Effect of Fungicide Treatments on Legume Inoculation

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The economic value of legume inoculation has been recognized for many years. It has been estimated that the nodule bacteria on leguminous plants fix 12 million dollars worth of nitrogen a year on North Dakota farms.

It is generally assumed that the fixation of atmospheric nitrogen can be increased by encouraging farmers to inoculate their legume seed with commercial cultures of legume bacteria. In addition to the inoculation of the legume seed with nitrogen-fixing bacteria some farmers may wish to treat this same seed with a fungicide to control damping-off and other fungus diseases.

The need and benefit from seed treatment for the control of seed-borne disease organisms are generally accepted for small grains. Greenhouse and field tests have shown that grass seeds, too, will often benefit from such treatments. In the case of legume seed, the tests to date show less consistent benefits, probably due to the variation in the quality of the seed used, as well as differences in the soil and environmental conditions under which the tests were made.

Emergence has been increased by the use of a fungicide in some cases while some fungicides have decreased the emergence of the seedlings. Brentzel (3) of this station found that Arasan did not decrease the emergence of sweetclover and alfalfa. Weathered and lower grade seed is more likely to benefit from seed treatment than bright plump seed.

Many people might say at this point, "Let's combine the treatments and gain the benefits derived from both." Unfortunately, the combination of the two treatments presents many problems which are difficult to surmount. The following information should enable the farmer to make a wise decision on whether to inoculate legume seed on his farm.

It has been known for centuries that legumes enrich the soil upon which they grow. Their ability to enrich soils depends on the legume bacteria which infect the tiny root hairs of the plant and form a nodule. The bacteria living within this nodule are capable of taking the atmospheric nitrogen out of the soil air and converting it to a combined form which the plant can use for its nutrition and growth.

Nearly all soils contain legume bacteria of one species or another. Many wild legumes act as a natural reservoir for these bacteria. However, all legume bacteria are not the same. The species that will infect alfalfa, for example, will not infect soybeans. Each species of nodule

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bacteria will only infect certain species of legumes. Furthermore, there may be variations between strains within the same species. One strain may fix nitrogen more effiently than another strain although they are both capable of forming nodules on the same species of legume.

The presence of nodules on legumes cannot be taken alone as evidence of efficient nitrogen fixation. The bacteria must also fix nitrogen efficiently or they are parasitic. The cost of inoculating seed is so low that we generally recommend inoculation as the best way to secure good nitrogen fixation.

The inoculation of treated seed presents a paradoxical situation. We inoculate with microorganisms to insure a good nodulation and we treat the seed with a disinfectant to kill unwanted disease-producing microorganisms. Thus, it can be understood why in most cases the two treatments are not compatible. Most disinfectants are not specific in their action on microbes and they will inhibit all microbes. Antibiotics are specific in their action on different microbial species, but they are still too expensive to use as seed treatments.

Some fungicides are more toxic than others to the nodule bacteria. Generally speaking, the non-metallic fungicides are the least toxic to bacteria and seed. Such compounds include Spergon, Arasan and Phygon. These findings agree with those of Brentzel of this station (2). Rhuloff and Burton (4) found that Spergon was the least toxic and Arasan was the most toxic to the bacteria of these three. They also found that the presence of peat as a carrier reduced the toxicity of these compounds.

Different species of nodule bacteria react differently to each fungicide. Therefore, the choice of fungicide depends upon the species of legume to be planted. If you desire to use both treatments on legume seed, the following information should be studied carefully.

The data of Rhuloff and Burton (4) indicate that Spergon is toxic to clover and cowpea nodule bacteria, but has little effect on the nodule bacteria of alfalfa, peas and beans. Phygon was moderately toxic to all species of nodule bacteria except the one that infects the bean groups which includes garden, pinto, navy and kidney beans. This group does not include soybeans.

Seed treated with a fungicide should be allowed to dry completely before adding the inoculant in order to obtain better survival of the nodule bacteria. Seed should be inoculated just before planting. Nodule bacteria also will have a much better chance of survival if the chemically treated seed is planted in a moist seedbed in order that the motile nodule bacteria may move away from the chemical on the seed.

In order to lessen the chances of a complete kill of bacteria by the fungicide it is a good procedure to double or triple the rate of application of the legume bacteria.

Another method has been tested with the objective of improving the compatibility of seed treatment and inoculation by using the inoculant in the dry state. Moisture is necessary for chemical disinfection. If the moisture on the seed could be avoided, the toxicity of the fungicide to the nodule bacteria could be reduced. F. E. Clark at the U.S.D.A. station in Beltsville (5) found that when the dry inoculant was added to soybeans that only 20 to 30 percent was retained on the seed compared with 80 percent retention for the wet method. The retention by the dry method on the small seeded

legumes, such as clover, was about 35 percent while that with the wet method was over 80 percent.

Another disadvantage of the dry method of application is that the inoculant has a tendency to sift down as the drill is pulled over the field; thus the distribution is not uniform over the field. Efforts have been made to compensate for the low retention by doubling the application but this still provides less than the recommended rate. If a farmer, nevertheless, elects to use the dry method he should use currently dated inoculant and should avoid exposing it to heat, sunlight, or drying and the inoculated seed should not be planted in a dry soil.

The foregoing information points out quite conclusively that the methods for combining inoculation and fungicide treatment are inadequate or unsatisfactory. We do not have an effective commercial fungicide which is harmless to nodule bacteria (6, 7). Any farmer who chooses to combine the two treatments should be aware that he is running considerable risk with respect to the survival of the seed inoculant and subsequent effective nitrogen fixation by the legume.

Summary

1. Inoculate if you are planting a new species of legume in an area for the first time. Soybeans and birdsfoot trefoil are examples of such legumes and their nodule bacteria are not likely to be present in new areas.
2. Inoculate when the legume being seeded has not been grown on the same field in the past 2 or 3 years. (1). Your seed dealer can supply the correct inoculant.
3. To both inoculate and treat the seed add the fungicide a few weeks before planting. Add the inoculant to the treated seed immediately before planting. Make a wise choice of fungicide according to the species of legume you are planting. Double the rate of inoculant application and plant the seed in a moist seedbed.

References

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