Soybean Inoculation Trial

Bob Henson

A field experiment was conducted at the North Dakota State University Carrington Research Extension Center to evaluate the response of soybean to commercial inoculants and to compare this response to varying levels of soil nitrogen (N).

The trial was sown to Roundup Ready® soybean cultivar 'RG405RR' (Maturity Group 0.5) on 28 May at the rate of 200,000 live seeds / acre in 7" rows. A soil sample the previous fall tested 16 lbs. NO_3^--N / acre, with adequate phosphorus. Although soybean had been grown previously in nearby fields, only one cycle of this crop (in 2001) had been grown in the plot area. In addition to an absolute control (no inoculum, no N fertilizer), N fertilizer treatments were included to study total N levels (soil test + fertilizer) of 50, 75, and 150 lbs. N / acre without inoculation. Additional inoculant treatments of interest were also included. Plots measured 10' x 25' and were arranged in a randomized complete block design with six replicates. Weeds were controlled with herbicides and hand weeding. No other pesticides were applied.

The 2004 growing season was not very favorable for full-season crops. Planting of frost-sensitive crops was delayed by rainy weather in May and the entire growing season was considerably cooler than normal. (Season-long growing degree days for corn were approximately 75% of normal.) A light frost on 20 August did minimal damage to the trial. When the first killing frost occurred on 1 October, the plots were in the R7-R8 growth stage. Since R7 is considered physiological maturity, the abrupt end to the growing season should not have affected yield.

Early in the season, severe stunting and leaf necrosis were observed on some plants where N fertilizer was applied ("Stunting" in Table 1), which undoubtedly affected the yields of these treatments. This phenomenon was observed in trials where ammonium nitrate was broadcast after planting (as in this trial) and also in plots where urea was broadcast and incorporated prior to planting. Similar symptoms have not been observed with identical treatments in previous years and we are currently seeking a logical explanation. Inoculated and control treatments were not affected.

Soybean inoculation trial at Carrington.

Table 1. Soybean performance in the inoculant evaluation trial (6 reps), NDSU Carrington, 2004.												
Treatment	Company	Formulation	Stunting (1-9)[1]	Visual Nodulation (1-9)[2]	Height (cm)	Grain Yield (bu/ac)	Test Weight (lb/bu)	Seed Weight (g/250)	Oil (%)	Grain Protein (%)	Protein + Oil (%)	Protein Yield (lb/ac)
Control (16 lbs N/acre)	---	---	1.3	4.7	60.7	29.1	58.6	32.9	20.0	33.9	53.9	589
50 N[3]	---	---	2.8	5.0	63.5	27.6	58.6	32.1	19.6	34.6	54.2	573
75 N[3]	---	---	5.7	7.3	62.8	28.2	58.2	32.4	19.4	36.0	55.3	608
150 N[3]	---	---	7.0	8.0	60.0	22.8	58.3	32.9	18.9	38.6	57.5	525
ABM Concentrate	America's Best	Liquid	1.3	4.7	61.5	28.3	58.2	33.5	19.9	34.2	54.1	581
ABM Exp 7	America's Best	Granular	1.0	5.0	60.3	25.6	58.2	33.6	20.0	34.0	53.9	520
ABM Liquid	America's Best	Liquid	1.3	5.0	58.8	27.6	58.6	33.6	19.9	34.1	54.0	564
Agribiotics Exp 1	Agribiotics	Liquid	1.3	4.3	62.5	27.9	58.6	32.5	19.7	34.7	54.4	584
Apex Extra	Agribiotics	Liquid	1.0	4.0	62.0	32.9	58.3	33.5	19.8	34.7	54.5	685
BYE Exp 6	Brett-Young Seeds	Peat	1.0	5.0	61.5	29.5	58.0	33.7	19.9	34.2	54.1	609
Dyna Start	United Ag. Products	Liquid	1.3	5.0	63.7	31.2	58.4	32.2	20.0	34.1	54.1	640
Primo	INTX Microbials	Liquid	1.2	4.7	62.2	31.3	58.2	33.6	19.8	34.5	54.3	649
N-Take-M	INTX Microbials	Liquid	1.3	4.7	63.0	29.3	58.3	32.6	20.0	33.9	53.9	596
N-Row	INTX Microbials	Granular	1.2	4.7	60.8	29.9	58.4	33.5	19.7	35.0	54.7	627
N-Take	INTX Microbials	Liquid	1.5	4.7	61.7	29.5	58.6	32.5	19.8	34.6	54.4	625
Nitragin Exp 1	Nitragin	Liquid	1.2	4.7	59.2	28.6	58.4	33.5	19.9	34.2	54.1	586
Nitragin Exp 2	Nitragin	Liquid	1.0	4.7	60.5	28.5	58.4	32.9	19.9	34.3	54.2	587
Optimize	Nitragin	Liquid	1.5	5.0	60.3	25.1	58.3	32.9	20.1	34.2	54.3	515
PhilomBios Exp 1	PhilomBios	Liquid	1.2	4.7	60.0	30.1	58.3	33.6	20.1	33.6	53.7	607
PhilomBios Exp 2	PhilomBios	Liquid	1.5	4.7	64.5	31.0	58.3	32.4	19.8	33.9	53.7	630
PhilomBios Exp 3	PhilomBios	Liquid	1.2	5.0	61.3	31.0	58.2	32.6	19.7	34.4	54.1	641
Pro-tec + Polymer	BioCoat Technologies	Pre-inoculant	1.3	4.3	59.8	29.5	58.3	32.6	20.0	33.9	53.9	600
ProLiquid	Advance Inoculant	Liquid	1.0	4.3	63.2	26.0	57.9	32.6	19.8	34.1	53.9	532
ProLiquid + Extender	Advance Inoculant	Liquid	1.0	4.3	63.8	27.1	58.1	32.2	19.7	34.4	54.1	560
Pulse RHP	Agribiotics	Peat	1.0	5.0	61.5	31.3	58.2	33.1	19.9	34.3	54.1	644
So-fast	United Ag. Products	Peat	1.3	4.3	63.7	30.9	58.3	33.2	19.8	34.3	54.2	636
TagTeam	PhilomBios	Peat	1.0	4.3	61.8	31.8	58.7	32.9	19.9	34.0	54.0	650
Mean	---	---	1.6	4.9	61.7	28.9	58.3	32.9	19.8	34.5	54.3	598
C.V. (%)	---	---	31.0	11.4	6.1	12.4	0.7	3.2	1.4	2.1	---	12.6
LSD (0.05)	---	---	0.6	1.0	NS	4.1	NS	NS	0.4	0.9	---	86
LSD (0.01)	---	---	0.8	1.3	NS	5.4	NS	NS	0.5	1.2	---	NS
[1]1 = no symptoms, 9 = all plants stunted with leaf necrosis				[2]1 = profuse, 9 = none								

