MINISTRY OF FOOD AND AGRICULTURE

# FSRP

West Africa Food System Resilience Program

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Edition



# PROTOCOLS

## FOR ESTABLISHING COMMUNITY FIELD DEMONSTRATIONS FOR SOYBEAN IN THE MIDDLE AND NORTHERN BELTS OF GHANA.

MINISTRY OF FOOD & AGRICULTURE
REPUBLIC OF GHANA

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MINISTRY FOR FOOD AND AGRICULTURE

FSRP

West Africa Food System Resilience Program

# DIRECTORATE OF AGRICULTURAL EXTENSION SERVICES.

# PROTOCOL FOR ESTABLISHING COMMUNITY FIELD DEMONSTRATIONS FOR SOYBEAN IN THE MIDDLE AND NORTHERN BELTS OF GHANA


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# TABLE OF CONTENT

## 1. MAIN OBJECTIVE

To increase productivity by enhancing farmers' knowledge of nutrient-dense varieties and a bundle of climate-smart technologies of soybeans.

### Specific objectives

- To demonstrate the performance of quality seeds of improved soybean varieties under local conditions.
- To compare the improved practice of the use of other climate-smart technologies, such as the use of seed inoculant, and the application of biochar and fertilizer to farmers' practices.
- To encourage the effective technology adoption of climate-smart technologies through farmer hands-on learning field days.

## 2. SITE SELECTION

- Site the demonstration field at an easily accessible location (e.g., along main roads, feeder roads, major farm paths, etc.), allowing passersby to see the plots clearly. **Please do not HIDE the demonstrations.**
- Select land that has well-drained soil, preferably sandy-loam soil.

**Table 1.**
Target locations in the middle and northern belt, and the soybean varieties to be used for the establishment of demonstrations.

| Middle/Northern Belt | | | | |
|---|---|---|---|---|
| **No.** | **Community/ Location** | **District** | **Region** | **Varieties** |
| 1 | | East Mamprusi | North East | Suong Pungun, Toondana |
| 2 | | West Mamprusi | North East | Favour, Toondana, |
| 3 | | Mamprugu Moagduri | North East | Favour, Toondana |
| 4 | | Tolon | Northern | Favour, Toondana |
| 5 | | Yendi | Northern | Favour, Toondana |
| 6 | | Savelugu | Northern | Suong Pungun,Toondana |
| 7 | | Gushegu | Northern | Afayak, Toondana |
| 8 | | Karaga | Northern | Afayak, Toondana |
| 9 | | Kumbungu | Northern | Afayak, Toondana |
| 10 | | Nanton | Northern | Afayak,Toondana |
| 11 | | Kintampo North | Bono East | Afayak, Toondana |

- Select soils with no hardpan to enhance water percolation and prevent flooding during heavy downpours.
- If possible, choose a flat land or a land with a gentle slope to avoid erosion of topsoil.
- Site must be free from litigation.
- Avoid coarse-textured or shallow soils (rocky).

## 3. SOIL SAMPLING

- Sample soil using the z-plane method.
- Sample at a depth of 0 - 20 cm.
- Sample at least 10 points along the plane.
- Mix the soils from the 10 points thoroughly and collect composite sample from it.
- Place composite samples into zip lock sampling bag and sealed accordingly.
- Label the samples with the right information using a permanent marker.

NB: The label should include location of sample, crop, lead farmer and date of sampling.

## 4. LAND PREPARATION

*Figure 1: Tractor-drawn equipment preparing land for use*

- ✓ Plan to prepare about 0.5 of an acre for this demonstration (29 x 62 m) (Refer to Figure 1 above)
- ✓ Slash and/or spray with herbicides where applicable.
- ✓ De-stump the area to remove shrubs or tree roots where applicable.
- ✓ During land preparation, turn the soil using the appropriate sustainable agricultural machinery (SAM) equipment e.g., tractor-drawn, animal drawn etc.
- ✓ Turn the soil 2 to 3 weeks before sowing.
- ✓ Evenly spread approximately 95 kg of the biochar and 95 kg of Organic manure (either poultry manure or cowdung) to the portion of the field allocated to each of the Plots 2 and 3 only.
- ✓ Harrow/level the soil surface either mechanically or manually before sowing to enhance seed germination.
- ✓ Harrowing (with incorporation of the biochar and organic manure) should be done about two weeks before sowing to level the soil surface after turning.
- ✓ Ridge with tractor, bullocks or using hoes about one week before sowing. It is vital for shallow soils or soils with a hardpan that could easily get flooded.

