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Iowa State University
2008 Soybean aphid insecticide trials

Table of Contents

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Introduction to Soybean Aphids

SOYBEAN, *Glycine max* (L.), grown in Iowa and most of the north-central region of the United States has historically used low amounts of insecticide. However, an invasive insect pest has threatened soybean production in Iowa, with the arrival of the soybean aphid (*Aphis glycines* Matsumura). The soybean aphid causes yield losses from direct plant feeding, and has been shown to transmit several plant viruses. In Iowa, soybean aphid colonize soybean fields beginning in June and has produced outbreaks in July and August capable of reducing yields by nearly 25% (Johnson 2006).

Since the arrival of the soybean aphid in Iowa we have added considerably to our knowledge and understanding of this new pest. We know that just the presence of the aphid is not enough to warrant the application of an insecticide; populations below 600 aphids per plant are typically needed before measurable yield lose will occur. Based on several years' worth of replicated field trials, we have developed a recommendation that incorporates an economic threshold of 250 aphids/plant (Ragsdale et al. 2007). We also know that natural enemies, like ladybeetles, can have a significant impact on aphid populations (Schmidt et al. 2007). In 2008, Iowa once again experienced damaging populations of soybean aphids. Yield reductions as high as four bushels per acre were experienced in university test plots in Iowa, and the continued need for research on soybean aphid management in Iowa.

Materials and Methods

Plots and treatments. We established experiments at the Iowa State University Northeast research farm in Floyd County, Iowa. In total, we evaluated 35 products alone or in combination in 2008 (Table 1). The experiment included three controls: an untreated control, a second untreated control which received Apron Maxx (mefenoxam plus fludioxonil at 6.25 g per 100 kg) seed, and a "zero aphid" treatment in which a tank-mix of two foliar insecticides (λ-cyhalothrin at 3.2 fl oz, and chlorpyrifos at 8 fl oz) were applied every time aphids were detected. The combination of these three treatments allow for estimation of total yield loss due to soybean aphids, and an estimation of the efficacy of seed applied fungicides (we will only address the impacts of insecticidal products). The treatments were arranged in a randomized complete block design with six replications, and soybeans (NK22N6 RR) were planted in 30 inch rows using no-till production practices on 19 May.

Application techniques. Both foliar and seed treatments were applied using techniques available to most producers in Iowa. Seed treatments were applied to the seed in a slurry and subsequently to the field at planting. All foliar treatments were applied using a backpack sprayer and TeeJet (Springfield, IL) twinjet nozzles (TJ 11002) with 20 gallons per acre at 40 pounds per square inch pressure.

Estimation of soybean aphid populations and cumulative aphid days. Soybean aphids were counted on consecutive plants at randomly selected locations within each plot. The number of plants counted ranged from 20 to 5. The number of plants counted was determined by the percentage of plants infested with aphids. When 0% to 80% of plants were infested with aphids, twenty plants were counted; when 81% to 99% of plants were infested, ten plants were counted; at 100% infestation, five plants were counted. All aphids (adults, nymphs and winged aphids) were counted on each plant. To estimate the total exposure of soybean plants to soybean aphids we calculated 'cumulative aphid days' based on the number of aphids per plant counted on each sampling date. The exposure of soybean plants to aphids between two sampling dates (the 'aphid days') is calculated with the following equation:

$$\sum_{n=1}^{\infty} = \left(\frac{x_{i-1} + x_i}{2} \right) \times t \qquad \text{equation [1]}$$

where x is the mean number of aphids on sample day i, x_{i-1} is the mean number of aphids on the previous sample day, and t is the number of days between samples i - 1 and i. Summing aphid days accumulated during the growing season or cumulative aphid days provide a measure of the seasonal aphid exposure that a soybean plant experiences.

Plant stand. Plant stands were taken at V2 in the seed treated treatments. The reported stand is the number of plants per 10 ft of row.

Yield analysis. Yields were determined by weighing grain with a grain hopper which rested on a digital scale sensor custom designed for each of the three harvesters. Yields were corrected to 13% moisture and reported as bushels per acre.

Statistical analysis. One way analysis of variance (ANOVA) was used to determine treatment effects within each experiment. The impact of treatments applied within each experiment on accumulation of aphid days was determined using log-transformed data to meet the assumptions of ANOVA. Means separation for all studies was achieved using a least significant difference test ($P \leq 0.05$). Treatment impacts on yield were determined using untransformed data. All statistical analysis was performed using SAS® software (SAS 2007).

Results

During the 2008 growing season foliar insecticides were applied on 1 August; aphid populations averaged five aphids per plant three days prior to insecticide application. Aphid populations peaked on 22 August at 541 aphids per plant at this research farm. The aphid free control did not reduce the exposure anymore than a single foliar application of any of the products tested (Table 2). This lack of a significant difference occurred despite applying insecticides on three different occasions.

We observed the lowest yields when soybeans were left untreated (Table 3, Figs. 1, 2, 3, and 4). The foliar applied insecticides we tested provided similar levels of soybean aphid control and yield protection (Fig. 2 and 3). Overall a single application of a foliar insecticide provided as much yield protection as three applications applied 22 July, 1August, and 22 August. The seed treatments we tested provided a lower level of soybean aphid control and lower yields as compared to all foliar applied insecticides (Fig. 2). Additionally, there were some differences in plant stands due to seed treatments, however these differences appear to be due to the fungicide and not the insecticide components of the seed treatments, and the differences in stand counts did not appear to affect yield or aphid exposure (Tables 2, 3, 4, and Fig. 1).

