

2024 Soybean Aphid Control Product Impact on Yield

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Objectives were to demonstrate yield impact of aphid control products in soybean, display aphid control product portfolios from six industry collaborators, and provide an unbiased evaluation of entries to allow growers to benchmark competitive performance of aphid control products on the market. Growers should use the data set as a guide to visit with their crop consultants or local suppliers to determine an aphid control product, if any, that may provide the greatest aphid control and return on investment based on local supplier pricing and availability of products.

MATERIALS AND METHODS

Experiments were conducted on a fine-textured webster-clay loam soil with 5.0% organic matter and a 6.8 soil pH near Renville, Minnesota, in 2024. Spring tillage was a field cultivator at 3" depth. Untreated soybean was seeded 1.25 inches deep on 30-inch row spacings at 140,000 seeds per acre on May 14, emerging May 22. Since soybean seed was untreated, Renestra was applied at 6.8 fluid ounces with 4 fluid ounces of Interlock as a blanket application for soil insect control at VE soybean June 1. Study was kept weed free with a pre-emergent application of Outlook on May 14 followed by a postemergence application of Enlist One, Roundup Powermax II, Zidua SC, and Class Act NG on June 1. A second postemergence application of Enlist One, Class Act NG, Section 3, Liberty 280SL and Interlock was applied on June 27. Treatments were applied July 29 to soybean with a hand boom sprayer in 20 GPA spray solution through AIXR11002 air-induction flat fan nozzles pressurized with CO₂ at 40 psi to the center two rows of four row plots 40 feet in length. All treatments included Masterlock adjuvant at 6.4 fluid ounces per acre unless indicated otherwise in the treatment name as "No Adjuvant".

Early season rainfall led to abundant water resources for germination and growth throughout the entire growing season. Aphid arrival began July 25, with a trial baseline per plant aphid count taken July 28 at 1 DBA on 285 individual plants to determine the economic threshold of 250 aphids per plant had been attained with an average of 367 aphids per plant (Table 1). The study was conducted on an aphid population that was estimated to be approximately 50% resistant to Group 3A pyrethroids in a 2023 aphid grant study. In 2024, the population was estimated to be approximately 89% resistant to Group 3A pyrethroids. This number was the average of non-3A aphid counts at 7 DAA evaluation divided by the average of 3A only aphid counts at 7 DAA and subtract that number from 1 and multiplied by 100.

Aphid data were collected from replications one, two, and three where five random plants per plot were counted the day before application (1 DBA), 3 DAA, 7 DAA and 14 DAA, on July 29, August 1, August 6 and August 12, respectively. Yield data were collected on September 24 utilizing a Hege 160 two-row small plot research combine equipped with a HarvestMaster large plot weight hopper. The middle two rows of the four-row plot were harvested and samples were taken with moisture and test weights recorded using a Perten 5200-A moisture tester. Experimental design for yield data was a randomized complete block with 6 replications; however, aphid count data were collected and analyzed as a randomized complete block with 3 replications. Data were analyzed with GLM procedure of SAS (Statistical Analysis Software, SAS Academic Studio October 30, 2024, SAS Institute, Inc.) at alpha=0.10 and differences are determined with 90% confidence; meaning, if the study was repeated 100 times, that 90 times out of 100 we would expect treatments that are statistically similar (within one LSD value of each other) to continue to be similar.

Description	367 Aphids per Plant
Application Code	A
Date	July 29
Time of Day	12:00 PM
Air Temperature (F)	85
Relative Humidity (%)	78
Wind Velocity (mph)	2
Wind Direction	NW
Soil Temp. (F at 6")	77
Soil Moisture	Good
Cloud Cover (%)	25
Crop Growth Stage (avg)	R4

RESULTS AND DISCUSSION

Treatments were first separated by aphid counts into two tiers (Table 2). Tier 1 included products or tank mixed products that were not group 3A insecticides (pyrethroids) and generally had significantly better aphid control compared to Tier 2 treatments which were all group 3A active ingredients only. Tier 1 includes treatments with Renestra, Sivanto Prime, Leverage 360, Ridgeback, Endigo ZCX, Sefina, Transform, Dimethoate, and Belay. Common actives in these products include afidopyropen (Sefina, Inscalis active, Group 9D), also a component of Renestra; flupyradifurone (Sivanto Prime, Group 4D); imidacloprid (Group 4A), a component of Leverage 360; thiamethoxam (Group 4A) a component in Endigo ZCX; sulfoxaflor (Transform, Isoclast active, Group 4C) also a component of Ridgeback; dimethoate (Group 1B); clothianidin (Belay, Group 4A). The untreated is located at the bottom of the table for comparisons.