# 5. FIELD LAYOUT (PLOT DEMARCATION)

**a.** Clear any vegetation, debris, stones or obstacles that may interfere with demarcation and planting.

**b.** Carry out the field layout using a tape measure, lines and pegs.

**c.** Follow the field layout provided in Figure 2 below.

**d.** Measure the total field area dimension (29 m x 62 m) using a tape measure and long pegs.

**e.** Demarcate the demonstration field into plots while demarcating the buffer and boundary margins.

**f.** Each plot or practice (Treatment) size is 18 m x 25 m per treatment/plot.

**g.** Leave buffer zones or pathways (2m) between plots to allow easy access for field management, observation, evaluation, and to minimize border effects.

**h.** In addition, leave 2 m margins around the boundaries of the field

**i.** Assign plot numbers and record them on a field sheet/ notebook.

**j.** Use durable labels or waterproof tags for easy identification of treatments and varieties.

**k.** Cross-check measurements to ensure each plot meets the required dimensions.

**l.** Make any necessary adjustments before sowing begins.

**m.** Share the layout with team members for consistency in trial management

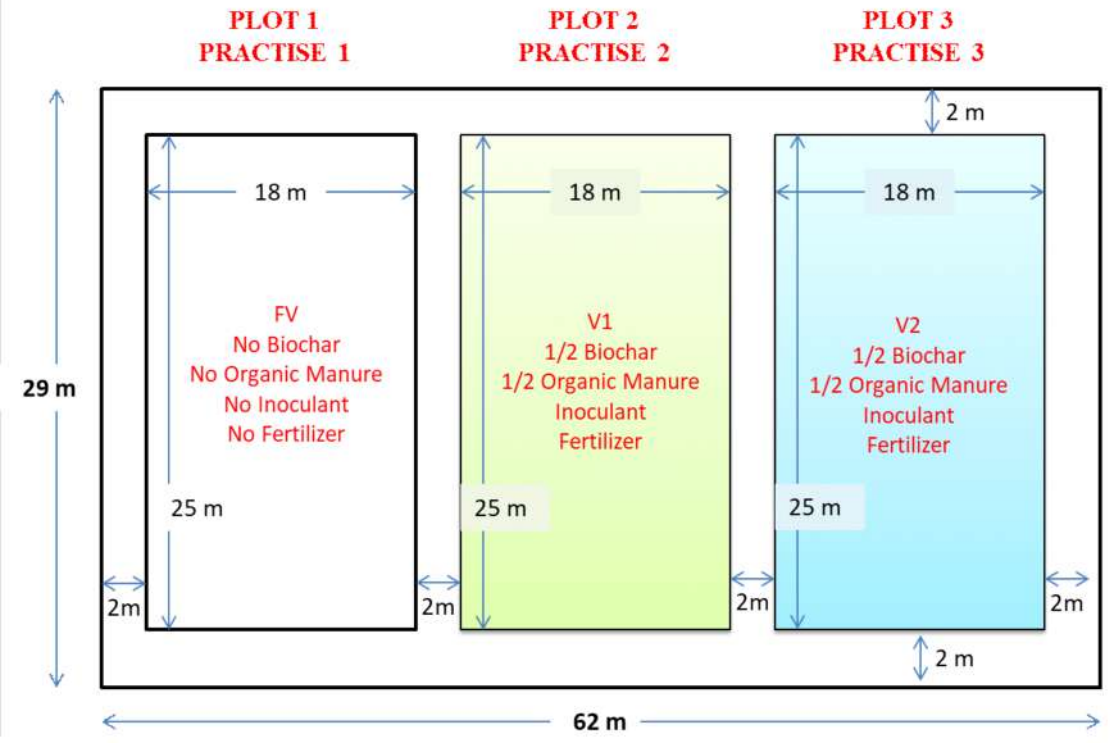



*Figure 2. Recommended field layout for the establishment of a demonstration field*