Discussion

Aphid populations measured in 2008 were relatively low compared to previous years at this location. Aphid populations did not reach the economic threshold (ET) until plants were approaching R6. This afforded us the opportunity to investigate the effects of treating soybean aphids at the ET during later reproductive stage soybeans (R5 - R7). Recall that the 250 aphid per plant threshold is recommended for soybeans in the R1-R5 stage. As shown by comparing the Warrior II at 250 aphids to the untreated controls we saw no benefit in controlling aphids after R5. The trends observed in this year's data are consistent with our past results. Again we observed little difference in performance amongst most of the foliar insecticides. The efficacy of the organophosphates (Dimethoate and Lorsban) and pyrethroids (Baythroid, Hero, Mustang Max, and Warrior) was indistinguishable from each other. Combining pyrethroid and organophosphate insecticides did not improve aphid control or soybean yield. This was true even for pre-mixed products (Cobalt, Endigo, and Leverage). Rather, the most important issue for effective soybean aphid management is the timing of a foliar-applied insecticide and not the product selected. This is truly remarkable given the comparison to the aphid-free control, which would represent an economic threshold of 5 aphids per plant.

Compared to the foliar insecticides, the seed-applied insecticides provide limited protection. Although we did observe some evidence of control between the untreated soybeans and the seed-treated soybeans, the variability among these treatments was great. Soybean aphid control from seed applied insecticides is not sufficient to protect plants from aphid outbreaks that occur in July or August, especially for soybeans planted in May. McCornack and Ragsdale (2006) showed that seed-applied insecticides are effective on soybean aphid, however this efficacy only lasts for the first month after planting.

Our recommendation for soybean aphid management continues to be to scout your fields and to apply foliar insecticides when populations exceed 250 aphids per plant (see Ragsdale et al. 2007 for a more detailed description). We are not recommending seed-applied insecticides (seed treatments) for aphid management, and we are not recommending one insecticide over another. Over the four years we have been assessing insecticide efficacy Warrior, Baythroid, and Lorsban have performed equally well and the seed treatments have not prevented the need for a foliar insecticide in high aphid years. Multiple insecticide treatments have not protected yields compared to a single foliar insecticide application at 250 aphids per plant.

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Table 1. 2008 Insecticide treatments used and rates at Floyd County, IA.

Treatment	Rate[1]	Active ingredient	Target application
Untreated	---------	-----------	-----------
Untreated[2]	6.25	mefenoxam +fludioxonil	ST
Zero aphid[3]	3.2 fl oz	λ-cyhalothrin	<5 aphids / plant
	4 fl oz	chlorpyrifos	
Warrior II at 250 [4]	1.9 fl oz	λ-cyhalothrin	250 aphids / plant
CruiserMaxx	56.25 g	thiamethoxam + mefenoxam + fludioxonil	ST
CruiserMaxx	56.25 g	thiamethoxam + mefenoxam + fludioxonil	ST
+ Dynasty	1 g	feudioxonil + azoxystrobin + metalaxyl	ST
CruiserMaxx	56.25 g	thiamethoxam + mefenoxam + fludioxonil	ST
+ Dynasty	1 g	feudioxonil + azoxystrobin + metalaxyl	ST
+ Mertect	5 g	thiabendazole	ST
CruiserMaxx	56.25 g	thiamethoxam + mefenoxam + fludioxonil	ST
+ Mertect	5 g	thiabendazole	ST
CruiserMaxx	56.25 g	thiamethoxam + mefenoxam + fludioxonil	ST
+ Apron XL	3.75 g	mefenoxam +fludioxonil	ST
V10170	NA	NA	ST
V10226	NA	NA	ST
V10170	NA	NA	ST
+ V10226	NA	NA	ST
Gaucho	62.5 g	imidacloprid	ST
+ Allegiance	4 g	metalaxyl	ST
+ Trilex	5 g	trifloxystrobin	ST
Gaucho	62.5 g	imidacloprid	ST
+ Allegiance	4 g	metalaxyl	ST
+ Trilex	5 g	trifloxystrobin	ST
+ Leverage	3.8 fl oz	imidacloprid + cyfluthrin	1 Aug
+ Stratego	10 fl oz	trifloxystrobin	1 Aug
Warrior II[2]	1.6 fl oz	λ-cyhalothrin	1 Aug
Warrior II[2]	1.9 fl oz	λ-cyhalothrin	1 Aug
Baythroid XL[2]	2.8 fl oz	cyfluthrin	1 Aug
Hero[2]	8 fl oz	ζ-cypermethrin + bifenthrin	1 Aug
Mustang Max[2]	4 fl oz	ζ-cypermethrin	1 Aug
Lorsban 4E	16 fl oz	chlorpyrifos	1 Aug
Lorsban Advanced	16 fl oz	chlorpyrifos	1 Aug
NuFos	16 fl oz	chlorpyrifos	1 Aug
Dimethoate	16 fl oz	dimethoate	1 Aug
Cobalt	13 fl oz	γ-cyhalothrin + chlorpyrifos	1 Aug
Baythroid XL	2 fl oz	cyfluthrin	1 Aug
+ Lorsban 4E	4 fl oz	chlorpyrifos	1 Aug
Centric	1.5 oz	thiamethoxam	1 Aug
Centric	2 oz	thiamethoxam	1 Aug
Endigo	2 fl oz	thiamethoxam + λ-cyhalothrin	1 Aug
Endigo	2.8 fl oz	thiamethoxam + λ-cyhalothrin	1 Aug
Leverage + COC	3.8 fl oz	imidacloprid + cyfluthrin	1 Aug
Leverage + NIS	3.8 fl oz	imidacloprid + cyfluthrin	1 Aug
Leverage	3.8 fl oz	imidacloprid + cyfluthrin	1 Aug
+ Stratego	10 fl oz	trifloxystrobin	1 Aug
spirotetramat	4 fl oz	spirotetramat	1 Aug
spirotetramat	4 fl oz	spirotetramat	1 Aug
+ Baythroid XL	2.8 fl oz	cyfluthrin	1 Aug
spirotetramat	6 fl oz	spirotetramat	1 Aug
+ Baythroid XL	2.8 fl oz	cyfluthrin	1 Aug