The untreated at all timings was statistically worse in treatment-to-treatment comparisons with all Tier 1 aphid counts 3, 7, and 14 DAA demonstrating excellent aphid infestation and product response. Aphid counts at 3 DAA were generally lower in Tier 1 compared to Tier 2; although, not all Tier 1 treatment comparisons were statistically better than all Tier 2 treatments. Tier 2 treatment 14 was statistically similar to Tier 1 treatments 1, 4, 6, and 8; and, Tier 2 treatment 17 was statistically similar to Tier 1 treatments 1, 6, and 8 at the 3 DAA evaluation as noted by the same letter designation next to the data within Table 2. However, neither of these Tier 2 treatments would keep pace with any Tier 1 treatment at the 7 and 14 DAA in treatment-to-treatment comparisons indicating the very high level of pyrethroid resistance in the aphid population.

Tier 2 treatments were statistically better than the untreated check at 3 and 7 DAA aphid counts. At the 14 DAA evaluation, treatments 14 and 17 were statistically similar in treatment-to-treatment comparisons with the untreated check and treatments 12 and 16 were statistically worse than the untreated check. This phenomenon is likely due to random error as it is unlikely that any insecticide would actually increase aphid populations 14 DAA; however, it is possible that neighboring plot treatments to 12 and 16 may have been better performing as compared to neighboring plot treatments to the untreated check which may have driven increased quantities of pyrethroid resistant aphids to seek refuge in the nearest pyrethroid only/untreated plot forcing an inadvertent consolidation of population. Adjuvant use or absence of adjuvant in Tier 2 treatment comparisons were not significant; meaning, use of adjuvant does not definitively increase aphid control.

Tier 1 aphid count treatment-to-treatment comparisons will be discussed to determine statistically significant differences in top of the market product performance. At the 3 DAA evaluation, Transform at 5.5 dry ounces per acre had the lowest average aphid per plant count (2/plant); however, it was statistically similar to all Tier 1 treatments with the exception of treatments 1 and 6. The 3 DAA evaluation demonstrates knockdown capabilities of products. At the 7 DAA evaluation, Transform at 5.5 dry ounces per acre continued to have the lowest average aphid per plant count (15/plant); however, it was statistically similar to all Tier 1 treatments with the exception of treatment 9. The 7 DAA evaluation demonstrates the short-term residual capabilities of products. At the 14 DAA evaluation, Sivanto Prime at 5.5 fluid ounces per acre had the lowest average aphid per plant count (11/plant); however, it was statistically similar to all Tier 1 treatments with the exception of treatment 8. The 14 DAA evaluation demonstrates the long-term residual capabilities of products in a timeline relevant to aphid population peak window. Any Tier 1 product is likely a responsible choice for aphid control for 14-days after application; however, there were statistical differences in yield data.

Soybean yield data determined treatment rank within each tier and listed in descending order (Table 2). Renestra at 6.8 fluid ounces per acre had the highest average soybean yield; however, it was statistically similar to Sivanto Prime at 5.5 and Leverage 360 at 2.8 fluid ounces per acre at 70.9, 70.6, and 69.7 bushels per acre respectively. Leverage 360 was statistically similar to Ridgeback and Endigo ZCX at 10.3 and 4.5 fluid ounces per acre, respectively, both averaged 65.6 bushels per acre. Sefina at 3.0 fluid ounces per acre and Transform at 5.5 dry ounces per acre were statistically similar to Ridgeback and Endigo ZCX to round out the top 7 performers.

Ranked treatments 8-11 were not significantly better than the untreated check and had a significant yield reduction as compared to ranked treatments 1-5, so although the aphid counts supported sufficient control from these treatments which placed them in Tier 1, the yield data did not support the aphid counts. This may be attributed to residual wear-off after 14-days, potential biological trade-offs as a result of treatments, or potential random error based on the geographical location of the six plots per treatment that were harvested and averaged. Additionally, one must keep in mind that although six replications were harvested, aphid count data were only collected from three of the six replications; meaning, potentially aphid infestation in the back three replications may have differed from the front three replications resulting in an unaccounted-for impact. As stated before, any Tier 1 product is likely a responsible choice and a grower may weigh insecticide cost points against yield impact to determine an ideal return on investment.

