

SEED ADDITIVES: INOCULANTS

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Rhizobia bacteria form a symbiotic association with legumes which results in the legume being able to fix gaseous nitrogen from the air into a form that is usable by the plant (ammonia). This association allows the legume grower to grow legumes without using nitrogen fertilizer as is required for non-legume plants and to grow a plant which can contribute usable nitrogen to succeeding non-legume crops such as corn.

Rhizobium bacteria are common soil organisms living and surviving in soils where legumes are normally grown. An inoculant is a concentrated form of Rhizobia bacteria which a farmer can use to ensure that the legume he plants will have an adequate supply of these organisms to obtain the maximum level of nitrogen fixation.

The farmer should use an inoculant when he has not grown legumes for a number of years in a particular area or when the area in which he is planting legumes has been exposed to stress conditions such as low pH or drought. Also, sandy or low organic content soils require the use of Rhizobium inoculants.

Rhizobium inoculants are available in either humus based or clay based forms. These can be supplied either as a pre-inoculant on purchased seed, or as a separate packaged inoculant product which the farmer applies to his seed at the time of planting. Also there are packaged inoculant products which include higher than normal levels of Rhizobium species along with stickers which allow the farmer to supply very high levels of bacteria for particularly stressful conditions of low pH and low soil moisture. These high levels of rhizobia may also be supplied as a calcium carbonate pelleted pre-inoculated seed.

Inoculants are prepared and applied to seed in several different forms with each inoculant type having one or more advantage or disadvantage as indicated in the chart below.

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<u>System or type of inoculant</u>	<u>Advantage</u>	<u>Disadvantage</u>
pre-inoculated - humus	easy to use	number of Rhizobia may be less than optimum
pre-inoculated - clay	easy to use, good coverage of seed	number of Rhizobia may be less than optimum
pre-inoculated - with humus CaCO ₃ pellet	very high levels of Rhizobia	more expensive
planter box - humus	fresh & high number of Rhizobia	not convenient for farmer, spotty coverage
planter box - clay	fresh & high numbers, very good coverage	not convenient for farmer
planter box - with sticker & high levels	very high numbers of Rhizobia	more expensive, time consuming

There are several "do's and don'ts" concerning the use and handling of inoculants. The more important of these characteristics need to be reviewed occasionally with both the farmer-customer and company employees. The five more basic points concerning the use of inoculants are identified and discussed below.

1. Inoculants contain rhizobium species which must be alive and viable to work. These rhizobium bacteria are living biological organisms and must not be handled like chemicals or fertilizer. Therefore, we recommend that the farmer store inoculants or pre-inoculated seed in cool areas. Treat inoculants or pre-inoculated seed like you would like to be treated, i.e., do not store where they will become too hot and dry or too cold.

2. Rhizobium inoculants are specific. This means that only inoculants labeled for alfalfa will work on alfalfa. Or conversely, an inoculant labeled for use on clovers, soybeans or other legumes will not work on alfalfa.

3. Some seed are planted after mixing with fertilizer slurries. This is acceptable as long as the pH of fertilizer is above 6.0. Inoculating alfalfa seed which has been treated with a fungicide is acceptable at the planter box but it is recommended that the farmer inoculate fungicide treated seed just prior to planting. Pre-inoculated seed which also have been pre-treated with a fungicide is satisfactory since the seed processors and inoculant companies only do such mixed pre-treating when they have already checked the compatibility of the particular fungicide and rhizobia.

4. Do not use an inoculant which has expired. Every inoculant company places an expiration date on their inoculant packages. After this date, the manufacture can no longer guarantee that the rhizobia are present in sufficient number to supply an adequate level of rhizobia. Therefore, be sure to check the expiration date given on the package.

5. Use a sticker when using a packaged planter box inoculant. The instructions for use are on the package. This is important because the seed are the carrier of the inoculant into the soil, and it is important to get as much of the inoculant as possible in the area of the developing roots. In this regard, it is important to remember that the rhizobium bacteria infect the developing root and not the seed. The use of a sticker takes more time, but it is time well spent because it ensures that most of the inoculant gets to the root zone.

Table 1 is from Advances in Agronomy Vol. 34, 1981, written by Tom LaRue and Tom Patterson and titled; "How Much Nitrogen do Legumes Fix?"

The values listed vary from state to state and from how the tests were made. However, the important point is that the values are quite substantial and illustrate the benefits of nitrogen fixation both with regard to the ability of legumes to manufacture their own nitrogen fertilizer and with regard to the ability of legumes to contribute nitrogen to non-legume crops.

A question often asked is, "When should a farmer use an inoculant?" There are three situations when the use of inoculants will pay big dividends. They are: (1) definitely when he has not grown the same legume in a particular field for more than two or three years; (2) anytime when a legume is planted in sandy, low organic soils, or soils exposed to stresses such as low pH; (3) when he is unsure of the number or quality of the rhizobium in his soils.

We believe it is important to look at rhizobium inoculants as one management tool which allows the legume to express its full genetic yield potential. Inoculation will not solve all the problems of growing legumes, but it can definitely assure you that you have eliminated one very important variable, i.e., the ability of the legume to have all of the nitrogen it needs.

The advantage the seedsman obtains from the use of an inoculant is that it provides one additional management tool which will ensure that the seed performs to its maximum genetic potential. The use of pre-inoculants, when possible, ensures the seedsman that the

Table 1. Nitrogen fixed by forage legumes.

Plant species	Amount of N fixed (lbs./acre/year)		Year Reported
1. Alfalfa	204 - 259	Geneva, New York	1933
"	189	Lexington, Kentucky	1950
"	132	Rosemount, Minnesota	1981
2. White Clover	114	Lexington, Kentucky	1950
"	239	Northern Ireland	1976
"	47 - 168	Beltsville, Maryland	1954
3. Red Clover	137	Lexington, Kentucky	1950
4. Sweet Clover	125	Riverside, California	1949
5. Vetch	98	New Brunswick, N.J.	1936
"	164	Riverside, California	1949
6. Korean lespedeza	172	Lexington, Kentucky	1950

farmer will indeed use an inoculant. A disadvantage of pre-inoculation is that the inoculant may not be as viable as when the farmer applies the inoculant at the planter box just prior to planting.

Other points which the seedsman should consider with the use of inoculants are: (1) inoculants can affect the seeding rate, (2) the seed will look different after inoculation; (3) germination or other quality parameters may change depending on how fragile is the seed.

Finally, the seedsman must look at inoculants just as the farmer looks at them -- as one more, and necessary, management tool at his disposal with which he can ensure the performance of his seed and with which the seedsman can ensure the ultimate satisfaction of the farmer.



Figure 1. Plants of red clover from non-coated and "NOCULIMED" seed.