Management of Soybean Insect Pests
Project 01-2020

Annual Report

Project Leader: Donald Cook – dcook@drec.msstate.edu
Don Cook, Research Entomologist, Delta Research and Extension Center, Mississippi State University, Stoneville, MS, (662) 686-3217, dcook@drec.msstate.edu

Co PI's: Whitney Crow, Extension Entomologist, Delta Research and Extension Center, Mississippi State University, Stoneville, MS, (662) 686-3227, wdc165@msstate.edu

Angus Catchot, Extension Entomologist, Department of Biochemistry, Molecular Biology, Entomology and Plant Pathology, Mississippi State University, Starkville, MS, (662) 325-2085, acatchot@entomology.msstate.edu

Jeff Gore, Research/Extension Entomologist, Delta Research and Extension Center, Mississippi State University, Stoneville, MS, (662) 686-3252, jgore@drec.msstate.edu

Rationale/Justification for Research:

Up to date non-biased information is critical for making any agricultural management decision, including insect management decisions. As production practices change, so can the impact of pests change. An example of this is greater risk from early season/soil insects as a result of reduced tillage and increased plant residue from the previous crop, native winter vegetation, and/or cover crops. Also, uncommon and unexpected insect pest issues can occur. For example, redbanded stink bug infestations were much more widespread during 2017 and 2020. As a result, many studies were conducted with regard to management, damage potential, and treatment thresholds. Also, many current management tools are under reregistration review. It is possible that some of the older insecticides, which growers rely on, may have uses either restricted or revoked in the near future. With a limited number of insecticides already, this would make insect management in soybeans, and all crops more challenging. Insecticide resistance can be a major issue for insect management, and new insecticides are not being brought to market regularly anymore. "Routine" studies to evaluate current insecticides, along with reports from growers and consultants provide the first indications of pending insecticide resistance issues. Current market conditions have reduced profit margins considerably. The most informed and economical insect management decision is always important, but may be even more important when profit margins are small. To keep information current, studies must be regularly conducted to evaluate management strategies and tools and to provide information on unexpected insect issues.

Annual Report of Progress Activity

During 2020 experiments were conducted to evaluate the performance of selected insecticides against a range of soybean insect pests including, seedling/soil insects (corn rootworm, wireworm, pea leaf weevil), bollworm, soybean looper, and stink bugs (including redbanded stink bug). Additionally, studies were conducted to evaluate the relationship between percent bollworm damaged pods at harvest and yield. Studies were

also conducted to evaluate treatment thresholds for redbanded stink bugs and the sensitivity of soybean during different reproductive growth stages to redbanded stink bug. These experiments were conducted at the Delta Research and Extension Center and on commercial farms.

Two experiments were conducted at DREC to evaluate the performance of at-planting insecticides against seedling/soil pests. In the first experiment, foliar applications of either Endigo or Brigade were made at-planting, at emergence, or 7 days after emergence (DAE) (Table 1). Gaucho seed treatment was included as a comparison. Gaucho resulted in greater plant density at 26 DAE compared to all other treatments. None of the foliar treatments resulted greater plant density than the untreated control. In the second trial, selected insecticide seed treatments and seed treatment packages were evaluated. At 35 DAE all of the insecticide seed treatments resulted in greater plant population than Trilex Allegiance (Fungicide Only) (Table 2). Also all of the insecticide seed treatments resulted in greater yields compared to Trilex Allegiance (Fungicide Only).

Two experiments were conducted at DREC to evaluate the performance of selected insecticides against bollworm infesting soybeans (Tables 3 and 4). In the first experiment all of the insecticide treatments reduced bollworm numbers compared to the non-treated control at 3 DAT (Table 3). At 6 DAT, all of the insecticide treatments, except Acephate plus Sniper, reduced bollworm numbers compared to the non-treated control. All of the insecticide treatments reduced bollworm numbers compared to the non-treated control at 8 DAT. After 8 DAT populations had declined in all plots. In the second experiment, all of the insecticide treatments reduced bollworm numbers compared to the non-treated at 3 and 6 DAT (Table 4). There were no difference among treatments at 8 DAT. Three additional trials were initiated on a commercial farm in Washington County. However bollworm populations crashed between the time of application and the first sample date.

A block of soybeans (Asgrow 46X6) was planted on 13 May at DREC. Five bollworm trials, including the one illustrated in Table 3, were conducted in this block. All were sampled 5 times over at 12 day period (same sample dates). The highest bollworm density observed across all 5 sample dates was 14 per 25 sweeps. Prior to harvest, five plants per plot in all of the trials were examined for bollworm damaged pods. Percent damaged pods and yield from all trials were pooled and subjected to regression analysis. No significant relationship between percent bollworm damaged pods and yield was observed (Figure 1).

Two experiments were conducted at DREC to evaluate the performance of selected insecticides against soybean looper. Moderate populations were present when experiments were initiated, but a cold front passed through at ca. 7 DAT which triggered a disease outbreak. This resulted in a rapid decline in populations. In the first experiment, all of the insecticides reduced soybean looper densities compared to the non-treated control at 5 DAT (Table 5). At 7 DAT all of the insecticides, except Intrepid Edge, reduced looper densities compared to the untreated check. No differences were

observed among treatments at 9 DAT. However, looper densities were fairly low in general at 7 and 9 DAT. In the second trial, all of the insecticide treatments, except Intrepid (6 oz), reduced looper densities compared to the untreated check at 4 DAT. Intrepid Edge (both rates) and Steward resulted in lower densities of loopers than Besiege (both rates) or Intrepid (both rates). Soybean looper densities declined dramatically by 8 DAT, and no differences among treatments were observed.

