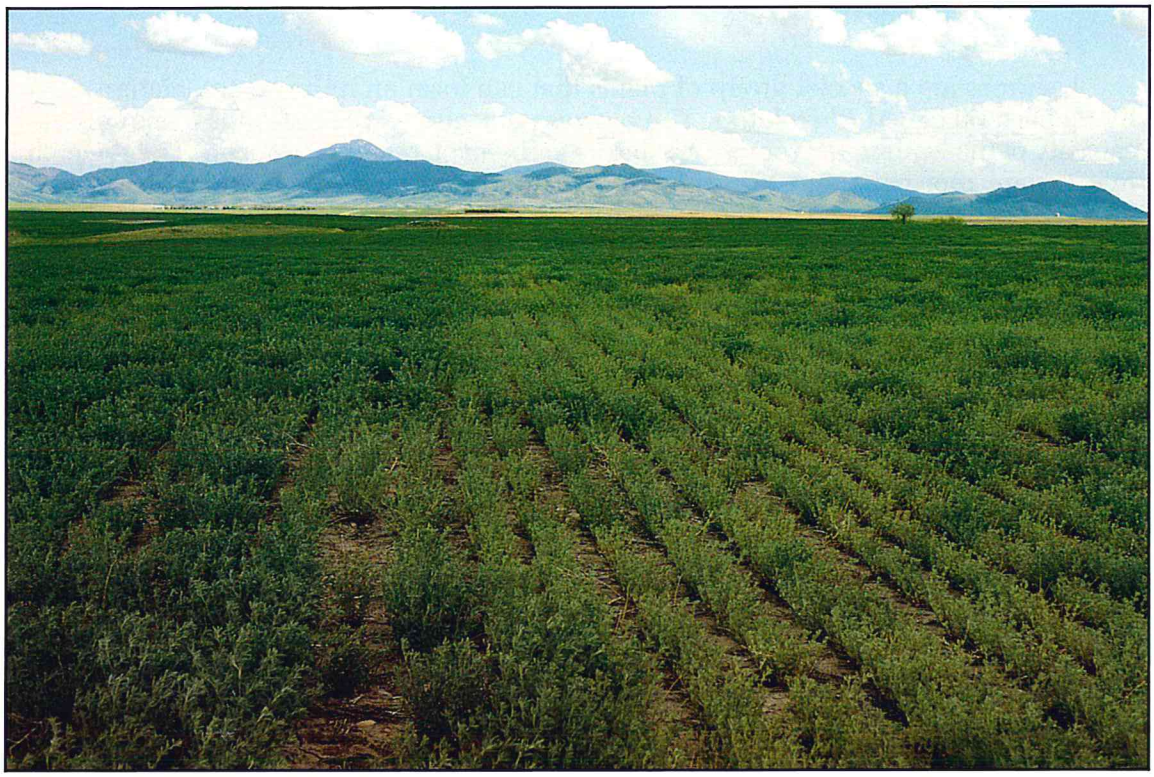
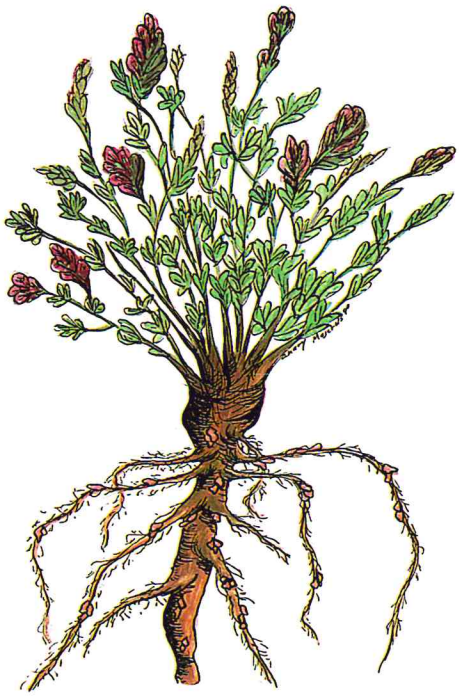
# *It Pays to Inoculate Legumes!*



Well-nodulated healthy alfalfa on the left, compared to nitrogen deficient alfalfa plants without nodules on the right.



