

Inoculating Forage Legumes



Forage legumes are very important for pasture and hay production. When grown with grass, they provide a higher quality pasture or hay than grass alone. Legumes make their own nitrogen and can also supply nitrogen to grass growing with them.

Legume inoculation is introducing legume bacteria into a root system to let legumes fix or change nitrogen into usable forms. It is the process of mixing legume seed with the correct strain of bacteria before planting. After the seed is planted, the bacteria will multiply if soil conditions are favorable.

After the legume seed germinates and begins to grow, bacteria invade the root hairs. They form growths on the roots called nodules. The bacteria live in these nodules and do their beneficial work. A red or pink color within the nodule indicates that the bacteria have nitrogen-fixing activity. Nodules that are white, green, or brown inside fix little or no nitrogen. These may be produced from native bacteria in the soil and are usually ineffective or less effective than nodules formed from added inoculum.

Nodules located on the major roots (or taproot) below the crown of the plant generally indicate successful nodulation by the added inoculum. These should have the red or pink color inside and may be in fairly large clumps. If there are no nodules or if you find small, weak, off-colored nodules on the small sideroots, inoculation may have been poor. Ineffective nodules may be from “native” bacteria in the soil, which are often poor nitrogen fixers.

You should check seedlings for nodule location and color around 6 weeks after emergence. Yellow, weak seedlings may indicate nitrogen deficiency, often the result of poor or ineffective inoculation. If nodulation is not satisfactory 6 weeks after seedling emergence, you may use one of these methods to save the crop:

1. Thoroughly mix 1 pound of the correct peat-based inoculum with 75 pounds of sand or 50 pounds of cottonseed meal, wheat middlings, or sawdust. Then, uniformly broadcast this mixture on each acre needing inoculation.
2. Mix a fine slurry of 1 pound of peat-based inoculum in 40 to 50 gallons of water per acre and apply as a broadcast spray over the field. Large spray tips without screens and vigorous agitation may be necessary.

Apply these treatments at sundown and on cloudy days before a rain. Keeping the inoculum cool and getting it into the soil with rain or irrigation is essential.

Plants Needing Inoculation

Research to develop grasses that will fix their own nitrogen has not reached practical application in the United States. Although some progress has been made, effectively inoculating legumes remains the proven way to fix nitrogen in any significant quantity.

All forage legumes require certain bacteria for their best nitrogen-fixing ability. The bacteria may be in the soil, but they usually must be added when you plant seed of a legume species for the first time. Soils that have grown legumes such as lespedezas, cowpeas, and peanuts may harbor enough effective nodule bacteria. However, when you put any legume on new land or plant on a rotational basis, it is always good insurance to inoculate the seed.

You should inoculate forage legumes, including white, red, crimson, sweet, subterranean, and arrowleaf clovers, alfalfa, and improved vetches. Many crop failures and reduced yields have resulted from failure to inoculate or from poor inoculation of legumes such as alfalfa and subterranean clover.

Methods of Inoculation

Many different methods have been used to supply bacteria for the legume seed. With any method, remember that bacteria frequently die when exposed to dry, hot conditions even for a short time.

The best method of inoculation is to use large numbers of live bacteria on the seed and apply them just before seeding. You do this by moistening the seed with a small amount of water-syrup (10 percent syrup) solution and adding commercial inoculant. The syrup sticks the inoculum to the seed and nourishes the bacteria in the soil until they can feed from the plant sugars.

Commercial supplements have been developed that do a good job of sticking large amounts of inoculant onto the seed. The supplements may contain gum arabic, synthetic gums, and sugar to stick the inoculum to the seed and protect the nodule bacteria until the seed germinates. One such product that is now commercially available is Pelinoc. The seeds are coated with a nutrient gel (about one-third of the inoculant may be mixed with the gel for the initial coating) that keeps the bacteria alive. A second coating of powdered inoculant adheres a large amount of inoculum firmly to the seed and aids in drying the seed.

You should plant inoculated seed immediately by broadcasting or using a cultipacker-type seeder, followed by a cultipacker, to ensure good seed contact with the soil at a shallow depth. **Caution: Do not mix inoculated seed**

with fertilizer or spread with bulk fertilizer. The salts and acids in the fertilizer will kill the bacteria and cause inoculation failure.

Inoculants

Commercial inoculants are sold in polyethylene packages and can be bought with the seed. Most are black-powdered, peat-based materials containing live bacteria. For 2 or 3 weeks after packaging, the bacteria may actually multiply in the bag. Under good conditions, the number of live bacteria within the bag will remain high for 2 or 3 months but then start to decrease. This death rate is greatly affected by temperature. With high temperature, death rate is accelerated and the life of the inoculum is short.

It is very important to buy fresh inoculants. Check the expiration date on the bags. You should refrigerate the inoculum or keep it in a cool, dry place until you use it.

Preinoculated Seed

Some small-seeded legumes are inoculated before being sold to the farmer. These are called “preinoculated.” Some are lime-coated and some are not. With either method, bacteria will not remain alive on the seed for long. If there is any question on viability of the bacteria, add inoculum before planting. You can buy oil-based stickers

for reinoculating lime-coated seeds since water will form a slurry mess with the lime coat.

Preinoculated seed without the lime coat can be reinoculated using a syrup solution or commercial sticker. If there is any doubt, reinoculate.

Bacteria in the Soil

As much as 150 to 250 pounds of nitrogen may be fixed by bacteria in the nodules of some forage legumes such as white clover and alfalfa. As the nodules slough off the roots and decompose, some of the bacteria return to the soil. If the chemical reaction of the soil is favorable, enough moisture and plant food are available, and the temperature is not too high, these bacteria can live in the soil. Populations of bacteria will build up with continued cropping with the same legume. However, persistence of bacteria in the soil is lowered by unfavorable soil conditions such as acidity, drought, and low soil fertility. Maintaining the soil pH between 6.0 and 7.0 helps keep stands of small-seeded forage legumes healthy and also helps with nitrogen fixation.



Small legume seeds being mixed with gel and inoculant.



Left: raw inoculated seed; right: gel-coated inoculated seed.

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