In Tier 2, with the exception of treatment 12, all treatments numerically yielded below the untreated check; and, 4 of the 6 Tier 2 treatments were statistically worse yielding than the untreated check. One must be reminded of the severe frequency of pyrethroid resistance in the tested aphid populations and understand that it does not mean these products are not effective on a susceptible aphid population. It is critical for growers to be aware of their population resistance.

Table 2. Aphid control product impact on aphid population and soybean yield in 2024.									
Treatment^a		Rate	App. Code^b	Aphids Counts^c				Harvest	Company
				1DBA	3 DAA	7 DAA	14 DAA	Yield	
#		oz/A* or fl oz/A		/Plant	/Plant	/Plant	/Plant	Bu/A^d	
TIER 1									
1	Renestra	6.8	A	441	120 b-d	31 a	18 a	70.9 a	BASF
2	Sivanto Prime	5.5	A	526	14 ab	22 a	11 a	70.6 a	Bayer
3	Leverage 360	2.8	A	469	34 ab	85 a	58 a	69.7 ab	Bayer
4	Ridgeback	10.3	A	375	52 a-c	130 ab	105 a	65.6 bc	Corteva
5	Endigo ZCX	4.5	A	393	12 ab	30 a	38 a	65.6 bc	Syngenta
6	Sefina	3	A	389	152 b-d	26 a	20 a	65.1 cd	BASF
7	Transform	5.5*	A	417	2 a	15 a	14 a	64.5 cd	Corteva
8	Hero+Dimethoate	5+8	A	446	105 a-d	210 ab	278 b	61.1 de	FMC
9	Belay	6	A	336	35 ab	396 b	128 ab	61.1 de	Valent
10	Endigo ZCX	3.5	A	301	32 ab	117 a	18 a	61.0 de	Syngenta
11	Belay	4.5	A	269	10 a	267 ab	78 a	57.8 e-g	Valent
TIER 2									
12	Sniper+Reform+Liberate	4.2+8+0.25% v/v	A	353	439 f	1326 d	1372 f	58.7 ef	Loveland
13	Tombstone Helios +Reform+Liberate	2.8+8+0.25% v/v	A	312	342 ef	1086 cd	786 c	55.6 f-h	Loveland
14	Zeta-Cyber+Bifen (No Adjuvant)	5	A	357	240 c-f	1145 cd	1259 ef	54.6 f-h	NGA
15	Bifenthrin (No Adjuvant)	4.2	A	247	288 ef	1001 cd	822 c	54.6 f-h	NGA
16	Bifenthrin	4.2	A	346	392 f	1284 d	1301 f	54.0 gh	NGA
17	Zeta-Cypermethrin+Bifenthrin	5	A	292	289 d-f	799 c	895 cd	51.4 h	NGA
UNTREATED									
18	Untreated Check	-	-	341	654 g	2006 e	1155 de	56.8e-g	-

^aMasterlock at 6.4 fl oz/A to all treatments unless noted otherwise.

