

New Soybean Inoculant Technology (2008 Final Report)

Purpose:

Soybeans require a significant amount of nitrogen to produce a high yielding crop. A 50 bu/ac crop requires 210 lbs/ac of nitrogen. About 75% of that nitrogen comes from nitrogen fixation. Once the nitrogen fixing bacteria are established in the soil they will survive in the ground for many years. At present, about 60% of Ontario soybeans receive an annual application of inoculants. Research conducted with older inoculant formulations confirmed that yield gains were inconsistent and very small if the field had successfully grown soybeans in the past.

Advances in inoculant technology have provided new soybean inoculant technology called "pre-inoculants". These products contain highly efficient strains of bacteria and "extenders" that prolong the viability of inoculants. Seed can be treated before it is delivered to the farm. Reduced inoculation procedures at planting time and excellent coverage are significant advantages to the grower, compared to traditional drill box application. These high quality inoculants provide between 800,000 and 1,400,000 bacterial cells per seed, much higher concentrations than were previously available. Researchers from Ohio State found yield gains to be common in productive fields with a history of soybeans. The average yield response from 64 Ohio trials was 1.9 bu/acre from all inoculants tested. At a cost of \$3.00-\$4.00/acre (depending on the seeding rate), a ½ bu/ac yield increase could be considered "break even". Researchers from Ohio suggest a profit of 300% compared to the investment when using an inoculant. Some states such as Michigan, Indiana, and North Dakota have also found average gains ranging from 1.0-2.7 bu/ac in fields with a history of soybeans. Other regions have found much lower gains.

Sixteen field trials were established in 2007 to assess the efficacy of two pre-inoculants in fields with a history of soybeans. Another twelve sites were conducted in 2008. A variety of soil types, yield potentials, crop rotations, and environments were chosen.

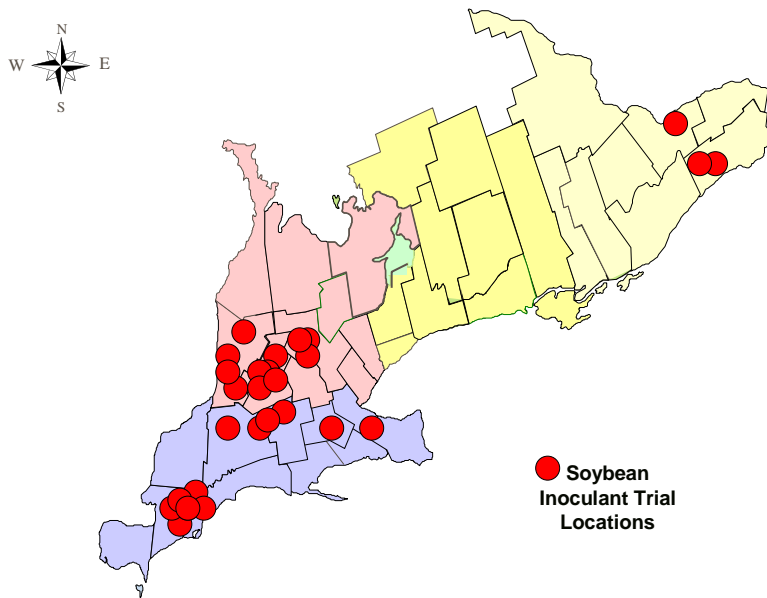
Methods:

Twenty eight trials were conducted across a wide geographic area in 2007 and 2008. (See Figure #1) These sites provided a range of soil types, growing conditions and yield potentials. Trials were replicated twice whenever possible with a minimum length for each treatment of 1000 feet. All trials included the following treatments:

Treatment:
Untreated Check
Cell Tech SCI
HiStick Liquid + Liquid Extender (2007)
HiStick NT + Extender (2008)

Fields were treated as a whole when applying herbicides, fertilizers, and tillage practices. Crop inputs were applied perpendicular to the direction of the inoculant treatments.

Figure #1. 2007- 2008 Soybean Inoculant Trial Locations



At each field site soil samples were collected at planting time. A standard soil test analysis was conducted as well as a PSNT nitrogen test. Both nitrate and ammonium levels were assessed along with the usual soil test values.

In addition, sufficient topsoil was removed from each site to permit a bioassay of the nodulation potential of the existing *Bradyrhizobium japonicum* populations indigenous at that field test location in 2007.

Field trials were weighed with a weigh wagon. Seed samples were collected and assessed for size and grade. Seed samples were also analyzed for oil and protein content by the University of Guelph, using near infrared reflectance (NIR).

