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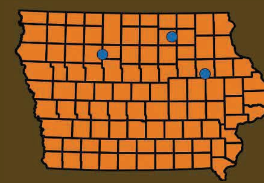
Field Crops Research



Are neonicotinoid seed treatments in soybean production worth it? 2015 Update

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Web Link:
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In a Nutshell

- Neonicotinoid seed treatments in soybean production are ubiquitous but recent evidence has called their benefit to yields and their ecological impact into question.
- Farmer-cooperators compared soybean yields from soybeans of the same variety grown from neonicotinoid-treated seeds and seeds not treated with a neonicotinoid.

Key findings

- At each location, there was no measured effect of seed treatment on soybean yield.
- Given the lack of measured yield benefit, the economic practicality of neonicotinoid seed treatments can be questioned.

Project Timline:
2014-2015

Soybeans at Dick Sloan's farm in late August 2015.

Background

Neonicotinoids, or "neonics" as they are often called, are a family of insecticides commonly found in corn and soybean seed treatments across the US Corn Belt. Seed treatments such as Poncho®, Votivo®, Gaucho®, and Cruiser® all contain a form of a neonicotinoid insecticide. These insecticides are systemic, meaning that as the crop grows from the treated seed the insecticide is translocated through the plant into root and leaf tissues. In turn, this provides protection from chewing and sucking insect pests of corn and soybeans, such as cutworms and aphids.

Recent findings, however, have implicated neonicotinoids among several factors negatively affecting the health of non-target beneficial insects, such as honey bees, parasitoids, and aquatic insect larvae. Pollinator species like honey bees can be at a high risk of exposure as the insecticide can be expressed in pollen due to the systemic nature of the insecticide (Sanchez-Bayo, 2014). Moreover, talc, a common lubricant used to move seed through the planter box while planting treated seed, can function as a carrier of the neonicotinoid insecticide seed treatment. Foraging bees can then come into contact with the contaminated talc as it is expelled during planting (Hodgson and Krupke, 2013). Concern has also surfaced about the persistence of neonicotinoid insecticides in the soil from plant residues and the potential effects on soil microorganisms (Hodgson and Krupke, 2013; Sanchez-Bayo, 2014). Furthermore, the US Environmental Protection Agency recently released a report that concluded that neonicotinoid seed treatments provide "little to no" agronomic or financial benefit to soybean production (Myers et al., 2014).

The objective of this research project was to assess the agronomic and economic performance of soybeans grown from neonicotinoid-treated seeds. Dick notes, "I want to reliably know that pesticide treatment of soybean seeds is not warranted." Comparisons are made on three cooperator farms between soybeans grown from seed treated and not treated with neonicotinoids.

Methods

This study was implemented by three farmer-cooperators: Dick Sloan near Rowley in Buchanan County; Bob Lynch near Gilmore City in Humboldt County; Wendy Johnson near Charles City in Floyd County.

Treatments were soybean seeds treated with a neonicotinoid (treated) and soybean seeds without neonicotinoid seed treatment (untreated). Each farmer selected a soybean variety suitable for his/her own operation and location. Thus, varieties differed among locations but were the same within each location. Dick

Sloan conducted the experiment in two fields in both 2014 and 2015--treated soybeans included a neonicotinoid, a fungicide and an inoculant while untreated soybeans included only an inoculant. Bob Lynch and Wendy Johnson each grew treated and untreated soybeans in a single field in 2014.

Dick and Bob planted their treated and untreated soybeans in replicated paired strips that ran the length of their fields. Wendy Johnson seeded one half of a field with treated soybean seeds and the other half with untreated soybean seeds, thus, no statistical analysis could be made. Specific information pertaining to each farm is presented in **Table 1**. Apart from the seed treatment, cooperators managed the soybeans in all strips similarly at each location (i.e., weeds were managed the same across all strips in a field). In both years and both fields, Dick's soybeans followed a cover crop consisting of cereal rye, oats and rapeseed that were seeded into standing corn the previous September.

In the fall, farmers harvested and weighed soybeans from strips of treated and untreated soybeans individually (except at Johnson) using a weigh wagon or yield monitor. Soybean yields were corrected for 13% moisture.

Table 1

Number of replications, soybean varieties, seed treatments and dates of field operations at each farm.

