Insect Management Reports

2013 Season

University of Delaware
Cooperative Extension -- IPM Program

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***Brown Marmorated Stink Bug Management in Bell Peppers, 2013*:** ‘Paladin” bell peppers were transplanted on May 23 at the University of Delaware’s Research farm located in Newark, DE. One row plots, 20 ft long on 6 foot center were replicated 4 times in a RCB design. All foliar treatments were applied with a CO_2 pressurized backpack sprayer with a single-row boom, equipped with 3 hollow cone nozzles per row (one over the top and one drop nozzle on each side) delivering 55 gpa at 40psi on July 8, 15, 29 and Aug 5. Plots were sampled twice a week from May 29 through Aug 1 by counting the number of adults and nymphs on10 plants per plot. All commercial size peppers were harvested on July 22 and Aug 13 and evaluated for the percent damage fruit. Data were analyzed using Proc GLM for the BMSB counts and the first harvest date (July 22). Means were separated by Tukey’s mean separation test (P=0.05). Data from the second harvest was extremely variable due to severe flooding in the plot resulting in the inability to use the data.

BMSB pressure was low throughout the season. No phytotoxicity was observed.

Treatment	Rate/Acre	Number BMSB /10 plants		
		3 DAT #1 July 11	4 DAT # 2 July 19	3 DAT # 3 Aug 1
Sniper 2 EC	6.4 oz	0.25a	0.00a	0.00a
Warrior II	1.92 oz	0.00a	0.00a	0.00a
Lannate LV	1.5 pt	0.00a	0.00a	0.00a
Lannate LV	2.25 pt	0.00a	0.00a	0.00a
Belay 2.13SC + NIS	4 oz + 0.25% V/V	0.00a	0.00a	0.50a
Belay 2.13SC + NIS	6 oz + 0.25% V/V	0.25a	0.00a	0.00a
Belay 2.13SC + Sniper 2 EC + NIS	4 oz + 4.3 oz + 0.25% V/V	0.00a	0.00a	0.00a
Danitol 2.4 EC + NIS	21 oz + 0.25% V/V	0.00a	0.00a	0.00a
Endigo ZC	4.5 oz	3.50a	0.00a	0.00a
Actara 25WDG	5.5 oz	0.00a	0.00a	0.00a
Acephate 97	1 lb	0.00a	0.00a	0.00a
Untreated	---	0.00a	0.00a	0.00a

[1] Means within a column followed by the same letter are not significantly different (Tukey’s, P=0.05).

Treatment	Rate/Acre	Percent Damaged Fruit July 22	Number Puncture Wounds per Fruit July 22
Sniper 2 EC	6.4 oz	2.51a	0.25a
Warrior II	1.92 oz	3.30a	0.17a
Lannate LV	1.5 pt	1.24a	0.02a
Lannate LV	2.25 pt	0.63a	0.01a
Belay 2.13SC + NIS	4 oz + 0.25% V/V	0.40a	0.01a
Belay 2.13SC + NIS	6 oz + 0.25% V/V	0.00a	0.00a
Belay 2.13SC + Sniper 2 EC + NIS	4 oz + 4.3 oz + 0.25% V/V	0.48a	0.03a
Danitol 2.4 EC + NIS	21 oz + 0.25% V/V	0.00a	0.00a
Endigo ZC	4.5 oz	1.18a	0.04a
Actara 25WDG	5.5 oz	0.00a	0.00a
Acephate 97	1 lb	0.76a	0.03a
Untreated	---	2.98a	0.11a

[1] Means within a column followed by the same letter are not significantly different (Tukey's, P=0.05).

***Brown Marmorated Stink Bug (BMSB) Management in Sweet Corn, 2013*:** Two plots of "Obsession II " Bt sweet corn were planted on May 30 and June 27 at the University of Delaware's Research farm located in Newark, DE. For the first planting, two row plots 25 foot long planted on 5 foot centers were replicated four times in a RCB design. For the second planting, two row plots 20 foot long planted on 5 foot centers were replicated three times in a RCB design. All materials were applied with a CO_2 pressurized back pack sprayer using a two nozzle boom equipped with D2 hollow cone nozzles delivering 17.9 gpa at 40 psi. BMSB population levels were evaluated by counting the number of adults and nymphs in a 3 minute visual inspections of all plants in the plot. At harvest for both plantings, all the primary ears (top ear) from each plot were husked and evaluated for damage from BMSB (blemished kernels). Data were analyzed using Proc GLM and means were separated by Tukey's mean separation test (P=0.05).

Table 1 . BMSB and Sap Beetle data – First Planting (May 30)

Treatment	Rate/Acre	Timing	Application Dates	No. BMSB Adults & Nymphs per 3 minute count[1] July 24	% Sap Beetle Damaged Ears Aug 7[1]	% BMSB Damaged Ears Aug 7 [1]
Warrior II	1.92 oz	Start at ear shank, 3-4 day schedule	7/19,7/22,7/25,7/29, 8/2 and 8/5	0.00a	0.00b	0.00b
Warrior II	1.92 oz	Silk, blister and milk	7/22,7/29, 8/5	0.00a	0.00b	0.00b
Warrior II	1.92 oz	Blister and Milk	7/29 and 8/5	0.75a	4.50ab	0.50b
Warrior II	1.92 oz	Milk	8/5	0.75a	6.50ab	0.00b
Hero EC	4.5 fl oz	Start at ear shank, 3-4 day schedule	7/19,7/22,7/25,7/29, 8/2 and 8/5	0.00a	0.50ab	0.00b
Hero EC	7 oz	Silk, blister and milk	7/22,7/29, 8/5	0.00a	1.50ab	0.50b
Hero EC	7 oz	Blister and Milk	7/29 and 8/5	1.75a	2.00ab	0.00b
Hero EC	7 oz	Milk	8/5	0.25a	10.00ab	4.50a
Untreated	--	--	--	1.25a	10.50a	1.00b

[1] Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Table 2 .BMSB Population and Damage Data – Second Planting (June 27)

Treatment	Rate/Acre	Timing	Application Dates	No. BMSB Adults & Nymphs per 3 minute count[1]		Mean % BMSB Damaged Ears
				Aug 15	Aug 23	Aug 29 [1]
Warrior II	1.92 oz	Start at ear shank, 3-4 day schedule	8/8,8/13,8/16,8/20, 8/23 and 8/26	0.00a	0.00a	0.00b
Warrior II	1.92 oz	Silk, blister and milk	8/13, 8/20 and 8/26	0.33a	0.00a	0.00b
Warrior II	1.92 oz	Blister and Milk	8/20 and 8/27	1.00a	0.67a	0.00b
Warrior II	1.92 oz	Milk	8/27	0.00a	1.00a	2.28ab
Hero EC	4.5 fl oz	Start at ear shank, 3-4 day schedule	8/8,8/13,8/16,8/20, 8/23 and 8/27	0.00a	0.00a	0.00b
Hero EC	7 oz	Silk, blister and milk	8/13, 8/20 and 8/27	1.33a	0.00a	0.00b
Hero EC	7 oz	Blister and Milk	8/20 and 8/27	0.00a	0.00a	0.00b
Hero EC	7 oz	Milk	8/27	0.00a	0.00a	1.33ab
Untreated	--	--	--	0.00a	0.33a	4.17a

[1] Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Chemical Management of Slugs in No-till Corn and Soybean Systems

Joanne Whalen, Bill Cissel and Phillip Sylvester – University of Delaware

Introduction: Slugs continue to be a major pest of concern in no-till corn and soybean production systems. An integrated approach to slug management is being investigated by the Mid-Atlantic Working Group including the evaluation of current and new slug management options. The following report is a summary of chemical management studies in Delaware from 2010 through 2013.