Visual nodulation scores on 16 August (R4 growth stage) showed that only the treatments with 75 or 150 lbs total N differed significantly from the control and the other treatments (Table 1). Plant height and lodging at maturity were also uniform across treatments.

Due to the unfavorable growing season, yields were considerably lower than normal. As noted above, yield reductions with N fertilizer were probably due to crop injury early in the season. In general, yields among inoculant treatments were similar to the control, although some inoculants performed significantly better than others. Of note is the relatively low yield with Optimize. Data from individual plots and on other parameters measured do not suggest that this result is inaccurate. However, the inoculant in Optimize is a proven product and the relatively poor performance may be related to the polymer additive. We are currently investigating this situation further.

With the exception of some of the INTX and Agribiotics entries, significant differences in grain protein were confined to the N fertilizer treatments, where crop injury resulted in lower yields. In general, protein and oil concentrations were inversely proportional, with protein decreasing as oil and grain yield increased. The sum of protein and oil hovered around 54%, which is the minimum number exporters use to determine the acceptability of grain quality. Soybean protein tends to decrease as production regions move farther from the equator and North Dakota is notorious for relatively low-protein soybean grain. Although transportation to the Far East markets is faster from the Northern Plains than from the southern U.S.A. and South America, these regions generally have a distinct quality advantage. The soybean industry as a whole needs to place more emphasis on this issue.

Inoculation-Nitrogen Fertility Management in Soybean, Harvey

Greg Endres

Table 1. Soybean seed inoculation trial, Harvey, 2003.					
	Plant	Seed			
Treatment description	Height	Yield	TW	Protein	Oil
	cm	bu/A	lb/bu	%	%
Untreated Check	56	40.4	58.9	38.7	16.4
150 lb/A soil N	65	49.9	59.4	39.7	16.0
Peat - S Culture	58	48.7	59.4	39.7	16.1
Peat 2X - S Culture	54	46.4	58.9	39.9	16.1
Liquid - Cell-Tech SCI	59	50.8	59.1	40.1	16.0
Liquid - Optimize	57	52.4	59.0	39.2	16.0
Granular - Soil Implant	57	49.4	59.2	39.8	16.0
mean	58	48.3	59.1	39.6	16.1
C.V.	10	18	1	2	2
LSD (0.05)	NS	NS	NS	NS	NS
Planting Date = May 26; Harvest Date = October 14; Previous Crop = Barley (no recent soybean history)					
Soil = 95 lb N; 8 ppm P; 410 ppm K; 111 lb S; 3.1 % OM; 6.8 pH.					
RG200RR soybean planted at 175,000 pls/acre in 7-inch rows on May 26.					