

2003 Ohio Soybean Inoculation Study

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Nine years of soybean inoculation evaluation consisting of 60 field trials and over 5000 research plots indicate that inoculating soybeans is a very profitable practice. Although the results have not always been positive, the long-term result is a profit of over 300 percent. For most inoculation products, a yield increase of half a bushel per acre is profitable and yield increases of 2 to 7 bu/acre have been common. Since 1995 the inoculation of soybean seed in Ohio has increased from a few thousand acres to over 2.5 million acres. The primary reason for the rapid increase in use of inoculation materials is that over time their use has been consistently profitable.

In 2003 we continued our evaluation of inoculation materials. Seventeen soybean inoculation products were evaluated using eight replications at each of five test sites in the soybean production region of Ohio. The inoculation treatments were applied to seed of the variety SC9737RR, marketed by Seed Consultants, within three hours of planting (except where noted) at the suggested application rate. The results of that work are presented in Table 1. Agronomic practice, site characteristics and monthly rainfall for each test site are described in Tables 2 and 3. The average yield increase due to inoculation was 1.5 bushels per acre. Yield increases due to specific treatments across test sites ranged from no yield increase to 2.6 bushels per acre, and the maximum yield increase due to inoculation at a test site was 9.8 bushels per acre. Based on the yield increase from these tests with soybeans at \$6.50 per bushel, inoculation increased profit by \$7.50 per acre, which is more than three times the cost to inoculate.

The test sites used in 2003 were well drained, had good fertility and an appropriate soil pH. The fields have been in a corn-soybean crop rotation where good crop management practices were used. Typically, under those ideal conditions we would not expect inoculation to increase soybean yield. The fact that yields were increased and inoculation was rather profitable, leads one to predict that even greater yield increases are likely where the soil conditions and cultural practices may be less ideal. Inoculation has not increased yield at every location every year due to dry soil conditions, flooding immediately after planting, or other adverse conditions. However, the average yield increase over 60 trials is more than 1.75 bushels per acre and the break-even yield is about one-third bushel per acre when soybeans are worth \$6.50 per bushel. Inoculating soybean seed continues to be a very profitable practice.

Table 1. Effect of Soybean Seed Inoculation on Grain Yield at Ohio Five Test Sites in 2003

Company	Treatment	Yield (Bu/Ac)					
		N1	N2	C1	S1	S2	Mean
Becker Underwood	Nod+® over Apron®Maxx® RTA®	50.7	51.7	46.6	52.9	55.9	51.6
Becker Underwood	Exp 2 over ApronMaxx® RFC®	49.7	52.9	51.2	52.6	53.2	52.0
Becker Underwood	Exp 2 with no fungicide	51.0	49.0	46.0	52.1	53.5	50.3
Loveland	Sowfast over ApronMaxx® RTA®	51.2	52.8	48.8	54.4	55.6	52.6
Rootscape	MycoApply over ApronMaxx® RTA®	49.8	52.1	47.5	52.9	52.5	51.0
Martin Marietta	SC27 with no fungicide	52.5	50.4	47.4	52.2	56.1	51.7
Nitragin	Cell-Tech Soybean + ApronMaxx® RTA®	51.4	52.7	45.9	51.1	54.5	51.1
Nitragin	Cell-Tech SCI + ApronMaxx® RTA®	52.1	47.3	46.5	53.9	54.5	50.8
Nitragin	NitraStick-S Sterile over ApronMaxx® RTA®	52.3	48.0	47.0	55.6	54.9	51.6
Agribiotics	Apex over ApronMaxx® RTA®	53.0	51.9	46.8	52.8	56.1	52.1
Agribiotics	PulsaR over ApronMaxx® RTA®	50.0	52.1	46.7	50.2	53.6	50.5
ABM	America=s Best over ApronMaxx® RTA®	51.9	50.3	46.3	52.2	54.3	51.0
Trace Chemical	Nitrofix Liquid over ApronMaxx® RTA®	52.6	54.2	44.9	53.9	56.1	52.4
Precision Labs Inc.	Launcher IS over ApronMaxx® RTA®	50.5	55.8	45.1	53.1	53.3	52.0
Precision Labs Inc.	Same material applied 10 days preplant	52.2	50.3	47.5	53.6	55.5	51.9
Precision Labs Inc.	Same material applied 20 days preplant	52.0	52.1	43.9	52.2	55.0	51.0
Untreated Check	Untreated Check Treatment	49.4	50.6	41.4	52.8	56.0	50.0
	LSD 0.3	1.7	2.4	1.7	1.5	1.8	0.8

Table 2. Production practices used and soil conditions for each test site in 2003.

