Final 2011 Delaware Soybean Board Report

Title: Evaluation of Perimeter Treatments as a Control Strategy to Manage the Stink Bug Complex and Evaluation of Insecticides to Control the Brown Marmorated Stink Bug

Personnel: Bill Cissel, Extension IPM Associate, Joanne Whalen, Extension IPM Specialist,

Objectives:

(1) Evaluate the effectiveness of perimeter treatments to control stink bugs in soybeans.

(2) Determine yield loss, seed quality, and the possibility of delayed plant growth, "stay green effect", caused by stink bug feeding.

(3) Evaluate the effectiveness of insecticides to control the brown marmorated stink bug on soybeans.

Methods:

(1) Evaluate the effectiveness of perimeter treatments to control stink bugs in soybeans.

Stink bug populations were monitored in fifty-two soybean fields throughout the state by taking one hundred weekly sweep net samples from late June to early September. The intent of the survey was to (1) identify fields to evaluate perimeter treatments, (2) determine the distribution of stink bugs within soybean fields including the brown (BSB), green (GSB), and brown marmorated stink bug (BMSB), and (3) to determine how widely distributed the BMSB is across the state.

Three fields were selected for evaluating the effectiveness of perimeter treatments, two fields located in New Castle County and one field located in Sussex County. The BMSB was the predominant stink bug species in both of the New Castle County fields, and BSB and GSB were the only stink bug species found in the Sussex County field. In the New Castle County fields, pre and post treatment sampling consisted of performing 100 sweeps in the field perimeters (0-100 ft) and in the field interiors (>100 ft). Once stink bug populations had reached a threshold of five stink bugs per twenty-five sweeps on the field perimeters, perimeter treatments were applied using commercial application equipment. Both of the New Castle County locations received a pyrethroid application around the entire perimeter of the field. In the Sussex County location, the perimeter treatment was arranged in paired treated and untreated plots along a wooded field edge in 90 ft wide x 200 ft long swaths. For the perimeter treatment, twenty sweeps per paired treatment were taken post-treatment at 0, 20, 45 and 90 ft from the field perimeter. The interior of the field was sampled by taking 10 sweep samples in 10 locations randomly throughout the field interior.

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Prior to harvest, subsamples were collected from the field perimeters and the field interiors to determine pod feeding damage and to evaluate seed quality. The fields were also monitored for symptoms of delayed plant growth or "stay green effect". A final evaluation was also performed to determine the stink bug infestation levels by examining three linear foot of row in five locations on the field perimeter and field interior.

(2) Determine yield loss, seed quality, and the possibility of delayed plant growth, "stay green effect", caused by stink bug feeding.

Prior to harvest, a sub-sample of nineteen fields (out of the 52 total fields sampled) were selected based on the level of stink bug infestation during pod formation and grain fill stages to be monitored for symptoms of delayed plant growth, evidence of pod feeding, and for reductions in seed quality. A final determination of stink bug populations in each field were also determined by randomly counting the number of stink bugs within three linear foot of row in five locations in the field perimeter and field interior that exhibited delayed plant growth. Five locations within the field interior that did not appear to exhibit delayed plant growth were also examined for comparison. Plant subsamples were taken from each of the fields to examine pods and seed for stink bug feeding damage and to evaluate reductions in seed quality.

(3) Evaluate the effectiveness of insecticides to control the brown marmorated stink bug on soybeans.

Replicated research plots were established at two locations: University of Delaware's Research Farm in Newark, DE planted on June 17 and at University of Delaware's Demonstration Farm located near Middletown, DE planted on June 2. In Newark, plots were 10 ft wide (4 rows planted on 30 inches) and 25 ft long, arranged in a randomized complete block design with four replications. In Middletown, plots were 6.25 ft wide (5 rows planted on 15 inches) and 18 ft long arranged in a randomized complete block design with six replications. BMSB populations were monitored on a weekly basis from late June to the end of September using a sweep net and counting the total number of BMSB adults and nymphs found in ten sweep net samples/plot. Ten leaves per plot were also examined and the total number of egg masses was recorded. Since BMSB populations in the Newark plot were extremely low, no insecticide treatments were applied.

