2004 Ohio Soybean Inoculation Study

Dr. Jim Beuerlein
The Ohio State University

Ten years of soybean inoculation evaluation consisting of 66 field trials and over 7000 research plots indicate that inoculating soybeans is a very profitable practice. The average yield increase over ten years has returned 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 two million acres. The primary reason for the rapid increase in use of inoculation materials is that over time their use has been profitable.

In 2004 we evaluated eighteen soybean inoculation products using eight replications at each of six test sites. The inoculation treatments were applied to seed of Asgrow AG3302, within three hours of planting (except where noted) and at the recommended 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 2.6 bushels per acre, and the maximum yield increase due to inoculation was 4.7 bushels per acre. Based on the average yield increase from these tests and with soybeans worth $6.50 per bushel, inoculation increased profit by $13.90 per acre in these test, which is more than four times the cost to inoculate.

The test sites used in 2004 were well drained, had good fertility and an appropriate soil pH and the previous crop was either corn or wheat. Typically, under such ideal conditions we would not expect inoculation to increase soybean yield. The fact that yields were increased leads one to predict that even greater yield increases are likely where the soil conditions and cultural practices are less ideal.

Inoculation has not always increased yield. When soil conditions were very dry or very wet for a week following planting the bacteria died before forming nodules and there was no yield increase. However, the average yield increase over 66 trials is more than 2.0 bushels per acre and the break-even yield is less than half bushel per acre when soybeans are worth $6.50 per bushel. Inoculating soybean seed continues to be a very profitable practice.

Observations and Recommend ations:

The quality and performance of inoculation materials has improved every year. 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. Some inoculation materials include additives that allow application up to 20 days before planting even on fungicide treated seed. Most inoculation companies are working to increase compatibility with fungicides 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. Inoculation products may be mixed with some fungicides and applied to the seed together. Be sure to check labels for compatibility. Work is underway to develop

formulations of fungicides that can be premixed with inoculation materials and applied together.

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. Over application is expensive and can cause seed metering problems for planters and drills. Seed inoculated at the recommended rate with dry inoculation materials will not look treated from a distance. 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.

With some dry materials it may be necessary to moisten seed to increase adherence. 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. Some of the dry inoculation material is often rubbed off seed as the seed moves down through the seed box to the metering units. Much of that rubbed off material is discharged down the seed tubes to the seed furrow and will be effective in forming nodules on soybean plant roots.

Table 1. Effect of Soybean Seed Inoculation on Grain Yield at Six Ohio Test Sites in 2004.

		Test Site*						
Company	**Treatment Description**	**N1**	**N2**	**C1**	**C2**	**S1**	**S2**	**Mean**
UTC1	UTC	59.8	44.4	48.6	63.5	68.8	73.5	**59.8**
UTC2	ApronMaxx RTA7	65.6	48.4	47.9	66.6	71.4	76.8	**62.8**
Precision	Launcher IS (7dpp,nf)**	65.1	50.9	44.8	65.7	71.1	75.0	**62.1**
Precision	Launcher IS (7dpp)	64.6	48.1	46.3	67.2	70.1	74.7	**61.8**
Precision	Launcher IS (20dpp,nf)	64.6	46.4	49.6	65.7	69.8	73.6	**61.6**
Precision	Launcher IS (20dpp)	63.5	46.2	48.2	67.7	72.3	75.6	**62.3**
Precision	Prosurge (20dpp,nf)	63.9	51.0	46.4	65.5	70.5	75.3	**62.1**
BeckerU	Nod+ 7	64.6	51.8	50.0	65.6	70.2	75.9	**63.0**
BeckerU	Nod+7 with Extender (5dpp)	64.2	51.8	50.8	66.9	71.4	77.3	**63.7**
BeckerU	Nod+7 with Subtilex	61.5	48.1	50.5	70.1	73.0	77.0	**63.4**
BeckerU	HiStick N/T	64.5	51.6	50.0	64.5	71.7	76.5	**63.1**
ABI	ABI Sterile Peat	64.5	52.1	47.5	67.9	70.1	73.3	**62.6**
ABI	ABI Exp Liq.	63.4	48.1	46.5	68.3	71.7	75.3	**62.2**
Nitragin	Optimize7	63.9	49.8	48.9	69.8	71.8	73.9	**63.0**
Agribiotics	Apex Extra7	64.7	51.3	47.3	69.1	70.7	74.6	**62.9**
Agribiotics	Agribiotics Exp 1 (7dpp)	64.7	50.5	47.5	66.6	70.8	76.6	**62.8**
Agribiotics	Pulse R HP7	62.5	50.0	53.3	66.8	68.7	74.4	**62.6**
B-Y Seeds	B-Y EXP-1 (nf)	63.1	46.0	50.1	68.2	72.2	73.2	**62.1**
UAP	So-Fast7	64.5	48.1	53.7	62.4	70.9	74.0	**62.3**
UAP	Dyna-Start7	63.0	51.5	49.9	64.2	72.7	74.9	**62.7**
Mean		**63.8**	**49.5**	**48.9**	**66.6**	**71.0**	**75.0**	**62.5**