[1] Foliar product rates are given a formulated product per acre, and seed treatments are given a grams active ingredient per 100 kg seed
[2] Treated with ApronMaxx fungicide seed treatment (6.25 g per 100 kg)
[3] Treated with insecticides 3 times (22 July, 1 August, and 22 August)
[4] Treated 22 August (281 aphids pet plant)

Table 2. 2008 cumulative aphid day exposure

Treatment	Rate[1]	Active ingredient	CAD	SEM	LSD[2]
Untreated	---------	-----------	3600	510	n
Untreated[3]	6.25	mefenoxam +fludioxonil	2635	564	n
Zero aphid[4]	3.2 fl oz	λ-cyhalothrin	135	12	cdef
	4 fl oz	chlorpyrifos			
Warrior II at 250 [5]	1.9 fl oz	λ-cyhalothrin	1721	273	klmn
CruiserMaxx	56.25 g	thiamethoxam + mefenoxam + fludioxonil	2161	397	lmn
CruiserMaxx	56.25 g	thiamethoxam + mefenoxam + fludioxonil	1995	440	klmn
+ Dynasty	1 g	feudioxonil + azoxystrobin + metalaxyl			
CruiserMaxx	56.25 g	thiamethoxam + mefenoxam + fludioxonil	2774	710	n
+ Dynasty	1 g	feudioxonil + azoxystrobin + metalaxyl			
+ Mertect	5 g	thiabendazole			
CruiserMaxx	56.25 g	thiamethoxam + mefenoxam + fludioxonil	1959	525	lklmn
+ Mertect	5 g	thiabendazole			
CruiserMaxx	56.25 g	thiamethoxam + mefenoxam + fludioxonil	2022	400	mn
+ Apron XL	3.75 g	mefenoxam +fludioxonil			
V10170	NA	NA	2370	736	n
V10226	NA	NA	1812	412	lmn
V10170	NA	NA	1719	390	jklmn
+ V10226	NA	NA			
Gaucho	62.5 g	imidacloprid	1941	290	mn
+ Allegiance	4 g	metalaxyl			
+ Trilex	5 g	trifloxystrobin			
Gaucho	62.5 g	imidacloprid	50	18	abc
+ Allegiance	4 g	metalaxyl			
+ Trilex	5 g	trifloxystrobin			
+ Leverage	3.8 fl oz	imidacloprid + cyfluthrin			
+ Stratego	10 fl oz	trifloxystrobin			
Warrior II[2]	1.6 fl oz	λ-cyhalothrin	58	16	abcd
Warrior II[2]	1.9 fl oz	λ-cyhalothrin	31	10	ab
Baythroid XL[2]	2.8 fl oz	cyfluthrin	120	23	cdef
Hero[2]	8 fl oz	ζ-cypermethrin + bifenthrin	132	42	cde
Mustang Max[2]	4 fl oz	ζ-cypermethrin	26	4	a
Lorsban 4E	16 fl oz	chlorpyrifos	494	55	ijk
Lorsban Advanced	16 fl oz	chlorpyrifos	583	111	hijkl
NuFos	16 fl oz	chlorpyrifos	584	102	hijkl
Dimethoate	16 fl oz	dimethoate	903	248	hijklm
Cobalt	13 fl oz	γ-cyhalothrin + chlorpyrifos	338	31	fghi
Baythroid XL	2 fl oz	cyfluthrin	192	28	efghi
+ Lorsban 4E	4 fl oz	chlorpyrifos			
Centric	1.5 oz	thiamethoxam	334	88	efghi
Centric	2 oz	thiamethoxam	478	127	ghij
Endigo	2 fl oz	thiamethoxam + λ-cyhalothrin	220	82	defg
Endigo	2.8 fl oz	thiamethoxam + λ-cyhalothrin	137	43	bcde
Leverage + COC	3.8 fl oz	imidacloprid + cyfluthrin	269	67	efghi
Leverage + NIS	3.8 fl oz	imidacloprid + cyfluthrin	180	46	cde
Leverage	3.8 fl oz	imidacloprid + cyfluthrin	204	37	defg
+ Stratego	10 fl oz	trifloxystrobin			
spirotetramat	4 fl oz	spirotetramat	476	77	ghij
spirotetramat	4 fl oz	spirotetramat	146	46	cde
+ Baythroid XL	2.8 fl oz	cyfluthrin			
spirotetramat	6 fl oz	spirotetramat	212	20	defgh
+ Baythroid XL	2.8 fl oz	cyfluthrin			