At the Middletown location, treatments were applied on August 16th using a CO^2 pressurized back pack sprayer equipped with a five nozzle broadcast boom delivering 17.8 gallons per acre. All plots were monitored on a weekly basis following treatment to determine the effectiveness of each treatment. Treatments consisted of (1) Baythroid XL, (2) Leverage 360, (3) Lannate LV, (4) Warrior II, (5) Endigo ZC, (6) Cobalt Advanced, (7)

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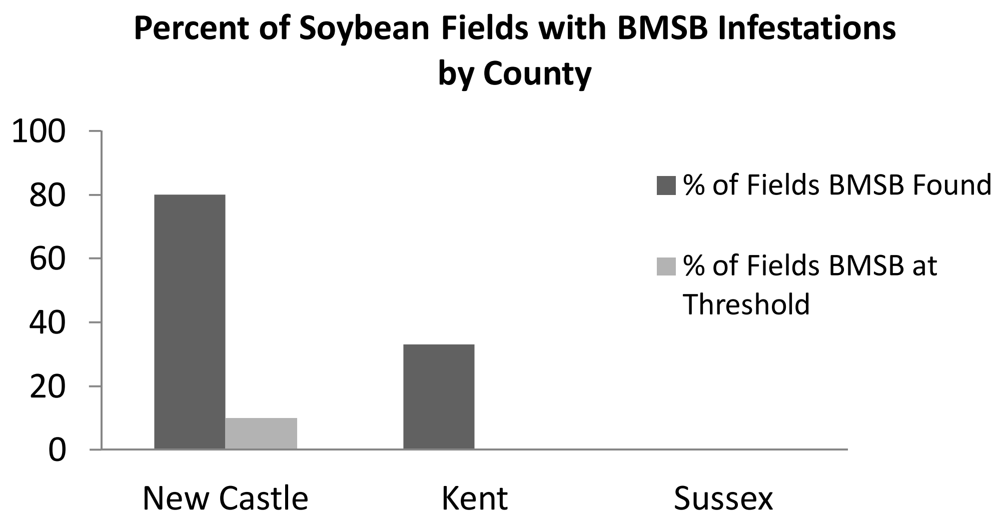
Acephate 97 UP, and (8) an untreated check. Yield data was collected on November 3 and subsamples were taken from each plot to evaluate seed quality.

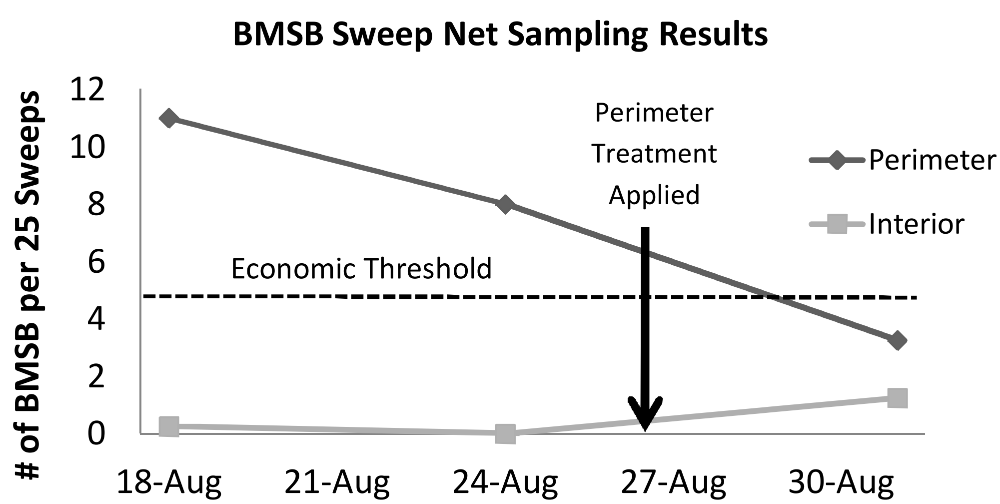
Results:

