PRACTICAL FARMERS OF IOWA
COOPERATORS' PROGRAM Farmer-Led Research

EXPERIMENT

2020

Are Neonic + Fungicide Soybean Seed Treatments Justified?

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Cooperators

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Funding

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In a Nutshell:

- Dick Sloan questions the value of neonicotinoid seed treatments and is concerned about their negative impacts. The objective of this trial was to measure the effect of a common neonicotinoid + fungicide soybean seed treatment on soybean yield, plant population and profitability. Sloan conducted this experiment twice.
- Sloan hypothesized that treated seed would be less profitable than untreated seed and would not significantly improve soybean yield or plant population.

Key Findings:

- In both experiments, untreated soybean seed was more profitable than neonicotinoid + fungicide treated seed.
- Yields were statistically similar, and untreated seed achieved the same percentage of its target plant population as treated seed at 50 days after planting.
- Sloan: "This project confirms my earlier results that soybean seed treatments are not justified in my production system. I will continue to plant untreated soybean seed, avoiding the additional expense and risks of treated seeds."

BACKGROUND

Neonicotinoids are a class of insecticide that causes paralysis and death of a broad range of insects by blocking receptors in their central nervous systems. When applied to soybeans in the form of a seed treatment, neonicotinoids enter seedling roots and are translocated to all parts of a growing plant.[1] Insect pests ingest the insecticide when feeding on any part of the plant, and protection lasts three to four weeks after planting.[1,2]

A growing body of scientific research has demonstrated that neonicotinoid seed treatments generally fail to significantly improve crop plant stands or yield.[1–4] PFI on-farm research conducted in 2014 and 2015 found no gains in soybean yield or profitability when using treated compared to untreated seed in 5 out of 5 trials.[4] Despite these findings, neonicotinoid seed treatments continue to be widely used as "insurance" and applied in a preventative manner, adding potentially unnecessary expense for growers and contributing to the widespread abundance of neonicotinoids in agricultural soils and non-target habitats.[2,3] In these environments, neonicotinoids work their way up the food chain, impacting beneficial insects, birds, rodents and deer, among a variety of other creatures.[5,6]

Dick Sloan questions the value of neonicotinoid seed treatments and is concerned about their social and environmental impacts. Sloan says, "Slugs can eat neonicotinoid-treated soybeans and just keep on slugging. But beneficial beetles that prey on slugs are sickened or killed by the insecticide the slugs have eaten, and this can lead to reduced plant populations." For this trial,

Harvest data were collected from only the middles of each strip. Photo taken Oct. 10, 2020.

Sloan chose to compare soybean yield, soybean plant population and profitability of untreated soybean seed with soybean seeds treated with both neonicotinoids and fungicide.

METHODS

Design

To test the benefit of neonicotinoid + fungicide seed treatments, Sloan compared two treatments:

1. Neonicotinoid + fungicide treated soybean seed
2. Untreated soybean seed (control)

Sloan conducted the experiment in two different fields: one planted to small grain and clover (2018) then corn (2019) and the other planted to continuous corn (2018, 2019) in the years preceding the experiment. On Nov. 5, 2019, Sloan no-till drilled a cover crop of cereal rye (70 lb/ac), winter wheat (10 lb/ac) and winter triticale (10 lb/ac) in 7.5-in. rows in both fields. On April 23, 2020, Sloan applied the residual herbicides Prowl H2O (2.5 pt/ac) and LV-4 (1 pt/ac) to manage overwintering broadleaf weeds.

Sloan established treatment strips on May 11 by drilling soybeans in 7.5-in. rows into the living cover crop. He drilled seed at a population of 136,000 seeds/ac in the treated strips and 140,700 seeds/ac in the untreated strips. The difference in seeding rates occurred because the seed treatment affected seed flow through Sloan's drill. Treatments were arranged randomly in adjacent strips measuring 45 ft by 1,320 ft and were replicated 6 times for a total of 12 strips in each field (**Figure A1**).

On May 30, Sloan terminated the cover crop in all strips with a tank mix of Roundup Powermax (2 pt/ac), adjuvants and drift retardant. One month later, on June 30, Sloan applied Roundup Powermax (2 pt/ac), Flexstar GT (3 pt/ac) and Warrant (2 pt/ac) for additional weed control.

