolest place in the house).
- Inoculants lose their effectiveness when stored in an open package. Always store inoculants in their original package and use them quickly after opening the bag.
- Seeds should be coated with inoculant just before planting.
- Nodulation will fail if the inoculated seed is exposed to the sun for any length of time or is sown into dry soil and left for several days before irrigation/rain.
- Do not use inoculant after its sell-by date, as the inoculant may then not be effective anymore.

Activity 5.1

Inquire about farmers’ experiences in using inoculant, are farmers using rhizobium if so what are some of the benefits and challenges from using the product.

SOYABEAN NUTRIENT REQUIREMENTS

The nutritional requirements of soya beans are moderately high in comparison with other grains. Soya beans consume more phosphorus, potassium, magnesium and calcium than maize crops do. The soya bean plant has a strong tap-root system and is able to use nutrients in the subsoil very effectively.

The nitrogen requirement of soya bean is met from the action of nitrogen fixation in the root nodules, but care must be taken that the seeds are inoculated with the correct nitrogen-fixing bacterium this enables plants not only to fix nitrogen to meet their own requirements, but also to carry over 30 to 50 kg of available nitrogen to the subsequent crop. There is therefore no need to apply nitrogen fertilizers like urea or ammonium nitrate. Other elements like phosphorous (P),
potassium (K) and microelements (calcium, manganese, sulphur) have to be supplied through fertilizers.

Soyabean does very well in rotation with a heavily fertilised crop where it utilises efficiently the residual fertiliser in the soil.

The availability of soil nutrients to soyabean crops is affected by soil pH. It is generally recommended that soil pH should be above 5.3. As soya beans are responsive to lime on acid soils, applying lime to the soyabean phase of crop rotations is considered to be good practice.

**BASAL FERTILIZERS**
On soils of poor to medium soil fertility, fertiliser is recommended to sustain the crop for the first six weeks before effective nodulation occurs. Soyabean needs phosphorous at planting. Good fertilizer types that supply phosphorous are SSP and Compound L. The recommended fertiliser application is 150-200 kg of Compound L or 200-250 kg of Single Super Phosphate (SSP) per hectare before planting, particularly where fertility is low. Gypsum can also be applied as basal fertilizer. Soyabean responds well to manure application.

**Activity 5.2**

*Practical demo*

*Demonstrate to farmers the application of rhizobium. Give the farmers an opportunity to practice rhizobium application.*

**Closing the session**

- Give farmers 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 objectives and ask farmers to explain what they have understood on each of the objectives, and you may close the session by asking these questions, this can help to measure the effectiveness of your session.
Preparation for the training: The trainer should take time to read and understand the training content.

**Learning outcomes**
By the end of the session they should be able to:
1. Understand and appreciate the importance of timely weeding.
2. Appreciate and understand the different control methods for common weeds.

**Duration:** 2 hours

**Methodology:** plenary/presentation/discussion/ and demonstration

**Materials required**
1. Flip chart and markers.
2. Fact sheets
3. Herbicide samples may be required.

**Discussion Points:** Discuss with farmers common weeds and weed management in soyabean where possible use examples and guided by the notes below

**WEEDS AND THEIR CONTROL**

Inefficient weed control is one of the main causes of low yields in soya bean.

- Weeds are unwanted plants that grow amongst crops in the field. They compete with crops for water, nutrients, space and light.
- Weeds can be categorised as annual and perennial weeds
  - Annual weeds complete their life cycle within one season (*ask participants to give examples of annual weeds*).
  - Perennial weeds have a life cycle longer than one season. They are present in the field all the time and usually multiply vegetatively (roots and stems) (*ask participants to give examples of annual weeds*).