(1) Evaluation of Perimeter Treatments

(A) Survey Result for BMSB Distribution in Delaware Soybean Fields



(B) Grower 1: Survey Results for BMSB Distribution within Soybean Fields



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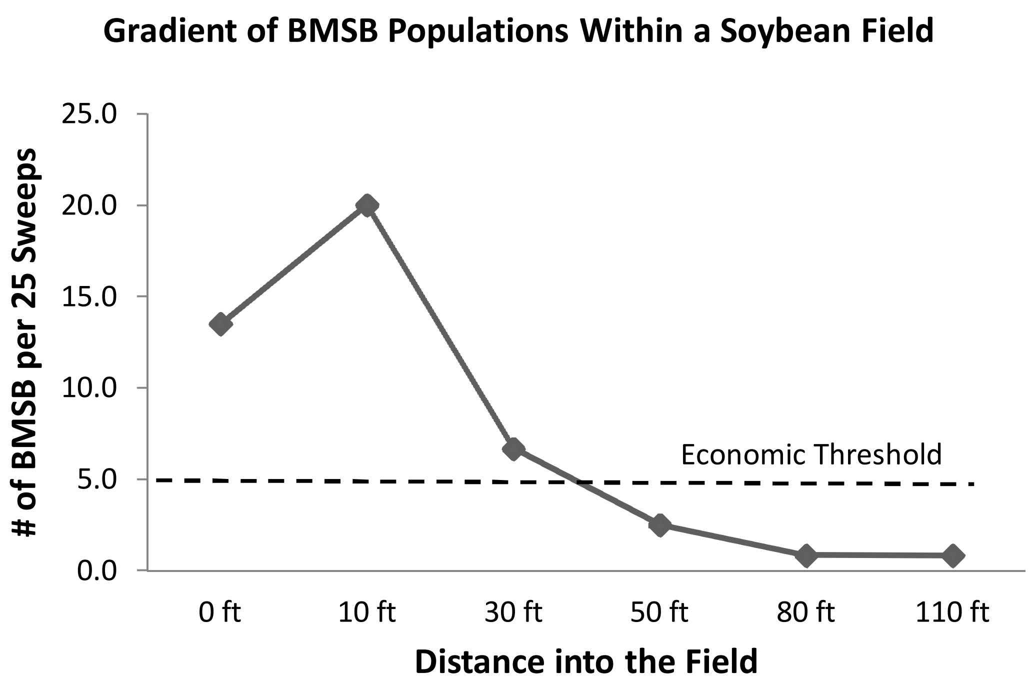
(C) Grower 2: Survey Results for BMSB Distribution within Soybean Fields



(D) Grower 1 & Grower 2: Pod Evaluation

Sampled 9/27	Perimeter (0-100 Ft)			Interiror (>100 Ft)		
	Avg # of Pods/Plant	% Flat Pods	% Pods with Aborted Seed	Avg # of Pods/Plant	% Flat Pods	% Pods with Aborted Seed
Grower 1	24	9.8	16.0	38.5	3.5	13.3
Grower 2	34	22.3	20.3	35.9	7.4	15.8

(E) Grower 1: Seed Quality Evaluation

Field Position	BMSB/25 sweeps 8/18	BMSB/25 Sweeps 8/24	Seed Quality Evaluation			
			% Clean	%Purple Stain	% Moldy	% Shriveled
Edge	15.5	26.5	2.02	0.00	92.22	5.76
Interior	2	6.5	98.48	0.23	1.23	0.06

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(F) Grower 2: Seed Quality Evaluation

Field Position	BMSB/25 sweeps 8/18	BMSB/25 Sweeps 8/24	Seed Quality Evaluation			
			% Clean	%Purple Stain	% Moldy	% Shriveled
Edge	20.75	13.3	8.95	0.28	89.63	1.14
Interior	0.25	0.83	97.41	1.17	1.17	0.26

(G) Grower 3: Pre-Treatment Sampling Results

Average # of Green and Brown Stink Bugs per 10 Sweeps						
Treatment	11-Aug		16-Aug		22-Aug	
	GSB	BSB	GSB	BSB	GSB	BSB
Treated Field Perimeter	0.25	0	0.75	0	2.25	0
Untreated Perimeter	0	0	1	0.5	1.5	0
Untreated Interior (>100 ft)	0	0	0	0	0	0

