Inoculation of Legumes

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Rhizobium

Nitrogen fixation in legumes depends on the formation of nodules by *Rhizobium.* Without sufficient nodule mass filled with an efficient, nitrogen-fixing strain of *Rhizobium,* nitrogen fixation will be inadequate. Inoculation of legume seed assures *Rhizobium* is present in the root environment.

Rhizobium is a common soil bacterium. *Rhizobium* is not toxic to humans, plants or animals. It is one of the most beneficial bacteria to agriculture. Some *Rhizobium* are specific and nodulate only specific legumes, while others may nodulate several legumes. Native *Rhizobium* may be in sufficient numbers to nodulate both native and introduced legumes. Often, the native *Rhizobium* are low in numbers, are the wrong species or strain for the introduced legume, or are not efficient nitrogen fixers. Inoculation usually corrects these problems.

Is Inoculation Necessary?

Growers must decide if they need to inoculate before planting. The following considerations should help evaluate whether inoculation is necessary.

1. If the legume to be planted was never grown or hasn't been grown in the field for more than five years; if the legume was grown and you don't know if it was well nodulated or how efficient nitrogen fixation was; or if the land was never in cultivation (native desert or range), it is wise to inoculate.

   The native *Rhizobium* is probably not in sufficient numbers to adequately nodulate the crop or may not be efficient in fixing nitrogen. Inoculation is inexpensive (less than $1-$5 per acre) compared with the expense of replanting.

2. If the legume was previously grown, but nodulation or nitrogen fixation was poor (as indicated by poor yield and nitrogen deficiency symptoms), the grower should inoculate. A grower should always determine the cause of a poor yield (insect, disease, weather, water, plant nutrition problems). If the field was inoculated and poor nodulation or poor nitrogen fixation resulted, eliminating plant stresses also may increase nodulation and nitrogen fixation.

3. If the legume was grown previously and was well nodulated and nitrogen fixation appeared adequate (as indicated by good yield and no nitrogen deficiency symptoms), there probably is no need to inoculate. Once *Rhizobium* is established in a field, it persists for several years between crops. There is no yield advantage to yearly inoculation of legume crops in fields, where the well-nodulated legume is routinely grown. Also, once a particular strain of *Rhizobium* is established in a field, it is difficult for another strain to establish itself. The established strain usually is more competitive than an introduced strain for nodulation sites on the plant.

4. If surrounding fields are planted or have been planted to the same well-nodulated legume there often is no need to inoculate. *Rhizobium* will spread to nearby fields after years of legume production. Alfalfa grown in the Mesilla Valley is a good example.

Inoculant Types and Suppliers

Several inoculant types are available. These include powder, granular, liquid and frozen concentrate. Pre-inoculated legume seed may also be available. The powder and granular inoculates are the most common, with liquid and frozen concentrate inoculates used for special purposes.

Powder inoculates are the most common and most reliable. Powder inoculates have been around since the turn of the century and are simply stuck to the seed before planting. Powder inoculates are available for all types of legumes and are the least expensive to use (less than $2 per acre). The black, or occasionally tan, powder contains approximately one billion *Rhizobium* per gram.

Granular inoculates are available for large-seeded legumes including beans, soybeans and peanuts. They contain about the same concentration of *Rhizobium* as the powder inoculate, but may cost two to three times as much. Particle size is larger than the powder, which allows the inoculate to flow through an insecticide, fertilizer or similar planter attachment. Although the cost may be higher, the inoculate can be distributed by the planter attachment and no seed mixing is required. Granular inoculate is particularly useful when pesticide-coated seed is planted or when excessive seed handling can damage the seed coat, as with peanuts.

Pre-inoculated seed is worth the extra cost (as compared with uninoculated seed) only if the inoculate is freshly added and the seed quickly planted. This is not generally the case in New Mexico. *Rhizobium* is a living organism and will not survive long if left exposed to air, heat, cold or light. If inoculation is considered necessary, use the previously discussed methods and don't waste money on pre-inoculated seed.

Liquid inoculants are better than those available a decade ago, and they are certainly much eaiser to use than the powder inoculants. However, be particuarly alert to the expiration date and handling of the inoculant by the dealer. Improper handling can kill *Rhizobium*.

Several inoculate companies produce legume inoculates, but only two serve New Mexico. They sell only by the case to agricultural suppliers. However, they can be contacted directly and may supply a grower or supplier when asked. They sell inoculates under several brand names. The two suppliers that serve New Mexico are:

Becker Underwood Inc.
1 (800) 892-2013

Nitragin Inc.
1 (800) 558-1003

For home gardeners, many garden seed companies offer small quantities of powder inoculates for a variety of garden legumes. These are usually called garden packs and contain several types of *Rhizobium* for most commonly grown garden legumes.

Inoculant Purchasing and Handling

Rhizobium inoculate is a living culture of bacteria and must be handled as such. *Rhizobium* are particularly sensitive to heat, desiccation and light. Many inoculate failures can be traced to improper purchasing and handling of the inoculant. If the inoculate is handled as a fertilizer or pesticide, either by the grower or supplier, the *Rhizobium* will likely be dead before it reaches the seed. Inoculant should be stored in a cool area away from desiccation and heat and refrigerated if it is to be stored for some time. Pesticides and some fertilizer coatings may kill *Rhizobium* when applied directly to the seed. Always make sure the inoculant label contains the following critical information: type of legume, quantity of seed (powder) or acreage of land (granular) the package will inoculate and expiration date.

The *Rhizobium* species must match the legume species. Alfalfa inoculate will not work on beans and bean inoculant will not work on alfalfa. Powder legume inoculates should indicate how many pounds or bushels of seed the inoculate should cover. Never use less than the recommended amount of inoculate for the given quantity of seed. If conditions are particularly hot or dry when planting, the inoculate is old or has been stored improperly, or the land has never been cultivated with legumes, double the amount of inoculate per quantity of seed. Adding double, triple or 10 times the recommended rate will not affect the environment or seed. Granular inocu-

lates are labeled to indicate how many acres the inoculate will cover. Adding more than the recommended rate is much more costly with granular than powder inoculates.

The expiration date is critical because inoculates are living cultures and their viability decreases with time. Never buy an inoculate that has passed the expiration date. Never buy an inoculate that has been stored improperly by the supplier, such as in a chemical or fertilizer warehouse.

Inoculating a Legume Crop

When inoculating with a granular inoculate, simply follow the label instructions. Never allow the inoculate to remain in a planting attachment in the hot sun for long. Remove unused inoculant from the attachment, seal it in the original bag and store in an area protected from heat and sun.

Powder inoculants require more handling. They must be securely stuck to the seed, and the seed planted immediately. Commercial stickers are available that help stick the inoculant to the seed. You can make your own sticker by preparing a sugar solution of 1 cup sugar to 1 quart of warm water. Slightly moisten the seeds with a small amount of water or sticker and mix with inoculant. Only a small amount of liquid should be used to prevent the seeds from getting too wet. A small cement mixer mixes the seed and inoculate uniformly. Pouring seeds and inoculate between clean, 5-gallon buckets also works well. After mixing, all the seeds should be evenly covered with small specks of inoculate. Plant the seeds immediately, making sure the inoculated seeds are not exposed to sunlight. If the seeds become too dry, the inoculate will come off. If large quantities of seed are to be inoculated and stored for several hours or overnight, put the inoculated seeds back in the original seed bag, add a moistened paper towel and close tightly. Inoculant poured on top of seed in a planter will result in poor inoculation.

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