Four experiments were conducted at DREC to evaluate the performance of selected insecticides against stink bugs. More redbanded stink bugs were present in 2020 compared to 2019, and this species was the predominant one present on most sample dates. In the first trial, all of the insecticides reduced redbanded stinkbug densities compared to the untreated check at 3 and 7 DAT (Table 7). At 3 DAT plots treated with Acephate plus Sniper, Endigo ZCX, or Acephate had fewer redbanded stink bug than plots treated with Belay. At 7 DAT Sniper, Endigo ZCX, and Acephate resulted in fewer redbanded stink bugs than Belay or Lannate (24 oz). At 14 DAT all of the insecticides, except Belay, Endigo ZCX, or Lannate (24 oz) reduced redbanded stink bug densities compared to the untreated check. Acephate resulted in lower redbanded stink bug densities compared to Belay, Endigo ZCX, and Lannate (both rates). At 3 and 7 DAT all of the insecticide treatments reduced stink bug densities (brown, green, southern green, and redbanded combined) compared to the untreated check (Table 8). Also, Sniper, Endigo ZCX, and Acephate resulted in lower stink bug densities than Belay or Lannate (16 oz) at 3 DAT. At 7 DAT Sniper and Endigo ZCX resulted in lower stink bug densities than Belay or Lannate (both rates). All of the insecticide treatments, except Belay and Lannate (24 oz), reduced stink bug densities compared to the untreated check at 14 DAT. Also, Acephate resulted in fewer stink bugs than Belay or Lannate. In the second experiment there were no differences among treatments for numbers of redbanded stink bugs at 3 or 14 DAT (Table 9). All of the insecticides reduced redbanded stink bug densities compared to the untreated check at 7 DAT. AT 11 DAT only Leverage 360 and Leverage 360 plus Acephate reduced redbanded stink bug densities compared to the untreated check. All of the insecticide treatments reduced densities of total stink bugs at 3 and 7 DAT (Table 10). AT 11 DAT only Leverage 360 and Leverage 360 plus Acephate reduced stink bug densities compared to the untreated check. There were no differences among treatments for stink bug densities at 14 DAT. In the third experiment all of the insecticide treatments reduced redbanded stink bug densities compared to the non-treated at 3, 7, and 11 DAT (Table 11). No differences among treatments were observed at 14 DAT. Also, all of the insecticide treatments reduced densities of total stink bugs compared to the non-treated at 3, 7, and 11 DAT (Table 12). By 14 DAT, only plots treated with Acephate plus Sniper (0.75lb + 4 oz) or Acephate plus Warrior (0.5 lb + 1.92 oz and 0.75 lb + 1.92 oz) had lower stink bug densities than the non-treated plots. In experiment 4, all of the insecticides reduced redbanded stink bug densities compared to the non-treated control at 3 and 7 DAT (Table 13). There were no differences among treatments at 11 DAT. At 14 DAT all of the insecticides, except Wrangler and Sniper plus Belay, reduced redbanded stink bug numbers compared to the non-treated. All of the insecticides reduced total stink bugs compared to the non-treated at 3 and 7 DAT (Table 14). At 11 DAT all of the insecticides, except Sniper, Wrangler, Belay, or Sniper plus Belay, reduced stink bug densities compared to the non-treated. All of the insecticide

treatments, except Wrangler, Belay, and Sniper plus Belay, resulted in lower stink bug densities that the non-treated control at 14 DAT.

An experiment was conducted to evaluate treatment thresholds for redbanded stink bug. Redbanded stink bug adults were much more prevalent than nymphs across all sample dates. The current threshold of 4 redbanded stink bugs per 25 sweeps resulted in similar total numbers of redbanded stink bugs compared to the weekly application treatment, or treating at 2 or 6 redbanded stink bugs per 25 sweeps (Figure 2). Treating at 4 redbanded stink bugs per 25 sweeps required 2 insecticide application, while the 2/25 threshold and the weekly application, resulted in 4 and 7 insecticide applications, respectively. The 12/25 redbanded stink bug threshold did not trigger in this trial. Percent stink bug damaged seed was determined using hand harvested and hand shelled samples. Percent damaged seed determined from machine harvested samples would be much lower. The 4/25 threshold resulted in similar percent damaged seed as the weekly application treatment and 2/25 treatment (Figure 3). Insecticide applications consisted of bifenthrin, acephate, or bifenthrin plus acephate. This treatment threshold (4/25) also resulted in similar yields as the weekly application treatment and 2/25 treatment (Figure 4). Another study was conducted to evaluate the sensitivity of soybean to redbanded stink bug infestations during various growth stages. Management of stink bugs during the R5 to R6, R5 to R7, or R5-R8 growth stages resulted in similar numbers of redbanded stink bugs across all sample dates as weekly insecticide applications (Figure 5). Management during R5 to R6, R5 to R7, and R5-R8, and weekly insecticide applications beginning at R5 required 3, 4, 6, and 6 insecticide applications, respectively. Insecticide applications consisted of bifenthrin, acephate, or bifenthrin plus acephate. Percent stink bug damaged seed was determined using hand harvested and hand shelled samples. Percent damaged seed determined from machine harvested samples would be much lower. Percent stink bug damaged seed followed a similar trend as total redbanded stink bugs. Management of stink bugs during R5 to R6, R5 to R7, or R5-R8 resulted in similar percent damaged seed as weekly insecticide applications (Figure 6). In this study there were no differences among treatments for yield (Figure 7).

In summary, the use of an insecticide seed treatment improved soybean stand establishment and yield in these studies. Foliar insecticide applications at-planting to 7 days after emergence did not maintain plant stand density. The insecticides that are recommended for bollworm control performed well. Bollworm infestations that reached a high of 14 larvae per 25 sweeps during a 12 day period did not result in levels of damaged pods (measured at harvest) that impacted yield. Most of the insecticides evaluated against soybean looper performed adequately. Looper infestations did not persist for an extended period of time, therefore it was not possible to evaluate the extended residual activity of some products exhibit. Mixed populations of stink bugs were present in experiments. However in most cases redbanded stink bug was the predominate species. Also, redbanded stink bug adults were more abundant than nymphs. Most of the insecticides performed satisfactorily against redbanded stink bug, as well as, other species. Some products maintained stink bug densities at low levels out to 11 and sometimes 14 DAT. Some re-infestation of stink bugs, including redbanded stink bug, did occur. Similar to results from 2017, treating redbanded stink bug at a

density of 4/25 sweeps resulted in similar damage levels and yield as when insecticides were applied weekly, with 5 fewer insecticide applications. In the current study managing redbanded stink bugs during the R5-R6 growth stages resulted in similar levels of damage as management from R5 to harvest, with 50% fewer insecticide applications.

Table 1. Impact of selected foliar insecticide treatments on soybean stand.

Treatment	Rate per acre (fl oz. prod.)	Application Timing[e]	Plant Density 26 DAE[f]
Non-Treated	-	-	16,885b
Endigo ZCX[a]	3.0	Pre-emerge	13,096b
Brigade 2EC[b]	4.27	Pre-emerge	8,888b
Endigo ZCX[a]	3.0	Emergence	14,351b
Brigade 2EC[b]	4.27	Emergence	18,325b
Endigo ZCX[a]	3.0	7 DAE	14,106b
Brigade 2EC[b]	4.27	7 DAE	16,318b
Gaucho 5FS[c]	2.5[d]	Seed Treatment	62,912a
P>F			<0.01

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).