Location	Year	No. replications	Seed treatment	Soybean planting date	Planting population, seeds/ac	Row spacing	Weed control	Harvest date
Sloan-1 (Rowley; northeast Iowa)	2014	3	PPST 2030 (Neonicotinoid + fungicide + inoculant)	May 7	148,000	7.5 in.	Pre-plant: Prowl + 2,4-D; At-plant: glyphosate; Post-plant: glyphosate (terminate cover crop) + Flexstar-GT	Sept. 28
Sloan-2 (Rowley; northeast Iowa)	2014	3	PPST 2030 (Neonicotinoid + fungicide + inoculant)	May 8	148,000	15 in.	Pre-plant: Prowl + 2,4-D; At-plant: glyphosate (terminate cover crop); Post-plant: Flexstar-GT + Assure II + Warrant	Oct. 10
Lynch (Gilmore City; north-central Iowa)	2014	2	CruiserMaxx® (Neonicotinoid + fungicide)	May 18	145,000	15 in.	Pre-plant: Optill Pro; post-plant: Flexstar GT	Oct. 8
Johnson (Charles City; north-central Iowa)	2014	1	Acceleron® (Neonicitinoid + fungicide)	May 27	160,000	15 in.	Pre-plant: Optill and Touchdown; post-plant: Touchdown, Fusillade, and Warrior	Oct. 16
Sloan-1 (Rowley; northeast Iowa)	2015	5	PPST 2030 & PPST 120 (Neonicotinoid + inoculant)	April 28 & 29	150,000	7.5 in.	Pre-plant: Prowl & LV4; post-plant: glyphosate (terminate cover crop), Flexstar GT + Warrant	Oct. 6
Sloan-2 (Rowley; northeast Iowa)	2015	5	PPST 2030 & PPST 120 (Neonicotinoid + inoculant)	May 2 & 3	150,000	7.5 in.	Pre-plant: Prowl + LV4; post-plant: glyphosate (terminate cover crop), Flexstar GT & Warrant	Oct. 3

Data from both Dick and Bob's farms were analyzed using JMP Pro 10 (SAS Institute, Inc., Cary, NC). Means separations between treatments are reported using the least significant difference (LSD) generated from a t-test. Statistical significance is reported at the $P \leq 0.05$ level with tendencies noted at the $0.05 < P \leq 0.10$ level.

Results and Discussion

Total rainfall and growing degree days (GDD) accumulated during the period of April 1-September 30, as well as the historical average, for each location is presented in **Table 2**. Rainfall at each location tended to be 3.4 – 6.9 in. greater than the corresponding historical average. GDD accumulated at each farm were near the historical averages.

Table 2

Total rainfall and growing degree days (GDD) during the period April 1 – Sept. 30 at each location compared to the historical average.

	Rainfall (in.)			GDD (base 50˚F)		
Location[a]	2014	2015	Historical avg.	2014	2015	Historical avg.
Sloan (Rowley)	29.2	28.2	24.8	2,522	2,865	2,795
Lynch (Gilmore City)	30.4	--	23.5	2,746	--	2,850
Johnson (Charles City)	29.7	--	24.8	2,615	--	2,837

[a] Rainfall data were accessed from the Independence (11 mi. from Sloan), Humboldt (12 mi. from Lynch), and Charles City (Johnson) weather stations (Iowa Environmental Mesonet, 2015).

Soybean yields

Figure 1 shows the soybean yields observed at each location. There was no difference in soybean yields grown from treated or untreated seed at Dick Sloan's (both fields, both years) and Bob Lynch's farms. Across the treatments, mean soybean yields were 55, 54, and 31 bu/ac at the Sloan-1, Sloan-2 and Lynch locations in 2014. In 2015, mean yields were 61 and 60 bu/ac for the Sloan-1 and Sloan-2 fields. In both years, the soybeans at Dick's followed a cereal rye-oats-rapeseed cover crop mix. Yields from the Sloan fields in both years were greater than the 10-year soybean yield average for Buchanan County of 47 bu/ac while yields from the Lynch farm in 2014 were less than the 10-year average for Humboldt County of 48 bu/ac (USDA-NASS, 2015). Bob attributed his wide variations in yield (evidenced by the large LSD) and low yields for soybeans from both treatments to the trial being conducted in a field with a history of low yields on his farm. Yields at the Johnson farm were 49 and 50 bu/ac for the soybeans grown from treated and untreated seeds, respectively, which were just greater than the 10-year average for Floyd County of 47 bu/ac (USDA-NASS, 2015). No statistical analysis could be made at the Johnson farm due to lack of replication.

Economic considerations

Each farmer provided the cost associated with the seed treatments (**Table 3**). Across the farms, the average cost associated with the seed treatments containing a neonicotinoid was $13.15/ac. The cost of the seed treatment was provided by each cooperator and the price of soybeans was accessed from the Chicago Board of Trade in November of each year (CME Group, 2014; 2015). The cost of the seed treatment at each farm each year is presented in terms of $/ac and bushels of soybeans per acre. Essentially, the cost in bu/ac is the additional amount of bushels the farmer "purchased" by applying the seed treatment. Thus, the seed treatment "pays for itself" if the treated soybeans out-yield the untreated soybeans by this amount (or greater). As there was no difference in soybean yields between soybeans grown from the treated and untreated seeds at both Sloan locations and the Lynch location (**Figure 1**), it appears that the cost of the seed treatment was not warranted.

