

**Western Illinois University- School of Agriculture**  
**Organic Research Program**  
**2013 Soybean Inoculant Study**  
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## **Introduction**

Microbial seed inoculants are used with the expectation that the applied microorganisms will enhance seedling health and ultimately crop yields. Inoculation of soybeans seeds with some microorganisms (e.g, Bradyrhizobia) is a well-established practice, whereas other microorganisms (e.g., Azospirillum and various mycorrhiza) have much less performance history in soybean production. Commercial inoculants vary with respect to microbial genetics, carrier material, stabilization technology and price, leaving farmers wondering which ones are a good investment. In 2013, a study was conducted at the WIU/Allison Organic Research Farm evaluating 3 inoculants: N-DURE from INTX Microbials, TerraMax Green Dry from TerraMax, Inc., and Bio-Coat Gold from Advancing Eco-Agriculture. N-DURE contains Bradyrhizobium bacteria, TerraMax Green Dry contains Azospirillum and Bradyrhizobium bacteria, and Bio-Coat Gold contains endo and ectomycorrhizal fungi.

## **Methods**

The study described in this report occurred at the WIU Allison Organic Research Farm in field (3-1) in south-west Warren County, IL. The soil is mapped mostly as Sable silty clay loam, is poorly drained, and has a long-term history of organic management following variations on a corn-soybean-wheat/red clover rotation.

This study was following organic corn in 2012. The corn stalks were disked once on 5/15/13 followed by a double pass with a soil finisher immediately before planting.

On 6/19/13, LVF 3507 (food grade) soybeans supplied by Lakeview Farms were inoculated on-site and then planted with a John Deere 12-row air vacuum planter at a target seeding rate of 170,000 seeds/acre. Inoculants were thoroughly mixed by hand with soybeans in clean 5 gallon buckets shortly before adding the seed to the planter boxes. The seed was inoculated at the following recommended rates: N-DURE @ 2.5 oz/50 lbs seed; TerraMax Green Dry @ 2 oz/50 lbs seed; and Bio-Coat Gold @ 2 oz/50 lbs seed. The control seed received no inoculation. The 4 treatments were randomly assigned to rows 1-4 (1 row per treatment), 5-8 and 9-12 of the 12 row planter.

Weed control consisted of rotary hoeing, once with an M&W hoe, and row crop cultivating twice with a modified IH 153 6-row cultivator. A very high level of weed control was achieved mechanically and all escapes were rogued manually.

On 7/3/13, soybean stand counts were estimated by counting the number of plants in 10' of a row for each subplot. Each treatment consisted of 10 subplots (2 x 5 reps) for the stand estimates (table 1).

One-row plots, with lengths ranging from 53'-58', were harvested on 10/28/13 using a KEM plot combine. The grain from each plot was weighed and the length of each plot was measured immediately following harvesting. The grain weights and plot lengths were used to estimate the yield of each plot.

Six replications of each treatment were planted. One was considered an edge of field buffer and another was not included in statistical analysis due to unexplainable outlier results.

## Results

All 3 of the inoculant treatments had higher average grain yields than the control, but all yields were within the LSD (4.8 Bu/A) and thus were not statistically different at  $\alpha = 0.05$  (table 1).

Stand establishment in the N-DURE plots was statistically significantly higher than in the control plots by over 10,000 plants/A. TerraMax Green Dry plots were also over 10,000 plants/A higher than the control plots, but not quite statistically significantly higher (table 1).

**Table 1:** Soybean Yields and Stand Associated with Treatments

Treatment	Soybean Yield (Bu/A)	Significance Groups ( $\alpha = 0.05$ )	Soybean Stand (plants/A)	Significance Groups ( $\alpha = 0.05$ )
N-DURE	49.9	a	131,551	a
TerraMax Green Dry	49.2	a	131,203	ab
Bio-Coat Gold	48.7	a	125,523	ab
Control (no treatment)	47.1	a	120,923	b
	LSD = 4.8		LSD = 10,616	

LSD = Least Significant Difference

Different letters associated with yields and stands in the table indicate significant differences among treatments.

## Discussion

The treatment rankings were the same for yield and stand count with all inoculant treatments having higher average values than the control treatments. This suggests a general pattern of

inoculants enhancing crop performance despite the mostly insignificant results presented in table 1.

When applying the Bio-Coat Gold inoculant after only a few minutes of soaking the seeds in water, we observed deterioration of many seed coats and splitting of some seeds. The product instructions recommend pre-soaking for up to a half hour before application of the inoculant. This does not seem to be appropriate for food grade soybeans because their thin seed coat becomes very fragile after just several minutes of soaking. Recommended application methods for the other inoculants did not include pre-soaking. While the visible damage after pre-soaking did not result in statistically significant reductions in stand count or yield, Bio-Coat Gold did rank lower than the other inoculant treatments (table 1).

### **Conclusion**

The results of this study were largely inconclusive, but suggest that the N-DURE inoculant may promote stand establishment and that negative effects from inoculation procedures are unlikely even when the seed treatment process causes some visible damage to seeds.

It is important to keep in mind that at current organic soybean and inoculant prices, inoculation can result in an economic advantage even if very little yield enhancement occurs because the cost of inoculation is significantly less than the value of 1 bushel of organic soybeans.

We plan to continue investigating biological inoculants and recommend that organic farmers use them on at least part of their soybean acres, especially areas where soil populations of inoculant organisms are likely to be low.