Measurements

Sloan conducted soybean stand counts in the small grain-clover/corn field on June 6 (26 days after planting [DAP]) and June 30 (50 DAP). In the continuous corn field, Sloan conducted stand counts on June 12 (32 DAP) and June 30 (50 DAP). The first stand counts were done by counting soybeans in 4 rows measuring 17 ft 5 in. long in every strip. The second stand count was done by counting soybeans inside a hula hoop that was randomly tossed in each strip. On Oct. 10, Sloan harvested soybeans from the middle 25 ft of each strip in both fields and reported yields for each individual strip. Yields were adjusted to standard moisture.

Data analysis

To evaluate effects of the seed treatment on soybean yield and stand count, we calculated treatment averages for each measurement then used t-tests to compute least significant differences (LSDs) at the 95% confidence level. The difference between each treatment's average soybean yield or stand count is compared with the LSD. A difference greater than or equal to the LSD indicates the presence of a statistically significant treatment effect, meaning one treatment outperformed the other and Sloan can expect the same results to occur 95 out of 100 times under the same conditions. A difference smaller than the LSD indicates the difference is not statistically significant and the treatment had no effect.

RESULTS AND DISCUSSION

Soybean plant population

Because treated seed was drilled at a slightly lower rate than untreated seed due to the interaction of its coating with Sloan's drill, comparing actual plant populations is deceptive. For this reason, we reported soybean plant populations both as a percentage of the target population and as the actual population (plants/ac) (**Table 1**).

In the initial sampling of both fields, untreated seed achieved a greater percentage of its target plant population compared to treated seed. However, by the date of the second sampling (50 DAP) there was no difference between the untreated and treated seed when it came to the percentage of their target populations.

Actual plant populations followed a similar pattern compared to populations expressed as percentages of the target population. Untreated soybean seed resulted in a greater number of plants/ac on all but the second sampling date in the field preceded by small grain-clover/corn. In that instance, untreated seed was unable to maintain its initial improvement to plant population relative to treated seed. Again, differences in actual plant populations may be due to untreated seed being planted at a higher rate than treated seed.

TABLE 1. Soybean plant populations on two sampling dates for both fields at Sloan's in 2020.

		CONTINUOUS CORN		SMALL GRAIN-CLOVER / CORN	
		June 6	June 30	June 12	June 30
Target population (plants/ac) [a]	Untreated	140,700			
	Treated	136,000			
Actual population (plants/ac)	Untreated	134,167	123,367	126,333	119,975
	Treated	120,667	111,533	105,333	109,450
Population as % of target population	Untreated	95% a	88% a	90% a	85% a
	Treated	89% b	82% a	77% b	80% a
	Diff.	7%	6%	13%	5%
	LSD	5%	6%	6%	8%

[a] Treated seed was unintentionally drilled at a lower rate than untreated seed due to the interaction of its coating with Sloan's drill.

Soybean yields

In both fields, soybean yields were statistically similar between treatments (**Figure 1**). Similar to the interpretation of plant populations, the higher seeding rate of untreated seed relative to treated seed may have led to greater yields than would otherwise have occurred had both treatments been seeded at the same rate.