All seed received a fungicide seed treatment (Apron XL 3FS 0.105 fl oz/cwt and Maxim 4FS 0.115 fl oz / cwt).

[a]Active ingredient – λ Cyhalothrin plus Thiamethoxam, Class – Pyrethroid, Neonicotinoid.

[b]Active ingredient – Bifenthrin, Class - Pyrethroid.

[c]Active ingredient – Imidacloprid, Class - Neonicotinoid.

[d]fl oz per cwt.

[e]Pre-emerge = directly after planting, Emergence = >75% emergence, 7 DAE = 7 days after emergence.

[f]DAE=Days after emergence.

Table 2. Impact of selected soybean seed treatment packages on stand establishment and yield.

Treatment	Rate fl oz/cwt	Insecticide component	Plants per acre 35 DAE[e]	Yield bu/acre
Trilex Allegiance	1.0	-	7,882b	19.0b
Trilex Allegiance + Poncho/Votivo	1.0 + 3.28	Poncho[a]	32,956a	50.3a
CruiserMaxx Vibrance	3.2	Cruiser[b]	30,669a	44.1a
CruiserMaxx Vibrance + Avicta	3.2 3.0	Cruiser[b]	37,081a	49.8a
Intego Suite	3.37	Nipsit[a]	32,343a	46.6a
Trilex Allegiance + Gaucho	1.0 + 2.5	Gaucho[c]	36,060a	50.0a
Trilex Allegiance + Poncho/Votivo + Gaucho	1.0 3.28 2.5	Poncho[a] + Gaucho[c]	34,263a	47.9a
Trilex Allegiance + Fortenza	1.0 1.084	Fortenza[d]	36,182a	46.6a
CruiserMaxx Vibrance + Fortenza	3.2 1.084	Cruiser[b] + Fortenza[d]	36,958a	45.8a
P>F			<0.01	<0.01

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).
[a]Active ingredient – Clothianidin, Class - Neonicotinoid.
[b]Active ingredient – Thiamethoxam, Class - Neonicotinoid.
[c]Active ingredient – Imidacloprid, Class - Neonicotinoid.
[d]Active ingredient – Cyantraniliprole, Class - Diamide.
[e]DAE=Days after emergence.

Table 3. Performance of selected insecticides against bollworm infesting soybeans, Experiment 1.

Treatment	Rate/acre (fl oz product)	Bollworm / 25 Sweeps		
		3 DAT[g]	6 DAT	8 DAT
Intrepid Edge 3SC[a]	4.0	0.9bc	0.0c	0.2b
Intrepid Edge 3SC[a]	5.0	0.2c	0.4c	0.0b
Intrepid Edge 3SC[a]	6.0	0.7bc	0.6bc	0.6b
Prevathon 0.43SC[b]	16.0	0.9bc	0.2c	0.2b
Besiege 1.252CS[c]	8.0	0.2c	0.4c	0.0b
Acephate 90S[d] + Sniper 2EC[e]	1.0[f] + 6.4	2.0b	2.2ab	0.6b
Non-Treated	-	7.1a	4.4a	3.6a
P>F		<0.01	<0.01	<0.01

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).

[a]Active ingredients – Spinetoram plus Methoxyfenozide, Class – Spinosyn and IGR.

[b]Active ingredient – Chlorantraniliprole, Class - Diamide.

[c]Active ingredients – λ Cyhalothrin plus Chlorantraniliprole, Class – Pyrethroid and Diamide.

[d]Active ingredients – Acephate, Class – Organophosphate.

[e]Active ingredient – Bifenthrin, Class – Pyrethroid.

[f]lb prod per acre.

[g]DAT=Days after treatment.

Table 4. Performance of selected insecticides against bollworm infesting soybeans, Experiment 2.

Treatment	Rate/acre (fl oz product)	Bollworm / 25 Sweeps 3 DAT[k]	6 DAT	8 DAT
Intrepid Edge 3SC[a]	5.0	0.9b	0.3b	0.6
Prevathon 0.43SC[b]	16.0	0.0c	0.0b	0.0
Besiege 1.252CS[c]	8.0	0.0c	0.0b	0.0
Acephate 90S[d] + Sniper 2EC[e]	1.0[j] + 6.4	0.2bc	0.3b	0.4
Steward 1.25C[f]	9.0	0.3bc	0.5b	0.2
Lannate 2.4L[g]	16.0	0.4bc	0.5b	0.4
Warrior II 2.08CS[h]	1.92	0.0c	0.8b	1.1
Warrior II 2.08CS[h] + Diamond 0.83EC[i]	1.92 + 6.0	0.4bc	0.5b	0.4
Non-Treated	-	5.4a	3.4a	1.4
P>F		<0.01	<0.01	0.11

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).
[a]Active ingredients – Spinetoram plus Methoxyfenozide, Class – Spinosyn and IGR.
[b]Active ingredient – Chlorantraniliprole, Class - Diamide.
[c]Active ingredients – λ Cyhalothrin plus Chlorantraniliprole, Class – Pyrethroid and Diamide.
[d]Active ingredients – Acephate, Class – Organophosphate.
[e]Active ingredient – Bifenthrin, Class – Pyrethroid.
[f]Active ingredient – Indoxacarb, Class – Oxydiazine.
[g]Active ingredient – Methomyl, Class – Carbamate.
[h]Active ingredient – λ Cyhalothrin, Class – Pyrethroid.
[i]Active ingredient – Novaluron, Class – IGR.
[j]lb prod per acre.
[k]DAT=Days after treatment.

Table 5. Evaluation of selected insecticides against soybean looper, Experiment 1.

Treatment	Rate/acre (fl oz product)	Soybean Looper / 25 Sweeps 5 DAT[d]	7 DAT	9 DAT
Prevathon 0.43SC[a]	14.0	1.5b	2.5b	4.8a
Prevathon 0.43SC[a]	20.0	4.3b	2.5b	4.8a
Besiege 1.252CS[b]	10.0	4.0b	2.5b	2.8a
Intrepid Edge 3SC[c]	4.0	3.3b	3.8ab	6.5a
Non-Treated	-	11.0a	5.3a	7.3a
P>F		<0.01	0.05	0.34

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).
[a]Active ingredient – Chlorantraniliprole, Class - Diamide.
[b]Active ingredients – Lambda Cyhalothrin plus Chlorantraniliprole, Class – Pyrethroid and Diamide.
[c]Active ingredients – Spinetoram plus Methoxyfenozide, Class – Spinosyn and IGR.
[d]DAE=Days after emergence.