Evaluation of Lannate LV to Control Slugs on Corn, 2010

In 2010, interest was expressed in evaluating the efficacy of Lannate (methomyl) LV for slug management in no-till corn systems. Although data from Europe indicated that Lannate LV may provide some level of slug control, no information was currently available in the United States regarding efficacy, length of control and the best timing for an application. A trial was conducted in a commercial no-till corn field with a history of slug problems. This trial was a cooperative effort between Don Ganske, DuPont Development Representative and Joanne Whalen and Bill Cissel, University of Delaware. The objective of this trial was to evaluate the efficacy of Lannate LV (methomyl) to control slugs at three different application timings: 1) late evening, 2) after dark and 3) early morning. Plots 20 ft long by 9 ft wide were replicated four times and arranged in a randomized complete block design. The trial was conducted in a commercial no-tillage corn field located near Middletown, DE. Corn was planted into heavy wheat-soybean stubble and slug pressure was rated as moderate to severe. Treatments were applied on 3-leaf stage corn using a CO_2 pressurized backpack sprayer equipped with a 6 nozzle boom on 18 inch spacing delivering 20 gpa at 35 psi. A one ft. x one ft. shingle trap was placed in the center of each of the plots in an attempt to estimate the slug population for each plot following the application of treatments. Visual slug counts were taken at night, 2 days after application by recording the total number of slugs found on 10 consecutive plants from each plot. Five days after treatment, 10 plants from each plot were examined for slug feeding injury on the newest emerged whorl leaves and the total numbers of slugs found under the shingle traps were recorded. Data were analyzed using Proc GLM and means were separated by Tukey's mean separation test (P=0.05)

Table 1. Slug Management with Lannate LV in No-Till Corn, 2010

Treatment Timing	Treatment	Rate/ Acre	Number Slugs per 10 Plants May 21 (2 DAT)		May 25 (5 DAT)		
					% Damaged Plant	Number Slugs per Shingle Trap	
			Grey Garden	Marsh		Grey Garden	Marsh
Early Evening (6:55 PM)	Lannate LV (2.4 SL)	1.5 pt	2.25b	0.00a	87.5a	1.25a	1.00a
Late Evening – (9:40 PM)	Lannate LV (2.4 SL)	1.5 pt	3.75b	0.25a	80.0a	0.25a	0.25a
Early Morning (5:15 AM)	Lannate LV (2.4 SL)	1.5 pt	2.75b	0.25a	100.0a	0.25a	1.25a
Untreated Check	--	--	24.5a	0.75a	92.5a	0.25a	0.75a

Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05)

Conclusions: At two days after treatment, there were significantly fewer grey garden slugs in each of the treatments compared to the untreated check (Table 1). At five days after treatment, there were no significant differences between the treatments and untreated check for the percentage of plants with slug feeding injury and slug counts under the shingle traps. Overall, grey garden slugs were the prominent species causing damage to the corn plants. Although some level of control was observed, this study indicated that additional information is still needed to determine timing and length of control. At all three application timings, weather conditions were favorable for slug activity on the plants. For the evening applications, slugs were present at both application timings because it was extremely still and there was free moisture on the leaves. We have observed that slugs are not out on plants at night even under slightly breezy conditions. For the morning application, weather conditions were foggy /dewy resulting in early morning slug presence on plants. This year's results lend support to the conclusion that Lannate LV acts as a contact material only and residual control is limited. It appears that slugs need to be present on the plants at the time of application to provide any level of suppression. However, more data was still needed to determine the best way to use Lannate LV as a slug management tool.

Evaluation of Lannate LV to Control Slugs in Corn: 2012 - Joanne Whalen and Bill Cissel University of Delaware

(I) Replicated Study: The unusually warm winter and spring conditions in 2012 were extremely conducive to slug problems. Since limited information was available on the proper application timing of Lannate LV as well as length of control for slug management in no-tillage corn systems, a second study was conducted in 2012. Plots were established in a field located near Wyoming, DE with heavy wheat-soybean stubble and history of severe slug problems. The field was treated with Deadline M-Ps on April 28 by the cooperating grower. . An untreated strip was left in the most severely damaged section of the field and plots were placed in this strip. Plots 10ft wide (4 rows) by 17.5ft long were arranged in a randomized complete block design with four replications. Treatments were applied on 2-3 leaf stage corn with a CO_2 pressurized backpack sprayer equipped with a 6 nozzle boom delivering 16.9 gpa at 40 psi. Treatments consisted of (1) Lannate LV at 1.5 pt/acre applied at dusk (7:40 PM) on May 3, (2) Lannate LV at 1.5pt/acre applied at dawn (5:40 AM) on May 4 and (3) an untreated check. Slug populations were monitored at night by visually inspecting all the plants in the center two rows of each plot and recording the number of slugs. The predominant species was the grey garden slug. Pre-treatment damage assessments were done by looking at the damage on the entire plant.. Post treatment damage assessments were performed by counting the number of plants with newly damaged whorl leaves in the center two rows of each plot. A plant was rated as damaged only if the newest emerged leaves had active slug feeding damage. Data were analyzed using Proc GLM and means were separated by Tukey's mean separation test (P=0.05).

Table 2. Slug Management with Lannate LV and Deadline MPs in No-till Corn,2012

			Percent Damaged Plants			Mean Number Slugs/35 ft. of row	
Treatment	Rate/A	Application Timing	May 2 Pre-trt	May 7 4 DAT	May 10 7 DAT	May 2 Pre-trt	May 6 3 DAT
Lannate LV (2.4SL)	1.5 pt	Dusk (7:40 PM)	79.33a	49.27ab	40.19a	5.25a	11.5a
Lannate LV (2.4SL)	1.5 pt	Dawn (5:40 AM)	87.82a	42.8b	45.94a	4.0a	9.75a
Untreated Check	---	---	87.77a	65.8a	53.92a	7.5a	15.0a
Deadline M-Ps	10 lbs (Apr.28)	Main Field by Grower	50.0 (April 27)	9.2 (May 3)	9.0 (May 17)	---	1/ 50 plantsl(May 6)

Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Conclusions: At four days after treatment, the percent damaged plants were significantly greater in the untreated check compared to the Lannate LV application applied at dawn (Table 2). Weather conditions were extremely foggy and dewy when the application was made at dawn and slugs were active on the plants. It was slightly breezy at the time of the dusk treatment and slugs were not active on the plants. The Lannate LV treatment applied at dusk was not significantly different from the untreated check for percent damaged plants. There were no significant differences between either treatment timing at seven days after treatment for the percent damaged plants and at three days after treatment for the number of slugs per 35ft row (Table 2). Lannate LV appears to have provided some level of control when applied at dawn but not at dusk. This is due to the fact that slugs were active on the plants at dawn but not at dusk lending support to the fact that Lannate is providing contact control. It did not provide extended control as evidenced by the lack of difference in plant damage at seven days after treatment. Overall, slug pressure remained moderate to high regardless of the treatment timing and the percent damaged plants and severity of damage remained at levels that were capable of causing economic losses. As indicated in Table 2, the Deadline M-Ps applied by the producer to the main part of the field provided very good control as evidenced by the reduction in the number of plants damaged at 19 days after treatment and the low number of slugs present on 50 plants at 8 DAT.

(2) 2012 Lannate Grower Demonstration – Commercial Field

We also evaluated the effectiveness of a Lannate LV application in a second commercial field with heavy wheat-soybean stubble and history of severe slug problems near Dover, DE. In this field Lannate LV and Deadline M-Ps were compared. Pre-treatment damage assessments were done by looking at the damage on the entire plant. . Post treatment damage assessments were performed by counting the number of plants with newly damaged leaves. Two hundred plants were sampled for plant damage in each treatment area (10 consecutive plants in 20 locations). Treatments were applied on May 5 with the Lannate LV treatment being applied at 5 AM when slugs were active and the Deadline M-Ps were applied mid-day. Corn was in the one-leaf stage. The grower did not feel that the Lannate LV was providing control so decided to treat the Lannate LV demonstration area with Deadline M-Ps as well.

Table 3. Comparison of Lannate LV and Deadline MP-s in a Commercial Demonstration, 2012

Treatment	Rate/A	Timing	Percent Damaged Plants	
			Pretreatment – May 4	Post Treatment – May 7
Lannate LV	1.5 pt	5 AM – May 5	71.3	82.0
Deadline M-Ps	10 lbs	Middle of the Day - May 5	67.0	20.0

Comments*:* Although replicated plots indicate that Lannate LV provides some level of control, Lannate LV applications in this commercial field in Delaware as well as commercial fields in Maryland and Virginia in 2012 resulted in poor control. In many cases, fields were re-treated with Deadline M-Ps with good results.

Overall Summary from 2010 and 2012 results: As a general summary, information from replicated trials and grower experiences indicate that:

(a) Lannate LV may provide 2-4 days control maximum which can vary with weather conditions at the time of application.
(b) At 5-7 days after treatment in our two research trials, the percent damaged plants in the Lannate LV treated plots was not significantly different from the untreated plots. This would indicate that Lannate LV provides short residual control.
(c) Based on our results, Lannate is providing contact control only and therefore, slugs must be present at the time of application.
(c) Additional information is needed on proper timing of Lannate applications related to weather conditions and slug activity.
(d) Based on observations in commercial situations, the Deadline M-Ps provided the most consistent control and provided longer residual control in both years. Lannate LV is providing some level of control, better than liquid nitrogen applied at night; however, more research is needed.