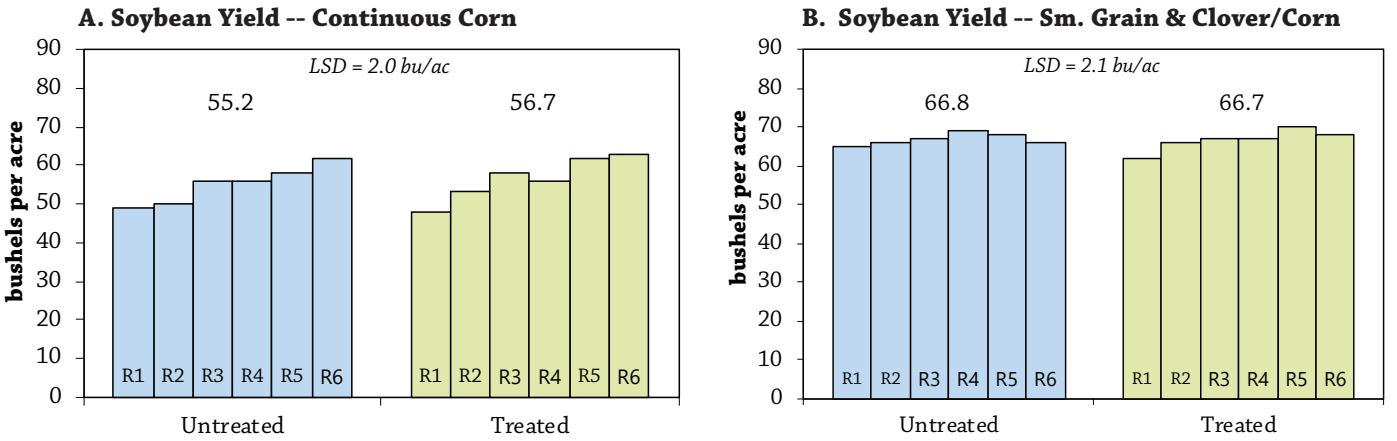

FIGURE 1. Soybean yields in both fields at Dick Sloan's. A) continuous corn, B) small grains-clover/corn. Columns represent yields for each individual strip. The average yield is indicated above each group of columns. Because the difference between averages in each field is less than the least significant difference (LSD), the treatment yields are considered statistically similar at the 95% confidence level.

Economic consideration

In both fields, the return on investment for the untreated strips was $11.89 greater than for the treated strips (**Table 2, Table 3**). Though seed in the untreated treatment cost slightly more due to being seeded at a higher rate, the total cost of the treated treatment was greater because of the seed treatment. Ultimately, Sloan was not able to recoup the added cost of the seed treatment because yields were statistically similar.

TABLE 2. Cost, revenue and return on investment ($/ac) for treatments in Sloan's continuous corn field in 2020.

OPERATION	TREATED	UNTREATED
Soybean Seed [a]	47.25	48.51
Soybean seed treatment	13.15	n/a
ROI CALCULATIONS		
Total cost	60.40	48.51
Soybean yield (bu/ac) [b]	55.9	55.9
Revenue @ $10.65/bu [c]	595.34	595.34
ROI: REVENUE - COST	534.94	546.83

[a] Different seeding rates led to different seed costs. The same seed was used in both treatments.
[b] Because soybean yields were statistically similar, the average of both treatment yields was sused to calculate ROI.
[c] Soybean prices were provided by Sloan.

TABLE 3. Cost, revenue and return on investment ($/ac) for treatments in Sloan's small grain-clover/corn field in 2020.

OPERATION	TREATED	UNTREATED
Soybean seed [a]	47.25	48.51
Soybean seed treatment	13.15	n/a
ROI CALCULATIONS		
Total cost	60.40	48.51
Soybean yield (bu/ac) [b]	66.8	66.8
Revenue @ $10.65/bu [c]	711.42	711.42
ROI: REVENUE - COST	651.02	662.91

[a] Different seeding rates led to different seed costs. The same seed was used in both treatments
[b] Because soybean yields were statistically similar, the average of both treatment yields was used to calculate ROI.
[c] Soybean prices were provided by Sloan.

CONCLUSIONS AND NEXT STEPS

Sloan was able to confirm his hypothesis that soybean seed treated with neonicotinoids and fungicide provides no benefit to the return on investments in comparison with untreated seed on his farm. These findings are true for both fields in which Sloan conducted this experiment. Furthermore, Sloan's findings align with previous trials conducted by himself and other PFI farmer-cooperators as well as with a growing body of scientific literature[1–4]. In Sloan's own words: "This project confirms my earlier results that soybean seed treatments are not justified in my production system. I will continue to plant untreated soybean seed, avoiding the additional expense and risks of treated seeds."