**Activity 6.1**

*Discuss how farmers control weeds in soyabean. Do farmers use herbicides to control weeds? If so, which herbicides do they use? If not, what are the reasons for not using herbicides? What technical support do farmers require in order to use herbicides effectively?*

Control weeds to minimize competition for nutrients, water sunlight and space. Weed control can be manual, chemical, cultural, or different combinations of any of the three. Early weed control is important since soya beans are sensitive to weed competition during the first six weeks.
Manual weed control:

Traditionally weeding with hoes is effective for small plantings of one or two hectares or where labour is plentiful. Weed within 2 weeks of planting and again 5-6 weeks after planting, depending on the weed pressure. If the plants grow very well and the canopy closes early, the second weeding is not needed. After 6-8 weeks soybeans can compete with all but the most persistent weeds, which may have to be removed by hand. Avoid weeding immediately after it has rained as this would lead to ineffective weed control. Poor hoe weeding or delay in weeding could cause significant reductions in soybean yields

Chemical weed control:

- Herbicides, if used properly, are safe and effective in controlling weeds. They offer a cost effective method of weed control in soybean production. While small areas can be weeded with hoes, we encourage farmers taking up soybean as a cash crop to use appropriate herbicides.
- Herbicides are available for pre-emergence or post-emergence weed control.
  - Pre-emergence herbicides are applied immediately after planting, but before the crop germinates.
  - Post-emergence herbicides are applied after both the crop and the weeds have germinated.
- Which type to use depends on the predominant weed species and the availability of the herbicide.
- Knowledge of the weed problems in a field and proper weed identification are essential when making herbicide decisions.
- Most herbicides selectively control certain weeds when applied as directed on the herbicide label. Weeds not listed on the label probably will not be controlled.
- Always read the label carefully and follow directions concerning application rates, timing, spray additives, application technique, personal protective equipment, and any restrictions when using chemicals.
- Use herbicides as presented in table 6.1 or seek advice from an extension agent.
Table 6.1: Herbicides used in soyabean production

<table>
<thead>
<tr>
<th>Product name</th>
<th>Active ingredient</th>
<th>Use rate</th>
<th>Amount for one sprayer load (20 l knapsack)</th>
<th>Weed spectrum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual Magnum</td>
<td>Metolachlor</td>
<td>1.1 l/ha</td>
<td>82 ml</td>
<td>Broad-leaf weeds and grasses</td>
</tr>
<tr>
<td>Sencor 480 SC</td>
<td>Metribuzin (triazine)</td>
<td>1.1 l/ha</td>
<td>75 ml</td>
<td>Broad-leaf weeds and grasses</td>
</tr>
<tr>
<td>Lasso 48 EC</td>
<td>Alachlor</td>
<td>2.5 l/ha</td>
<td>75 ml</td>
<td>Grasses and volunteer wheat</td>
</tr>
<tr>
<td>Fusilade Super</td>
<td>Fluaziflop-p-butyl</td>
<td>1.5 l/ha</td>
<td>75 ml</td>
<td></td>
</tr>
<tr>
<td>Classic</td>
<td>Chlorimuron ethyl</td>
<td>45 g/ha</td>
<td>5 g</td>
<td>Nutsedge and broad-leaved weeds</td>
</tr>
</tbody>
</table>

Dual Magnum, Sencor 480 SC and Lasso 48EC are pre-emergence herbicides while Fusilade Super and Classic are post-emergence herbicides.

Cultural weed control
Production practices that allow early establishment of the crop 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 soybean crop. Removing weeds in the field before they have reached physiological maturity (formed seeds) is an important weed control strategy for the next crop in the following cropping season even if you have already harvested your crop. This prevents the weeds from producing seeds that would have germinated in the next cropping season.

Activity 6.2

**Practical Demo**
Demonstrate proper herbicide application, following the following sequence:
weed identification, herbicide selection, reading and understanding the herbicide label, sprayer calibration, mixing the herbicide, herbicide application and safety precautions (safe use of herbicides).

Closing the session
- Give farmers 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 objectives and ask farmers to explain what they have understood on each of the objectives, and you may close the session by asking these questions, this can help to measure the effectiveness of your session.
SESSION SEVEN: PEST AND DISEASE MANAGEMENT

Preparation for the training: The trainer should take time to read and understand the training content.

