Yield effects of seed applied fungicide, insecticide and *Rhizobium* inoculants on soybean.

Bruce Potter, University of Minnesota Department of Entomology and Southwest Research and Outreach Center

**Summary**
Optimize *Rhizobium* inoculant; ApronMaxx and Soygard Multipak fungicides; and Cruiser and Gaucho insecticides, were applied alone and in combinations were applied to soybean seed in a 2004 trial planted at the University of Minnesota Southwest research and outreach center. The trial site had been in a corn/soybean rotation for many years. Crop injury was not observed with any treatment. There were differences in number of nodes/plant at R2 but these did not appear to be associated with any one product and may reflect soil moisture differences early in the season. Under low soybean aphid and bean leaf beetle populations occurred in this trial. Differences in root disease, soybean height, nodulation or yield were not observed among treatments.

**Background**
Soybean growers are increasingly being asked to apply products to soybean seed in an attempt to control problems at planting. These products include, fungicides to control early season root pathogens, insecticides to control insects including soybean aphid, bean leaf beetle and seedcorn maggot and yield savings have been reported. Yield benefits from the inoculation of soybean seed with *Bradyrhizobium* bacteria have also been reported. This approach may be economical when particular problems occur in a field but causes an investment of capital up front, limiting other management expenditures.

**Objective**
This trial was designed to examine: 1) The effect of inoculating soybean seed with nitrogen fixing bacteria under a corn soybean rotation in SW Minnesota. 2) The effect of seed applied insecticides and fungicides on yield and 3) Potential positive or negative effects from combing bacterial inoculant, insecticidal and fungicidal products.

**Site description and application description**
The trial was planted at the University of Minnesota, Southwest Research and Outreach Center near Lamberton, Redwood County, Minnesota. Site and application details are shown below. Planting of this trial was delayed by excessive rainfall and wet cold conditions continued after planting. The 2004 growing season was well below average (261 GDD below average May 1-September 30) in temperature and above average in rainfall (8.22 inches above average May 1 - September 30). The cool season resulted in less vegetative soybean growth than typical. However, a very warm September produced good yields in this trial due to good fill of pods produced and large seed size. Detailed temperature and rainfall information for this location can be found at [http://swroc.coafes.umn.edu/Weather/weather.htm](http://swroc.coafes.umn.edu/Weather/weather.htm).

Overwintering bean leaf beetle populations were low in this trial due to low local populations and late planting. The soybean aphid infestation was detected late and very
slow to develop during 2004. Populations never exceed 20/plant and peaked late in soybean development.

County: Redwood, MN  
Nearest town: Lamberton, MN  
Soil type: Normania and Ves loams, Webster clay loam  
Fertility:  
P(bray)- 17 ppm,  
K – 144 ppm, pH 5.9  
Previous crop: Corn  
Tillage: Soil save Fall 2002  
   Field cultivator 2x 4/30/04  
Cultivar: Crop Plan 2020 RC (roundup ready SCN resistant)  
Planting date: May 28, 2004  
Seeding rate: 175,000 seeds/acre  
Row spacing: 30”  
Weed control: Prowl @ 2.5 pt./acre PPI 4/30/04 PPI Roundup Weathermax @ 22 oz./acre 7/22/04 POST  

Design: Randomized complete block with 4 replications  
Plot size: 10’ x 30’

Seed was treated by pipetting chemical(s) on to seed in seal able plastic bags, mixing thoroughly and allowing drying. Seed was planted within 24 hours of treating.

Combinations were selected in part on expected marketing and rates were held constant between treatments. Various combinations of Optimize inoculant( *Bradyrhizobium japonicum* bacteria + activator, Nitragin, Inc. @ 4.25 fl oz/cwt seed); Apron Maxx RFC fungicide (Mefanoxam + fludioxonil), Syngenta Crop Protection Inc. @ 1.5 fl oz/cwt seed); Soygard Multi-Pak fungicide (azoxystrobin + metalaxyl), Gustafson, LLC @ 6 fl oz/cwt seed, Cruiser insecticide (thiometoxam), Syngenta Crop Protection, Inc., @ 12.8 fl oz/cwt; and Gaucho insecticide (imidichloprid), Bayer Crop Science @ 2 fl oz/cwt seed.

The following treatment comparisons were made:  

Soybean plant populations based on five 1-meter sections of row/plot. Soybean nodulation, root disease and growth were obtained by sampling 5 representative plants/plot.