Chemical Control of Slugs in Corn and Soybeans - 2013 Season
Joanne Whalen. Bill Cissel and Phillip Sylvester – University of Delaware

In addition to metaldehyde, there are now a number of iron based products with federal labels for slug management including Sluggo, Ferroxx and IronFist. Sluggo and IronFist have federal and state labels and have recently been marketed in our area. In 2013, Ferroxx had a federal label but did not have a state label. Limited local replicated data is available for the use of these products in corn and soybeans. Therefore, trials were established in corn and soybean systems to compare these products to both metaldehyde (Deadline M-Ps) and Lannate LV. The soybean trials were supported by the Delaware Soybean Board.

(I) Chemical Control to Manage Slugs in Field Corn

Replicated research plots were established on a commercial no-tillage corn field with a history of slug problems located near Middletown, DE. Plots were 20 ft long by 15 ft wide, arranged in a randomized complete block design with four replications. Treatments consisted of (1) Lannate LV at 1.5 pt/A, (2) Sluggo at 20 lb/A, (3) Iron Fist at 20 lb/A, (4) Ferroxx at 20 lb/A, (5) Deadline M-Ps at 10 lb/A, and (6) an untreated check. Treatments were applied on May 9 to spike stage corn with severe slug feeding damage. The Lannate LV treatment was applied at dusk (8:45 pm) using a CO_2 pressurized backpack sprayer equipped with a six nozzle boom on 18 inch spacing delivering 16.9 gpa at 40 psi. There was no measurable wind speed with high relative humidity, making the weather conditions favorable for slug activity at the time the

Lannate LV application was made. The dry formulations were broadcast using a hand seeder calibrated for each product. The percent damaged plants was determined by examining every plant in the center three rows of each plot and noting feeding injury on the newest emerged whorl leaves. At 25 days after treatement (DAT), plant vigor was evaluated by measuring the height of five consecutive plants in each of the center three rows of each plot. Yield was determined by hand-harvesting the ears from the center two rows of each plot on September 9. The ears were shelled and kernel weight was adjusted for moisture using a Dickey John moisture tester.

Table 4. Chemical Control to Manage Slugs in Field Corn, 2013: Percent Damaged Plants

Treatment	Rate/A	Percent Damaged Plants				
		May 8 Pre-Treatment	May 13 4 DAT	May 16 7 DAT	May 21 12 DAT	June 3 25 DAT
Lannate LV	1.5 pt	91a	77a	88a	100a	65a
Sluggo	20 lb	79a	49ab	64ab	90a	48ab
Iron Fist	20 lb	87a	42b	40bc	89a	26ab
Ferroxx	20 lb	91a	56ab	54abc	87a	36ab
Deadline M-Ps	10 lb	74a	34b	13c	31b	10ab
Untreated Check	--	74a	76a	91a	100a	40b

Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Conclusions: At 4 and 7 days after treatment, the percent damaged plants were significantly greater in the untreated check compared to the Deadline M-Ps and Iron Fist treatments (Table 4). At 12 days after treatment, only the Deadline M-Ps treatment had significantly fewer damaged plants compared to the untreated check. There were no significant differences between the average plant height and yield when comparing all treatments to the untreated check.

(2) Chemical Control to Manage Slugs in Soybeans (*funded by the Delaware Soybean Board)*

Slug management in no-tillage soybeans can be a challenge because slugs often feed below ground, severing the hypocotyl and killing the plant before it has a chance to emerge. Usually, the problem is not identified until the soybeans have failed to emerge, at which point the field has likely experienced a significant stand reduction. Rescue treatments to prevent additional stand losses and damage to emerged plants has traditionally included a broadcast application of a metaldehyde bait (e.g.Deadline M-Ps). There are additional available slug management products in the marketplace but there is limited local data evaluating efficacy of these products in soybeans. As a result, two replicated research trials were established to evaluate efficacy of the available slug control products to manage slugs in soybeans. The first trial was established on a commercial soybean field located near Middletown, DE with severe above and below ground slug feeding. The objective of this trial was to evaluate each of the products ability to control slugs as a rescue treatment. The second trial was established in a soybean field located at the Delaware State University's Smyrna Outreach and Research Center with a history of slug problems. The objective of this trial was to evaluate the efficacy of each of the products applied preventatively when conditions are favorable for slug activity and the likelihood of having a problem is high.

(A) Soybean Trial 1: Rescue Treatment

Replicated research plots were established in a commercial no-tillage soybean field with severe slug pressure. At the time of treatment, there was both below ground and above ground slug feeding on the soybean plants. Plots were 15 ft wide x 20 ft long arranged in a randomized complete block design with four replications. Treatments included (1) Lannate LV at 1.5 pt/A, (2) Sluggo at 20 lb/A, (3) Iron Fist at 20 lb/A, (4) Ferroxx at 20 lb/A, (5) Deadline M-Ps at 10 lb/A, and (6) an untreated check. The Lannate LV treatment was applied on June 4 at 5:15 pm using a CO_2 pressurized backpack sprayer equipped with a 6 nozzle boom delivering 16.9 gpa at 40 psi. It was hot and sunny with an average wind speed of 4.7 mph, making the conditions unfavorable for slug activity at the time the Lannate LV application was made. The dry formulations were made using a hand seeder calibrated for each of the products. Pre-treatment and post-treatment evaluations included stand counts and percent damaged plants. Stand counts were determined by counting the total number of plants in the center two rows of each plot and reported as plants per acre. The percent damaged plants was determined by examining the number of plants within the center two rows with slug feeding damage on the newest growth. Yield was calculated by harvesting the center two rows from each plot and reported as grams per plot.

Table 5. Soybean Trial 1 (Rescue Treatment), 2013: Stand Counts

		Stand Count (plants per Acre)				
Treatment	Rate/A	June 4 Pre-Trt	June 10 6 DAT	June 13 9 DAT	June 18 14 DAT	June 26 22 DAT
Lannate LV	1.5 pt	83,823a	68,389a	80,150a	79,715a	68,389a
Sluggo	20 lb	69,117a	77,972a	90,605a	87,991a	90,605a
Iron Fist	20 lb	73,529a	63,162a	59,242a	79,715a	72,745a
Ferroxx	20 lb	67,647a	84,942a	90,605a	90,605a	95,832a
Deadline M-Ps	10 lb	67,647a	75,975a	87,991a	90,605a	95,832a
Check	--	80,882a	56,193a	59,242a	60,984a	61,855a

Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Table 6. Soybean Trial 1 (Rescue Treatment), 2013: Percent Slug Damaged Plants

Treatment	Rate/A	% Slug Damaged Plants				
		June 4 Pre-Trt	June 10 6 DAT	June 13 9 DAT	June 18 14 DAT	June 26 22 DAT
Lannate LV	1.5 pt	71.2a	83.4a	46.3a	42.0ab	34.2a
Sluggo	20 lb	92.6a	64.1a	20.5c	36.1b	21.8ab
Iron Fist	20 lb	79.9a	50.4a	22.1bc	35.0b	18.6ab
Ferroxx	20 lb	92.9a	58.4a	20.1c	30.8bc	21.3ab
Deadline M-Ps	10 lb	65.6a	55.0a	17.7c	15.2c	9.6b
Check	--	74.6a	88.1a	44.8ab	56.6a	28.8a

Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Conclusions: There were no significant differences between treatments for stand count at any of the sampling dates (Table 5). In addition, no significant differences in yield were found between the treatments and the untreated control. At 9 days after treatment, the Sluggo, Ferroxx, and Deadline M-Ps treatments had significantly fewer plants with slug feeding damage compared to the untreated check (Table 6). At 14 days after treatment, the percentage of plants with new feeding damage was significantly less for all the treatments compared to the untreated check except the Lannate LV treatment. The Deadline M-Ps treatment provided the greatest length of control being the only treatment that was significantly different compared to the untreated check for the percentage of damaged plants at 22 days after treatment.

(b) Soybean Trial 2: Preventative Treatment

This trial was conducted to determine if a preventative treatment can be applied prior to plant emergence to reduce losses from slugs. This trial was established in a soybean field located at the Delaware State University's Smyrna Outreach and Research Center with a history of slug problems. The field was determined to be at risk for slug problems based on field history, pre-plant slug sampling results, and favorable weather conditions for slug activity at the time of planting. Plots were 15 ft wide x 20 ft long arranged in a randomized complete block design with four replications. The treatments included (1) Sluggo, (2) Iron Fist, (3) Ferroxx, (4) Deadline M-Ps, and (5) an untreated check. Treatments were applied on June 25 prior to plant emergence using a hand seeder calibrated for each product. The percent damaged plants was determined by counting the total number of plants and the number of plants with new slug feeding damage in two random, three foot sections per plot. Slug pressure was low to moderate and shortly after plant emergence, the weather conditions quickly became less favorable for slug activity.