## Please Note The Following:

| | | |
|---|---|---|
| a. | 'FV' refers to | - Variety from the farmer's own source |
| b. | 'V1' refers to | - Favour or Afayak or Suong Pungun where applicable |
| c. | 'V2' refers to | - Toondana |
| d. | 'P1' refers to | - Plot 1 or Practice 1 i.e. Farmer practice plot where farmer will sow his own variety in the manner he is usec to and will most likely not carry out seed inoculation no apply fertilizer, organic manure and biochar. |
| e. | 'P2'and 'P3' | - Plots or Practices i.e. plots that will receive the bundle of improved technologies or practices for soybeans |
| f. | Number of plots | - 3 |
| g. | Plot width (Row length) | - 18 m |
| h. | Number of rows in a plot | - 30 rows |
| i. | Number of hills in a row | - 250 hills |
| j. | Number of hills in a plot | - 7500 hills |
| k. | Number of plants per0 row | - 500 plants |
| l. | Plant population per plot | - 15,000 plants |
| m. | Spacing between rows | - 60 cm |
| n. | Spacing within rows | - 10 cm |
| o. | No. of seeds per hill | - 2 seeds |
| p. | Number of varieties | - 3 varieties (2 climate-smart varieties and one farmers' variety) |
| q. | Number of treatments | - 3 treatments |
| r. | Technologies being promoted | - Climate-smart seed<br>- Biochar<br>- Organic manure<br>- Inoculant<br>- Fertilizer (TSP)<br>- Other good agronomic practices |

## 6. SEED DRESSING

**a.**Dress seeds with fungicides such as, Captan, Apron Plus or Thiram at the rate of one sachet/8 kg seeds before planting.

**b.**Dressing seeds can help protect seeds and seedlings from fungal pathogens and insect pests.

## 7. SEED INOCULATION

**a.** Inoculation enhances nitrogen fixation from the atmosphere through Rhizobium bacteria.

**b.** Inoculation minimizes nitrogen fertilizer use, thereby reducing the cost of production and increasing crop yields.

**c.** Use Sarifix inoculant.

**d.** Sarifix comes in 100 g sachets.

**e.** Each 100 g sachet can be used to inoculate 10 kg of seed.

**f.** However, since each plot shall require 3 kg of seed for planting, use only 30 g of inoculant per plot (except the farmer's plot). Note that 30 g of the inoculant sachet is a little above 1/3 portion of the whole sachet.