Learning outcomes
By the end of the session they should be able to:
1. Identify the major pests and diseases of soyabean
2. Appreciate and understand the management of the major pests and diseases.

Duration: 2 hours
Methodology: Plenary/Presentation/Discussion and Demonstration

Materials required
1. Flip chart and markers.
2. Fact sheets
3. Posters showing pictures of different pests and diseases

Discussion Points: Discuss with farmers common soyabean pests and diseases and their management. Where possible use examples and be guided by the notes below.

MAJOR PESTS OF SOYABEAN

ACTIVITY 7.1

Enquire from farmers on major soyabean pests in the area and how they manage them? Do the pests pose a serious problem to soyabean production? Are the management practices employed by farmers effective? Discuss.

Soyabean has relatively few pests compared to other grain legumes. It is subject to attack by leaf eaters such as semi-loopers and leaf rollers. Common pests affecting soyabean in Zimbabwe are aphids, the green stinkbug, cutworms and snout beetle.

The crop can tolerate up to 30 per cent defoliation without significant yield loss, above which economic yield loss occurs. If pests are damaging leaves, there is no need to spray, as leaf damage is
unlikely to reduce the yield. From flowering onwards soyabean becomes attractive to pod sucking bugs that can seriously reduce seed quality.

If pests are damaging pods, control them by spraying with pesticides. Some examples of insecticides are indicated in table 7.1. Always follow the manufacturer’s recommendations or seek advice from an extension agent.

**Table 7.1: Insecticides for controlling insect pests in soyabean.**

<table>
<thead>
<tr>
<th>Product name</th>
<th>Name of active ingredient</th>
<th>Use rate (L/ha)</th>
<th>Amount for one sprayer load (20 l)</th>
<th>For which pest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karate</td>
<td>Lambda-cyhalothrin</td>
<td>0.1</td>
<td>5 ml</td>
<td>Cutworms, bollworms, loopers</td>
</tr>
<tr>
<td>Fenvalerate</td>
<td>Fenvalerate</td>
<td>1</td>
<td>50 ml</td>
<td>Cutworms, flea beetles, bollworms, semi-loopers</td>
</tr>
</tbody>
</table>

**MAJOR DISEASES OF SOYABEAN**

**Activity 7.2**

*Enquire from farmers on major soyabean diseases in the area and how they manage them? Do the diseases pose a serious problem to soyabean production? Are the management practices employed by farmers effective? Discuss how disease control can be made effective.*

Soyabean diseases can be caused by fungi, bacteria or viruses. They can result in major yield losses. Common soyabean diseases are mentioned in table 7.2.
Table 7.2: Major soyabean diseases