Table 7. Soybean Trial 2 (Preventative Treatment), 2013: Percent Damaged Plants

Treatment	Rate/Acre	Percent Damaged Plants		
		July 3 8 DAT	July 11 16 DAT	July 17 22 DAT
Sluggo	20 lb	6.8a	0a	0a
Iron Fist	20 lb	9.1a	0a	0a
Ferroxx	20 lb	3.7a	0a	0a

Deadline M-Ps	10 lb	3.2a	0a	0a
Check	--	35.8b	0a	0a

At 8 days after treatment, all of the treatments had significantly fewer damaged plants compared to the untreated check (Table 7). However, at 16 and 22 days after treatment, there was no new slug feeding damage on any of the plants, regardless of the treatment. The drastic reduction in slug activity is likely a result of the hot weather conditions that may have caused slugs to move deeper in the soil profile and caused the plants to grow rapidly. Additional data needs to be collected to determine if this is a suitable management strategy when weather conditions are favorable for slug activity over prolonged periods of time and under heavy slug pressure.

Early Season Management of Melon Aphids in Watermelons with Foliar Insecticides, 2013- 'Sugar Red ' seedless watermelons and the pollinizer variety 'Accomplice' were planted on May 17 at the University of Delaware's Research and Education Center located near Georgetown, DE. Single row plots, 20 ft long were established on 7 ft centers arranged in a RCB design with four replications. Foliar treatments were applied on June 19 with a CO_2 pressurized backpack sprayer delivering 24.5 gpa @ 40 psi. Aphid populations were evaluated by collecting 20 leaves per plot and counting the total number of aphids on 20 leaves on all evaluation dates (June 17 and 24; July 8).
Data were analyzed using Proc GLM and means were separated by Tukey's means separation test (P=0.05).

Melon aphid populations were moderate. No phytotoxicity was observed.

Treatment	Rate/Acre	Number of Melon Aphids per 25 leaves [1]		
		June 17 Pre-treatment	June 24 5 DAT	July 8 19 DAT
Assail 30 SG	4 oz	12.75a	0.25a	0.00a
Belay 2.13 SC	4oz	2.25a	6.75a	2.75a
Movento 240 SC + NIS	4 oz + 0.25% NIS V/V	53.50a	0.50a	3.75a
Movento 240 SC + NIS	5 oz + 0.25% NIS V/V	0.25a	5.25a	0.00a
Beleaf 50 SG	2.8 oz	29.25a	0.00a	0.75a
Lannate LV	2 pt	41.50a	4.25a	0.00a
Actara 25 WDG	3 oz	0.00a	0.00a	0.25a
Vydate L	2 pt	14.00a	0.00a	0.00a
Endigo ZC	4.5 oz	11.00a	0.25a	0.00a
Untreated	---	10.50a	0.25a	2.00a

[1]Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Early Season Evaluation of Foliar Insecticides for Control of Lepidopterans on Sweet Corn, 2013**:** 'Xtra Tender 270 A' sweet corn was planted on April 17 at the University of Delaware Research and Education Center located near Georgetown, Delaware. Plots were 25 ft long and two rows wide, planted on 30 inch centers. Each treatment was replicated 4 times and arranged in a RCB design. Silk sprays began at ear shank emergence. All applications were made using a CO_2 pressurized back pack sprayer delivering 17.9 gpa @ 40 psi. At harvest (July 3), all the ears from each plot were husked and evaluated for damage as percent clean ears (fresh market) and percent clean plus tip damaged ears (less than 1.0 inches from the tip- processing ears). The total number of live larvae of each species were identified and counted. Data were analyzed using Proc GLM and means were separated by Tukey's mean separation test (P=0.05). Corn earworm pressure was low and sap beetle pressure was moderate.

Trt #	Treatment	Application Date	Rate/A
1	Besiege Warrior II	A - 6/17, B- 6/20 C– 6/24, D—6/27 E – Jul 1	Besiege – 7.5 fl oz Warrior II - 1.92 fl oz
2	A,B,C - Besiege D, E - Warrior II	A - 6/17, B – 6/20, C– 6/24 D – 6/27, E- 7/1	Besiege - 9 fl oz Warrior II - 1.92 fl oz
3	A, B – Blackhawk 36WG C,D,E – Warrior II	A – 6/17, B – 6/20 C – 6/24, D - 6/27, E- Jul 1	Blackhawk – 3.3 oz Warrior II – 1.92 fl oz
4	A, B – Radiant SC C,D,E – Warrior II	A – 6/17, B – 6/20 C – 6/24, D - 6/27, E- Jul 1	Radiant SC – 6 fl oz Warrior – 1.92 fl oz
5	A,B,C,D,E – Hero EC	A - 6/17, B- 6/20 C– 6/24, D—6/27, E – Jul 1	Hero EC – 4 oz
6	A,B,C,D,E – Sniper 2EC	A - 6/17, B- 6/20 C– 6/24, D—6/27, E – Jul 1	Sniper 2 EC – 2.1 fl oz
7	Warrior II	A - 6/17, B- 6/20 C– 6/24, D—6/27, E – Jul 1	1.92 oz/A
8	Untreated	-------	-------

Trt #	% Clean Ears (Fresh Market)[1]	% Clean + Tip Damaged Ears (Processing)[1]	Percent Damaged Ears[1]	
			CEW	Sap Beetles
1	97.21a	99.53a	0.00b	2.32b
2	92.82a	98.48a	0.00b	7.18ab
3	94.95a	99.59a	0.41b	3.76b
4	91.98a	97.25a	0.00b	8.02ab
5	92.17a	98.50a	0.00b	7.83ab
6	95.82a	97.07a	1.34b	2.84b
7	97.60a	98.92a	1.00b	1.40b
8	73.88b	88.03b	12.53a	14.09a

[1]Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Management of Corn Borer and Corn Earworm in Early Season Snap Beans with Foliar Insecticides, 2013-
'Slenderette' snap beans were planted on June 6 at the University of Delaware's Research and Education Center located near Georgetown, DE. Four row plots 25 ft long planted on 30 inch centers were arranged in a RCB design with four replications. Foliar treatments were applied on July 9 (late bud stage), July 15 (pin stage) and July 23 (6 days from harvest) with a CO_2 pressurized backpack sprayer equipped with a six nozzle boom delivering 18 gpa @ 30 psi. Plots were harvested on July 29 from a 6 ft row section and all the beans were evaluated for corn borer and corn earworm injury. Data were analyzed using Proc GLM and means were separated by Tukey's means separation test (P=0.05).

Corn borer and corn earworm pressure was light. No phytotoxicity was observed.

Treatment	Rate/Acre	Treatment Dates	Percent ECB Damaged Beans July 29 [1]	Percent CEW Damaged Beans July 29 [1]
Besiege Warrior II	10 fl oz 1.92 fl oz	July 9, 15 July 23	0.00a	0.00a
Belt SC	3 fl oz	July 9,15,23	0.23a	0.23a
Acephate 97 Warrior II	1 lb 1.92 fl oz	July 9,15 July 23	0.14a	0.00a
Blackhawk 36WG	3.3 oz	July 9,15,23	0.00a	0.38a
Warrior II	1.92 fl oz	July 9,15,23	0.00a	0.67a
Sniper 2EC	4 fl oz	July 9,15,23	0.00a	0.00a
Coragen 1.67 SC	3.5 fl oz	July 9,15,23	0.32a	0.92a
Coragen 1.67 SC	5 fl oz	July 9,15,23	0.33a	0.00a
Radiant SC	8 fl oz	July 9,15,23	0.00a	0.21a
Untreated	------	----	0.00a	1.78a

[1]Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Late Planted Field Corn Variety Trial , 2013
University of Delaware ***J. Whalen and B. Cissel***

Objective:. Producers continue to have questions about the effect of fall armyworm feeding in whorl stage corn and ear damage from corn earworm in later plantings of field corn. Foliar insecticides have not provided effective control of these two insects. Research results from trials with newer BT technologies (i.e. Herculex, SmartStax and Viptera) indicate that these technologies can provide control of these two insect problems. This is the second year of a trial established to determine the effectiveness of “newer” Bt technologies in controlling worm pests in “double crop“ field corn under Delaware conditions.