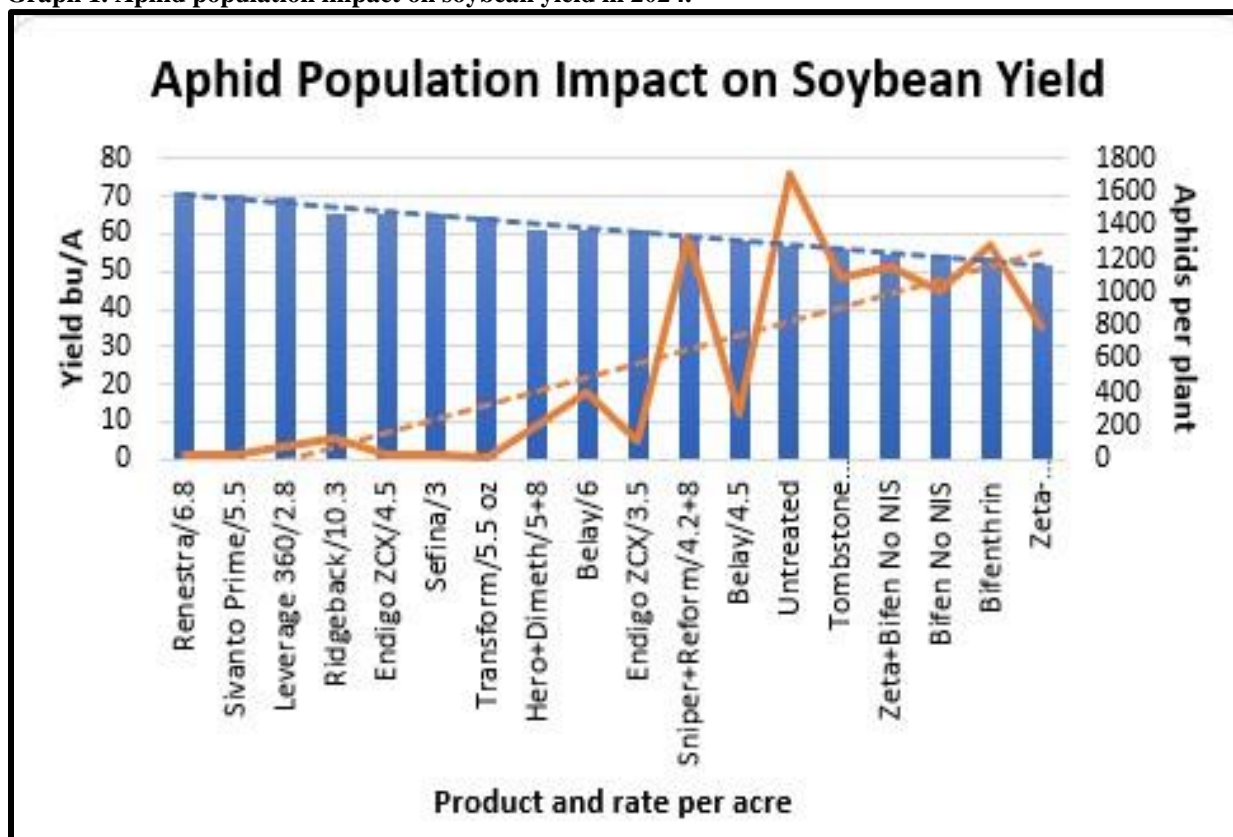
^bApplication codes refer to the information in Table 1.

^cLetters next to data indicate statistical significance at 90% repeatability wherein data with the same letters are similar.

^dBu/A=Soybean yield in bushels per acre corrected to a standard moisture of 13.5%.