### Follow the following steps for seed inoculation

**a.** Measure and place 3 kg of soyabean seeds in a container large enough to accommodate the seeds.

**b.** Dissolve the gum Arabic enclosed with the inoculant packet in 50 ml of warm water (about 10 bottle corks).

**c.** Add the gum Arabic solution to the seeds by sprinkling.

**d.** Mix thoroughly until all seeds are uniformly covered with the gum Arabic solution.

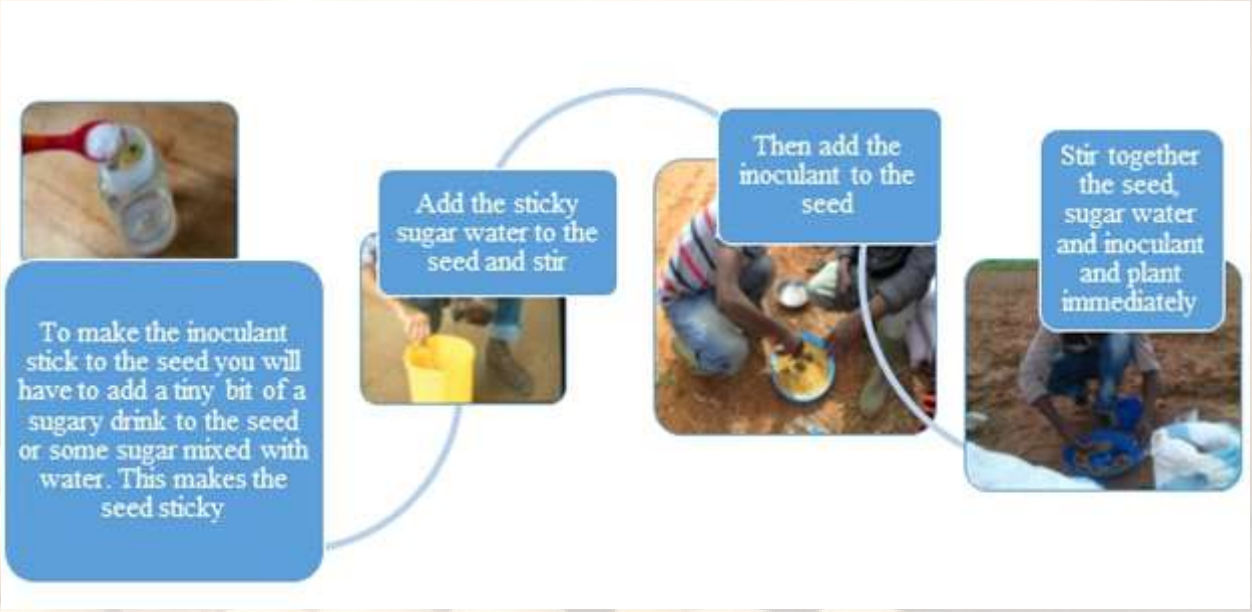



*Figure 3. Steps to seed inoculation*

**e.** Add 30 g (roughly 1/3 portion of the whole sachet) of inoculant to the seeds already covered in gum Arabic solution and mix thoroughly until all the seeds are uniformly coated with the inoculant.

**f.** You can apply the gum Arabic solution and mix the inoculant with your hands and wash your hands when done.

**g.** Avoid exposure of the inoculated seeds to sunlight by covering with a paper, cloth, etc. Exposure to sunlight will kill the rhizobia bacteria.

**h.** Cover the container with the inoculated seeds with a piece of cloth and put under a shade to allow them to cool dry for about 15 minutes.

**i.** Ensure that you sow the inoculated seeds right after the cool drying or within the same day.

## 8. SOWING

**a.** Soybean can be sown close together because close sowing does not result in intense competition for nutrients like maize and other crops.

**b.** Optimum populations are needed to obtain high yields and decrease weed problems because the crop canopy closes rapidly and shades emerging weeds between the rows.

**c.** Sow your soybean when there is enough moisture in the soil but not water logging.

**d.** Sow in the morning or late afternoon, especially when using inoculant, to escape direct sunlight, which makes the bacteria ineffective.

**e.** Sow soybean about as deep as the space between your finger joints (3-5 cm). Deeper sowing may result in loss of vigour or failure of seedlings to emerge.

**f.** Each plot will require up to 3 kg of seed.

**g.** Sow at a spacing of 60 cm x 10 cm.

**h.** Sow three seeds per hole at the spacing stated above and thin-out to two plants per hole two weeks after emergence.

**i. S**ow in rows. Do not broadcast your soyabean seeds and do not practice random sowing as any of these will not help to achieve the recommended plant population.

**j.** Sow using a cutlass, a dibber or a hand-held roller planter where applicable (Figure 4).

**k.** Conduct refilling where necessary.

**l.** The farmer will choose the mode of sowing for his/her field (Practice 1).

*Figure 4: Methods of sowing soybean seeds*

## Table 2. Seed rate

| | P1 | P2 | P3 |
|---|---|---|---|
| **PRACTICE** | **PRACTICE 1** | **PRACTICE 2** | **PRACTICE 3** |
| **PLOTS** | **PLOT 1** | **PLOT 2** | **PLOT 3** |
| **Practice/ Treatment** | FV<br>-No Biochar<br>- No Organic manure<br>-No Inoculant<br>-No fertilizer | V1<br>+ ½ Biochar<br>+ ½ Organic manure<br>+ Inoculant<br>+ fertilizer | V2<br>+ ½ Biochar<br>+ ½ Organic manure<br>+ Inoculant<br>+ fertilizer |
| **Seed rate** | Farmer to determine | 3 – 3.5 kg | 3 – 3.5 kg |

## 9. FERTILIZER APPLICATION

**a.** The Triple Super Phosphate (TSP) is a water-soluble P fertilizer for legumes with 46 % $P_2O_5$ as the active ingredient.