Table 6. Evaluation of selected insecticides against soybean looper, Experiment 2.

Treatment	Rate/acre (fl oz product)	Soybean Looper / 25 Sweeps 4 DAT[f]	8 DAT
Intrepid Edge 3SC[a]	4.0	0.4e	0.3
Intrepid Edge 3SC[a]	5.0	0.9de	0.3
Prevathon 0.43SC[b]	14.0	2.3cde	0.0
Besiege 1.252CS[c]	7.0	2.9bcd	0.0
Besiege 1.252CS[c]	10.0	2.9bcd	0.0
Intrepid 2F[d]	4.0	4.5bc	0.3
Intrepid 2F[d]	6.0	8.7ab	0.8
Steward 1.25EC[e]	10.0	0.6e	0.0
Lannate 2.4L[f]	24.0	1.2cde	0.3
Non-Treated	-	13.9a	1.3
P>F		<0.01	0.22

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).
[a]Active ingredients – Spinetoram plus Methoxyfenozide, Class – Spinosyn and IGR
[b]Active ingredient – Chlorantraniliprole, Class - Diamide.
[c]Active ingredients – λ Cyhalothrin plus Chlorantraniliprole, Class – Pyrethroid and Diamide.
[d]Active ingredient – Methoxyfenozide, Class – IGR.
[e]Active ingredient – Indoxacarb, Class – Oxydiazine.
[f]Active ingredient – Methomyl, Class – Carbamate.
[f]DAE=Days after emergence.

Table 7. Evaluation of selected insecticides against redbanded stink bug, Experiment 1.

Treatment	Rate/acre (fl oz product)	Redbanded Stink Bugs / 25 Sweeps 3 DAT[g]	7 DAT	14 DAT
Acephate 97S[a] + Sniper 2EC[b]	0.77[f] + 6.4	0.9c	0.5bc	2.2bc
Belay 2.13SC[c]	4.0	1.4b	1.9b	3.5ab
Sniper 2EC[b]	6.4	0.3bc	0.0c	2.1bc
Endigo ZCX 2.7CS[d]	4.5	0.0c	0.0c	3.4ab
Lannate 2.4L[e]	16.0	0.4bc	0.7bc	2.7b
Lannate 2.4L[e]	24.0	0.3bc	2.0b	3.2ab
Acephate 97S[a]	1.03 [f]	0.0c	0.1c	0.5c
Non-Treated	-	9.3a	14.0a	6.0a
P>F		<0.01	<0.01	0.02

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).
[a]Active ingredient – Acephate, Class – Organophosphate.
[b]Active ingredient – Bifenthrin, Class – Pyrethroid.
[c]Active ingredient – Clothianidin, Class – Neonicotinoid.
[d]Active ingredients – λ Cyhalothrin plus Thiamethoxam, Class – Pyrethroid and Neonicotinoid.
[e]Active ingredients – Methomyl, Class – Carbamate.
[f]lb (wt) product per acre.
[g]DAT=Days after treatment.

Table 8. Evaluation of selected insecticides against redbanded, brown, green, southern green stink bug (total), Experiment 1.

Treatment	Rate/acre (fl oz product)	Total Stink Bugs / 25 Sweeps[g]		
		3 DAT[h]	7 DAT	14 DAT
Acephate 97S[a] + Sniper 2EC[b]	0.77[f] + 6.4	0.9bc	1.1bcd	2.9bcd
Belay 2.13SC[c]	4.0	2.6b	4.2b	5.7ab
Sniper 2EC[b]	6.4	0.3c	0.2d	2.4cd
Endigo ZCX 2.7CS[d]	4.5	0.2c	0.2d	4.1bcd
Lannate 2.4L[e]	16.0	2.5b	2.6bc	3.8bcd
Lannate 2.4L[e]	24.0	1.0bc	4.0b	5.1bc
Acephate 97S[a]	1.03[f]	0.0c	0.4cd	1.5d
Non-Treated	-	14.0a	21.1a	10.0a
P>F		<0.01	<0.01	<0.01

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).

[a]Active ingredient – Acephate, Class – Organophosphate.

[b]Active ingredient – Bifenthrin, Class – Pyrethroid.

[c]Active ingredient – Clothianidin, Class – Neonicotinoid.

[d]Active ingredients – λ Cyhalothrin plus Thiamethoxam, Class – Pyrethroid and Neonicotinoid.

[e]Active ingredients – Methomyl, Class – Carbamate.

[f]lb (wt) product per acre.

[g]Brown, Green, Southern Green, and Redbanded Stink Bug combined.

[h]DAT=Days after treatment.

Table 9. Evaluation of selected insecticides against redbanded stink bug, Experiment 2.

Treatment	Rate/acre (fl oz product)	Redbanded stink bug / 25 sweeps			
		3 DAT[e]	7 DAT	11 DAT	14 DAT
Leverage 360 3SC[a]	2.8	0.1a	0.3b	0.4b	1.5a
Leverage 360 3SC[a] + Acephate 97S[b]	2.8 + 0.515[d]	0.0a	0.4b	0.3b	1.2a
Sniper 2EC[c] + Acephate 97S[a]	5.12 + 0.515[d]	0.1a	0.7b	2.4a	1.4a
Non-Treated	-	0.7a	7.6a	3.6a	2.7a
P>F		0.40	0.05	0.01	0.72

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).
[a]Active ingredient – β Cyfluthrin plus Imidacloprid, Class – Pyrethroid plus Neonicotinoid.
[b]Active ingredient – Acephate, Class – Organophosphate.
[c]Active ingredient – Bifenthrin, Class – Pyrethroid.
[d]lb (wt) product per acre.
[e]DAT=Days after treatment.

Table 10. Evaluation of selected insecticides against redbanded, brown, green, southern green stink bug (total), Experiment 2.

Treatment	Rate/acre (fl oz product)	Total stink bug / 25 sweeps[e]			
		3 DAT[f]	7 DAT	11 DAT	14 DAT
Leverage 360 3SC[a]	2.8	0.2b	0.9b	1.3b	4.6a
Leverage 360 3SC[a] + Acephate 97S[b]	2.8 + 0.515[d]	0.2b	1.3b	1.3b	4.4a
Sniper 2EC[c] + Acephate 97S[a]	6.4 + 0.515[d]	0.6b	1.2b	5.9a	2.8a
Non-Treated	-	4.8a	16.0a	12.7a	7.8a
P>F		0.01	0.04	<0.01	0.58

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).
[a]Active ingredient – β Cyfluthrin plus Imidacloprid, Class – Pyrethroid plus Neonicotinoid.
[b]Active ingredient – Acephate, Class – Organophosphate.
[c]Active ingredient – Bifenthrin, Class – Pyrethroid.
[d]lb (wt) product per acre.
[e]Brown, Green, Southern Green, and Redbanded Stink Bug combined.
[f]DAT=Days after treatment.

