Evaluating Yield Response of Biological Seed Treatments in Soybean
2022

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Background
There are many biological seed treatments (e.g., fungi, amino acids, bacteria) marketed to growers under the premise that this practice will produce a positive ROI due to plant health promoting properties. Most of these biological products are applied as a seed treatment prior to planting, but others are applied in-furrow or broadcast or sprayed over the crop. Growers often purchase these products with the intention of maximizing seed yield to gain a competitive advantage. We evaluated 13 commonly marketed biological seed treatment products at 10 sites in Wisconsin in 2022. In addition, we were part of a national effort to evaluate biological seed treatments. Nine additional states participated in evaluation of these seed treatment products.

Methods
Small plots were established at 10 sites, corresponding to our soybean variety trial program sites, in WI in 2022 (Table 1). Plots were planted with a research plot planter and harvested with a research plot combine equipped with weighing and moisture sensors. All plots were seeded at 140,000 seeds/acre. Standard management practices for weed control and tillage (where used), were employed. Seed of appropriate zone maturity was selected for each region (Table 1). All seed was pre-treated by the seed company with a common fungicide and insecticide including fluxapyroxad, imidacloprid, metalaxyl, and pyraclostrobin. All biological seed treatments were applied to the seed according to the product label using a small batch seed treater on top of the fungicide and insecticide seed treatment. Grain yield and plant population at growth stage V2 were recorded. Seed treatment information is presented in Table 2.

Region	Location	Tillage	Soil texture	pH	OM (%)	P (ppm)	K (ppm)	Planted	Harvested	Asgrow variety	Seed RM	Average yield (bu/a)	Std. Err.
South	Arlington	no-till	Silt Loam	6.8	4.3	72	288	9-May	7-Oct	AG22XF2	2.2	78.7	0.7
	Clinton	no-till	Silt Loam	6.8	4.4	31	254	10-May	19-Oct	AG22XF2	2.2	64.4	0.8
	Platteville	no-till	Silt Loam	6.8	3.5	81	185	10-May	18-Oct	AG22XF2	2.2	94.3	0.5
Central	Fond du Lac	no-till	Silt Loam	7.2	4.1	61	262	6-May	7-Oct	AG20XF1	2.0	62.3	0.6
	Galesville	conventional	Silt Loam	5.8	3.9	54	282	5-May	6-Oct	AG20XF1	2.0	77.4	0.7
	Hancock (Irr)	conventional	Sand	5.7	0.6	114	117	4-May	6-Oct	AG20XF1	2.0	59.4	0.6
North Central	Menomonie	no-till	Sandy Loam	6.1	1.6	35	86	5-May	11-Oct	AG11XF2	1.1	43.0	1.0
	Marshfield	no-till	Silt Loam	6.9	4.3	30	168	13-May	11-Oct	AG11XF2	1.1	53.2	0.4
	Seymour	conventional	Silt Loam	7.1	2.9	19	138	12-May	10-Oct	AG11XF2	1.1	74.4	0.6
North	Spooner (Irr)	conventional	Sandy Loam	6.4	2.4	37	121	24-May	10-Oct	AG11XF2	1.1	60.8	0.4

Table 1. Site information for biological seed treatment trials in 2022.

Treatment	Company	Product name	Main ingredients
1	Sunrise	BioBuild™ Soy Bio ST + R	*Azospirillum brasiliensi, Bacillus licheniformis, B. amyloliquefaciens, B. subtillis, Pseudomonas fluorescens, Rhizobium*
2	ABM	SabrEx® Soybeans PB	*Trichoderma virens*
3	ABM	Graph-Ex®	*Rhizobium*
4	BASF	Vault® IP Plus	*Bacillus subtillis, Bacillus amyloliquefaciens, Bradyrhizobium japonicum*
5	3Bar Biologicals	Bio-YIELD® ST	*Pantoea agglomerans*
6	3Bar Biologicals	Bio-YIELD®	*Pseudomonas brassicacerum*
7	Lallemand	LAL FIX Proyield + LAL RISE Start SC	*Bradyrhizobium elkanii; Delfia acidourarus; Bacillus velenzensis*
8	Lallemand + Agrilead	Rise & Shine	*Bacillus velenzensis*
9	Valent	MycoApply EndoFuse	*Glomus intraradices, G. mosseae, G. aggregatum, G. etunicatum*
10		Non treated control	
11	Valent	Aveo EZ	*Bacillus amyloliquefaciens* strain PTA-4838
12	Biovante	BioCoreSoybeans	Azotobacter and *Bacillus sp*.
13	Biovante	Invade 5G	Azotobacter and *Rhizobium*
14	YieldMaster	SoyFx	Potash and *Bacillus sp*.

Table 2. Seed treatment information for biological seed treatment trials in 2022.

Results

Plant population at the V2 stage and seed yield data were analyzed within and across sites. Across all 10 locations, there were no significant difference in yield between the treatments. There was a significant difference in plant populations across the 10 locations, although no treatment resulted in significantly different plant population than the control (Table 3).