	N1	N2	C1	S1	S2
	<u>Henry Co.</u>	<u>Huron Co.</u>	<u>Mercer Co.</u>	<u>Preble Co.</u>	<u>Clinton Co.</u>
<u>Tillage</u>					
Fall	None	Plow	Chisel	None	Chisel
Spring	None	Field Cultivator	Disk	None	Field Cultivator
<u>Normal Variety Weed Control</u>					
Preemergence	Canopy XL/Dual II/Roundup UltraMax used at all test sites.				
Postemergence	Basagran/Flexstar/Select used at all test sites.				
<u>Roundup Ready Variety Weed Control</u>					
Pre/Postemergence	Roundup UltraMax used at all test sites.				
<u>Soil and Crop Background</u>					
Soil Type	Hoytville	Kibbie	Mercer	Crosby	Westland
Soil pH	5.96	6.32	6.11	6.82	5.86
Soil Test P(ppm)	98	15	33	7.5	40
Soil Test K(ppm)	299	75	185	275	197
Fertilizer	0-0-0	0-0-0	0-0-0	0-0-0	0-0-0
Previous Crop	Corn	Soybean	Corn	Corn	Corn
Plant Date	5/26	5/25	5/23	5/24	5/27
Harvest Date	10/19	10/18	10/20	10/21	10/22

Table 3. Monthly and total rainfall for each test site in 2003.

	N1		N2		C1		S1		S2	
	Henry Co.		Huron Co.		Mercer Co.		Preble Co.		Clinton Co.	
	----- 2003 (Normal) -----									
May	1.9	(3.3)	5.9	(3.6)	7.0	(4.1)	3.9	(3.8)	5.0	(4.7)
June	2.3	(3.5)	5.0	(3.9)	6.4	(3.8)	7.9	(3.9)	6.2	(3.6)
July	4.7	(4.0)	5.7	(4.2)	14.2	(4.4)	11.8	(3.4)	4.6	(3.9)
August	4.4	(3.1)	2.8	(3.5)	8.5	(3.6)	5.2	(3.1)	4.2	(3.5)
September	5.0	(2.8)	6.3	(3.2)	6.1	(3.3)	7.2	(2.7)	5.1	(3.0)
TOTAL	18.3	(16.7)	25.7	(18.4)	42.2	(19.2)	36.0	(16.9)	25.1	(18.7)

Observations and Recommendations:

Dry and liquid formulations of a product appear to perform similarly. Most inoculated seed should be planted as soon as possible after treatment (12 hours or less) so the bacterial cells will remain moist and survive long enough to infect soybean roots following germination. However, some inoculation materials include additives which allow application up to 20 days before planting even on some fungicide treated seed. Several inoculation companies are working toward that end to give producers more management flexibility in the use of inoculation materials.

When applying a fungicide or using fungicide treated seed, be sure the fungicide has dried before applying inoculation material to the seed. Currently, many inoculation products may NOT be mixed with fungicides and applied to the seed together. One exception is that liquid formulations may be mixed with ApronMaxxRTA fungicide and applied together. Inoculation materials retain their activity on treated seed for at least 24 hours and some survive on untreated seed for up to seven days. See package label for specific information. Work is underway to develop formulations of fungicides that can be premixed with inoculation materials and applied together at planting.

When loading a drill or planter using an auger, liquid or dry inoculation materials should be added to the seed as it enters the auger for thorough application. When loading a planter or drill from bags, fill the seed box to a depth of three inches and scatter an appropriate amount of inoculation material over the seed and mix thoroughly. Continue to add seed in six-inch layers, treating each layer until the box is filled. With some dry materials it may be necessary to moisten seed to increase adherence. A few small specks of inoculation material on each seed are adequate. At the recommended use rate, there will be up to 1,000,000 bacterial cells on each seed. Excessive application of inoculation material is expensive, will likely not increase yields more than the recommended application rate, and could cause seed metering problems resulting in reduced numbers of seeds planted. Excessively wet or dry periods following planting have decreased performance of inoculation materials.