**b.** Measure 1 g of TSP fertilizer per hill with bottle cork; let the bottle cork guide in measuring the quantities required i.e. full cork is approximately 2g, half of a bottle cork is 1g, etc.

**c.** Apply fertilizer at sowing when there is sufficient soil moisture for both sowing and fertilizer application.

**d.** If for any reason the fertilizer cannot be applied at sowing, ensure that it is applied at the next available time within two (2) weeks after sowing and **NOT** later than 2 weeks after sowing, when there is sufficient soil moisture.

**e.** Apply the fertilizer using either the drilling method or the band placement/ spot application method.

**f.** When using the Drilling method, use a dibber (with about 5 cm width) to create a furrow opposite the side where the seeds were sown. Pour in the quantity of fertilizer and cover with soil.

**g.** When using the band placement/spot application method, make holes about 5 cm opposite the side or hole that seeds were sown and 3 cm deep.

**h.** The two methods of fertilizer application can be practiced at sowing or after sowing.

**i.** If applying after germination, place the fertilizer 5 cm away from the base of the plant.

## 10. WEED CONTROL

Follow one of the two methods of weed control described below:

### Manual weed control

**a.** Hand weeding (with hoe) is preferred.

**b.** First weeding with a hoe should be done 2-3 weeks after sowing.

**c.** Second weeding with hoe should be 5-6 weeks after sowing.

**d.** The second weeding should be done before flowering to prevent loss of flowers.

**e.** Always weed buffer or border margins.

**f.** Avoid weeding immediately after rain to avoid weed seed transport in the field.

### Chemical weed control

**a.** Pre-emergence herbicides (combine glyphosate at 100 ml and alligator 150 ml per 15 L knapsack) can also be applied immediately or a day after sowing.

**b.** Apply post-emergence, also called selective herbicides (aryloxyphenoxy propionates and imidazolinone) when soybeans have attained 3 to 4 leaves (80 ml each in a 15 L knapsack).

**c.** Control weeds in the buffer or border margins always.

# 11. PESTS AND DISEASES CONTROL

**a.** Insect pests attack soybean crops in the field right from sowing through harvest. Hence, farmers need to check fields regularly for insect damage.

**b.** Usually, one or two sprayings of these insecticides is adequate to control pests.

**c.** However, the level of pest infestation will determine the number of sprayings that will be needed.

**d.** When to first spray soyabean plants depends on the time pest infestation is noticed and the level of infestation, but usually first at flowering and then another spraying may be enough based on pest incidence – normally 21 days after the first spraying.

**e.** Spraying should be done early in the morning or late in the afternoon

## Aphids control and management

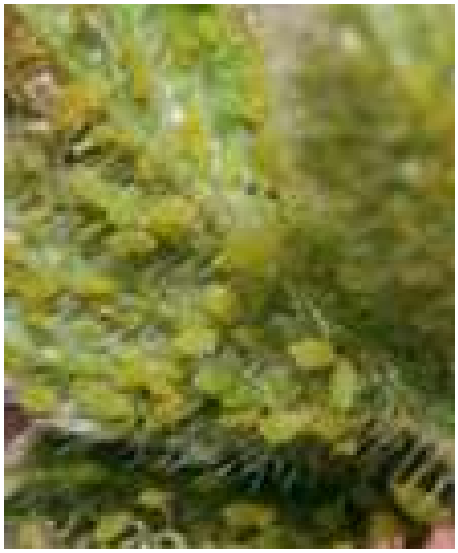
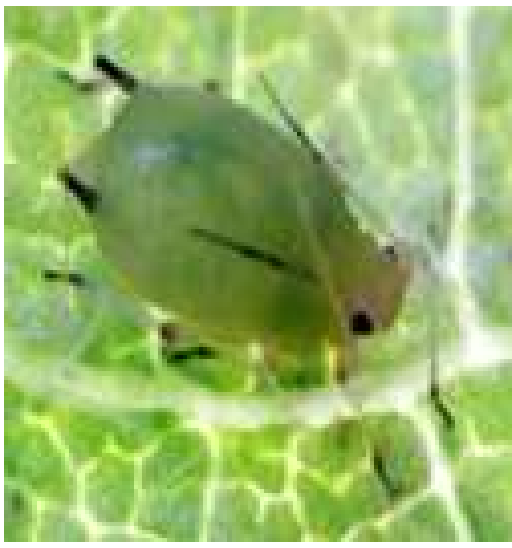
• Hand-pick and crush aphids at low infestation. Uproot and burn or bury severely infested plants more than 50 cm deep away from the crop.