<table>
<thead>
<tr>
<th>Causative Agent</th>
<th>Disease</th>
<th>Description</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fungi</td>
<td>Rust</td>
<td>The infected leaves have small tan to dark brown or reddish brown lesions on which small raised pustules (or ‘bumps’) occur on the lower surface of the leaves. Brown or rust-coloured powder falls when severely infected leaves are tapped over a white paper or cloth. Severe infection leads to premature defoliation and yield losses up to 80%. The disease is of great economic importance in the areas where rainfall and humidity are high. Late planted soybean is prone to soybean rust infection.</td>
<td>Use Carbendazim / Flusilazole (Punch® Extra at 350 to 500 ml/ha) and Triadimenol (Shavit® at 500 ml/ha). 2-3 fungicide sprayings will be required at 3 week intervals beginning at first flower. Ensure good cover spray of all leaves, but especially the upper leaves of the canopy. Planting should be timely at least before end December.</td>
</tr>
<tr>
<td>Fungi</td>
<td>Frogeye leaf spot</td>
<td>Symptoms appear as brown, circular to irregular spots with narrow reddish brown margins on the leaf surfaces. The central areas of the spots turn ash grey to light brown. Sometimes lesions can develop on stems and pods from where mature seeds are infected. Infected seeds may show discoloration of the seed coat that ranges from small specks to large blotches of light to dark grey or brown.</td>
<td>Used of non-infected seed and resistant varieties, in combination with crop rotations. Foliar fungicides are not often economical unless disease starts early on a very susceptible variety.</td>
</tr>
<tr>
<td>Fungi</td>
<td>Damping off and Anthracnose</td>
<td>Seed borne diseases caused by several fungi. The diseases cause rotting of seeds before emergence from the soil or death of seedlings after emergence. When seedlings emerge from the soil, they often have brown, sunken cankers on the leaves, which can become covered with pink spores in moist weather. Damping off and anthracnose are favoured by cool weather.</td>
<td>Plant good quality seed in well drained, non-compacted fields. Fungicidal seed treatments may reduce seed and seedling diseases. Seed treatment with 2 or more active ingredients like Apron Star</td>
</tr>
<tr>
<td>Bacteria</td>
<td>Bacterial blight</td>
<td>Plant resistant varieties. Rotate with non-host crops. Use pathogen-free seed. Avoid field cultivation when foliage is wet.</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>When plants are infected early in the season they may be stunted and die. Symptoms in later growth stages consist of angular lesions, which begin as small water-soaked yellow to light brown spots on the leaves. The centres of the spots will turn a dark reddish-brown to black and dry out. Water-soaked tissue then surrounds the lesions and is bordered by a yellowish-green halo. Eventually the lesions will fall out of the leaf. The disease spreads during windy rainstorms and during cultivation while the foliage is wet. The bacteria are carried over in crop debris and in infected seeds. Seeds usually do not show symptoms.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wildfire</td>
<td>Plant resistant varieties. Rotate with non-host crops. Use pathogen-free seed. Avoid field cultivation when foliage is wet.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Symptoms consist of light-brown necrotic spots of variable size, surrounded by broad yellow halos on the leaves. In damp weather the spots enlarge forming large dead areas on the leaf. Wildfire disease is commonly associated with bacterial blight. The bacteria causing wildfire are seed-borne and also are carried over in crop debris.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virus</td>
<td>Soyabean Mosaic Virus (SMV)</td>
<td>Plant seeds free of viruses (SMV and others). Plant early.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Viral diseases can be transmitted by aphids, beetles and whiteflies. Soybean seeds originating from infected plants can also carry viruses. Most of the viral diseases result in foliar symptoms such as mosaic and mottling, thickening/brittling of older</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
leaves, puckering, leaf distortion, severe reduction in leaf size, and stunting of plants.

**General Disease Control**

**Fungal and Bacterial**

- Plant resistant varieties.
- Plant in a good seedbed and avoid poorly drained or compacted soils.
- Rotate soybean with non-legumes to prevent the built-up of diseases.
- Treat seeds with fungicides (for example Captan, Apron Star or Thiram).

**Viral**

- Plant resistant varieties.
- Many viruses involved in mosaic disease are seed transmitted. Therefore, do not plant seeds from mosaic-affected plants. Instead, use certified seed or use seeds from healthy plants only.
- Uproot and destroy affected plants. This can reduce the incidence of insect-transmitted viruses.
- Control weeds in and around the soybean fields.
- Soybean is most vulnerable to virus infections in the pre-flowering stage. During this period, spray one or two times with insecticides to reduce the number of insects that can transmit viruses.

**ACTIVITY 7.3**

*Discuss what measures farmers should take to ensure the safe use of pesticides.*

**Safe use of chemicals**

- Use only herbicides, pesticides and fungicides that are recommended for use on soybean to avoid damage to the plant.
- Chemicals can be toxic, so always follow instructions on the product package or from the agro-dealer for safe use. Also follow the instructions about the time needed between spraying and safe consumption of fresh pods.
- Do not store chemicals in the same place as food.

Do not eat from the same spoon you used to measure chemicals.
Closing the session

- Give farmers 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 objectives and ask farmers to explain what they have understood on each of the objectives, and you may close the session by asking these questions, this can help to measure the effectiveness of your session.
Preparation for the training: The trainer should take time to read and understand the training content.