(H) Grower 3: Post-Treatment Sampling Results

Average # of GSB and BSB per 10 Sweeps												
Sample Date	Treatment	Distance From Field Edge										
		0 ft		20 ft		45 ft		90 ft		**Interior (>100 ft)**	
		GSB	BSB	GSB	BSB	GSB	BSB	GSB	BSB	GSB	BSB
1-Sep	Treated	0.13	0.13	0	0	0	0	0	0	0	0
	Untreated	0.25	0.38	0	0.13	0	0	0	0		
7-Sep	Treated	0	0.13	0	0	0.25	0	0.13	0	0.15	0.15
	Untreated	0.13	0.25	0.25	0	0.38	0	0.13	0.13		
27-Sep	Treated	0	0.13	--	--	0.75	0.13	--	--	1.4	0.6
	Untreated	0.38	0.13	--	--	0.88	0.63	--	--		
4-Oct	Treated	1.38	0	--	--	1.0	0	1.88	0	0.3	0.4
	Untreated	2	0.13	--	--	2.5	0.25	1.38	0.13		

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(I) Grower 3: Seed Quality Evaluation

Sample Location	Treatment	% Clean	% Purple Stain	% Moldly	% Shriveled
Field Edge (0 ft)	Treated	98.25	0.75	0	1
	Untreated	98.0	1.5	0	0.5
Field Edge (45 ft)	Treated	99.5	0	0	0.5
	Untreated	98.5	1.25	0	0.25
Field Interior (>100 ft)	Untreated	98.33	0.67	0	1

Determine yield loss, seed quality, and the possibility of delayed plant growth, "stay green effect", caused by stink bug feeding

(J) Pre-Harvest Stink Bug Sampling

Field ID #	Sample Date	Areas of Delayed Maturity						Senesced Areas		
		Field Perimeter (<100 ft)			Field Interior (>100 ft)			Field Interior (>100 ft)		
		GSB	BSB	BMSB	GSB	BSB	BMSB	GSB	BSB	BMSB
1	11-Oct	1	0	0				0	0	0
2	12-Oct	0	0	0	0	0	0	0	0	0
4	13-Oct	2	0	0				13	0	0
5	14-Oct	0	0	0	0	0	0	0	0	0
6	17-Oct	0	0	0				0	0	0
7	18-Oct	0	0	0				0	0	0
8	19-Oct	1	0	0				0	0	0
9	18-Oct	0	0	0	0	0	0	0	0	0
10	19-Oct	0	0	0	0	0	0	0	0	0
11	20-Oct	0	0	0				0	0	0
12	21-Oct	1	0	0	0	0	0	0	0	0
13	5-Oct	0	0	0	0	0	0	0	0	0
	11-Oct	0	0	0	0	0	0	2	0	0
	18-Oct	1	0	0	0	0	0	0	0	0
14	5-Oct	0	0	0	0	0	0	0	0	0
	11-Oct	0	0	0	0	0	0	0	0	0
	18-Oct	3	0	0	0	0	0	0	0	0
15	11-Oct	0	0	0	0	0	0	0	0	0
16	11-Oct	3	0	0	0	0	0	0	0	0
	20-Oct	47	0	0	0	0	0	0	0	0
17	11-Oct	0	0	0	0	0	0	0	0	0
	18-Oct	0	0	0	0	0	0	0	0	0
18	18-Oct	0	0	0	0	0	0	0	0	0
	11-Oct	0	0	0	0	0	0	0	0	0
19	20-Oct	0	0	0	0	0	0	0	0	0

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NOTE: The areas of delayed maturity that were sampled in (Table J) were not determined to have been a result of stink bug infestations.

(K) Pod Evaluation

Field ID #	Sample Location	total # pods/ 20 plants	% pods with aborted seed	% flat
1	Exterior	480	16.04	9.79
	Interior	769	13.26	3.51
2	Exterior	691	20.26	22.29
	Interior	717	15.76	7.39
6	Exterior	895	12.96	10.73
	Interior	733	10.64	3.27
11	Exterior	836	23.33	1.2
	Interior	853	15.83	13.6
20	Exterior	742	14.15	1.08
	Interior	675	10.07	1.63