Figure 1

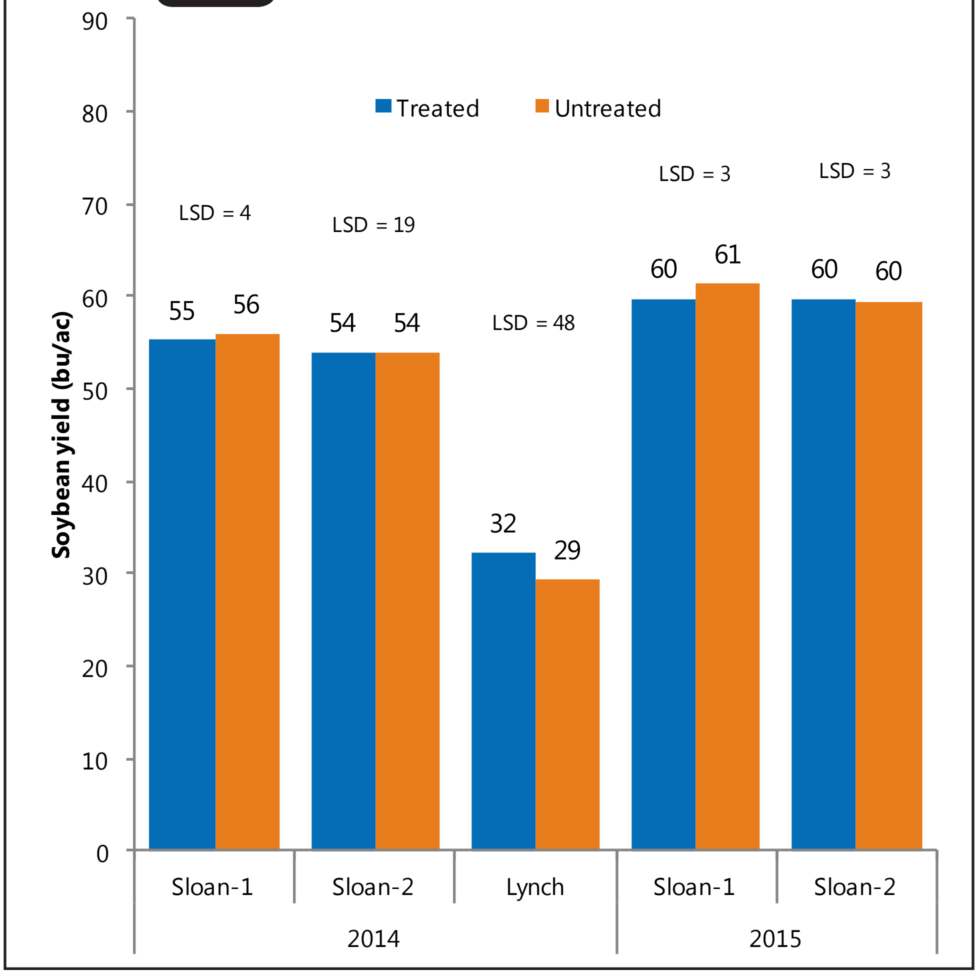

Figure 1. Mean soybean yields of the soybean grown from treated and untreated seed observed at Dick Sloan's and Bob Lynch's farms in Fall 2014 and at Dick Sloan's in Fall 2015. The mean yield for each treatment is displayed above each column. The least significant difference (LSD) between treatments is listed for each farm. By farm, differences between treatment means that are less than the LSD are not significantly different.

Table 3

Costs associated with seed treatments at each location

Location	Seed treatment	Cost/unit[a]	Units/ac	Cost/ac	Cost of treatment in soybean bu/ac[b]	Significant yield difference between treated and untreated?[c]
Sloan, 2014	PPST 2030	$13.25	1.1	$14.58	1.4	No
Lynch, 2014	Cruiser-Maxx®	$10.00	1.0	$10.00	1.0	No
Johnson, 2014	Acceleron®	$13.00	1.1	$14.86	1.4	--
Sloan, 2015	PPST 2030 & PPST 120	$13.25	1.1	$14.58	1.7	No

[a] Quoted from each farmer.

[b] Price of soybeans for 2014 was set at $10.47/bu, accessed Nov. 25, 2014 from the Chicago Board of Trade (CME Group, 2014). Price of soybeans for 2015 was set at $8.78/bu, accessed Nov. 4, 2015 from Chicago Board of Trade (CME Group, 2015).

[c] Figure 1.

Conclusions and Next Steps

Farmer-cooperators compared soybean yields from soybeans of the same variety grown from neonicotinoid-treated seeds and seeds not treated with a neonicotinoid. At each farm, there were no differences in soybean yields between soybeans grown from treated and untreated seed. On average, the farmer-cooperators spent the equivalent of 1.4 bu/ac on the seed treatment. With this in mind, the cost of the seed treatment cannot be justified on these farms for these years, given that no significant increase in yield to cover that cost was provided.

Given the findings in the EPA report and the findings of the farmer-cooperators in the present study, as well as the potential harmful effects of neonicotinoids on non-target species such as honey bees, it seems the use of neonicotinoid seed treatments in soybean production can be questioned. Dick Sloan conducted trials in two separate fields over two years (four separate fields) and came up with the same results in both instances. He also planted his soybeans following a cereal rye-oats-rapeseed cover crop mix. As a result of these trials, Dick says, "I can now say with a certain degree of confidence that these treatments are not necessary on my farm."

Soybeans emerge through dying rye cover crop in late May 2015 at Dick Sloan's farm.

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