Procedures: Eight field corn hybrids were planted on June 25 at the University of Delaware’s Research and Education Center located near Georgetown, DE. Research plots 20 ft wide (8 rows on 30-inch centers) by 30 ft long were replicated four times in a randomized complete block design. Stand counts were taken from the center two rows of each plot (60 linear foot of row) on July 15. No fall armyworm larvae were detected while corn was in the whorl stage. Corn earworm damage was evaluated on Sept 4 before physiological maturity. Twenty five ears were collected from a single row and evaluated for corn earworm population levels and damage. The following data was collected: number of larvae per ear; number of clean ears, infested ears (1 or more larvae per ear) and damaged ears (included ears with and without larvae present); average centimeters of CEW damage per ear; and number of ears with tip damage (1" or less). Plots were harvested at physiological maturity on October 30 and yields adjusted to 15.5 % moisture. Data were analyzed using Proc GLM and means were separated by Tukey’s mean separation test (P=0.05).

Results:

Variety	Traits	Av # CEW/Ear[1]	% Clean Ears Sept 4[1]	% Ears CEW Tip Damage Sept 4[1]	% Infested + Damaged Ears Sep 4[1]	Av Cm CEW Damage/Ear Sep 4[1]	Yield BU/A Oct 30[1]
NK N68B-3111	Viptera	0.00b	100.00a	0.00c	0.00b	0.00c	157.36a
NK N60F-3111	Viptera	0.00b	100.00a	0.00c	0.00b	0.00c	157.09a
NK N61X-3110	Viptera	0.00b	99.00a	1.00c	1.00b	0.00c	145.95a
DKC 62-98	GENVT2P	0.07b	90.00a	8.00c	10.00b	0.04c	138.97a
DKC 62-95	RR-2	0.88a	13.00b	54.00a	87.00a	1.98b	126.56a
X20558 SSX Mycogen	SmartStax	0.04b	88.00a	7.00c	12.00b	0.08c	132.10a
X20579 RR Mycogen	Roundup Ready	1.23a	6.00b	32.00ab	94.00a	5.49a	135.61a
X29562 HXX Mycogen	Herculex XTRA	0.81a	29.00b	10.00bc	71.00a	1.97b	139.06a

[1]Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Management of Green Peach Aphids in Bell Peppers with Foliar Insecticides, 2013- 'Paladin ' peppers were planted on June 25 at the University of Delaware's Research and Education Center located near Georgetown, DE. Plots consisted of one, 20 ft long row planted on 7-ft centers arranged in a RCB design with four replications. Foliar treatments were applied on Aug 14 with a CO_2 pressurized backpack sprayer equipped with a three nozzle boom (2 drops and one over the center of the row) delivering 55gpa @ 40 psi. Aphids populations were evaluated by collecting and counting the total number of aphids found on 20 leaves per plot at each evaluation date (Aug 12,19,28;Sept 4). Data were analyzed using Proc GLM and means were separated by Tukey's means separation test (P=0.05). Green peach aphid populations were moderate. No phytotoxicity was observed.

Treatment	Rate/Acre	Number of Green Peach Aphids per 20 leaves [1]			
		Aug 12 Pretrt	Aug 19 5 DAT	Aug 28 14 DAT	Sept 4 21 DAT
Sivanto	7.5 fl oz	6.25a	3.75b	1.25b	1.75a
Sivanto	10 fl oz	6.50a	1.00b	5.75ab	1.25a
Endigo ZC	4.5 fl oz	6.25a	1.75b	2.25b	1.25a
Movento 240SC	5 fl oz	2.75a	4.25b	11.25ab	5.50a
Acephate 97	1 lb	6.25a	2.50b	5.00b	6.25a
Beleaf 50SG	2.8 oz	10.75a	2.00b	1.75b	2.00a
Fulfill WDG	2.75 oz	5.25a	3.00b	10.00ab	2.00a
Untreated	-----	4.75a	30.25a	18.75a	4.25a

[1]Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Late Season Management of Melon Aphids in Watermelons with Foliar Insecticides, 2013- 'Sugar Red ' seedless watermelons and the pollenizer 'Accomplice' were planted on May 17 and June 25 at the University of Delaware's Research and Education Center located near Georgetown, DE. Single row 20 ft long plots planted on 7-ft centers were arranged in a RCB design with four replications. Foliar treatments were applied with CO_2 pressurized backpack sprayer equipped with a four nozzle boom delivering 24.5 gpa @ 40 psi on July 24 for the May 17 planting and on July 31 and Aug 14 for the June 25 planting. Aphid populations were evaluated by collecting 20 leaves per plot and counting the total number of aphids on 20 leaves on all evaluation dates. Data were analyzed using Proc GLM and means were separated by Tukey's means separation test (P=0.05). Melon aphid populations were moderate. No phytotoxicity was observed.

Table 1. May 17 Planting

Treatment	Rate/Acre	Number of Melon Aphids per 20 leaves [1]	
		July 23 Pre-treatment	July 29 5 DAT
Assail 30 SG	4 fl oz	30.50a	2.25b
Belay 2.13 SC	4 fl oz	28.25a	15.50ab
Movento 240 SC + NIS	4 fl oz + 0.25% NIS V/V	4.75a	6.50ab
Movento 240 SC + NIS	5 fl oz + 0.25% NIS V/V	2.75a	5.00b
Sivanto	7.5 fl oz	31.25a	6.75ab
Sivanto	10 fl oz	23.25a	1.75b
Actara 25 WDG	3 oz	7.50a	7.25ab
Vydate L	2 pt	1.75a	37.75a
Endigo ZC	4.5 oz	14.50a	5.50b
Untreated	---	4.50a	24.50ab

[1]Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Table 2. June 25 Planting

Treatment	Rate/Acre	Number of Melon Aphids per 20 leaves [1]					
		July 30 Pre-treatment	Aug 8 8 DAT #1	Aug 12 12 DAT #1	Aug 19 5 DAT #2	Aug 28 14 DAT #2	Sep 4 21 DAT #2
Assail 30 SG	4 oz	8.75a	5.25a	5.75a	10.50a	0.00c	4.00a
Belay 2.13 SC	4oz	31.00a	4.50a	10.50a	4.75a	0.75c	7.00a
Movento 240 SC + NIS	4 oz + 0.25% NIS V/V	12.00a	3.00a	7.00a	3.75a	0.25c	1.00a
Movento 240 SC + NIS	5 oz + 0.25% NIS V/V	12.00a	3.75a	7.50a	2.50a	0.25c	1.75a
Sivanto	7.5 fl oz	8.50a	1.25a	8.75a	7.75a	0.50c	3.00a
Sivanto	10 fl oz	9.75a	3.00a	7.00a	2.00a	1.00bc	9.25a
Endigo ZC	4.5 oz	4.25a	11.25a	10.75a	3.25a	3.50ab	4.00a
Untreated Check	--	5.75a	3.00a	5.00a	13.25a	5.25a	4.75a

[1]Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Impact of Brown Marmorated Stink Bug (Halyomorpha halys) on Lima Beans

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Methods

'C-Elite' lima beans were planted on June 28, 2013 and May 12, 2016 at the University of Delaware's Research farm located in Newark, DE to evaluate the feeding effects of brown marmorated stink bug (BMSB) on lima beans. In 2013, plots were 15 ft. long by 10 ft. wide (four rows planted on 30 inch centers including a border row) and in 2016, plots were 15 ft. long by 15 ft. wide (six rows planted on 30 inch centers including border rows). Plots were arranged in a randomized split plot design with 8 replications. At the initiation of the experiment (Aug 5, 2013 and June 29, 2016), each of the plants used in the experiment were caged with a nylon mesh bag secured to the ground with landscape staples around the base of the plant and tied at the top. The cages remained over the plants until harvest regardless of the infestation timing to limit unwanted insects from re-infesting the plants. In 2016, some of the plants experienced moderate to severe defoliation from Mexican bean beetles. Plants were artificially infested at three infestation timings (plant growth stages); flowering, pinning, and pod fill with four bug densities; 0, 1, 3, and 5 BMSB adults per plant for a period of 7 days. Plants were infested with naturally occurring field populations of BMSB adults in 2013. In 2016, bugs were obtained from Phillip Alampi Beneficial Insect Laboratory, New Jersey Department of Agriculture, Trenton, NJ. After the week long infestation period, the bugs were removed from the cages and recorded as live, dead, or missing. In 2016, dead bugs were replaced daily.

At harvest (Sep 25, 2013 and August 9, 2016), the pods were stripped from the plants, counted, and examined for external puncture wounds. Shelled beans were then counted and examined for evidence of stink bug feeding damage, recording the total number of damage beans and the number of puncture wounds per damaged bean. Puncture wounds per damaged bean were not recorded in 2016.

Data were analyzed using analysis of variance (ANOVA) by using mixed effects model (PROC MIXED procedure) and means were separated using Tukey's mean separation test. Years were analyzed separately.

