MODULE 5: DEMONSTRATION 5

SEED INOCULATION

PURPOSE

- To demonstrate the preparation of stickers, methods of coating seeds with inoculant and a seed pelleting technique.

CONCEPTS OF DEMONSTRATION

Sticker materials are recommended to bind the rhizobia to the seed. The stickers used in the following demonstrations are gum arabic, carboxymethylcellulose, and sugar. All these adhesives, must be dissolved in water before use.

Two seed coating methods are used; the slurry method and the two-step method. In the slurry method, inoculant is first mixed with the sticker. The resulting slurry is then applied to the seeds.

The two-step method requires seed coating in two stages. First, the seeds are coated with a sticker. The inoculant is then added and coated onto the sticky seeds. The amounts of sticker used for each method vary with seed size (Module 5).

Under certain conditions (Module 5) it is advisable to pellet inoculated seeds with a protective layer of powdered calcium carbonate or rock phosphate. This treatment is most commonly done with seeds of pasture legumes. The pellet is applied after seed coating by either the slurry method or the two-step method. The seeds are rolled in the pelleting material immediately after inoculation while they are still wet and sticky.

RECOMMENDATIONS TO FARMERS FROM RESULTS OF THIS DEMONSTRATION

To learn proper seed inoculation techniques

To follow the demonstrated procedures for seed pelleting when required.

To use stickers for seed inoculation.

CONDUCTING THE DEMONSTRATION

The amounts of materials needed should be gauged according to the number of participants in the demonstration exercise. The list of materials below is based on 10-20 practicing participants.
Material Requirements:

balance
heating plate
source of clean water
measuring container (100-500 ml capacity)
plastic bags of 1 liter capacity
plastic bags, very strong, of 20 liter capacity
wooden stirring rods
plastic buckets, 20-25 liter (5-6 gallon) capacity, with lids
methylethylcellulose (100g)
gum arabic, granular (100 g)
sugar, granular (1kg)
calcium carbonate, powdered in 1 kg
soybean inoculant, 100 packages
seeds of soybean
seeds of a pasture legume

Preparations just prior to demonstration exercise:

Twenty batches of 100 g soybean seeds in 1 liter plastic bags
Twenty batches of 100 g other seeds in 1 liter plastic bags
Ten batches of 5 kg soybean seeds in 20 liter plastic bags
Two batches of 4 g carboxymethylcellulose, approximately 250 ml
Two batches of 40 g gum arabic, approximately 250 ml
Two batches of 500 g sugar in 2 liter container
Twenty batches of 2 g inoculant (protected from moisture loss)
Twenty batches of 1.5 g inoculant (protected from moisture loss)
Ten packages of 50 g inoculant (protected from moisture loss for bulk coating)
Twenty batches of 35 g powdered calcium carbonate

Note: The techniques of this demonstration should be taught through participation. First demonstrate, then have the important parts of your demonstrations repeated. Make sure to correct any mistakes your participants may make. In order to save materials, seed batches are small for this demonstration. They may, of course, be modified according to materials available and number of people participating.

Measurements are given in grams, liters and milliliters. You are advised to convert these specific volumes and weight measurements into more convenient local units. One teaspoon, for instance, holds 5 ml of sticker and 1 heaped teaspoon of inoculant is 5 grams. Three teaspoons make 1 tablespoon. If these measurements do not apply, other measuring utensils that are readily available may be used (eg., tins, jars, etc.).
Several stickers are used here for comparison. Demonstrations for farmers may use readily available sticker (e.g., sugar).

Preparing Sticker Materials

**Gum arabic.** Heat 100 ml water in a container. Add 1 teaspoon of gum arabic and stir until it is dissolved. In the same manner, add the remaining gum while stirring until the total of 40 grams are dissolved. Set aside to cool.

**Carboxymethylcellulose.** Dissolve 4 g in 100 ml of cool water. Stir until the cellulose powder is dissolved.

**Sugar.** Place 100 ml of water into a small pot or beaker. Add 10 grams of sugar. Stir until dissolved.

THE SLURRY METHOD

**Preparing the slurry.** For coating soybean seed, a slurry consisting of one part of inoculant and three parts sticker is recommended. Refer to Module 5 for the proper proportions for seeds of various sizes. For demonstration and practice of this procedure, only a small amount of seed will be coated.

1) Weigh 2 g of inoculant and place it into a container. Add 6 ml of water. Mix the inoculant and the water until a uniform mixture is achieved.

2) Weigh 100 g of seeds and place them into a container. Add 2 ml of the slurry. Stir the seeds with a wooden stick until they are uniformly coated with the inoculant slurry. Alternatively, the seeds may be coated by shaking as described for the two-step method below.