[1] Foliar product rates are given a formulated product per acre, and seed treatments are given a grams active ingredient per 100 kg seed
[2] Least significant difference (LSD). Means labeled with a unique letter were significantly different (P = 0.05).
[3] Treated with ApronMaxx fungicide seed treatment (6.25 g per 100 kg)
[4] Treated with insecticides 3 times (22 July, 1 August, and 22 August)
[5] Treated 22 August (281 aphids pet plant)

Table 3. 2008 treatment yields

Treatment	Rate[1]	Active ingredient	Yield	SEM	LSD[2]
Untreated	---------	-----------	58.0	2.6	abc
Untreated[3]	6.25	mefenoxam +fludioxonil	59.6	2.1	cdefgh
Zero aphid[4]	3.2 fl oz 4 fl oz	λ-cyhalothrin chlorpyrifos	60.1	2.2	cdefghij
Warrior II at 250[5]	1.9 fl oz	λ-cyhalothrin	58.9	1.6	abcdefg
CruiserMaxx	56.25 g	thiamethoxam + mefenoxam + fludioxonil	59.5	2.1	abcdefgh
CruiserMaxx + Dynasty	56.25 g 1 g	thiamethoxam + mefenoxam + fludioxonil feudioxonil + azoxystrobin + metalaxyl	58.2	1.1	abcd
CruiserMaxx + Dynasty + Mertect	56.25 g 1 g 5 g	thiamethoxam + mefenoxam + fludioxonil feudioxonil + azoxystrobin + metalaxyl thiabendazole	60.2	1.8	abcdefghi
CruiserMaxx + Mertect	56.25 g 5 g	thiamethoxam + mefenoxam + fludioxonil thiabendazole	57.1	2.7	abc
CruiserMaxx + Apron XL	56.25 g 3.75 g	thiamethoxam + mefenoxam + fludioxonil mefenoxam +fludioxonil	58.2	1.5	abcd
V10170	NA	NA	59.1	2.0	abcdefgh
V10226	NA	NA	56.1	2.7	a
V10170 + V10226	NA NA	NA NA	57.5	2.6	abc
Gaucho + Allegiance + Trilex	62.5 g 4 g 5 g	imidacloprid metalaxyl trifloxystrobin	57.5	1.8	abc
Gaucho + Allegiance + Trilex + Leverage + Stratego	62.5 g 4 g 5 g 3.8 fl oz 10 fl oz	imidacloprid metalaxyl trifloxystrobin imidacloprid + cyfluthrin trifloxystrobin	66.9	1.6	l
Warrior II[2]	1.6 fl oz	λ-cyhalothrin	63.3	1.7	ijk
Warrior II[2]	1.9 fl oz	λ-cyhalothrin	62.2	2.1	ghijk
Baythroid XL[2]	2.8 fl oz	cyfluthrin	61.6	2.6	defghijk
Hero[2]	8 fl oz	ζ-cypermethrin + bifenthrin	62.3	1.3	ghijk
Mustang Max[2]	4 fl oz	ζ-cypermethrin	63.2	1.681	ijk
Lorsban 4E	16 fl oz	chlorpyrifos	58.6	0.9	abcde
Lorsban Advanced	16 fl oz	chlorpyrifos	60.2	1.7	cdefghi
NuFos	16 fl oz	chlorpyrifos	60.9	2.4	bcdefghi
Dimethoate	16 fl oz	dimethoate	60.4	1.6	cdefghi
Cobalt	13 fl oz	γ-cyhalothrin + chlorpyrifos	61.9	1.8	efghijk
Baythroid XL + Lorsban 4E	2 fl oz 4 fl oz	cyfluthrin chlorpyrifos	62.9	1.7	efghijk
Centric	1.5 oz	thiamethoxam	62.5	1.7	fghijk
Centric	2 oz	thiamethoxam	61.7	1.7	hijk
Endigo	2 fl oz	thiamethoxam + λ-cyhalothrin	62.5	1.8	efghijk
Endigo	2.8 fl oz	thiamethoxam + λ-cyhalothrin	61.9	1.6	efghijk
Leverage + COC	3.8 fl oz	imidacloprid + cyfluthrin	63.6	1.8	ijkl
Leverage + NIS	3.8 fl oz	imidacloprid + cyfluthrin	62.0	1.4	efghijk
Leverage + Stratego	3.8 fl oz 10 fl oz	imidacloprid + cyfluthrin trifloxystrobin	62.5	2.1	hijk
spirotetramat	4 fl oz	spirotetramat	61.5	2.0	defghi
spirotetramat + Baythroid XL	4 fl oz 2.8 fl oz	spirotetramat cyfluthrin	61.9	1.8	efghijk
spirotetramat + Baythroid XL	6 fl oz 2.8 fl oz	spirotetramat cyfluthrin	65.0	1.9	kl

[1] Foliar product rates are given a formulated product per acre, and seed treatments are given a grams active ingredient per 100 kg seed
[2] Least significant difference (LSD). Means labeled with a unique letter were significantly different (P = 0.05).
[3] Treated with ApronMaxx fungicide seed treatment (6.25 g per 100 kg)
[4] Treated with insecticides 3 times (22 July, 1 August, and 22 August)
[5] Treated 22 August (281 aphids pet plant, plants were at R6)

Table 4. Mean plant stand in 10 ft of row.