Table 1. 2013 brown marmorated stink bug feeding injury assessment

Infestation Timing/Density		**# of Pods**	**# of Beans**	**% Damaged Beans**	**Avg # of Puncture Wounds**
Infestation Timing	Flowering	11.5a	26.4a	0.1a	0a
	Pinning	13.0a	30.6a	1.39a	0ab
	Pod Fill	11.1a	25.8a	7.7b	0.21c
Infestation Density	0	12.1a	31.2a	0.3a	0a
	1	12.4a	30.0a	1.5ab	0.3a
	3	11.9a	25.1a	3.0ab	0.1a
	5	11.0a	23.4a	7.5b	0.2a

Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05)

Table 2. 2016 brown marmorated stink bug feeding injury assessment

Infestation Timing/Density		# of Pods	# of Beans	% Damaged Beans
Infestation Timing	Flowering	60.6a	151.5a	0.24a
	Pinning	62.7a	147.2ab	0.21a
	Pod Fill	48.5a	107.2b	2.64b
Infestation Density	0	42.2a	106.9a	0.12a
	1	45.4a	111.5a	0.53a
	3	44.0a	96.4a	0.28a
	5	40.2a	91.0a	2.16a

Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05

Results

There were no significant differences for the number of pods or number of beans for infestation timing and density in 2013 (Table 1). In 2016, the timing of infestation and infestation density did not have an effect on the number of pods per plant; however, the infestation timing did for the number of beans per plant. Infestations initiated during the pod fill stage resulted in fewer beans per plant compared to flowering stage infestations (Table 2).

The timing of infestation had a significant effect on the percentage of damaged beans in 2013 and 2016 with infestations occurring during the pod fill stages having the greatest percentage of damaged beans compared to when infestations were initiated at earlier growth stages (Table 1 & 2). Infestation density was also significant for the percent of damaged beans in 2013. Densities of 5 bugs per plant resulted in a higher percentage of beans with stink bug feeding injury compared to the check (Table 1). There were no significant differences for the percent of damaged beans in 2016 regardless of the infestation density (Table 2). The average number of puncture wounds per damaged bean was significantly higher when infestations occurred during the pod fill growth stage compare to when infestations occurred during flowering or pinning stage in 2013 (Table 1). Furthermore, infestation density did not have a significant impact on the average number of puncture wounds on the beans.

Discussion

These results suggest that BMSB infestations occurring between flowering and pod fill do not have a significant impact on the number of pods set. However, BMSB infestations can cause beans to abort, reducing the total number of beans per plant, especially when infestations occur during the pod fill stage. Pod and bean abortion from stink bug feeding has been documented in other leguminous crops. The greatest percentage of damaged beans and greatest number of puncture wounds per bean was recorded when infestations were initiated during the pod fill stage. This suggests that the pod fill growth stage is the most sensitive to BMSB feeding and infestations occurring during this time can result in bean abortion and injury. The density of bugs also influenced the percentage of damaged beans. A significant increase in the percentage of damaged beans occurred when densities reached 5 BMSB per plant.

Squash Bug Management in Pumpkins, 2013: Two plantings of 'Corvette PMR' pumpkins were planted on June 14 and June 25 at the University of Delaware's Research and Education Center located near Georgetown, DE. Plots consisted of one 20 ft-long row on 10 ft centers. Each treatment was replicated four times and arranged in a RCB design. Foliar treatments were applied with a CO_2 pressurized back pack sprayer equipped with a 3 nozzle boom(2 drops and one over the top) on July 16 (first planting) and on July 24 and 31 (second planting) delivering 55 gpa at 40 psi. Squash bug population levels were evaluated by counting the number of egg masses and live squash bugs per 20 ft of row on all plants. Data were analyzed using Proc GLM and means were separated by Tukey's mean separation test (P=0.05).

Table1. Squash Bug Evaluations – Planting # 1 (June 14)

Treatment	Rate/ Acre	Mean Number Live Squash Bugs per Plant [1]			
		Pre-Trt – July 15		7 DAT – July 23	
		Egg Masses	Adults + Nymphs	Egg Masses	Adults + Nymphs
IKI - 3106	11 oz	0.18a	0.27a	0.25a	0.30a
IKI - 3106	16.4 oz	0.21a	0.11a	0.22a	0.05a
Closer	3 oz	0.30a	0.00a	0.14a	0.03a
Closer	5 oz	0.11a	0.07a	0.11a	0.00a
Untreated	--	0.14a	0.12a	0.21a	0.28a

[1] Means in a column followed by the same letter are not significantly different (P= 0.05; Tukey's Test).

Table 2. Squash Bug Evaluations – Planting # 2 (June 25)

Treatment	Rate/ Acre	Mean Number Live Squash Bugs per Plant [1]					
		Pre-Trt – July 23		5 DAT # 1 – July 29		8 DAT # 2 – Aug 8	
		Egg Masses	Adults + Nymphs	Egg Masses	Adults + Nymphs	Egg Masses	Adults + Nymphs
IKI - 3106	11 oz	0.52a	0.12a	0.93a	1.66a	0.40a	0.40a
IKI - 3106	16.4 oz	0.30a	0.90a	0.24ab	1.33a	0.27a	0.07a
Closer	3 oz	0.09a	0.03a	0.09ab	0.03a	0.07a	0.00a
Closer	5 oz	0.45a	0.21a	0.42ab	0.56a	0.00a	0.13a
Assail 30 SG	5.3 oz	0.21a	0.09a	0.06b	0.03a	0.13a	0.07a
Belay 2.13SC	4 oz	0.47a	0.03a	0.16ab	0.79a	0.07a	0.93a
Hero EC	7 oz	0.21a	1.21a	0.15ab	0.03a	0.20a	0.00a
Untreated	--	0.61a	0.21a	0.27ab	0.51a	0.27a	0.60a

[1] Means in a column followed by the same letter are not significantly different (P= 0.05; Tukey's Test).

***Evaluation of Bt and Non-Bt Sweet Corn Varieties for Control of Ear Invading Insect Pests, 2013*:** Two Bt sweet corn varieties (Protector and SV9010SA) and two non-Bt varieties (Garrison and EX08767143) were planted on June 25 at the University of Delaware Research and Education Center located near Georgetown, Delaware. Plots were 25 ft long and two rows wide, planted on 30 inch centers. Each treatment was replicated 4 times and arranged in a RCB design. All applications were made using a CO_2 pressurized back pack sprayer delivering 17.9 gpa @ 40 psi. Treatments were applied on the following dates : #1 - Aug 12, #2 - Aug 15, # 3 - Aug 19, #4 - Aug 22 and # 5 - Aug 26. At harvest (Aug 28), 25 ears from each plot were husked and the following data was collected: (a) corn earworm kernel damage separated into 3 categories: tip, upper ear and lower ear damage; (b) square centimeters of corn earworm damage; (c) square centimeter of fall armyworm damage; and (d) number of corn earworm, fall armyworm and sap beetle larvae per 25 ears. The corn earworm larvae were categorized as small, medium or large. Data were analyzed using Proc GLM and means were separated by Tukey's mean separation test (P=0.05)..

Table 1. Treatments – Rates and Dates

Variety	Total # Appl.	Treatment #	Treatment Dates	Treatment	Rate/A
EX 08767143 (non-BT)	5	1,2,3	Aug 12, 15, and 19	Besiege	9 oz
		4	Aug 22	Lannate LV + Warrior II	24 oz + 1.92 oz
		5	Aug 26	Hero EC	8 oz
	4	1,2,3	Aug 12, 15, and 19	Besiege	9 oz
		4	Aug 22	Lannate LV + Warrior II	24 oz + 1.92 oz
	3	1,3,5	Aug 12, 19 and 26	Besiege	9 oz
	0	---	--	Untreated	---
Garrison (non-BT)	5	1,2,3	Aug 12, 15, and 19	Besiege	9 oz
		4	Aug 22	Lannate LV + Warrior II	24 oz + 1.92 oz
		5	Aug 26	Hero EC	8 oz
	4	1,2,3	Aug 12, 15, and 19	Besiege	9 oz
		4	Aug 22	Lannate LV + Warrior II	24 oz + 1.92 oz
	3	1,3,5	Aug 12, 19 and 26	Besiege	9 oz
	0	---	--	Untreated	---
Protector (Bt)	5	1,2,3	Aug 12, 15, and 19	Besiege	9 oz
		4	Aug 22	Lannate LV + Warrior II	24 oz + 1.92 oz
		5	Aug 26	Hero EC	8 oz
	4	1,2,3	Aug 12, 15, and 19	Besiege	9 oz
		4	Aug 22	Lannate LV + Warrior II	24 oz + 1.92 oz
	3	1,3,5	Aug 12, 19 and 26	Besiege	9 oz
	0	---	--	Untreated	---
SV 9010SA (Bt)	5	1,2,3	Aug 12, 15, and 19	Besiege	9 oz
		4	Aug 22	Lannate LV + Warrior II	24 oz + 1.92 oz
		5	Aug 26	Hero EC	8 oz
	4	1,2,3	Aug 12, 15, and 19	Besiege	9 oz
		4	Aug 22	Lannate LV + Warrior II	24 oz + 1.92 oz
	3	1,3,5	Aug 12, 19 and 26	Besiege	9 oz
	0	---	---	Untreated	---