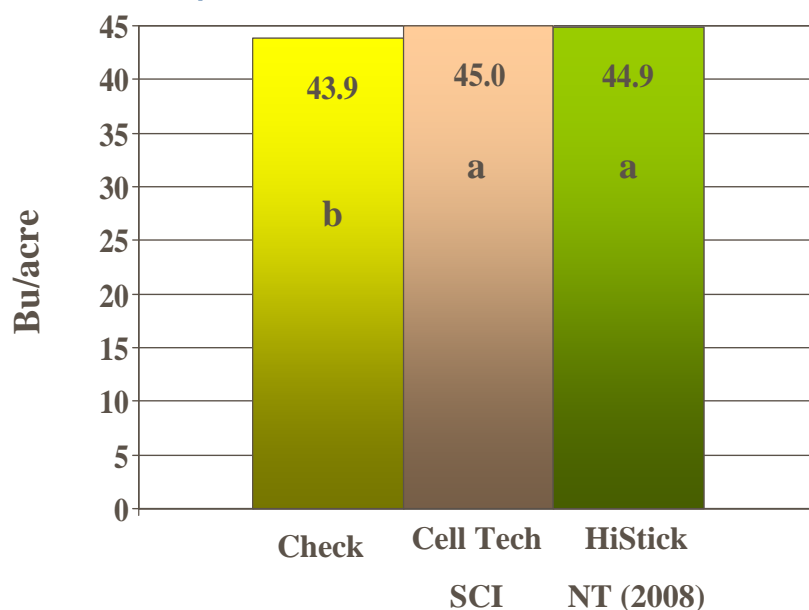
Results and Summary:

Statistically significant yield differences were found between the untreated and the inoculant treatments (see Figure #2). No statistical difference was found between the two inoculants. The average statistical yield gain of the inoculants compared to the untreated control was 1.0 bu/ac across the two years. At a selling price of \$10.00/bu and a yield gain of 1.0 bu/ac a return of \$6.67/acre would be realized when using an inoculant. (Assuming a cost of \$3.33/ acre for the inoculant) Table #1 shows the average trial results.

No statistical differences were found in oil or protein content of the seed. PSNT could not be correlated to yield.

Figure #2.

Yield Response of 28 Inoculant Trials (07-08)



* Values followed by the same letter are not significantly different at the 5% confidence level.

Table 1. Yield Response to Inoculants (bu/ac) (2007)

Trial No.	County	Untreated	Cell Tech	HiStick	Average Inoculant Response	Nitrate (ppm)	Ammonium (ppm)
1	Huron	35.36	34.74	33.81	-1.08	6.26	1.52
2	Huron	43.09	44.12	43.55	0.74	9.47	1.17
3	Middlesex	34.14	34.54	34.54	0.40	14.59	1.13
4	Perth	33.96	36.51	35.28	1.93	10.72	2.86
5	Perth	24.02	23.53	24.99	0.24	16.07	3.32
6	Wellington	34.88	33.02	34.88	-0.93	12.38	1.80
7	Niagara	31.66	35.15	33.37	2.60	12.23	1.28
8	Wellington	29.24	29.84	28.44	-0.10	16.09	2.08
9	Dundas	48.85	47.90	47.70	-1.05	22.81	1.06
10	Kent	44.80	47.20	49.50	3.55		
11	Brant	14.90	15.10	15.00	0.15	6.54	2.18
12	Perth	24.87	28.05	27.06	2.69	15.03	0.85
13	Perth	34.21	41.67	39.91	6.58	19.12	1.53
14	Russell	43.80	43.80	42.40	-0.70		
15	Kent	57.80	58.60	58.10	0.55	8.69	1.14
16	Kent	51.00	50.70	51.40	0.05	20.48	1.65
Average		36.66	37.78	37.49	0.98		

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Table 2. Yield Response to Inoculants (bu/ac) (2008)

Trial No.	County	Untreated	Cell Tech	HiStick NT	Average Inoculant Response	Nitrate (ppm)	Ammonium (ppm)
1	Middlesex	50.03	52.70	51.37	2.01	19.91	1.05
2	Huron	55.83	53.30	55.27	-1.55	14.08	2.26
3	Perth	53.59	56.17	54.11	1.55	21.92	1.81
4	Middlesex	40.15	39.75	40.85	0.15	10.08	2.21
5	Huron	56.88	57.90	58.91	1.52	12.79	1.41
6	Wellington	48.17	50.34	49.70	1.85	20.31	1.45
7	Dundas	47.20	47.60	46.85	0.02		
8	Perth	53.73	54.78	57.96	2.64	12.86	1.41
9	Lambton	50.50	50.25	50.50	-0.13	22.97	3.11
10	Kent	54.85	56.70	55.00	1.00	24.10	
11	Kent	48.85	51.55	50.70	2.28	9.88	
12	Kent	54.05	55.90	55.75	1.78	21.66	
Average		51.15	52.24	52.25	1.10		

Conclusions:

- 1) An average yield gain of 1.0 bu/ac was gained with the use of an inoculant on fields with a history of soybeans averaged across the two years. 75% of trials showed a numerical yield increase.
- 2) No statistical difference was found between the two inoculants.

Next Steps:

There is some evidence to suggest that yield gains are higher in the southwest compared to central and eastern Ontario. Trials should be conducted at least one more year to investigate possible regional differences.

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- 5) Becker Underwood

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