Treatment	Product	Plant population ppa/1000	
2	SabrEx® Soybeans PB	128.7	A
6	Bio-YIELD®	121.5	AB
11	Aveo EZ	120.7	AB
3	Graph-Ex®	120.6	AB
7	LAL FIX Proyield + LAL RISE Start SC	118.7	AB
4	Vault® IP Plus	117.9	AB
1	BioBuild™ Soy Bio ST + R	117.5	AB
12	BioCoreSoybeans	117.3	AB
10	Non treated control	116.7	AB
5	Bio-YIELD® ST	116.5	AB
13	Invade 5G	116.0	AB
14	SoyFx	115.1	B
8	Rise & Shine	114.7	B
9	MycoApply EndoFuse	114.2	B

Table 3. Plant populations at the V2 growth stage across 10 locations. Means with the same letter are not significantly different from each other ($P>0.05$)

Yields

Table 4 shows yields for all treatments at all locations along with a standard error. Standard error allows us to estimate how representative the results are compared to the whole population. A high standard error shows that sample means are widely spread around the population mean. A low standard error shows that sample means are closely distributed around the population mean.

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Treatment	ARL mean	stderr	CLN mean	stderr	PLT mean	stderr	FDL mean	stderr	GAL mean	stderr	HAN mean	stderr	MEN mean	stderr	MAR mean	stderr	SEY mean	stderr	SPO mean	stderr
BioBuild™ Soy Bio ST + R	73.1	2.0	61.6	3.0	95.8	0.7	59.4	2.0	78.6	2.7	56.7	2.1	39.5	1.6	52.3	0.7	72.0	2.2	61.6	0.9
SabrEx® Soybeans PB	80.2	2.3	68.9	1.8	95.1	1.5	65.2	1.9	81.9	2.4	61.4	2.9	44.3	1.9	52.8	1.3	72.1	3.0	61.5	1.5
Graph-Ex®	84.7	1.6	69.0	1.6	95.1	0.7	62.3	2.2	79.1	3.0	56.3	3.0	39.3	1.4	51.9	0.8	74.9	2.1	59.7	1.0
Vault® IP Plus	78.1	2.4	68.2	2.6	94.9	2.6	68.7	2.6	78.5	2.2	57.0	2.3	37.4	1.3	54.2	1.0	75.9	1.5	59.3	1.0
Bio-YIELD® ST	78.8	3.0	62.7	3.4	94.7	2.0	65.0	0.7	73.1	2.6	57.5	2.8	39.0	2.2	52.6	1.9	75.7	2.8	61.1	1.2
Bio-YIELD®	77.0	3.0	64.6	1.5	95.6	2.2	61.1	2.2	72.4	2.6	56.8	1.8	44.0	1.9	52.6	2.1	72.1	2.7	59.5	1.7
LAL FIX Proyield + LAL RISE Start SC	78.3	2.3	66.9	2.4	93.8	1.0	59.4	2.4	76.6	1.6	59.5	1.9	37.9	1.2	53.0	1.5	74.1	2.4	60.7	1.7
Rise & Shine	83.2	0.9	59.9	2.7	89.4	2.7	60.7	3.0	76.9	3.6	59.5	2.3	39.4	1.9	53.5	1.8	75.5	1.4	61.6	1.5
MycoApply EndoFuse	76.8	2.0	61.0	2.3	92.0	2.3	60.7	2.7	77.7	1.7	57.4	2.1	39.4	1.3	51.9	1.6	71.1	0.8	59.6	0.8
Non treated control	77.4	2.0	55.2	1.7	94.8	1.6	60.8	2.7	78.6	3.2	62.0	1.7	46.9	2.0	54.9	1.8	74.6	2.5	63.3	1.3
Aveo EZ	73.8	3.5	68.2	2.7	94.0	3.1	63.1	2.0	76.1	3.3	63.1	2.7	61.1	2.0	54.1	1.9	74.0	1.2	62.6	1.2
BioCoreSoybeans	80.1	1.8	56.9	3.2	94.9	1.9	63.0	1.5	79.3	2.1	62.6	2.3	34.8	1.5	54.8	2.2	76.3	2.0	59.7	0.9
Invade 5G	77.1	2.1	67.8	3.2	93.7	2.4	59.5	2.6	80.0	1.2	63.4	1.9	61.2	3.1	52.2	1.6	78.6	2.3	61.2	2.3
SoyFx	83.4	1.0	70.4	1.3	96.6	2.2	63.3	3.0	74.9	3.1	58.9	1.3	38.2	1.5	53.6	1.9	74.8	1.0	60.0	1.1

Table 4. Combined data for all locations using Bayesian methodology.

Bayesian analysis creates a distribution of the estimate instead of just point estimates. In Table 5 the yield difference of each treatment from the control across all locations is shown. From the generated posterior distribution of yield for each treatment, we calculated the probability that the yield difference (treatment minus control) > 0 (Table 5).

Treatment	Yield difference from control (bu/a)	Probability diff > 0 (%)
BioBuild™ Soy Bio ST + R	-1.8	11.8
SabrEx® Soybeans PB	**1.5**	**82.3**
Graph-Ex®	0.4	59.5
Vault® IP Plus	0.3	58.8
Bio-YIELD® ST	-0.9	28.7
Bio-YIELD®	-1.3	19.9
LAL FIX Proyield + LAL RISE Start SC	-0.8	29.0
Rise & Shine	-0.9	27.7
MycoApply EndoFuse	-2.1	8.7
Aveo EZ	**2.1**	**91.4**
BioCoreSoybeans	-0.6	36.4
Invade 5G	**2.7**	**95.2**
SoyFx	0.6	67.2

Table 5. Yield difference (treatment minus control) and probability for 13 biological seed treatments across 10 locations in 2022. Bolded results had high probability and largest positive difference from the control.

This trial will be repeated in 2023 and Wisconsin data will be included in a region-wide, multistate and multiyear analysis of yield and population data that will be published in 2024.

This is a preliminary report meant to relay preliminary findings. More data will be released once the trial is complete. This data is not for publication.

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