Table 11. Evaluation of selected insecticides against redbanded stink bug, Experiment 3.

Treatment	Rate/acre (fl oz product)	Redbanded stink bug / 25 sweeps			
		3 DAT[e]	7 DAT	11 DAT	14 DAT
Acephate 97S[a] + Sniper 2EC[b]	0.5[d] + 4.0	0.2b	0.2b	0.1bc	1.6a
Acephate 97S[a] + Sniper 2EC[b]	0.75[d] + 4.0	0.0b	0.0b	1.1b	0.4a
Acephate 97S[a] + Sniper 2EC[b]	1.0[d] + 4.0	0.2b	0.2b	0.4bc	0.3a
Acephate 97S[a] + Sniper 2EC[b]	0.5[d] + 6.4	0.0b	0.0b	0.3bc	2.4a
Acephate 97S[a] + Sniper 2EC[b]	0.75[d] + 6.4	0.2b	0.4b	0.6bc	0.8a
Acephate 97S[a] + Sniper 2EC[b]	1.0[d] + 6.4	0.2b	0.0b	0.1bc	1.2a
Acephate 97S[a] + Warrior 2.08CS[c]	0.5[d] + 1.92	0.2b	0.0b	0.4bc	0.0a
Acephate 97S[a] + Warrior 2.08CS[c]	0.75[d] +1.92	0.0b	0.3b	0.2bc	0.3a
Acephate 97S[a] + Warrior 2.08CS[c]	1.0[d] + 1.92	0.3b	0.7b	0.0c	1.0a
Non-Treated	-	13.0a	10.4a	4.4a	3.3a
P>F		<0.01	<0.01	<0.01	0.17

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).
[a]Active ingredient – Acephate, Class – Organophosphate.
[b]Active ingredient – Bifenthrin, Class – Pyrethroid.
[c]Active ingredient – λ Cyhalothrin, Class – Pyrethroid.
[d]lb (wt) product per acre.
[e]DAT=Days after treatment.

Table 12. Evaluation of selected insecticides against redbanded, brown, green, southern green stink bug (total), Experiment 3.

Treatment	Rate/acre (fl oz product)	Total stink bug / 25 sweeps[e]			
		3 DAT[f]	7 DAT	11 DAT	14 DAT
Acephate 97S[a] + Sniper 2EC[b]	0.5[d] + 4.0	0.2b	0.2b	1.3b	3.7ab
Acephate 97S[a] + Sniper 2EC[b]	0.75[d] + 4.0	0.0b	0.2b	3.0b	0.4cd
Acephate 97S[a] + Sniper 2EC[b]	1.0[d] + 4.0	0.2b	0.2b	1.1b	1.4a-d
Acephate 97S[a] + Sniper 2EC[b]	0.5[d] + 6.4	0.0b	0.0b	1.3b	5.6ab
Acephate 97S[a] + Sniper 2EC[b]	0.75[d] + 6.4	0.2b	0.7b	1.8b	1.6a-d
Acephate 97S[a] + Sniper 2EC[b]	1.0[d] + 6.4	0.2b	0.0b	0.4b	1.7a-d
Acephate 97S[a] + Warrior 2.08CS[c]	0.5[d] + 1.92	0.2b	0.0b	1.7b	0.2d
Acephate 97S[a] + Warrior 2.08CS[c]	0.75[d] +1.92	0.0b	0.3b	0.9b	1.2bcd
Acephate 97S[a] + Warrior 2.08CS[c]	1.0[d] + 1.92	0.3b	0.7b	0.4b	2.8abc
Non-Treated	-	18.6a	14.6a	11.3a	6.5a
P>F		<0.01	<0.01	0.03	0.05

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).
[a]Active ingredient – Acephate, Class – Organophosphate.
[b]Active ingredient – Bifenthrin, Class – Pyrethroid.
[c]Active ingredient – λ Cyhalothrin, Class – Pyrethroid.
[d]lb (wt) product per acre.
[e]Brown, Green, Southern Green, and Redbanded Stink Bug combined.
[f]DAT=Days after treatment.

Table 13. Evaluation of selected insecticides against redbanded stink bug, Experiment 4.

Treatment	Rate/acre (fl oz product)	Redbanded stink bug / 25 sweeps 3 DAT[h]	7 DAT	11 DAT	14 DAT
Acephate 97S[a]	0.75[g]	0.3b	1.0b	0.2a	0.4cd
Endigo ZCX[b]	4.5	0.4b	0.6b	0.9a	1.2bcd
Sniper 2EC[c]	6.4	0.4b	0.7b	2.0a	1.3bcd
Wrangler 4F[d]	1.5	0.6b	1.2b	2.6a	4.1ab
Leverage 360 3SC[e]	2.8	0.0b	0.4b	1.3a	0.3cd
Belay 2.13SC[f]	4.0	0.4b	0.3b	3.3a	1.5bc
Sniper 2EC[c] + Acephate 97S[a]	6.4 + 0.75[g]	0.0b	0.9b	0.7a	1.4bc
Sniper 2EC[c] + Wrangler 4F[d]	6.4 + 1.5	0.0b	0.2b	1.1a	1.2bcd
Leverage 360 3SC[e] + Acephate 97S[a]	2.8 + 0.75[g]	0.0b	0.0b	0.2a	0.0d
Sniper 2EC[c] + Belay 2.13SC[f]	4.0 + 4.0	0.0b	0.4b	2.5a	2.6ab
Non-Treated	-	7.9a	11.1a	4.3a	5.7a
P>F		<0.01	<0.01	0.08	<0.01

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).

[a]Active ingredient – Acephate, Class – Organophosphate.

[b]Active ingredient – λ Cyhalothrin plus Thiamethoxam, Class – Pyrethroid plus Neonicotinoid.

[c]Active ingredient – Bifenthrin, Class – Pyrethroid.

[d]Active ingredient – Imidacloprid, Class – Neonicotinoid.

[e]Active ingredient – β Cyfluthrin plus Imidacloprid, Class – Pyrethroid plus Neonicotinoid.

[f]Active ingredient – Clothianidin, Class – Neonicotinoid.

