# Soybean Inoculation Trial, 2007

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Biological nitrogen fixation is the process that changes atmospheric $N_2$ to biologically useful $NH_3$ by common soil bacterium, *Rhizobium*. In legumes, bacteria live in small growths on the roots called nodules. Nitrogen fixation in legume crops starts with the formation of a nodule. In a new field with legume crops, the poor nitrogen fixation is often attributed to the lack of native nitrogen fixing bacteria to form nodules. In this case, using seed inoculated with the correct *Rhizobium* should be considered as an option.

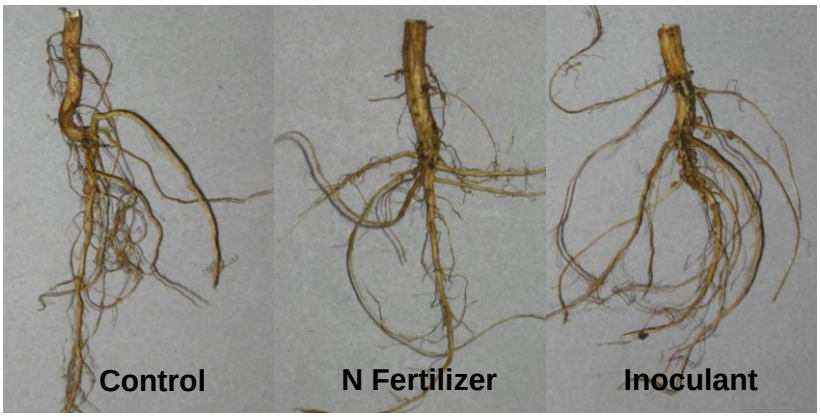
A soybean inoculation trial was conducted at the Carrington Research Extension Center to compare inoculant treatments submitted by commercial manufacturers / distributors to an absolute control (no inoculum, no N fertilizer) and a treatment with 60 lbs. total N (soil test + fertilizer)/acre. The experiment was conducted on a field which did not have a known history of soybean production. A soil test the previous fall indicated 40 lbs. $NO_3^-$-N / acre in the top 24 inches. The soil tested 6 ppm (Olsen) for phosphate. Cultivar, RG601RR, was sown at the rate of 200,000 live seeds / acre on 5 June in a randomized complete block design with six replicates. Individual plots were 7 (7-inch) rows wide x 25-feet long. Plant and root samples for biomass and nodule measurement were collected at early bloom (July 12) and soybean was harvested on October 22.

The number of nodules and the dry matter of the nodules in 9 of 11 inoculant treatments were significantly higher than the control and N treatment and there was no difference between the control and N treatment (Table 1 and Figure 1). However, these differences were not translated into significant differences in days to bloom, canopy closure, and physiological maturity, plant height, and plant biomass. Treatment differences in plant stand population and root biomass were not related to inoculation.

**Table 1. Soybean development in commercial inculant evaluation trial at North Dakota State University Carrington Research Extension Center, 2007.**

| Product/Treatment | Brand-Company | Formulation | Plant Stand | Days to Bloom | Days to Canopy Closure | Days to PM | Plant Ht at Harvest | Plant Biomass | Root Biomass | Nodule Number | Nodule Mass |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | plant/ac | | | | cm | g/plant | g/plant | No./plant | g/plant |
| Control | NA | NA | 160266 | 37.2 | 37.3 | 107.7 | 94.3 | 4.95 | 0.82 | 1.3 | 0.020 |
| 60 lbs. N (soil + Fert) | NA | NA | 152679 | 37.3 | 37.2 | 107.8 | 100.0 | 6.28 | 1.00 | 1.0 | 0.011 |
| Dyna-Start | Loveland Products | Liquid | 169749 | 37.3 | 37.2 | 108.7 | 98.5 | 5.25 | 0.93 | 8.4 | 0.045 |
| Dyna-Start + Dyna-Start Pro | Loveland Products | Liquid | 182077 | 37.0 | 37.0 | 108.3 | 104.0 | 5.35 | 0.98 | 13.3 | 0.070 |
| Dyna-Start + LI 6194 | Loveland Products | Liquid | 175439 | 37.2 | 37.8 | 108.4 | 94.8 | 5.05 | 0.77 | 8.5 | 0.058 |
| LI 6226 | Loveland Products | Liquid | 157895 | 37.3 | 37.3 | 108.8 | 105.5 | 5.40 | 0.90 | 2.3 | 0.011 |
| Excalibre | Advanced Bio. | Dry + Liquid | 171053 | 37.2 | 37.0 | 108.0 | 100.5 | 5.88 | 1.10 | 2.5 | 0.021 |
| Nod+ | Becker underwood | Liquid | 177810 | 38.2 | 38.3 | 107.3 | 90.5 | 4.67 | 0.78 | 11.5 | 0.058 |
| Nod+ plus Extender | Becker underwood | Liquid | 152679 | 37.3 | 37.8 | 107.8 | 96.2 | 5.65 | 0.97 | 9.5 | 0.063 |
| Vault | Becker underwood | Liquid | 169275 | 37.3 | 37.8 | 108.0 | 96.7 | 5.60 | 0.87 | 8.7 | 0.051 |
| Optimize | EMD Crop Bio. | Liquid | 148412 | 37.2 | 37.2 | 107.7 | 96.2 | 7.02 | 1.18 | 11.8 | 0.072 |
| Cell Tech | EMD Crop Bio. | Liquid | 162162 | 37.5 | 38.3 | 107.5 | 93.5 | 4.83 | 0.82 | 9.1 | 0.064 |
| Protec + Nitrogen S | Pro Coat Tech. | Peat | 183658 | 37.7 | 37.8 | 108.8 | 100.0 | 4.72 | 0.77 | 6.0 | 0.045 |
| | | Mean | 167746 | 37.4 | 37.6 | 108.0 | 97.1 | 5.44 | 0.93 | 7.1 | 0.045 |
| | | C.V.% | 11.9 | 2.0 | 4.5 | 1.0 | 9.9 | 25.4 | 25.5 | 39.7 | 67.1 |
| | | LSD.05 | 23085 | NS | NS | NS | NS | NS | 0.3 | 3.3 | 0.035 |