Table 2. Corn Earworm (CEW) Damage

Variety	Total # Appl.	Damage per 25 Ears			Av Square Cm Damage [1]
		Tip (top kernels only)[1]	Upper Ear (< 1 cm) [1]	Lower Ear (> 1 cm) [1]	
EX 08767143 (non-BT)	5	0.00c	0.00b	0.00a	0.25b
	4	0.00c	0.00b	0.00a	0.00b
	3	0.00c	0.00b	0.00a	0.25b
	0	1.25b	8.75a	0.25a	19.63a
Garrison (non-BT)	5	0.00c	0.00b	0.00a	0.00b
	4	0.00c	0.00b	0.00a	0.13b
	3	0.00c	0.00b	0.00a	0.00b
	0	4.75a	7.25a	0.00a	13.74a
Protector (Bt)	5	0.00c	0.00b	0.00a	0.00b
	4	0.00c	0.00b	0.00a	0.00b
	3	0.00c	0.00b	0.00a	0.00b
	0	0.00c	0.00b	0.00a	0.00b
SV 9010SA (Bt)	5	0.00c	0.00b	0.00a	0.00b
	4	0.00c	0.00b	0.00a	0.00b
	3	0.00c	0.00b	0.00a	0.00b
	0	0.00c	0.00b	0.00a	0.00b

[1]Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Table 3. Corn Earworm Population Counts

Variety	Total # Appl.	Number per 25 Ears[1]			
		Total	Small	Medium	Large
EX 08767143 (non-BT)	5	0.00b	0.00b	0.00b	0.00b
	4	0.00b	0.00b	0.00b	0.00b
	3	0.00b	0.00b	0.00b	0.00b
	0	10.00a	2.75a	5.06a	2.25a
Garrison (non-BT)	5	0.00b	0.00b	0.00b	0.00b
	4	0.25b	0.00b	0.00b	0.00b
	3	0.00b	0.00b	0.00b	0.00b
	0	11.75a	4.50a	5.75a	1.50ab
Protector (Bt)	5	0.00b	0.00b	0.00b	0.00b
	4	0.00b	0.00b	0.00b	0.00b
	3	0.00b	0.00b	0.00b	0.00b
	0	0.00b	0.00b	0.00b	0.00b
SV 9010SA (Bt)	5	0.00b	0.00b	0.00b	0.00b
	4	0.00b	0.00b	0.00b	0.00b
	3	0.00b	0.00b	0.00b	0.00b
	0	0.00b	0.00b	0.00b	0.00b

[1]Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Table 4. Fall Armyworm (FAW) and Sap Beetle (SB) Population Counts and Damage Evaluations

Variety	Total # Appl.	Number per 25 Ears		Av. Sq Cm FAW Damage per 25 ears
		FAW	SB	
EX 08767143 (non-BT)	5	0.00a	0.50a	0.00a
	4	0.00a	0.00a	0.00a
	3	0.00a	1.00a	0.00a
	0	0.25a	1.00a	1.00a
Garrison (non-BT)	5	0.00a	0.00a	0.00a
	4	0.00a	0.00a	0.00a
	3	0.00a	0.00a	0.00a
	0	0.00a	1.75a	0.00a
Protector (Bt)	5	0.00a	0.00a	0.00a
	4	0.00a	0.00a	0.00a
	3	0.00a	0.00a	0.00a
	0	0.00a	0.00a	0.00a
SV 9010SA (Bt)	5	0.00a	0.00a	0.00a
	4	0.00a	0.00a	0.00a
	3	0.00a	0.00a	0.00a
	0	0.00a	0.00a	0.00a

[1]Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Comments: Insect pressure was extremely light in 2013. For the non- Bt sweet corn varieties (EX 08767143 and Garrison), , all treatments resulted in significantly lower corn earworm damage (tip, upper ear and average square centimeters of damage) and number of corn earworm larvae per 25 ears compared to the untreated control. For the Bt sweet corn varieties (SV 9010SA and Protector), ~~,~~ no corn earworm damage or larvae were detected in any of the treatments or the untreated control. Additional research is needed to determine if these treatment schedules will be effective under normal and/or high insect pressure.

Watermelon Spider Mite Management Trial, 2013 – **‘**Sugar Red’ seedless watermelons and the pollinizer variety ‘Accomplice’ were planted on May 17 at the University of Delaware's Research and Education Center located near Georgetown, DE. Plots consisted of two 20 ft long rows on 7ft centers. Each treatment was replicated four times and arranged in a RCB design. Foliar treatments were applied as a broadcast spray using a CO_2 pressurized back pack sprayer delivering 24.5 gpa @ 40 psi on July 9. Two-spotted spider mite populations were evaluated by counting the number of mites per 25 leaves after vining on July 8, 15 and 23. Data were analyzed using Proc GLM and means were separated by Tukey’s mean separation test (P=0.05).

Spider mite populations were extremely low due to the excessive season long wet weather and flooding of the plots. No phytotoxicty was observed.

Treatment	Rate/Acre	Mean Number Mites per 25 Leaves [1]		
		July 8 Pre-trt	July 15 6 DAT	July 23 15 DAT
Oberon 2SC + NIS	8.5 oz+ 0.25V/V	2.00a	0.00a	2.50a
Sniper 2 EC	6.4 oz	10.00a	0.00a	4.50a
Hero EC	10.3 oz	3.25a	0.00a	28.5a
Zeal WSP + NIS	2 oz + 0.25V/V	1.25a	0.00a	0.00a
Zeal WSP + NIS	3 oz + 0.25V/V	0.50a	0.00a	0.00a
Agri-Mek 0.7 SC + NIS	16 oz + 0.25V/V	5.00a	0.00a	0.75a
Portal	2 pts	2.25a	0.25a	2.00a
GWN 1708 + NIS	24 oz + 0.25V/V	5.50a	1.25a	2.00a
GWN 1708 + NIS	32 oz + 0.25V/V	0.50a	0.00a	2.00a
Untreated	--	6.25a	0.50a	2.50a

[1] Means within a column followed by the same letter are not significantly different (Tukey’s; P=0.05).

Final 2013 Delaware Soybean Board Report

Title: Management of Slugs in Delaware Soybean Fields

Personnel: Bill Cissel, Extension IPM Agent
Joanne Whalen, Extension IPM Specialist
Phillip Sylvester, Kent County Extension Agriculture Agent

Objectives:

1. Document the economic loss of slugs in Delaware no-till soybean fields.

2. Evaluate the effectiveness of alternative chemistries for slug management in soybeans.

Document the economic loss of slugs in Delaware no-till soybean fields

Determining the economic losses associated with slug infestations can be challenging because in many situations, soybeans are capable of compensating for stand reductions and can tolerate a considerable amount of foliar feeding. As a result, there is not much information documenting economic losses associated with slug infestations on soybeans in Delaware. The cost of treating a field can be easily documented but in many situations, the slug infestation goes unnoticed until significant stand reductions have occurred. When slug infestations are severe, it is not uncommon for plant populations to be reduced to levels that require the field to be replanted. Aside from the costs associated with replanting (i.e. seed, labor, fuel, etc.), there may also be additional economic losses due to a later planting date and reduced yield potential. Documenting the economic loss of slugs in Delaware no-till soybeans is important because it is required to pursue a Section 18 emergency uses. . This information could also provide support for the continual and future labeling of existing and novel chemistry to control slugs in soybeans.

To gain information on the economic loss of slugs in Delaware on soybeans, we sampled 13 no-till soybean fields across the state before planting with a history of slug problems. Each field was sampled using shingle trapping methods prior to planting by placing five 1 ft^2 shingle traps in each field and monitoring the traps weekly until planting to determine slug population composition and density estimates. At each of the sampling locations, we also searched under the crop residue, recording the total number of slugs by species and the presence of slug eggs. After planting, we monitored 28 soybean fields for slug feeding damage by taking stand counts in 10 random locations in each field and estimated the percentage of plants with slug feeding damage. The fields were sampled to establish base line data on the slug pressure in each field and to locate fields that are at risk for economic losses due to slug infestations.