[g]lb (wt) product per acre.

[h]DAT=Days after treatment.

Table 14. Evaluation of selected insecticides against redbanded, brown, green, southern green stink bug (total), Experiment 4.

Treatment	Rate/acre (fl oz product)	Total stink bug / 25 sweeps[h] 3 DAT[i]	7 DAT	11 DAT	14 DAT
Acephate 97S[a]	0.75[g]	0.6bc	1.3b-e	2.7b-e	1.9bcd
Endigo ZCX[b]	4.5	0.4bc	1.3b-e	1.4cde	2.7bc
Sniper 2EC[c]	6.4	0.8bc	1.1b-e	3.9a-d	1.4bcd
Wrangler 4F[d]	1.5	1.3b	3.7b	4.6a-d	8.1a
Leverage 360 3SC[e]	2.8	0.4bc	0.9cde	1.3cde	0.6cd
Belay 2.13SC[f]	4.0	1.4b	2.5bc	9.1ab	4.0ab
Sniper 2EC[c] + Acephate 97S[a]	6.4 + 0.75[g]	0.0c	1.7bcd	0.9de	2.6bc
Sniper 2EC[c] + Wrangler 4F[d]	6.4 + 1.5	0.0c	0.2de	1.6cde	2.0bcd
Leverage 360 3SC[e] + Acephate 97S[a]	2.8 + 0.75[g]	0.0c	0.0d	0.43	0.4d
Sniper 2EC[c] + Belay 2.13SC[f]	4.0 + 4.0	0.0c	0.4de	6.0abc	4.2ab
Non-Treated	-	12.7a	19.2a	12.1a	9.1a
P>F		<0.01	<0.01	<0.01	<0.01

Means within columns followed by a common letter are not significantly different (FPLSD, *P*=0.05).

[a]Active ingredient – Acephate, Class – Organophosphate.

[b]Active ingredient – λ Cyhalothrin plus Thiamethoxam, Class – Pyrethroid plus Neonicotinoid.

[c]Active ingredient – Bifenthrin, Class – Pyrethroid.

[d]Active ingredient – Imidacloprid, Class – Neonicotinoid.
[e]Active ingredient – β Cyfluthrin plus Imidacloprid, Class – Pyrethroid plus Neonicotinoid.
[f]Active ingredient – Clothianidin, Class – Neonicotinoid.
[g]lb (wt) product per acre.
[h]Brown, Green, Southern Green, and Redbanded Stink Bug combined.
[i]DAT=Days after treatment.

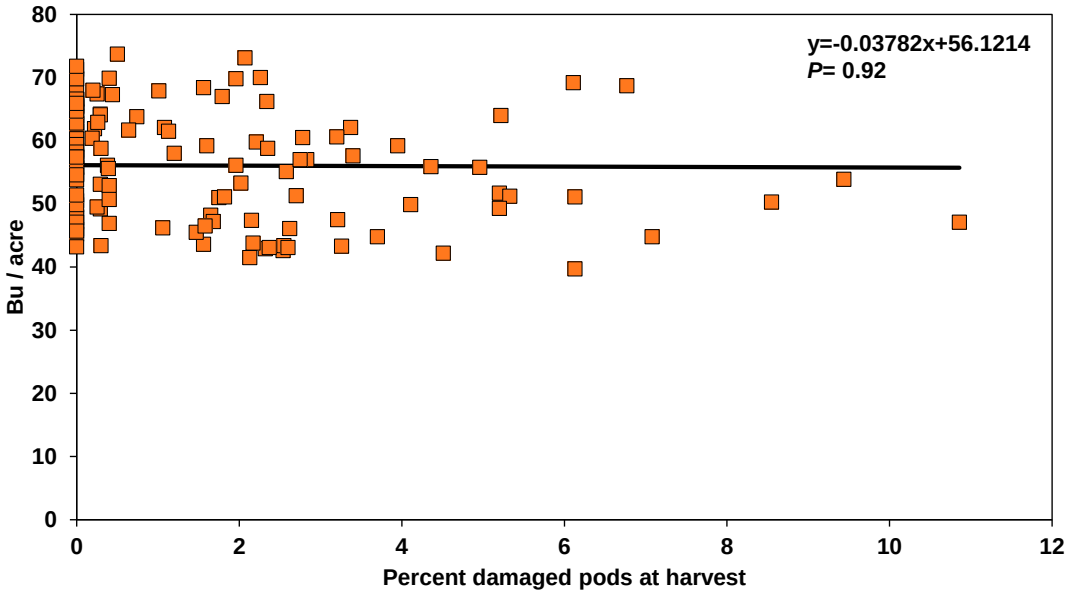

Figure 1. Relationship between percent bollworm damaged pods at harvest and yield.

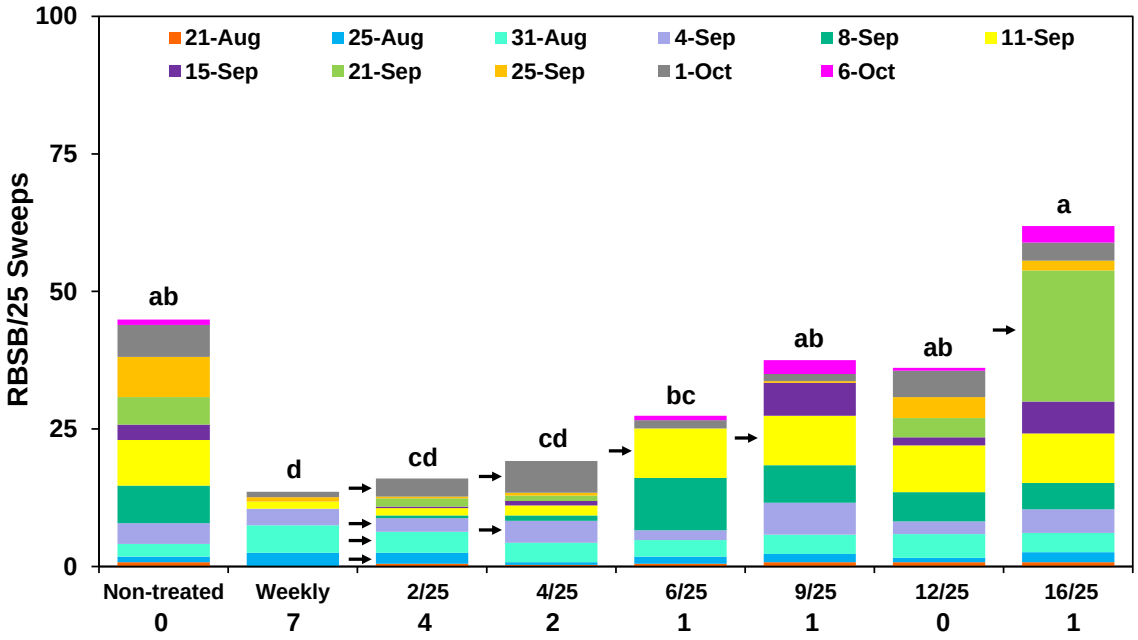

Figure 2. Impact of treatment thresholds on redbanded stink bug densities. Thresholds expressed as number of stink bugs per 25 sweeps. Numbers below treatment labels indicate number of insecticide applications. Arrows beside bars indicate timing of applications. Analysis (letter separations) is for total redbanded stink bugs across all sample dates.