3) Immediately after coating, spread the seeds onto clean paper and allow them to dry. Repeat the seed coating procedure (Steps 1-3) with slurries made from the other sticker solutions to achieve the treatments as summarized below:

   a) 100 g of soybean seeds coated with 2 ml of a slurry, prepared by mixing 2 g of inoculant with 6 ml of gum arabic solution.

   b) 100 g of soybean seeds coated with 2 ml of a slurry prepared by mixing 2 g inoculant with 6 ml of carboxymethylcellulose solution.

   c) 100 g of soybean seeds coated with 2 ml of a slurry prepared by mixing 2 g inoculant with 6 ml of sugar solution.

After coating, compare the four different treatments. Inspect them for evenness of coating and for adhesion quality. The best coating is usually achieved with gum arabic followed closely by carboxymethylcellulose as a sticker. Sugar should be third best. Water looks good initially but the inoculant tends to flake off the seed after drying. Whenever possible, a
sticker should be used for seed coating.

THE "TWO-STEP" METHOD

Place 100 g of soybean seeds into a plastic bag and add 2 ml sugar solution. Inflate the bag and gather the ends of the plastic bag and twist it shut, trapping a maximum of air inside. The walls of the bag must be tight. Shake the bag vigorously for about one minute until the seeds are uniformly coated. Open the bag and add 1.5 g of inoculant. Close the bag and shake gently. Stop after one minute because prolonged shaking could dislodge the inoculant from the seeds.

Repeat the coating procedure with the following treatments:

1) 100 g seed wetted with 1.5 ml gum arabic solution and then coated with 1.5 g peat inoculant.
2) 100 g seed wetted with 2 ml carboxymethylcellulose and then coated with 1.5 g peat inoculant.
3) 100 g seed wetted with 2.5 ml water and then coated with 1.5 g peat inoculant.

Immediately after coating, spread the seeds on paper and allow them to dry in a cool, shady place. Compare the five different treatments. When we compare them with the slurry treatments we will immediately notice a darker color on all the seeds. We have actually applied more inoculant to the seed by this method. Again, the gum arabic and the carboxymethylcellulose treatments usually look better followed by the sugar treatments. The inoculant will not stay on as well when water is used.

The two-step method allows us to apply a maximum amount of inoculant to the seed. We could actually apply much more inoculant, especially with gum arabic and carboxymethylcellulose. If we used, for instance, 3 ml of the sticker, we could coat as much as 10 g of inoculant for 100 g seeds, which means $10^8$ rhizobia per seed if the inoculant contains $10^9$ rhizobia per gram. Such a rate is, under normal conditions, rarely desirable and not very cost effective for farmers. To apply more than this is not practical because the seeds would clump if more sticker than 3 ml of sticker per 100 g of soybean seeds were applied.
INOCULATING FOR FIELD APPLICATION

If sturdy plastic bags can be obtained, the upper limit for coating by shaking sticker-coated seeds with inoculants may be 5 kg of seeds. The inflated bag should then be rolled on the ground for seed coating. A better container may be a 20 liter plastic bucket with a lid. The sticker most likely on hand may be sugar. If available, carboxymethylcellulose or gum arabic may be used instead.

Procedure. Weigh 5 kg of soybean seeds and place them into a container of 20 liter capacity. Add 220 ml of sugar solution; close the lid tightly and shake for 1 minute. Open the container and make certain the seeds are evenly coated, not clumped together, and that no sticker residue is clinging to the walls. Add 50 g of inoculant and tightly close the lid. Shake gently. After 1 minute open the lid and inspect seeds for uniformity of coating. If coating is not complete, immediately continue shaking for 30 seconds. After coating, spread seeds on a clean canvas or paper. After the seeds have dried, package them and place them into a cool, shaded place until sowing. Sow as soon as possible after coating.

If more than 5 kg need to be coated and the container gets too heavy for shaking by hand, it can be rolled on the ground.

Pelleting Seeds

Pelleting after slurry application. Make a slurry from the 4 ml of sugar solution and 5 g of inoculant. Place 100 g of pasture legume seeds in a plastic bag of 1 liter capacity. Add 4.5 ml of the slurry. Close the bag and trap as much air inside as possible. Shake until the seeds are uniformly coated. Open the bag and add 35 g of calcium carbonate powder. Shake gently until all the seeds are uniformly pelleted. Spread pelleted seeds on paper and allow them to dry in the shade.

Repeat the application with 4.5 ml slurry with gum arabic as a sticker.

Pelleting after the "two-step method of inoculation." Place 100 g of siratro seeds into a plastic bag of 1 liter capacity. Add 4 ml of sugar sticker. Close bag with air trapped inside. Shake until coating has been achieved. Add 1.5 g of inoculant and shake gently for 1 minute. Open the bag and add 35 g of calcium carbonate. Shake gently until all seeds are uniformly coated. Spread pelleted seeds on paper and allow to dry in the shade.

Repeat this treatment with 4 ml of gum arabic as a sticker. Compare all four treatments for evenness of coating, firmness of pellet and amount of calcium carbonate adhering to the seed.

To accommodate the pelleting material, more sticker must be applied. Carboxymethylcellulose may also be used as a sticker. Water is unsuitable for pelleting because it does not make a firm enough pellet.