APPENDIX – TRIAL DESIGN AND WEATHER CONDITIONS

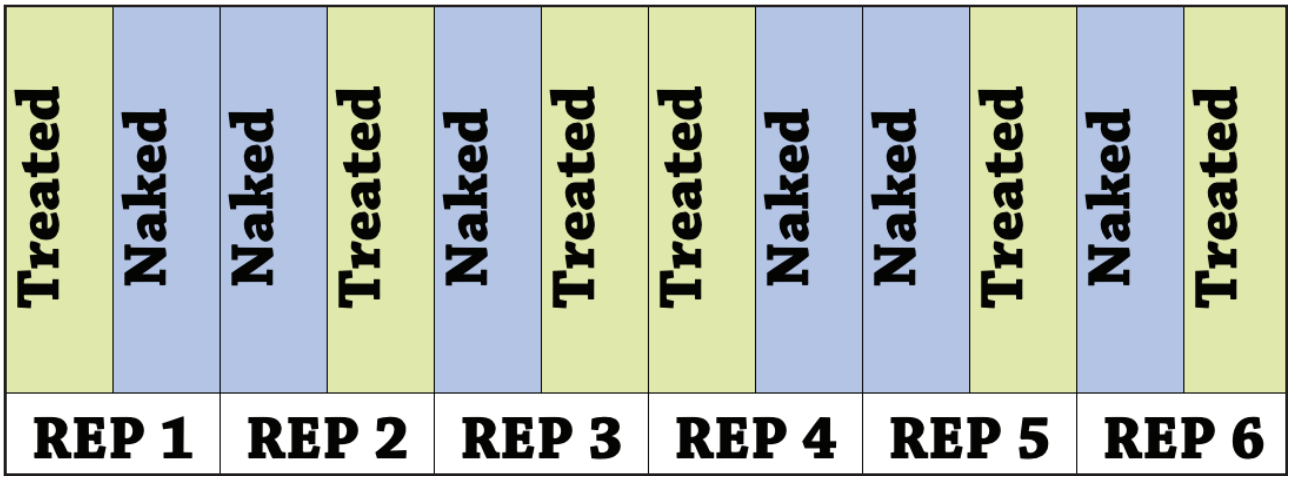

FIGURE A1. Dick Sloan's experimental design consists of six replications of both treatments. This design allows for statistical analysis of the data.

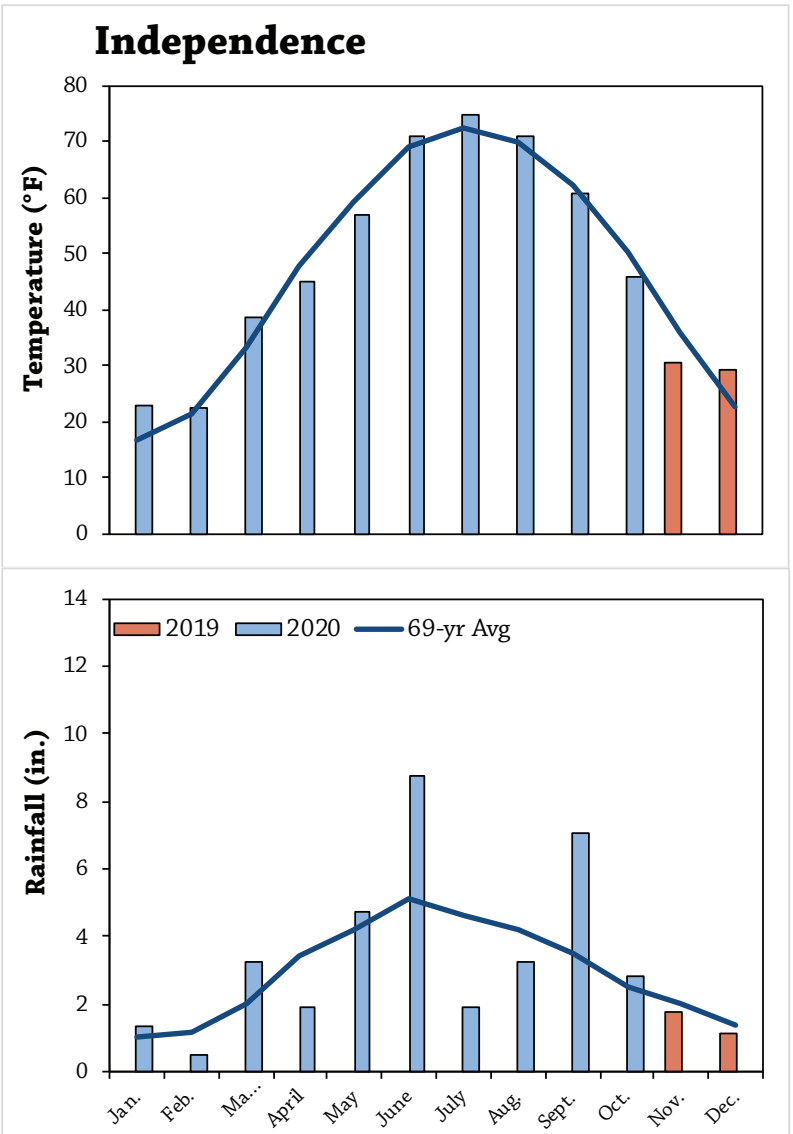

FIGURE A2. Mean monthly temperature and rainfall during the trial period and the long-term averages at Independence the nearest weather station to Sloan's farm (about 7 miles away)[7].

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PRACTICAL FARMERS of Iowa

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