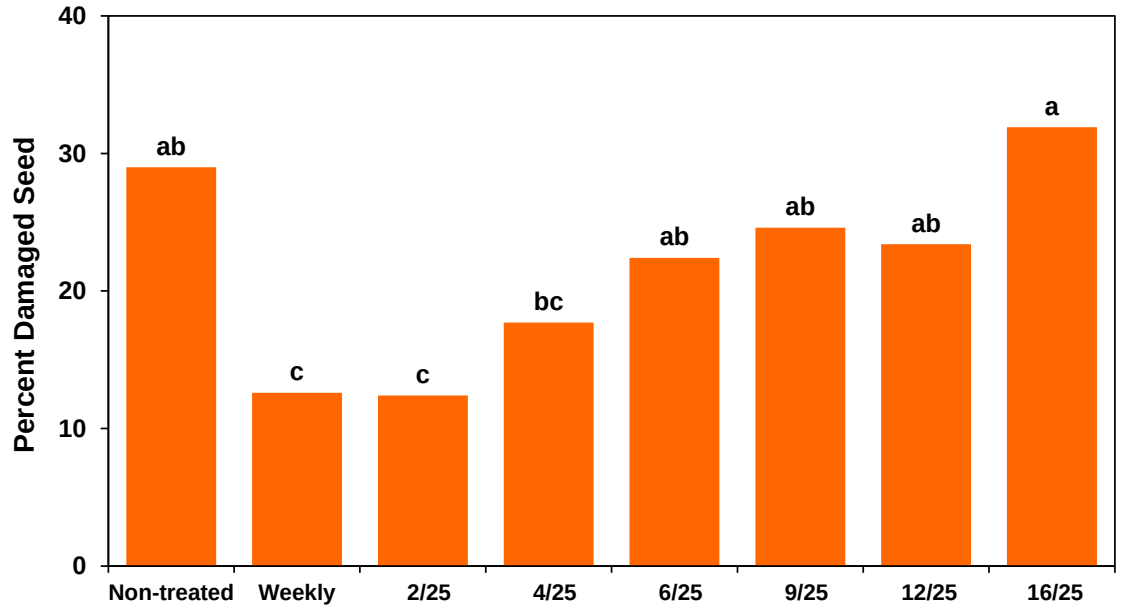

Figure 3. Impact of treatment thresholds on redbanded stink bug damaged seed. Seed damage data are from hand harvested plants and hand shelled pods.

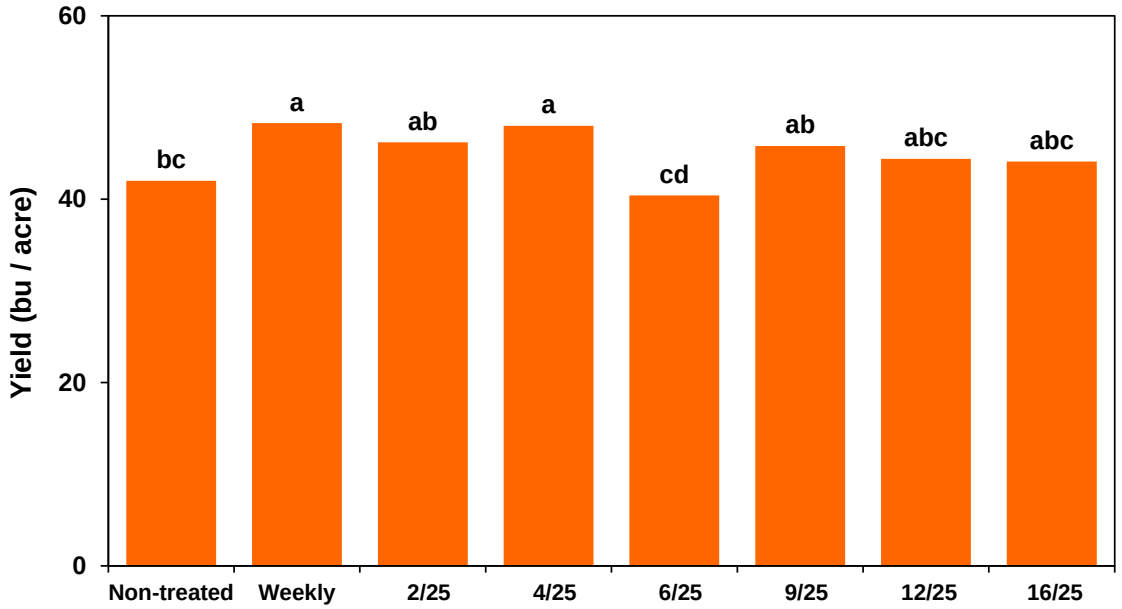

Figure 4. Impact of redbanded stink bug treatment thresholds on soybean yield.