Treatment	Rate[1]	Active ingredient	Stand	SEM	LSD[2]
Untreated	---------	-----------	71.5	3.0	d
Untreated[3]	6.25	mefenoxam +fludioxonil	89.1	3.3	a
CruiserMaxx	56.25 g	thiamethoxam + mefenoxam + fludioxonil	74.7	3.0	bcd
CruiserMaxx	56.25 g	thiamethoxam + mefenoxam + fludioxonil	81.8	3.0	abc
+ Dynasty	1 g	feudioxonil + azoxystrobin + metalaxyl			
CruiserMaxx	56.25 g	thiamethoxam + mefenoxam + fludioxonil	80.0	3.0	dcd
+ Dynasty	1 g	feudioxonil + azoxystrobin + metalaxyl			
+ Mertect	5 g	thiabendazole			
CruiserMaxx	56.25 g	thiamethoxam + mefenoxam + fludioxonil	73.3	3.0	cd
+ Mertect	5 g	thiabendazole			
CruiserMaxx	56.25 g	thiamethoxam + mefenoxam + fludioxonil	73.0	3.0	cd
+ Apron XL	3.75 g	mefenoxam +fludioxonil			
V10170	NA	NA	80.0	3.0	abc
V10226	NA	NA	83.0	3.0	abcd
V10170	NA	NA	82.0	3.0	abc
+ V10226	NA	NA			
Gaucho	62.5 g	imidacloprid	86.0	3.0	abc
+ Allegiance	4 g	metalaxyl			
+ Trilex	5 g	trifloxystrobin			
Gaucho	62.5 g	imidacloprid	79.3	3.0	abc
+ Allegiance	4 g	metalaxyl			
+ Trilex	5 g	trifloxystrobin			
+ Leverage	3.8 fl oz	imidacloprid + cyfluthrin			
+ Stratego	10 fl oz	trifloxystrobin			

[1] Foliar product rates are given a formulated product per acre, and seed treatments are given a grams active ingredient per 100 kg seed
[2] Least significant difference (LSD). Means labeled with a unique letter were significantly different (P = 0.05).
[3] Treated with ApronMaxx fungicide seed treatment (6.25 g per 100 kg)