## Steps for Effective Legume Inoculation

1. Buy inoculant specific for the crop being seeded.
2. Check the expiration date and storage conditions. Inoculant should not be stored in hot buildings. Do not allow inoculant to be exposed to sunlight or heat for any length of time. Store inoculant in a cool, dark location such as a refrigerator.
3. When using preinoculated seed, check the expiration date and use as soon as possible. It is cheap insurance to reinoculate preinoculated seed to ensure viability of the rhizobia.
4. Coat seeds sparingly with a sticker solution ratio of 1:10 sticker to water. Stickers include corn syrup, sugar or powdered milk. Commercial stickers are also available.
5. Under adverse or dryland conditions apply inoculant to seed at twice the recommended rate (2 bags of inoculant per 50 lbs. alfalfa seed). Work with 50 - 100 pound quantities of seed to achieve adequate coverage and mix thoroughly by hand or with a cement mixer to coat all seed.
6. Seed as early as possible. Under dryland conditions early spring moisture is critical for stand establishment.
7. Granular inoculant is available commercially for alfalfa and some large seeded legumes. Check with your local distributor.

# LEGUME INOCULATION

Legumes are a special group of plants that can form an intimate association with living bacteria called ***Rhizobium***. The purpose of legume inoculation is to exploit the capacity of the legume-*Rhizobium* symbiosis to fix plant available nitrogen. The rhizobia infect plant root hairs and form nodules. Inside these nodules the rhizobia convert nitrogen from the atmosphere into ammonium, a form available to the plant. This process is called nitrogen fixation.

Soils contain a vast population of living organisms, including bacteria. However, some soils lack sufficient numbers of the specific rhizobia needed for effective legume nodulation. Proper inoculation corrects these deficiencies by placing thousands of the appropriate rhizobia on or near the seed.

The association between the legume and *Rhizobium* is very specific. For example, the rhizobia which form a symbiosis with alfalfa will not form a symbiosis with soybeans, beans or peas. Effective inoculation requires the addition of the specific rhizobia (inoculum) to the legume seed or another appropriate carrier.

Rhizobia should be applied to the seed in a peat base using a sticker solution. Peat protects the rhizobia from desiccation and toxic substances. The sticker solution helps glue the rhizobia to the seed. Common stickers include a 10% solution of sugar, honey, corn syrup or powdered milk mixed with 90% water. Commercial stickers are also available.

Small seeded legumes, such as alfalfa, must be seeded at a shallow depth (¼ - ½") to allow seedlings to emerge. However, rhizobia are very susceptible to heat and desiccation and may die before the seeds germinate and the roots can be nodulated. Applying inoculant (rhizobia in peat base) on carriers in addition to the seed will allow placement of the inoculant deeper in the soil (3 - 4") into moisture and cooler conditions. This should enhance rhizobia survival until the seeds germinate and the roots begin to grow. Clay particles, bran or a small grain cover crop seed are some examples of potential inoculant carriers. Inoculant should not be mixed with or applied to fertilizer as it will kill the rhizobia.

Inoculation success is evaluated by appearance of the plant and nodulation. Dark green, healthy looking plants indicate adequate nitrogen. Stunted, yellowish plants may indicate nitrogen deficiency. Pink to red nodules contain leghemoglobin and are classified as active, nitrogen fixing nodules. Green nodules are not active and contain a breakdown product of leghemoglobin. White nodules do not contain leghemoglobin and are ineffective.

Legumes with ineffective or no nodulation yield poorly and require large amounts of nitrogen fertilizer. They can rapidly deplete soil nitrogen reserves. With proper inoculation, nitrogen can be returned to the soil and the amount of nitrogen fertilizer needed for succeeding crops reduced.

This bulletin was funded by Agricultural Energy Conservation Program administered by the Department of Natural Resources and Conservation/Conservation Districts Bureau in conjunction with the Highwood Alkali Association and conservation districts from Pondera, Toole, Chouteau, Daniels and Roosevelt counties. The Montana Agricultural Experiment Station, Montana State University and Montana Salinity Control Association were instrumental in formulating this brochure.