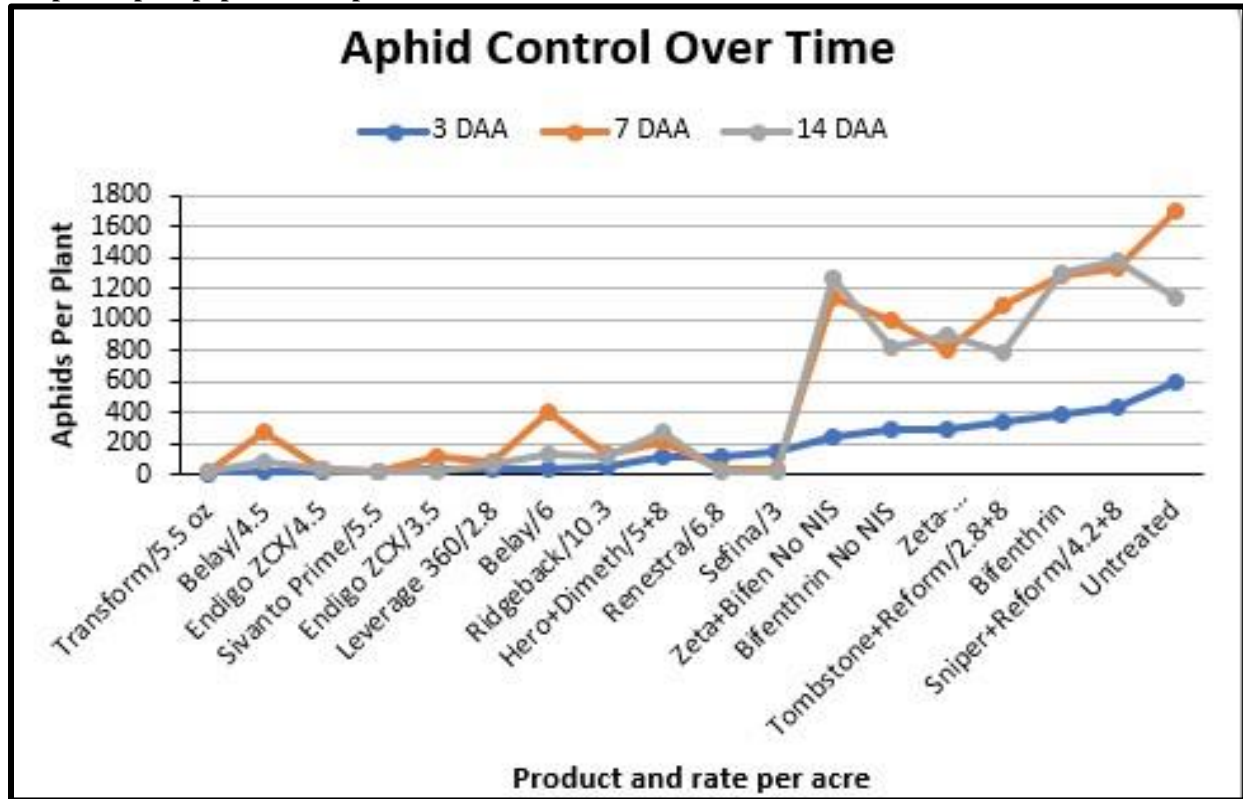
Correlation can be applied to many data sets, however, not all data sets should be considered for correlation and the statistical value of correlation can become meaningless if used inappropriately. Correlation values range from -1 to +1; a value of 0 means no correlation, a negative value demonstrates a negative relationship between two data sets (moving in different directions), and a positive value demonstrates a positive relationship between two data sets (moving in the same direction). The further from “0” the correlation value is, the stronger the relationship; so, the closer to -1 the more negative the correlation relationship while the closer to +1 the more positive the correlation relationship. The correlation between the 7 DAA aphid count data and soybean yield is -0.76 indicating there is a strong negative correlation between higher aphid populations in the data set that is consistently resulting in lower yields (Graph 1). The value of this strong correlation reiterates the importance of controlling aphids in soybean and applying products at an economic threshold of 250 aphids per plant. This strong negative correlation also suggests there was little impact on the data set from any other pest or disease and increases the confidence growers can have making decisions on aphid control based on this data set.

Graph 1. Aphid population impact on soybean yield in 2024.



Product residual impact on aphid population from application date to 14 DAA provided note-worthy observations (Graph 2). Transform, Sivanto Prime, Endigo ZCX, Leverage 360, and Ridgeback had great knockdown and consistent residual over time. Renestra and Sefina were less effective with initial knockdown, however had consistent and reliable residual control over time. Belay was an interesting one as both Belay treatments had a great knockdown at 3 DAA, a population increase at 7 DAA, while returning to a lower aphid count 14 DAA; a pattern only consistent with the untreated check. This may mean Belay functions better at a low-mid infestation proportionally than at a high infestation; meaning, if the aphid infestation for the year is anticipated to be severe in both numbers and duration as compared to mild in both numbers and duration that a grower should proceed with caution in selecting this Tier 1 product. Hero+Diamethate had knockdown, but lacked residual 14 DAA as compared to the other Tier 1 products evaluated. All Tier 2 products appeared to follow a similar response within the tier demonstrating the progression of resistant populations.

Graph 2. Aphid population impact over time.



CONCLUSION

Aphids continue to be an economically impactful pest in soybean. The difference between controlling soybean aphid that has reached economic threshold with a Tier 1 product compared to the untreated check can be a yield difference of 1.0 to 14.1 bushels with an average gain of 8.0 bushels of soybean per acre. At \$10.00 per bushel the economic impact can be calculated between \$10 to \$141 and an average of \$80 financial loss per acre based on the results of this singular study. Resistance in aphid populations continues to be a challenge for growers. New modes of actions or premixed products with multiple modes of action included in a single jug can help in combating resistance. Overuse of any single mode of action without the addition of a second family of insecticides for multiple cropping seasons can create or grow resistance in aphid populations. It is critical for a grower to know if they have a resistant aphid population prior to selecting a product for aphid control. Growers should use the data set as a guide to visit with their crop consultants or local suppliers to determine an aphid control product, if any, that may provide the greatest aphid control and return on investment based on their aphid population resistance, if any, and on local supplier pricing and availability of products.

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