**Learning outcomes**

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

1. Appreciate the optimum time for harvesting;
2. Explain the critical loss points in harvesting and post-harvest handling
3. Appreciate different categories of storage pests;
4. Appreciate the different storage techniques and facilities that can be used

**Duration:** 2 hours

**Methodology:** Plenary/Presentation/Discussion and Demonstration

**Materials required**

1. Flip chart and markers.
2. Fact sheets
3. Models of improved grain storage structures

**Discussion Points:** Discussion on with farmers about their experiences harvesting soyabean, when to harvest, how, technologies, reducing harvesting loses. Be guided by the notes below;

**HOW DO YOU KNOW THAT THE SOYABEAN IS RIPE?**

Depending on the variety, soybeans can be harvested between 100 and 150 days after planting. If a farmer harvests before the crop is mature, it can mould and eventually rot due high moisture, adversely affecting the quality.

Farmers can use the following factors in determining when to harvest soyabean

- Days to maturity
- The pods produce a rattling sound when shaken
- Defoliation of leaves, yellowing and drying of pods. (90% of pods)
- Most of the lower leaves have dropped and the rest are yellow coloured.
- Feel the beans inside the pods, which should be firm but not hard.
HARVESTING SOYABEAN
Using simple hand harvesting techniques a worker can cut, thresh and clean one bag (91 kg) of soya beans in a day. Under large scale production soyabean is mechanically harvested using combine harvesters.

During hand harvesting, cut the mature plants just above ground level. It is recommended not to pull the plants out by the roots. The roots of soybean plants have nodules of nitrogen fixing bacteria, which may help establish a colony of these bacteria in your soil to aid future plantings. To avoid shattering, it is advisable to harvest early in the morning.

Steps followed during soyabeans harvesting:

1. Dry the cut soybean plants in the sun and protect from rain and animals. Preferably, dry on a mat, plastic sheet or tarpaulin, or on a raised platform.
2. Thresh gently on a clean surface when the plants are dry.
3. Dry the threshed grains on mats, plastic sheets or other clean surface for two sunny days; protect from rain and animals. Test the grain to see if it is dry enough by biting or pinching grain with finger nails - grain should break or crack, not bend or stick between the teeth or fingernails.
4. Clean the grains. Winnow to remove chaff, dust and other rubbish. Also remove shrivelled, diseased, broken grains and grains of other varieties.
5. Place grain in clean bags or other containers; if re-using bags in which grain was previously stored, the bags must first be washed and then disinfected by boiling them in water for 5 minutes. If the bag is polyethylene, make sure it doesn’t touch the outside of the pot or it will melt. Completely dry the container/bag.
6. Grain can be treated before storage to control storage pests. For example, coat grain with Actellic Super. Coating grain with edible oil or ash also reduces insect pests.
7. Use hermetic bags, for example PICS (Purdue Improved Cowpea Storage) triple bags to store grain under air-tight conditions and keep away insects from the grain. Place grain in the innermost bag and tie this bag tightly, then tie the middle bag, and finally tie the outermost bag. When all the bags are tied, any insects in the grain die from lack of oxygen. It is not necessary to treat seed against storage pests when using PICS bags. There are other hermetic bags that have double bags (one inner plastic bag and an external polypropylene bag).
8. Clean the storage room; remove all old grains and insects. Do not store grain which is to be eaten in the same place as pesticides or other dangerous chemicals. Stack the grain bags on a raised platform or wooden pallet away from the wall. Avoid direct contact of storage bags with the ground. Inspect and remove infested or rotting grains on a regular basis.

