



Updated June 2011

Soybean Seed Applied Inoculation

Kurt Thelen, and Terry Schulz, Crop and Soil Sciences, Michigan State University

Nitrogen fixation is a result of the symbiotic relationship of Rhizobia bacteria and soybean plants. These bacteria fix atmospheric N_2 into the NH_4 form which is useful to the plant. In return, the plant provides the bacteria with carbon photosynthesis products (dicarboxylic acids), which the bacteria use as food. Establishing rhizobia or inoculation in a field that has never grown soybean is needed to ensure nitrogen fixation. Elmore (1996) suggests when and how soybeans should be inoculated, and provides recommendations on inoculate type to use.

Soybeans grown on soils without a rhizobia population will use available soil nitrogen, and if soil nitrogen levels are low because of soil type, soil erosion, etc., the symptoms of nitrogen deficiency may occur. Field studies in Northern Michigan showed 45% and 23% soybean yield increases in 2004 and 2005 where inoculant was used and fields had not seen a previous soybean crop. Soybean plant coloration differences were obvious in this study, as inoculated plots appeared much greener. On other Michigan sites with a history of soybean cropping, soybean seed inoculation increased yield by an average of 1.3 bushels, with significant increases at 6 of 14 sites from 2003 to 2005. **Because most commercially available inoculant products are relatively inexpensive, the 1.3 bushel/acre expected average yield increase will generally cover application costs. Therefore, it is recommended to apply Rhizobium inoculant to soybean seed each time you plant soybeans.** This is especially true on sandy soils, where it is more difficult for the Rhizobia to survive from one season to the next.

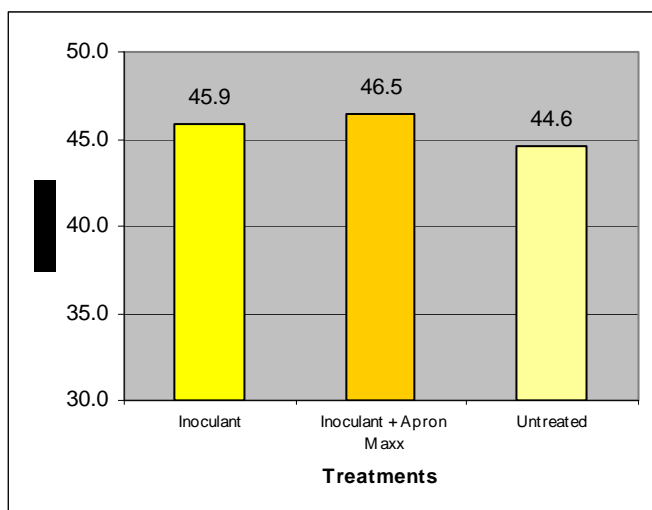
Also, it is important to inoculate on any soil if soybeans are to be grown for the first time.

Two types of inoculants can be used: seed-applied and soil-applied. The seed-applied inoculate is more effective when mixed with water to form a slurry which is used to coat the seed. This should be done as close to planting time as possible, preferably within several hours. The soil-applied inoculate may be easier to apply than the seed-applied inoculate, but it is more expensive on a per acre basis. Thus, seed applied inoculant is generally the method of choice for most growers.

In addition to the recommended short time period between seed applied inoculant application and planting, there are other potential challenges associated with proper soybean seed inoculation. Care should be taken in applying inoculant to fungicide or insecticide treated seed. Fungicide and insecticide labeling should be checked to ensure that the particular pesticide product is compatible with Rhizobium inoculant. Potter (2004) conducted field trials to examine the effects of inoculating soybean seed with rhizobium, seed applied insecticides and fungicides, and combining bacterial inoculant, insecticidal and fungicidal products in Southwest Minnesota. For the trial, one bacterial inoculant, two insecticidal products, and two fungicidal products were used. There were 12 treatment combinations among the 5 different products tested. The results showed that crop injury was not observed with any treatment.



Further, differences in root disease, soybean height, nodulation or yield were not observed among treatments. **A three year Michigan study tested the effects of combinations of seed inoculant, fungicidal seed treatment, and insecticidal seed treatment. Inoculant was used alone, in combination with either Apron Maxx, Cruiser, or Gaucho, and in combination with Apron Maxx and one of the two seed applied insecticides. Results of the trial showed that in fields where soybean seed inoculation did significantly increase yields versus non-inoculated seed, the addition of insecticidal and fungicidal seed treatments did not significantly negate the observed yield increases.**



Results from Soybean Inoculant/Fungicide Trials, 14 Michigan sites in soybean rotation, 2003-2005.

Finally, Rhizobia do not function below pH 5.0 and molybdenum, which is important for Rhizobia nodule formulation, can be deficient at pH levels below 6.0. Liming of low pH soils is the best solution for these challenges.

Recommendations:

- Inoculates should be stored in a cool place and not exposed to the sun prior to use. Refer to product labels for specific handling recommendations.**
- The safest approach is to buy fresh inoculate each year.**
- Seed should be planted within four hours of inoculation. New products are being developed with a longer preplant application interval but data on the performance of these products is somewhat limited.**

- When applying a fungicide or using fungicide treated seed, be sure the fungicide has dried before applying inoculate to the seed. Inoculate should NOT be mixed with fungicides and applied together. Refer to product labels for specific handling recommendations**
- When loading a drill or planter using an auger, inoculation materials (liquid or dry) should be added to the seed as it enters the auger for thorough application.**
- When loading a drill or planter from bags, fill the seed box to a depth of three inches and scatter the appropriate amount of inoculate over the seed and mix it in thoroughly. Continue to add seed in six-inch deep layers, treating each until the seed box is filled.**
- With some dry materials it may be desirable to slightly moisten seed to increase the adherence of inoculate. Individual seeds need no more than a three to five percent coating of dry material. Liquid materials will usually cover most of the seed.**
- Seeding equipment should be calibrated using treated seed.**
- Lime soils used for soybean production according to soil test recommendations.**

Additional information about increasing soybean yields and profitability can be found online at <http://www.michigansoybean.org>

References:

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- Elmore, R. W. (1996). *Soybean Inoculation—When is it necessary?* University of Nebraska. [WWW document]. URL: <http://ianrpubs.unl.edu/fieldcrops/g737.htm>
- Potter, B. (2004). *Yield effects of seed applied fungicide, insecticide and Rhizobium inoculants on soybean.* University of Minnesota. Southwest Research and Outreach Center. [WWW document]. URL: <http://swroc.coafes.umn.edu/SWMNPEST/04publications/yieldeffects/innoculant.htm>