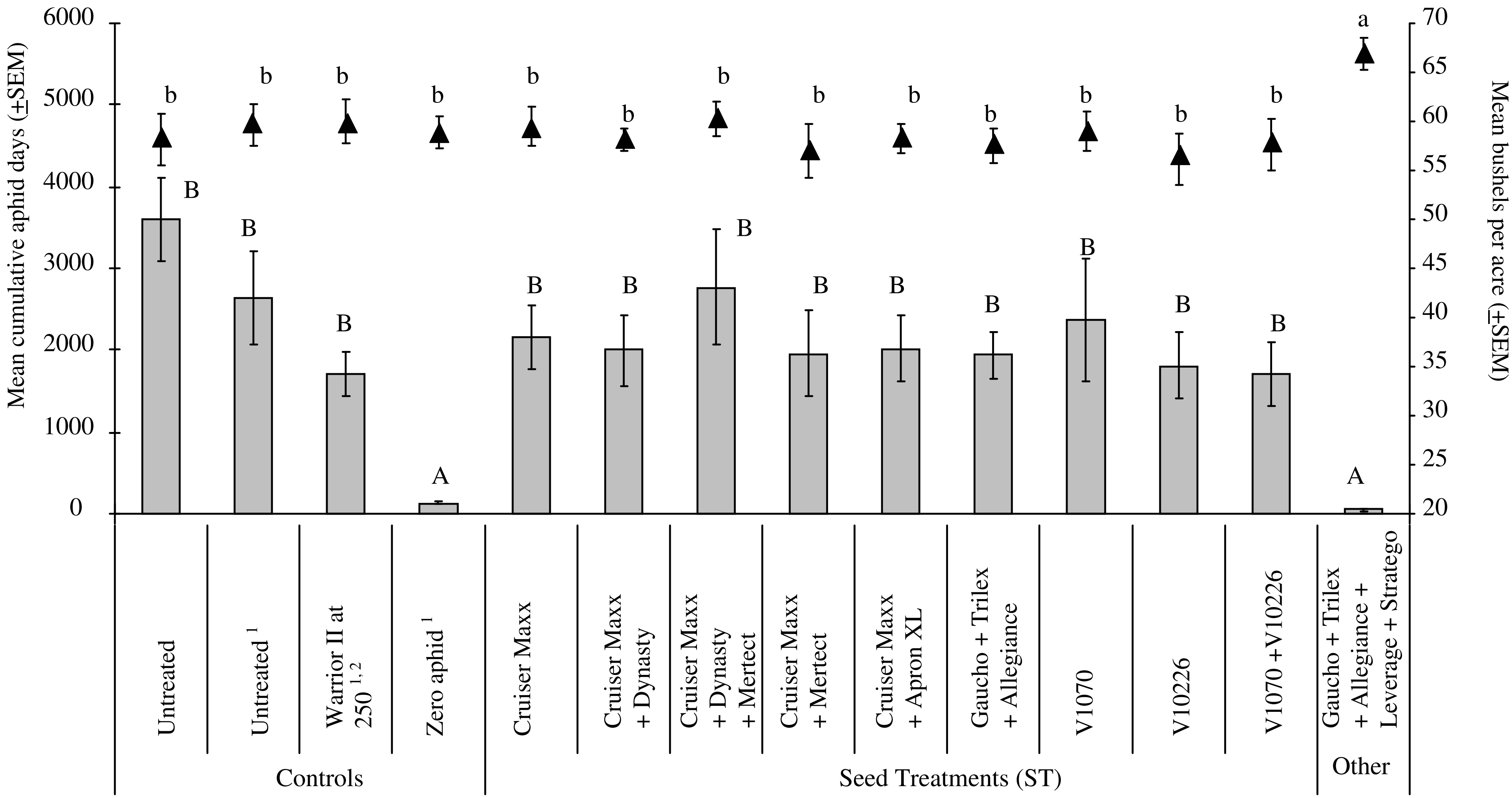

Figure 1. Impact of seed-applied insecticides on soybean exposure to aphids and yield. The aphid free control was treated with insecticides 3 times (22 July, 1 August and 22 August) all other foliar treatments were 1 August. Rates are only given if the same product was applied at different rates all other insecticide rates can be found in table 1. Cumulative aphid days are represented by bars and capital letters (right axis). Yields are represented by triangles and lowercase letters (left axis). Means with a unique letter are significantly different ($P \leq 0.05$). [1]Treated with ApronMaxx seed treatment (6.25 g per 100 kg). [2] Treated 22 August (281 aphids per plant, plants were at R6).