(L) Seed Quality Evaluation

Field ID #	Location	% clean	% purple	% moldy	% shriveled
1	perimeter	8.95	0.28	89.63	1.14
	interior	97.41	1.17	1.17	0.26
2	perimeter	2.02	0.00	92.22	5.76
	interior	98.48	0.23	1.23	0.06
4	perimeter	99.58	0.42	0.00	0.00
	interior	99.12	0.38	0.25	0.25
5	perimeter	99.35	0.38	0.27	0.00
	interior	99.88	0.06	0.06	0.00
6	perimeter	99.83	0.00	0.00	0.17
	interior	99.69	0.21	0.00	0.10
7	perimeter	99.87	0.09	0.00	0.04
	interior	99.92	0.04	0.00	0.04
8	perimeter	99.95	0.00	0.00	0.05
	interior	99.85	0.05	0.00	0.10

The samples in Field ID 1 and Field ID 2 indicate a high percentage of moldy seed on the field perimeters. At the time of sampling, the seed from both of these fields were not fully mature on the field perimeters and a large percentage of the mold occurred after the samples were collected. Therefore, it cannot be determined if stink bug feeding is responsible for the high percentage of moldy seed.

Evaluate the effectiveness of insecticides to control the brown marmorated stink bug on soybeans

(M)Brown Marmorated Stink Bug Insecticide Trial Sample Results - Newark

Newark Insecticide Efficacy Trial												
Treatment	Average # of BMSB Adults and Nymphs per 10 Sweeps											
	7/5	7/11	7/20	7/25	8/4	8/11	8/19	8/31	9/8	9/16	9/21	9/30
Baythroid XL	0	0	0	0	0.25	0	0	0.25	0.50	1.0	0.75	0
Leverage 360	0	0	0	0	0.25	0.5	0.25	0.25	0	0	0	0
Lannate LV	0	0	0	0	0	0.25	0.25	1.25	0.25	0.25	1.0	0
Warrior II	0	0	0	0	0	0	0	1.0	0.25	0.25	0	0
Endigo ZC	0	0	0	0	0	0	0	0	0.75	0	0	0
Cobalt Advanced	0	0	0	0	0.25	0	0	0.25	0	0.50	0	0
Acephate 97 UP	0	0	0	0.25	0	0.25	0	0	0.75	0.50	0.25	0
Untreated	0	0	0	0	0	0	0	0.5	0	0	0	0

(N) Brown Marmorated Stink Bug Insecticide Trial Sampling Results - Middletown

Middletown Insecticide Efficacy Trial												
Treatment	Average # of BMSB Adults and Nymphs per 10 Sweeps											
	6/22	6/28	7/6	7/12	7/19	7/27	8/3	8/10	8/23	8/31	9/13	9/27
Baythroid XL	0	0	0	0	0.33	0	0.17	0	0.17	0.33	0.33	0.17
Leverage 360	0	0	0.33	0.17	0.83	0.17	0.17	0.17	0.50	0.17	0.00	0
Lannate LV	0	0	0	0	0.33	0	0.17	0.33	0.17	0.17	1.17	0
Warrior II	0	0	0	0	0.50	0.17	0	0.33	0	0	0.33	0
Endigo ZC	0	0	0	0	0	0	0	0	0	0	0.33	0
Cobalt Advanced	0	0	0	0	0.33	0	0.33	0	0.50	0.67	0.17	0
Acephate 97 UP	0	0	0	0	0.67	0.17	0	0	0	0	0.17	0
Untreated	0	0	0	0.33	0.33	0.17	0	0	0	0.17	0.17	0.17

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(O) Brown Marmorated Stink Bug Insecticide Trial Yield and Seed Evaluation-Middletown

Middletown Insecticide Efficacy Trial					
Treatment	Rate/Acre	Yield Bushels per Acre	Seed Quality Evaluation		
			% Purple Stain	% Moldy	% Shriveled
Baythroid XL	2.8 oz	68.7a	1.83a	1.0a	1.0a
Leverage 360	2.8 oz	65.3a	2.33a	0.33a	0.5a
Lannate LV	1.5 pt	68.4a	1.33a	1.16a	2.0a
Warrior II	1.92 oz	68.1a	0.83a	0.83a	1.0a
Endigo ZC	4.0 oz	71.3a	2.33a	0.83a	1.17a
Cobalt Advanced	22 oz	69.4a	0.58a	1.54a	1.89a
Acephate 97 UP	1 lb	69.4a	1.98a	1.13a	1.49a
Untreated	--	66.3a	1.83a	0.67a	0.67a