• Apply neem oil. Add 10 ml of soap to 1 litre of water and stir to mix. Add 50 ml of neem oil to the 1 litre water-soap solution and mix thoroughly.
Add the oil-water-soap solution to the 15L Knapsack sprayer

• Apply Cypermethrin products (Caweperthrin, Cypercan, Fastrack 10 SC) at a rate of 40 ml/15 L knapsack sprayer

• Lambda-cyhalothrin products (e.g. Conquer Super 2.5EC, Bonlambda 2.5EC, Contihalothrin 2.5 EC) at a rate of 100 ml per 15 L knapsack sprayer

*Figure. 5 Aphids*

## Thrips control and management

• Prior to sowing, plough and harrow the field to destroy diapausing nymphs of thrips by exposing them to sunlight or natural enemies.

• Sow early to ensure the crop is well established and better able to withstand thrips infestation.

• Avoid sowing soybean near infested thrips fields to prevent cross-infestation.

• Spray with Deltamethrin products (e.g. Deltapaz 1.25 EC, Delete 2.5 SC, Decis 2.5 EC) at 75-100 mls/15 L knapsack sprayer.

• Spray Lamda-cyhalothrin product (Pawa EC, Lambda-Super EC, Controller 2.5 EC) at a rate of 35-40mls/ 15 L knapsack sprayer.



*Figure. 6 Thrips*

## Pod borer control and management

• Hand-pick eggs and larvae from plants and crush them if infestation is low.

• Create a conducive environment for natural enemies (e.g., ladybird beetles, spiders, praying mantis, etc.) to multiply, e.g. by minimizing spraying of synthetic insecticides and by mulching.

• Apply Cypermethrin products (Caweperthrin, Cypercan, Fastrack 10SC) at a rate of 40ml/15L knapsack sprayer.

• Apply Lambda-cyhalothrin 25 g/l products (e.g. Conquer Super 2.5 EC, Bonlambda 2.5 EC, Contihalothrin 2.5 EC) at a rate of 40 ml/15 L knapsack sprayer.

• Apply during early infestation and at early morning or late evening, maximum two times per sowing season.

*Figure. 7 Pod borer*



## Pod sucking bugs control and management

• Sow early to avoid periods of heavy infestation.

• Clean up haulms to prevent the pod sucking bugs from over seasoning in the crop residues.

• During flowering and pod formation, pod sucking bugs can be collected and killed by hand in small plots.

• Spray with Pyrethrin-based insecticides such as Lambda-cyhalothrin 25 g/l products (e.g. Conquer Super 2.5 EC, Bonlambda 2.5 EC, Contihalothrin 2.5 EC) at a rate of 40 ml/15 L knapsack sprayer.




*Figure. 8 Pod sucking bugs*

## Soybean weevil control and management

• Harvest grains early or promptly to avoid field infestation of soybean weevil from transferring into storage.

• Ensure that grains are clean and dried to a safe moisture level of 8- 10 % before storage.

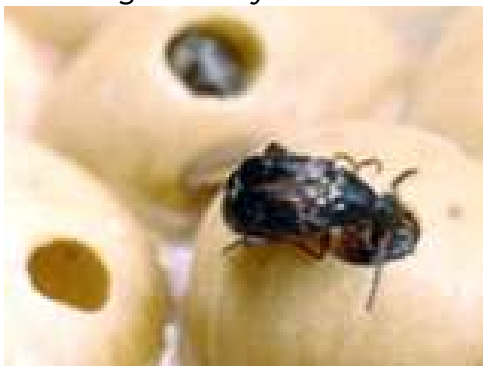
• Use airtight containers, e.g. Purdue triple plastic bags for storage.