## Figure 1. Effect of N fertilization and inoculation on soybean nodule development in the commercial inoculant evaluation trial at North Dakota State University Carrington Research Extension Center, 2007.




Soybean yields were exceptional with a trial average of 50.3 bushels/acre. Although there were no statistical differences in yield, seeds per pound, and test weight, soybean yields in all inoculant treatments were numerically higher with 1.6 – 8.9 bushels/acre yield increase over the control and N treatment. Protein and oil content in soybean grain were significantly affected by inoculation. Inoculation significantly increased protein content in the grain, while oil content tended to decrease in association with this response.

Our results indicated that inoculation significantly improved nodule development in soybean planted in a field having no soybean history. Although nodulation in soybean did not have significant correlation with soybean yield and quality, soybean yield tended to increase and grain protein content increased with seed inoculation.

**Table 2. Soybean yield and quality in the commercial inoculant evaluation trial at North Dakota State University Carrington Research Extension Center, 2007.**

| Product/Treatment | Brand-Company | Formulation | Protein | Oil | Seeds/ pound | Test Weight | Seed Yield |
|---|---|---|---|---|---|---|---|
| | | | % | % | | lb/bu | bu/ac |
| Control | NA | NA | 32.9 | 17.0 | 3572 | 58.1 | 46.1 |
| 110 lbs. N (soil + Fert) | NA | NA | 32.4 | 17.0 | 3481 | 58.1 | 48.8 |
| Dyna-Start | Loveland Products | Liquid | 34.7 | 16.4 | 3358 | 57.8 | 51.4 |
| Dyna-Start + Dyna-Start Pro | Loveland Products | Liquid | 34.3 | 16.6 | 3266 | 57.9 | 55.0 |
| Dyna-Start + LI 6194 | Loveland Products | Liquid | 34.8 | 16.4 | 3400 | 58.1 | 54.9 |
| LI 6226 | Loveland Products | Liquid | 34.1 | 16.6 | 3318 | 58.0 | 52.0 |
| Excalibre | Advanced Bio. | Dry + Liquid | 33.0 | 16.8 | 3458 | 57.6 | 51.3 |
| Nod+ | Becker underwood | Liquid | 34.5 | 16.5 | 3545 | 57.7 | 49.4 |
| Nod+ plus Extender | Becker underwood | Liquid | 34.4 | 16.5 | 3515 | 57.8 | 51.1 |
| Vault | Becker underwood | Liquid | 34.3 | 16.7 | 3529 | 58.1 | 50.4 |
| Optimize | EMD Crop Bio. | Liquid | 34.2 | 16.7 | 3521 | 57.6 | 49.6 |
| Cell Tech | EMD Crop Bio. | Liquid | 34.9 | 16.4 | 3572 | 58.1 | 47.9 |
| Protec + Nitrogen S | Pro Coat Tech. | Peat | 34.8 | 16.4 | 3342 | 57.2 | 51.2 |
| | | Mean | 34.0 | 16.6 | 3466 | 57.8 | 50.3 |
| | | C.V.% | 3.5 | 2.2 | 5.4 | 1.3 | 10.6 |
| | | LSD.05 | 1.4 | 0.4 | NS | NS | NS |