LSD 0.3	**1.8**	**2.9**	**2.9**	**3.0**	**1.8**	**1.8**	**1.0**

* N1 = Henry Co., N2 = Huron Co., C1 = Mercer Co., C2 = Delaware Co., S1 = Preble Co., S2 = Clinton

** dpp = days pre plant, nf = no fungicide on seed.

Table 2. 2004 Production Background Information

	N1 Henry Co.	N2 Huron Co.	C1 Mercer Co.	C2 Delaware Co.	S1 Preble Co.	S2 Clinton Co.
Tillage						
Fall	None	Plow	Chisel	None	None	Chisel
Spring	None	Field Cult.	None	None	None	Field Cult.
Soil and Crop Background						
Soil Type	Hoytville	Kibbie	Mercer	Blount	Crosby	Westland
Soil pH	6.7	5.7	6.4	6.1	6.8	6.2
Soil Test P(ppm)	56	72	40	52	78	47
Soil Test K(ppm)	251	437	221	230	298	248
Fertilizer	0-0-0	0-0-0	0-0-0	0-0-0	0-0-0	0-0-0
Previous Crop	Corn	Soybean	Corn	Wheat	Corn	Corn
Plant Date	5/28	5/18	5/29	5/13	5/11	5/10

Weed Control was accomplished with Roundup7 UltraMax7

Table 3. 2004 Rainfall Data

	N1 Henry Co.		N2 Huron Co.		C1 Mercer Co.		C2 Delaware Co.		S1 Preble Co.		S2 Clinton Co.	
	2004 (Normal)											
May	**8.0**	(3.3)	**3.9**	(3.6)	**5.3**	(4.1)	**4.6**	(3.8)	**5.0**	(3.8)	**4.1**	(4.7)
June	**4.5**	(3.5)	**4.3**	(3.9)	**6.5**	(3.8)	**5.8**	(3.8)	**6.6**	(3.9)	**3.1**	(3.6)
July	**2.6**	(4.0)	**4.2**	(4.2)	**4.1**	(4.4)	**3.0**	(3.8)	**6.1**	(3.4)	**4.6**	(3.9)
August	**3.9**	(3.1)	**3.6**	(3.5)	**6.3**	(3.6)	**6.8**	(3.1)	**2.3**	(3.1)	**1.7**	(3.5)
September	**1.0**	(2.8)	**1.7**	(3.2)	**1.1**	(3.3)	**1.1**	(2.9)	**5.9**	(2.7)	**2.0**	(3.0)
TOTAL	**20.0**	(16.7)	**17.7**	(18.4)	**23.3**	(19.2)	**21.3**	(17.4)	**25.9**	(16.9)	**15.5**	(18.7)