Means within a column followed by the same letter are not significantly different (Tukey's mean separation test; P=0.05)

Discussion

Evaluate the effectiveness of perimeter treatments to control stink bugs in soybeans

Based on the 2011 survey results, soybean fields in New Castle County and western Kent County were at greatest risk for BMSB infestations. In New Castle County, BMSBs were found in eighty percent of the fields surveyed and ten percent of the fields were at or above a threshold of five stink bugs per twenty-five sweeps. In Kent County, BMSBs were found in thirty-three percent of the fields surveyed and none of the fields reached or exceeded the threshold. When factoring in the complex of stink bug species within a field including GSB, BSB, and BMSB, twenty percent of the New Castle County fields and nineteen percent of the Kent County fields were at threshold. In Sussex County, BMSBs were not found in any of the soybean fields included in the survey and none of the fields reached threshold for GSB or BSB.

The survey results also suggest that stink bugs are not evenly distributed throughout a soybean field and that stink bugs, especially the BMSB, tend to be concentrated on field perimeters. This finding agrees with prior research and suggests that perimeter treatments may be an effective control strategy to manage stink bugs in soybeans. The two fields in New Castle County that were selected for perimeter treatments provide a good example of the concentration of BMSB on the field perimeters compared to the interior of the field. On Aug 26, a perimeter treatment was applied on Grower Field 1 and was successful in reducing BMSB populations below the economic threshold. The perimeter treatment applied on Grower Field 2 was not successful in significantly reducing stink bug populations because a heavy rain event occurred immediately following the application. Once it was determined that the application was not successful, a second application was not warranted because the soybeans had progressed in their lifecycle and reached a point in which the stink bug infestations no longer posed a serious threat. The seed quality results indicate that there was an increase in the percentage of moldy seeds in the field perimeters compared to the subsamples collected from the interior of field in both Grower field 1 and Grower field 2. However, when the subsamples were collected, the soybean plants on the field perimeters were slightly delayed in maturity compared to the rest of the field and the seed was not physiologically mature. As a result, mold quickly developed on the seed in storage. At this point, although it appears that stink bug infestations may have contributed to the slight delay in maturity, more data is needed to draw a definite conclusion. Researchers in Virginia and Maryland also evaluated perimeter treatments for managing stink bugs and initial findings suggest that this may be an effective control strategy. However, additional research is needed to further evaluate the use of perimeter treatments to manage stink bugs in soybeans.

Determine yield loss, seed quality, and the possibility of delayed plant growth, "stay green effect", caused by stink bug feeding

Stink bug populations were greatest on the field perimeters in all of the fields surveyed. Typically, field edges also have the most variability in plant health and yield. This created a challenge in determining the effects of stink bug feeding injury from the normal variability found on field edges. None of the fields surveyed exhibited any symptoms of delayed plant growth compared to what would be expected under typical growing conditions. There also was not a significant difference in purple stain, shriveled seed or moldy seed when comparing the sample results in the field perimeters to the field interiors except for what was discussed in Field ID # 1 and Field ID # 2. There was an increase in flat pods and pods with aborted seed in the field perimeters compared to the interior portions of the field. Although flat pods and pods with aborted seeds can result from stink bug feeding, it can also occur when plants are stressed. Prior research conducted in Virginia and Maryland suggests that the most damage from stink bug feeding occurs during the R4 (full pod) growth stage and that infestations are of greatest concern from R3 (flowering) to R6 (full bean). Additional research is needed to fully understand the impacts stink bug infestation have on soybeans.

Brown Marmorated Stink Bug Insecticide Efficacy Trial

Overall, BMSB populations were low in the Newark and Middletown plots. In Newark, populations never reached levels high enough to evaluate. In Middletown, treatments were applied on August 16, as soon as BMSB started to move into the plots. However, populations never increased to levels high enough to evaluate efficacy and there were no significant difference in BMSB populations on any of the post application sampling dates. There were also no significant differences between yield or seed quality between each of the treatments. Research conducted in Virginia, indicates that initial control of BMSB in soybeans can be achieved with labeled products but additional research needs to be conducted to determine residual activity.

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