Do not mix varieties when harvesting especially when heaping the crop.
Critical loss points for Soyabean

Table 8.1: Critical farm level loss points for soyabean

<table>
<thead>
<tr>
<th>Loss point</th>
<th>Type &amp; nature of loss</th>
<th>Causes of loss</th>
<th>Proposed loss management practices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field drying &amp; harvesting (13.9%)</td>
<td>Quantitative lodging, rodents, termites, storage insect infestation, theft, domestic animals, wildlife damage, late harvesting, Qualitative late rains (rotting, sprouting, moulds), storage insect infestation</td>
<td>-delayed harvesting -poor harvest management -varietal susceptibility</td>
<td>-early harvesting (immediately after attainment of physiological maturity) -early harvesting, use of proper method of harvesting, gleaning.</td>
</tr>
<tr>
<td>Storage (9.4%)</td>
<td>Quantitative storage insect pests, theft, termites, rodents, Qualitative Fungal infestation, discolouration of grain, storage pests</td>
<td>-poor storage structures -poor storage practices (drying, insect control) -resistance to grain protectants by some pests such as LGB - high moisture content at storage -poor shelling practices</td>
<td>-use of improved grain storage structures, -hermetic storage for pests like LGB -drying grain to the recommended moisture content before storage -proper storage management (use of recommended grain protectants as instructed)</td>
</tr>
<tr>
<td>Homestead drying (7.2%)</td>
<td>Quantitative Wildlife &amp; domestic animals, spoilage from rains, shattering/spillage. Qualitative spoilage from rains</td>
<td>-poor drying structures -poor management of drying process</td>
<td>-use of recommended improved drying structures (materials, dimensions, roof) -proper grain handling during drying to minimize spillage and shattering -introduction of appropriate and affordable drying technologies (e.g. solar)</td>
</tr>
</tbody>
</table>

A number of innovative grain storage technologies can be used successfully by smallholder farmers as highlighted below:

ACTIVITY 8.3
Break farmers into groups and ask them to:
- List the causes of losses in soyabean harvesting and postharvest handling
- Ask the participants to propose management practice to curb each of the losses

Major soya bean losses are incurred during field drying/harvesting, storage, and homestead drying. Harvesting, threshing, winnowing/cleaning, and storage are the critical farm level loss points for soyabean.

Table 8.1 illustrates the main critical loss points (with % loss in brackets), loss types, causes of loss for soyabean and practices to manage the losses.
1. **Hermetic bags**

Hermetic bags (already referred to earlier) are made of a multi-layer polythene material that incorporates a gas barrier that restricts oxygen and water vapour movement. The effectiveness of hermetic storage is hinged on low oxygen environment together with elevated carbon dioxide levels. These hermetic sacks are made in a variety of sizes that can hold 50kg to 3 tonnes of grain/seed. They are appropriate for smallholder farmers who may want to store small quantities of seed for planting in the next season.

The bags are prone to damage by rodents, therefore rodent management very critical.

![Hermetic bag](Image)

*Source: (https://www.rockefellerfoundation.org/blog/awareness-key-reducing-podt-harvest/)*

**Metal Silos**

![Metal silo](Image)

*Source: Institute of Agricultural Engineering, Ministry of Agriculture Mechanisation and Irrigation Development.*

A metal silo is a cylindrical structure, constructed from a galvanized iron sheet and hermetically sealed, killing any insect pests that may be present. The impact of metal silo technology includes improving food security, empowering smallholder farmers, enhancing income opportunities and job creation, and safeguarding the agro-ecosystems. Picture below metal silo shows the different components of a metal silo. The metal silo can be fabricated in different sizes, 100 kg–3000 kg holding capacity by trained local artisans, with the corresponding prices of $72.00 to $422.00 (IAE prices). Peak Trading (Pvt) Ltd sells 2 ton metal
silos at $350 each. The use of metal silo, therefore, should be encouraged in order to prevent storage losses and seed quality and viability.

Fig 4: Components of a metal silo
Source: Institute of Agricultural Engineering, Ministry of Agriculture Mechanisation and Irrigation Development.