Results and discussion
Although planted, late this trial experience very wet, cool soil conditions before and after planting. Root rots, primarily *Fusarium sp.* and *Rhizoctonia sp.*, were present in all
treatments early in the season with occasional mortality into the R2 stage. Root disease was rated on the 1-5 scale presented in Table 1. Warmer, drier conditions later in the seasons allowed soybeans an opportunity to regenerate root systems and adequate soil moisture limited the impacts of reduced root systems. Populations of both bean leaf beetle and soybean aphid were low in 2004 with overwintering beetle feeding being observed on less than 1% of plants and aphid populations peaking at less than 20 soybean aphids/plant on R5 soybean late in August.

Soybean yield, nodulation and disease assessments are shown in table 1 for the early and late planning dates respectively.

No differences in soybean yield were detected between treatments in the early planting date. Additionally although some were slightly advanced in the number of nodes at R2, differences in height were not observed. These small differences in vegetative stage are most easily explained by slow and uneven early season growth in cold saturated soils. Extreme variability in nodule numbers/plant hindered analysis of the data but no obvious differences were observed.

These 2004 data should reinforce that prophylactic treatments have a down side potential in that an economic return will not occur where no problem exists that not all soils with a frequent history of soybean will respond to supplementation with nitrogen fixing bacteria. Unfortunately, the low, difficult to quantify insect populations in this trial prevent confidence in evaluating insecticide performance and potential interactions with inoculants.

**Acknowledgments:**
Many thanks to Derek Erickson, Mellisa Olsem, and Mark Anderson for aphid counting. Yield data would not have been possible without the intrepid SWROC mobile plot crew of Steve Quiring and Jeff Irlbeck.

Gaucho®
® Register trademark of Bayer Crop Science and is not currently labeled on Soybean in MN

Cruiser®
®Registered trademark of Syngenta Crop Protection, Inc. and not currently labeled on soybean in MN

Soygard®
®Registered trademark of Gustafson, LLC

Allegience®
®Registered trademark of Gustafson, LLC for metalaxyl

Protége’™
™ Trademark of Syngenta Crop Protection, Inc. for azoxy strebin

ApronMaXX™,
™ Trademark of Syngenta Crop Protection, Inc.

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Table 1. The effect of seed applied insecticide, fungicides and Rhizobium inoculants on soybean nodulation and yield. University of Minnesota – Southwest Research and Outreach Center, Lamberton, MN. (2004). B. Potter

<table>
<thead>
<tr>
<th>Date</th>
<th>Rated</th>
<th>plants/meter at VC-V1</th>
<th>vegetative stage at R2</th>
<th>height at R2 CM</th>
<th>root disease score 1-5</th>
<th>nodule at 13% moisture</th>
<th>bushels at R2</th>
<th>% protein</th>
<th>% oil</th>
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<tr>
<td>6/14/2004</td>
<td>1 Untreated</td>
<td>24.7 a</td>
<td>8.9 ab</td>
<td>37.3 a</td>
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<td>24.8 a</td>
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<tr>
<td>7/22/2004</td>
<td>2 Optimize</td>
<td>25.3 a</td>
<td>8.7 bcd</td>
<td>36.4 a</td>
<td>1.6 a</td>
<td>29 a</td>
<td>49.03 a</td>
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<td>3 Apron Maxx RFC</td>
<td>27.2 a</td>
<td>8.5 bcd</td>
<td>37.3 a</td>
<td>1.4 a</td>
<td>23.6 a</td>
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<tr>
<td>7/22/2004</td>
<td>4 Apron Max RFC + Cruiser</td>
<td>27.7 a</td>
<td>8.9 ab</td>
<td>38.5 a</td>
<td>1.9 a</td>
<td>25.5 a</td>
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<td>8.6 bcd</td>
<td>36.8 a</td>
<td>1.7 a</td>
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<td>25.9 a</td>
<td>8.4 d</td>
<td>37.7 a</td>
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LSD (P=.05) N.S. 0.41 N.S N.S N.S N.S
Standard Deviation
CV
Grand Mean
P(Bartlett's X2) 0.201 0.506 0.456 0.211 0.001* 0.233
P(F) 0.0879 0.0019 0.4409 0.7252 0.6071 0.3428

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

1 No disease
2 Disease visible on root system but no root death
3 Necrosis on at least one main root
4 Necrosis on majority of root system
5 Plant death