• Disinfect storage facility and bags with pirimiphos-methyl product (e.g. Antuka EC, Ateco super 25 EC) at 250 g/L.

• Fumigate grains with aluminium phosphide (e.g. Temephos or phostoxin tablet). Use one tablet per 25 kg storage bag.

*Figure. 9 Soybean weevil*





## 12. HARVESTING

**a.** Harvest soybean when about 85 % of the pods have turned brown.

**b.** Cut the mature plants at ground level.

**c.** Stack them loosely on a tarpaulin and allow them to dry in the open (aerated space) for 2 weeks before threshing.

**d.** Do not harvest by hand-pulling because this may deprive the soil of nutrients added by the crop.

**e.** Thresh manually or mechanically when the plants are properly dried and as soon as possible.

## 13. OBSERVATIONS

**a.** Demarcate 5 x 5 m area (Net plot) for all data collection at maturity.

**b.**The following observations will be made on all plots:

- Sow establishment 2 WAP: Count the number of plants in the net plot at 2 WAP
- Days to maturity (DM): Number of days when 75% of the plants in a plot reach maturity
- Sow stand at maturity: Count the number of plants in the net plot at maturity
- Dry weight of pods /plot (DPW kg/m2): collect pods from the net plot; dry pods until the moisture is reduced to < 10 % and weigh.
- Dry weight of seeds /plot (DKW kg/m2): thresh the dry pods from the net plot and weigh

**c.** Remarks: record any special observations made during the season and at the end of season regarding growth, variability of field, drought, insect attack and diseases or any other special factor that may affect crop performance.

**d.**Farmer preferred criteria (Early maturity, grain color, resistance to insect's or diseases).

## 14. FIELD DAYS

| Field days | Activity |
|---|---|
| **First Field Day** | Seed Inoculation, sowing and fertilizer application |
| **Second Field Day** | Vegetative growth stage |
| **Third Field Day** | Reproductive phase |
| **Fourth Field Day** | Harvesting and Yield Studies or Sensory Analysis |

## General Information

**1. Expectations**

**a.**The Size of the demo must be achieved to be accepted as a demo

**b.**The host farmer must be ready and willing to invest in the demo (labour)

**c.**Demo plots shall be sited along the farmers' route

**d.**There should be a distance/alley between the demo plot and neighbouring farms

**2. Responsibilities**

**2.1 Partner**
a.Provides land for the demonstration
b.Takes care of land preparation
c.Takes care of field-sowing, fertilizer application, weeding, and harvesting

**3.0 Project:**
a.Other related costs (Inputs, meetings, incidentals)
b.Monitoring of Demo at various stages

**3.1 Have a signpost showing:**

- The treatment (s) being tested.....
- Contact information for inquiries about the demo.....

3.2 Demo Size: Half of an acre

3.3 Name of Partner .....

3.4 Name of Field Officer: .....

3.5 Name of Lead Farmer: ..... (Female/Male)

3.6 Region: ..... District: ..... Town: .....

3.7 GPS coordinates of demo plot: .....

3.8 Previous crop: .....

3.9 Please include weather data for the demo location, where available.

3.10 Record the sowing and harvesting dates, as well as the weight of the harvested soyabean, in the tables provided below:

## Sowing Date

| Treatment | Plot 1<br>Practice 1 | Plot 2<br>Practice 2 | Plot 3<br>Practice 3 |
|---|---|---|---|
| **Sowing date** | | | |

| Treatment | Plot 1<br>Practice 1 | Plot 2<br>Practice 2 | Plot 3<br>Practice 3 |
|---|---|---|---|
| **Harvesting date** | | | |
| **Weight (sub-plot 1)** | | | |
| **Weight (sub-plot 2)** | | | |

**4.0 General observations**.....

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## 5.0 Data Collection Plan for Demonstration

Farmers' comments on technologies during field days/visits

| S/No. | Name | Age (≥18) | Disabled | | Gender | | Assessment of Technology (Like or Dislike) | Reason for like or dislike |
|---|---|---|---|---|---|---|---|---|
| | | | Yes | No | M | F | | |
| 1. | | | | | | | | |
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