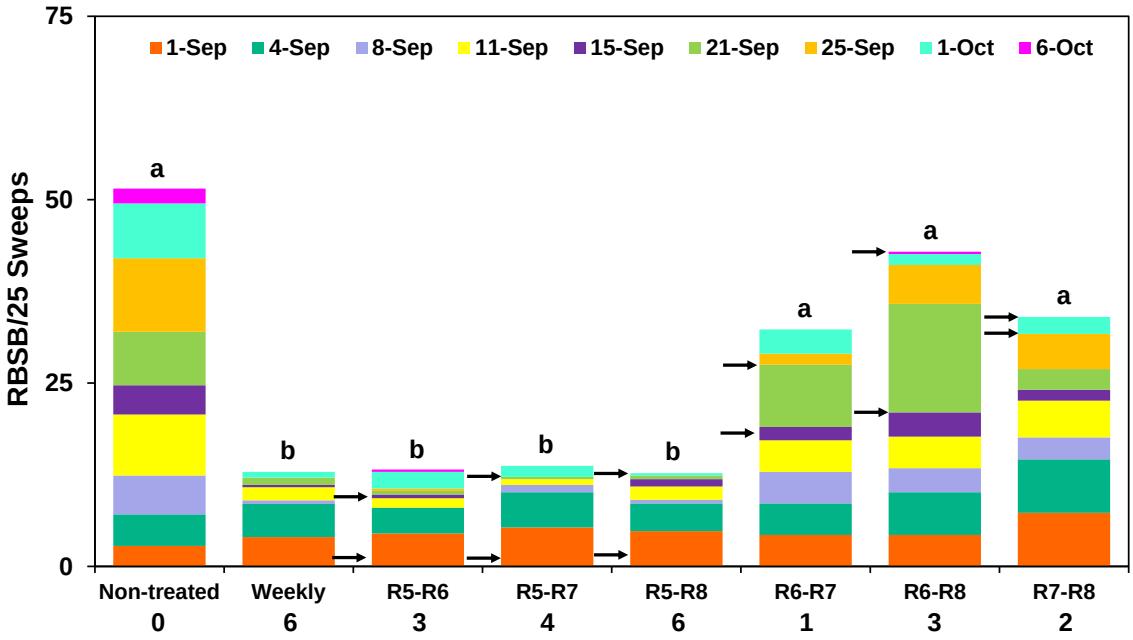

Figure 5. Impact of treatment timing on redbanded stink bug densities. Treatments indicate during what growth stage(s) redbanded stink bugs were managed. Numbers below treatment labels indicate number of insecticide applications. Arrows beside bars indicate growth stage(s) in which applications made in relation to sample date and insect density. Analysis (letter separations) is for total redbanded stink bugs across all sample dates.

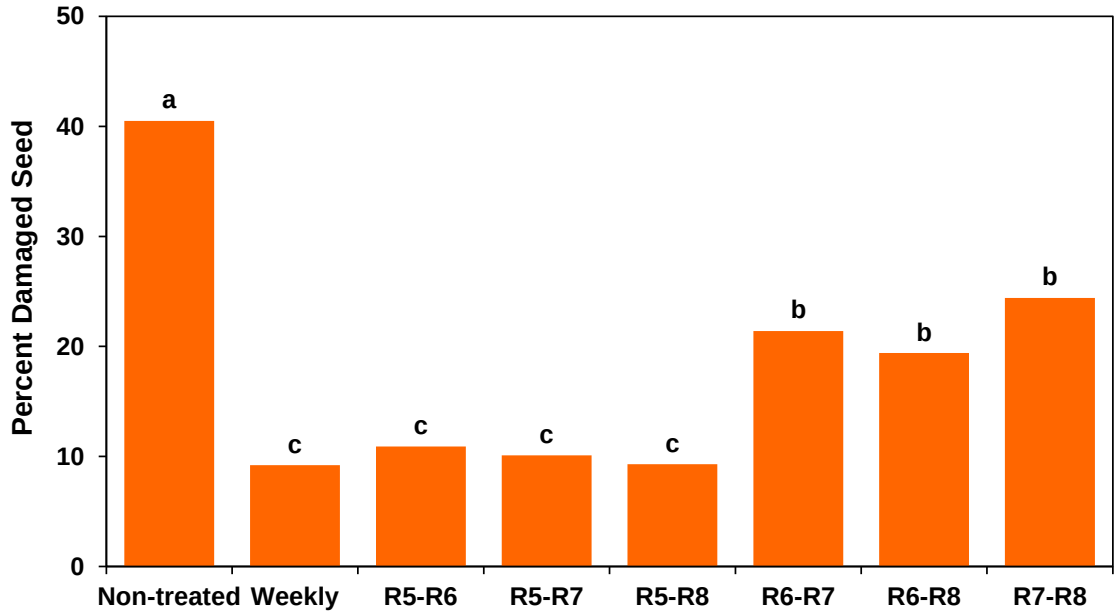

Figure 6. Impact of treatment timing on redbanded stink bug damaged seed. Treatments indicate during what growth stage(s) redbanded stink bugs were managed. Seed damage data are from hand harvested plants and hand shelled pods.

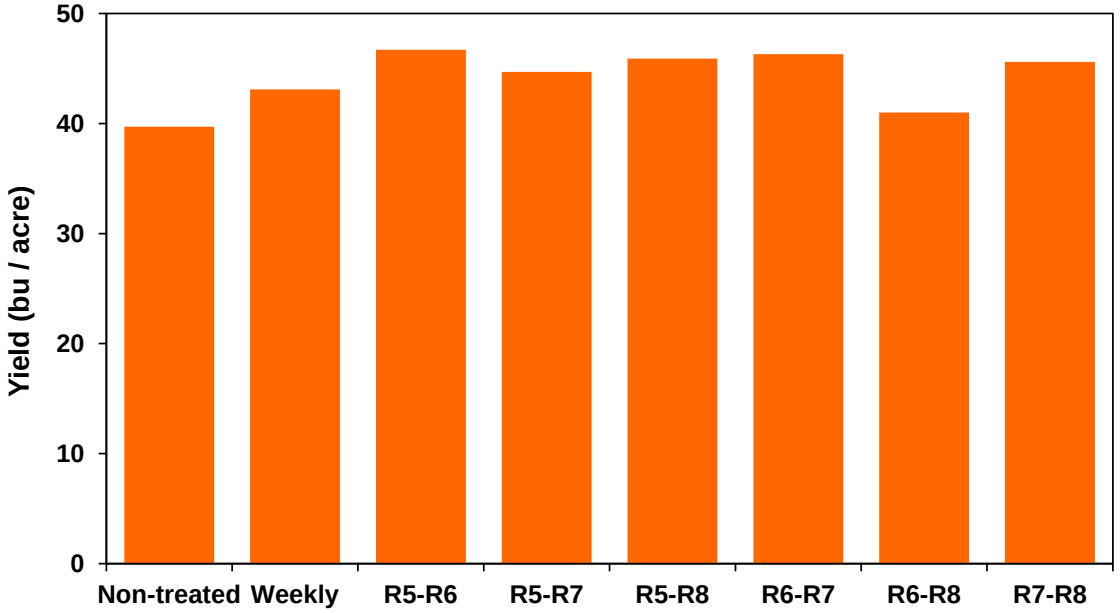

Figure 7. Impact of treatment timing for redbanded stink bug on yield.