Advantages of Silos
- Keeps soybean for long without damage
- Low maintenance costs
- Cheap in long run
- Saves space
- Easy to load & off load
- Theft proof (provided it is placed in a secure structure)
- Rodent proof
- No need for chemicals
- Decent & attractive
**Improved Granary**

![Improved Granary Image](image)

*Source: Institute of Agricultural Engineering, Ministry of Agriculture Mechanisation and Irrigation Development.*

An ideal granary should be easy to construct using local durable materials, easy to maintain, durable, economic, of suitable size, theft proof, fire proof, socially acceptable, useable for different commodities or purposes, readily accessible for loading and inspection. It should protect the seed from insect pest infestation and complete admix chemicals, protect seed from vermin, keep the seed dry and cool thereby inhibiting mould growth, seed respiration and insect multiplication. These requirements dictate how and with what materials a store should be built. The basic components of an improved granary are: foundation, floor on a raised platform, walls, roof, compartment walls, compartment ceiling, main door and compartments. Reducing post-harvest losses will contribute significantly to improving yield, quality and household income to soyabean farmers. Adoption of the storage technologies highlighted in this paper will significantly contribute to loss reduction.

**Closing the session**

- Give farmers 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 objectives and ask farmers to explain what they have understood on each of the objectives, and you may close the session by asking these questions, this can help to measure the effectiveness of your session.
## Annex 1: Soyabean Gross margin Budget

### Soyabean Budget per ha - Dryland

<table>
<thead>
<tr>
<th>Gross Yield</th>
<th>2000 kgs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producer Price</td>
<td>$0.56 per kg</td>
</tr>
<tr>
<td>Recovery Rate</td>
<td>100% of Gross Yield</td>
</tr>
<tr>
<td>Gross Income GI-(US$)</td>
<td>$1120.00</td>
</tr>
</tbody>
</table>

### VARIABLE COSTS

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Item</th>
<th>unit</th>
<th>Quantity/ha</th>
<th>Price USD/unit</th>
<th>Cost (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>Soyabean seed</td>
<td>kg</td>
<td>100</td>
<td>$1.60</td>
<td>$160.00</td>
</tr>
<tr>
<td>Fertilizers</td>
<td>Compound L</td>
<td>kg</td>
<td>250</td>
<td>$0.67</td>
<td>$167.50</td>
</tr>
<tr>
<td></td>
<td>Lime</td>
<td>kg</td>
<td>500</td>
<td>$0.12</td>
<td>$60.00</td>
</tr>
<tr>
<td></td>
<td>Rhizobium</td>
<td>kg</td>
<td>4</td>
<td>$1.25</td>
<td>$5.00</td>
</tr>
<tr>
<td>Herbicides</td>
<td>Bateleur Gold 650 EC</td>
<td>liters</td>
<td>1.0</td>
<td>$31.00</td>
<td>$31.00</td>
</tr>
<tr>
<td></td>
<td>Fusilade</td>
<td>L</td>
<td>1</td>
<td>$20.00</td>
<td>$20.00</td>
</tr>
<tr>
<td>Pesticides</td>
<td>Carbaryl</td>
<td>kg</td>
<td>1</td>
<td>$6.00</td>
<td>$6.00</td>
</tr>
<tr>
<td></td>
<td>Shavit</td>
<td>L</td>
<td>1</td>
<td>$68.00</td>
<td>$68.00</td>
</tr>
<tr>
<td></td>
<td>Thiram</td>
<td>kg</td>
<td>1</td>
<td>$263.00</td>
<td>$263.00</td>
</tr>
<tr>
<td>Packaging</td>
<td>50kg sacks</td>
<td>units</td>
<td>40</td>
<td>$0.50</td>
<td>$20.00</td>
</tr>
<tr>
<td>Labour contracted</td>
<td></td>
<td>Ld</td>
<td>6</td>
<td>$3.50</td>
<td>$21.00</td>
</tr>
</tbody>
</table>

| Subtotal | $821.50 |
| Miscellaneous @5% | $41.08 |

| Total Variable costs - TVC | $862.58 |

### Returns

| Gross Margin (profit/loss) | $257.43 |
| Cost per kg | $0.43 |
| Break even yield | 1540.31 kg |
| Net returns per $ invested | $0.30 |
| family labour required | 3 days per labour |
| Return to family labour | $76.61 day |

**NB: the gross margin budget is only a guide. Farmers should use figures relevant for their circumstances**