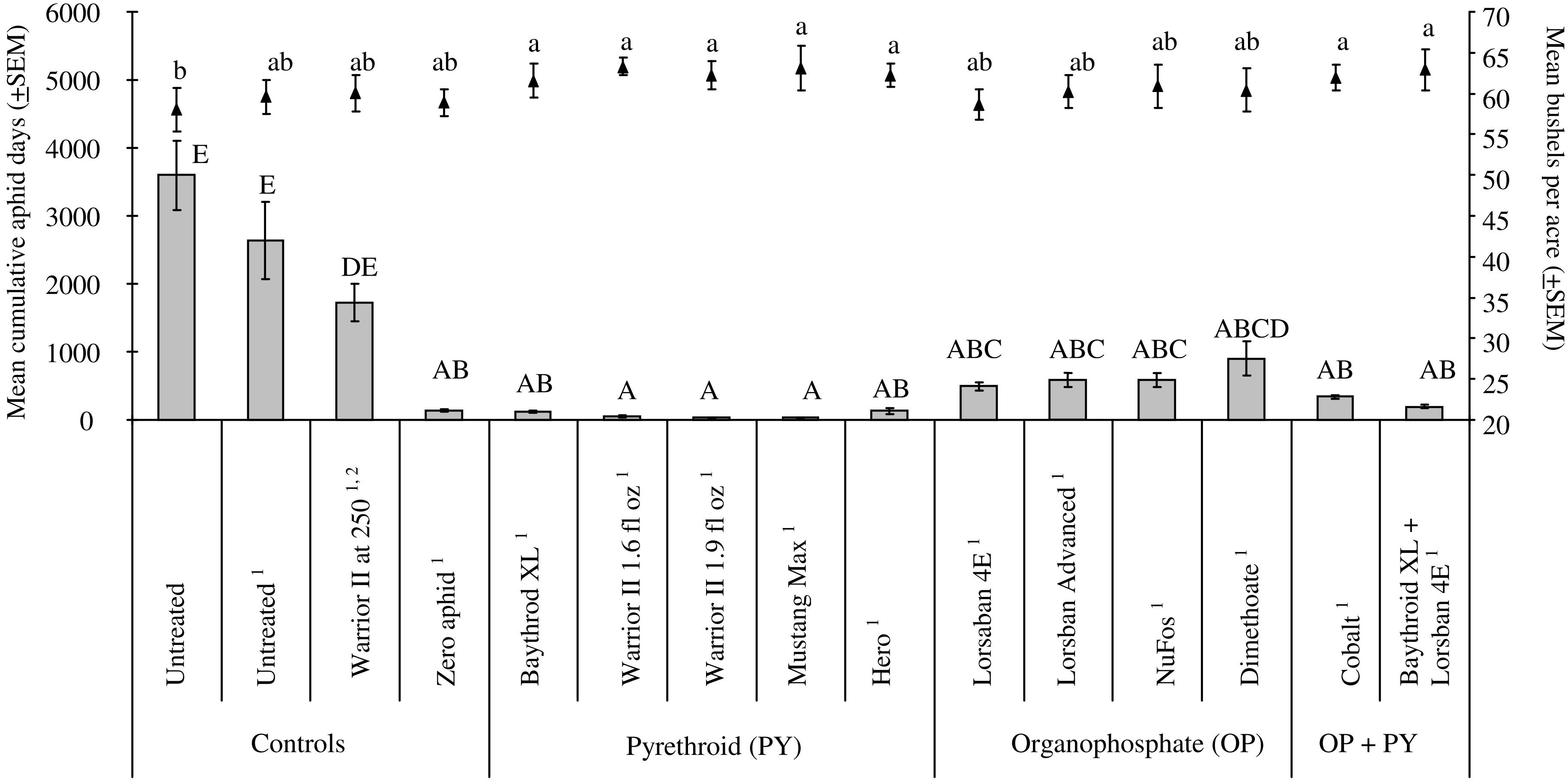

Figure 2. Impact of foliar-applied insecticides on soybean exposure to aphids and yield. The aphid free control was treated with insecticides 3 times (22 July, 1 August and 22 August) all other foliar treatments were 1 August. Rates are only given if the same product was applied at different rates all other insecticide rates can be found in table 1. Cumulative aphid days are represented by bars and capital letters (right axis). Yields are represented by triangles and lowercase letters (left axis). Means with a unique letter are significantly different ($P \leq 0.05$). [1]Treated with ApronMaxx seed treatment (6.25 g per 100 kg). [2]Treated 22 August (281 aphids per plant, plants were at R6).

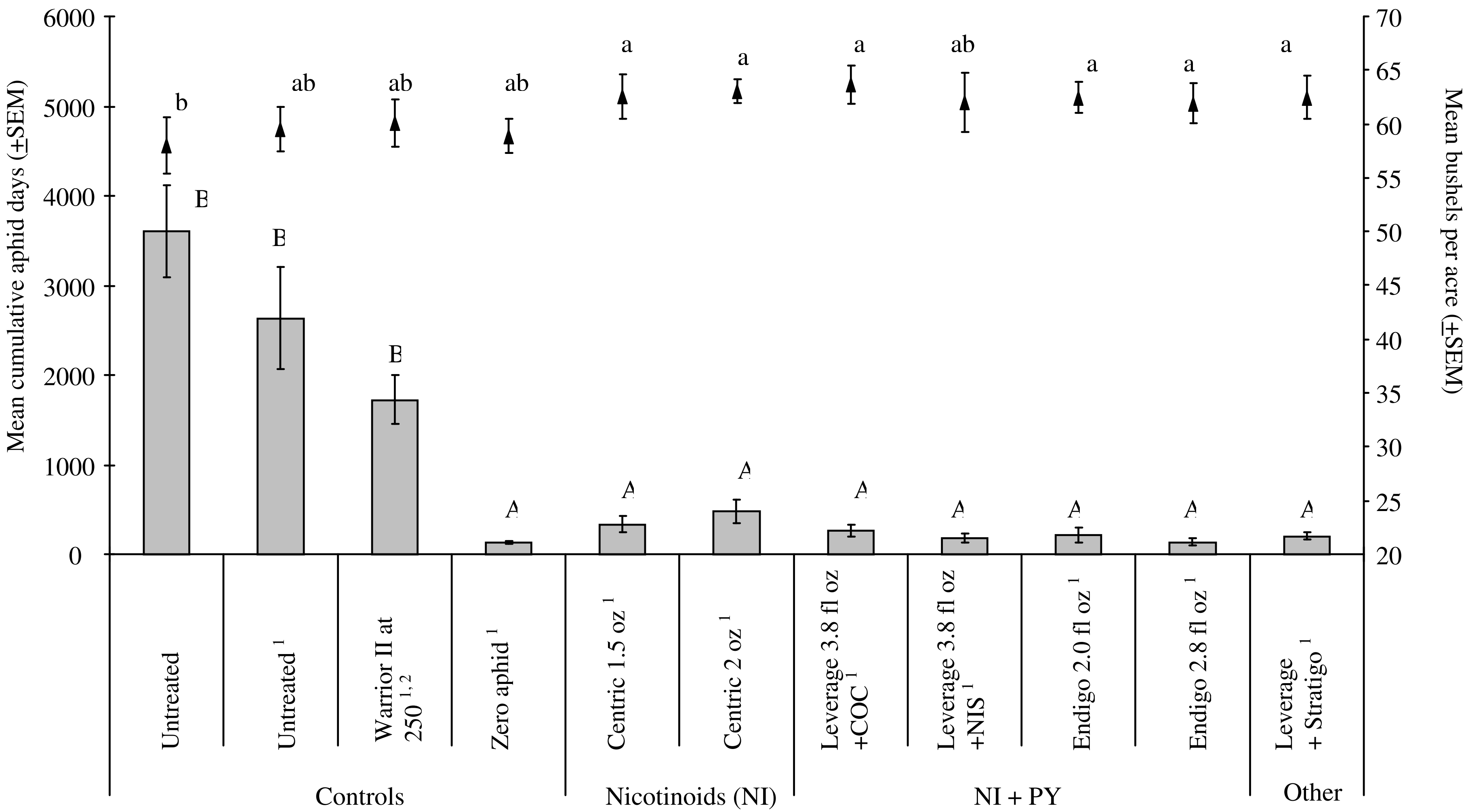

Figure 3. Impact of foliar-applied insecticides on soybean exposure to aphids and yield. The aphid free control was treated with insecticides 3 times (22 July, 1 August and 22 August) all other foliar treatments were 1 August. Rates are only given if the same product was applied at different rates all other insecticide rates can be found in table 1. Cumulative aphid days are represented by bars and capital letters (right axis). Yields are represented by triangles and lowercase letters (left axis). Means with a unique letter are significantly different ($P \leq 0.05$). [1]Treated with ApronMaxx seed treatment (6.25 g per 100 kg). [2] Treated 22 August (281 aphids per plant, plants were at R6).

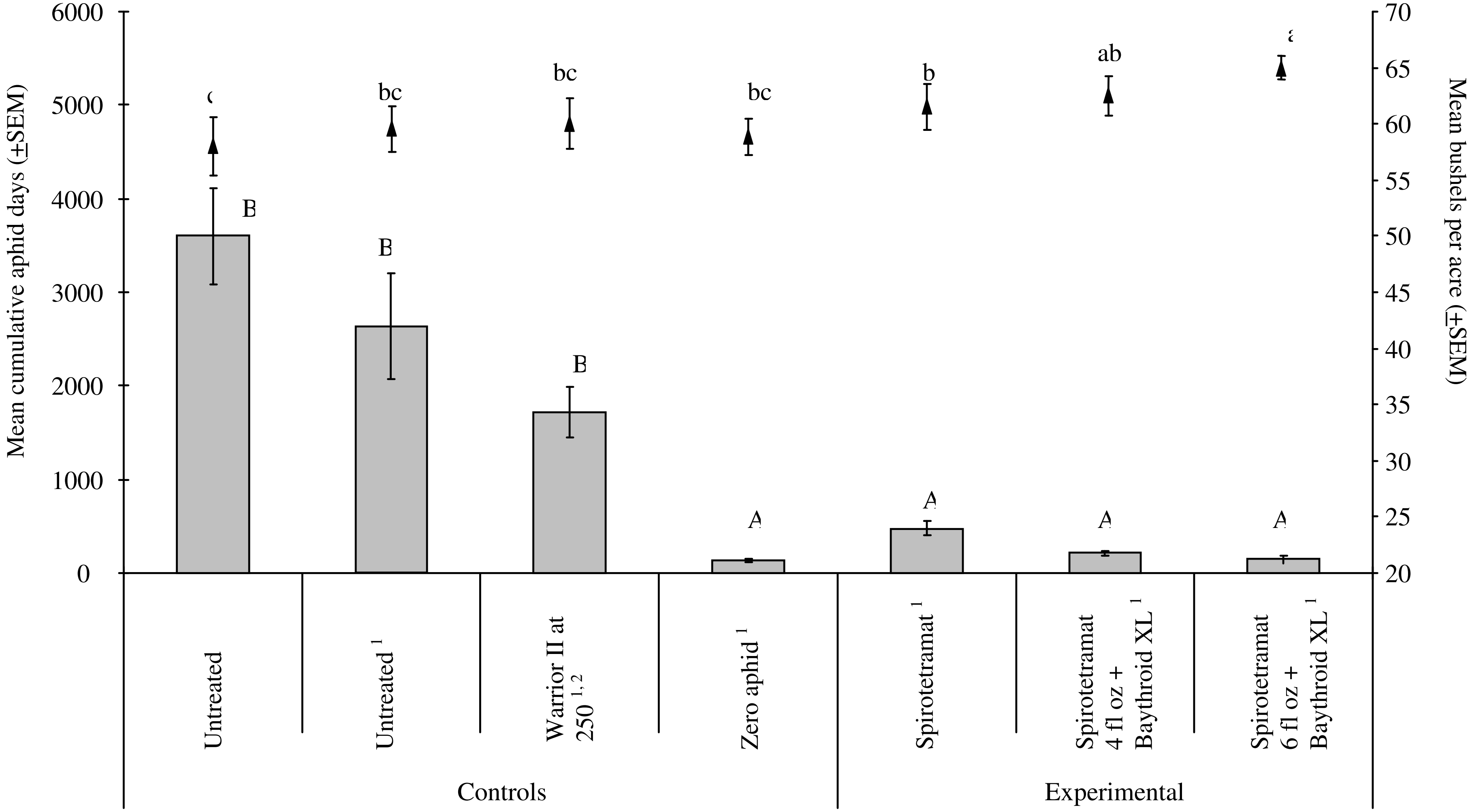

Figure 4. Impact of experimental insecticides on soybean exposure to aphids and yield. The aphid free control was treated with insecticides 3 times (22 July, 1 August and 22 August) all other foliar treatments were 1 August. Rates are only given if the same product was applied at different rates all other insecticide rates can be found in table 1. Cumulative aphid days are represented by bars and capital letters (right axis). Yields are represented by triangles and lowercase letters (left axis). Means with a unique letter are significantly different ($P \leq 0.05$). [1]Treated with ApronMaxx seed treatment (6.25 g per 100 kg). [2] Treated 22 August (281 aphids per plant, plants were at R6).