This Project was funded by the Delaware Soybean Board

Table 1. Pre-Plant Sampling Results

Sampling Date	Shingle Samples					Residue Samples 1 ft x 1 ft				
	Marsh		Grey Garden			Marsh		Grey Garden		
	Juvenile	Adult	Juvenile	Adult	Eggs	Juvenile	Adult	Juvenile	Adult	Eggs
Field 1										
4/9	0	0.2	0	0	0	0	0.2	0	0	0
4/16	0	0	0	0	0	0	0.2	0	0	0
4/23	0	0	0	0	0	0	0.4	0	0	0
4/30	0	0	0	0	0	0	0.6	0	0	0
5/8	0	0	0.2	0	0	0	0	0	0	0
Field 2										
4/9	0	0	0	0	0	0	0	0	0	0
4/16	0	0.8	0	0.4	0	0	0.4	0	0	0
4/23	0	0.2	0	0.4	0	0	0	0	0.2	0
4/30	0	0.2	0	0	0	0	0	0.6	0.6	0.2
5/8	0	0	1	0	0	0	0	0	0	0
Field 4										
4/9	0	1	0	0	0	0	0.4	0	0	0
4/16	0	0.8	0	0	0	0	0.4	0	0	0
4/23	0	4	0	0	0	0	2	0	0	0
4/30	0	0.6	0	0	0	0	1.2	0	0	0.2
5/7	0	1.4	0	0	0	0	0.8	0	0	0.4
Field 5										
4/9	0	2.2	0	0	0	0	0.2	0	0	0
4/16	0	3.4	0	0	0	0	1.2	0	0	0
4/23	0	3	0	0	0	0	1	0	0	0
4/30	0	2.4	0	0	0	0.2	1	0	0	0.8
5/7	0	2.8	0	0	0	0	1.2	0	0.2	0
Field 6										
4/30	0	1	0	0	0	0	0.4	0	0	0
5/7	0	0.4	0	0	0	0	0	0	0	0
Field 7										
4/3	0	0.4	0	0	0					
4/9	0	1	0	0	0	0	0	0	0	2.2
4/15	0	1	0.2	0	0	0.2	0.2	0	0	1.8
4/23	0	1.2	0	0	0	0	0	0	0	0
5/7	0	1.6	0	0.6	0	0	0.4	1.6	0	1.6

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Sampling Date	Shingle Samples					Residue Samples 1 ft x 1 ft				
	Marsh		Grey Garden			Marsh		Grey Garden		
	Juvenile	Adult	Juvenile	Adult	Eggs	Juvenile	Adult	Juvenile	Adult	Eggs
Field 8										
4/3	0	0.4	0.8	0	0	0	0	0	0	0
4/9	0	0	0.8	0	0	0	0	0	0	0
4/16	0	1.6	0	0	0	0	0	0	0	0
4/23	0	1.2	0	0.4	0	0	0	0	0	0
5/1	0	0	0	0	0	0	0	0	0	0
Field 9										
4/3	0	1.2	0	0	0	0	0	0	0	0
4/9	0	0.6	0	0	0	0	0	0	0	0
4/16	0	0.4	0	0.2	0	0	0	0	0.2	0
4/23	0	1	0	0	0	0	0	0	0	0
5/1	0	0	0	0	0	0	0	0	0	0
Field 10										
4/16	0	0	0	0	0	0	0	0	0	0
4/24	0.4	0.8	0	0.2	0	0	0	0	0	0
5/2	0	0	0	0	0	0	0	0	0	0
Field 11										
4/16	0	0.4	0	0	0	0	0	0	0	0
4/24	3.2	0.2	0	0	0	0	0	0	0	0
5/2	0	0	0	0	0	0	0	0	0	0
Field 12										
4/23	0	0	0	0	0	0	0	0	0	0
Field 13										
4/23	0	0	0	0	0	0	0	0	0	0

Table 2. Post-Planting Sampling Results: Stand and Percent Damaged Plants

Sample Date	# plants/3 ft row	% Slug Damaged Plants
Field 1		
5/30	13.8	11.59
6/4	12.2	15.57
6/11	9.7	3.09
6/20	12.2	0.82
6/24	14.3	0.70
Field 2		
5/30	10	37.00
6/11	8.1	43.21
6/20	9.1	3.30
6/24	9.6	0.00

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Sample Date	# plants/3 ft row	% Slug Damaged Plants
Field 3		
6/4	12.7	0.00
6/19	11.8	13.56
6/24	12.5	3.20
Field 4		
5/30	12.6	7.14
6/4	13.1	9.92
6/19	13	18.46
6/24	10.8	1.85
Field 6		
6/4	13.3	9.02
6/12	11.4	18.42
6/20	11.4	14.91
6/25	11.6	5.17
Field 8		
7/17	8.3	8.62
Field 9		
7/17	8.9	7.87
Field 14		
6/4	23.6	15.68
Field 15		
6/13	10.7	6.54
6/19	10.3	21.14
Field 16		
6/20	12.0	0.00
Field 17		
6/19	9.5	54.74
Field 18		
6/27	6.4	39.22
6/19	11.5	31.30
Field 19		
6/20	9.3	0.00
Field 20		
6/19	17.7	0.00
Field 21		
6/19	7.1	69.01
6/27	7.4	10.81
Field 22		
6/19	6.9	47.83
6/27	6.4	23.44

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Sample Date	# plants/3 ft row	% Slug Damaged Plants
Field 23		
6/19	13.3	0.00
Field 24		
6/20	12.6	3.97
Field 25		
6/20	11.6	62.07
Field 26		
6/27	11.6	0.86
Field 27		
6/27	10.9	3.82
Field 28		
6/19	12.6	11.90

Conclusion: Although slug feeding was present in approximately 90 percent of the fields surveyed, significant stand loss only occurred in 2 of the 28 fields sampled. In speaking with producers, it was difficult to determine if this resulted in significant yield loss due to plant compensation.

Demonstration Plot 1: Documenting the Economic Loss of Slugs

A demonstration plot was established in a commercial no-till soybean field located near Middletown, DE with severe above and below ground slug feeding damage. The objective of the demonstration plot was to determine the potential economic losses from slugs. The field was monitored on a weekly basis after emergence for plant population and percent damaged plants by dividing the field into three zones based on the severity of slug feeding damage; A (minor), B (severe), and C (moderate to severe). Stand counts were taken by recording the total number of plants in 30 row ft in ten random locations in each zone. Percent damaged plants were determined by recording the number of plants within each sampling location with slug feeding damage on the newest emerged leaves. To determine the possible yield losses associated with slug damage, GPS coordinates were recorded marking areas in the field with the most and least severe slug feeding damage. This information will be superimposed onto a yield map to determine what impacts slug feeding may have caused on yield.

Table 3. Demonstration Plot 1: Plant Population and Percent Damaged Plants

Sample Date	Plant Population (plants/A)			Percent Damaged Plants		
	A	B	C	A	B	C
4-Jun pre-trt	85,233	59,774	76,931	17.5	36.1	41.0
10-Jun	161,389	114,068	134,740	17.9	22.7	11.8
19-Jun	208,959	151,925	117,057	9.2	14.3	18.7
26-Jun	222,408	149,434	148,438	0.1	0.8	0.5

Conclusion: In the worst areas of the field, Zones B and C, significant stand losses were observed compared to Zone A which had very low slug pressure (Table 3). Deadline M-Ps were applied by by air on June 6 to prevent any further stand losses

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from occurring and to protect the plants that had emerged. Prior to the aerial application of Deadline M-Ps, Zone B and C experienced significant slug feeding damage with the percentage of damaged plants reaching 36.1 and 41.0 percent, respectively. After the Deadline M-Ps application, the percent of damaged plants was reduced drastically as indicated in Table 3. A portion of Zone C was replanted because stand losses were so severe which explains the substantial increase in the plant population on June 26. Once yield maps are obtained from the grower, differences in yield can be compared between each of the zones to determine the effects of slugs on soybeans and the potential yield benefit of replanting.

Evaluate the effectiveness of alternative chemistries for slug management in soybeans

Slug management in no-tillage soybeans can be a challenge because slugs often feed below ground, severing the hypocotyl and killing the plant before it has a chance to emerge. Usually, the problem is not identified until the soybeans have failed to emerge, at which point the field has likely experienced a significant stand reduction. Rescue treatments to prevent additional stand losses and damage to emerged plants has traditionally included a broadcast application of a metaldehyde bait (e.g.,Deadline M-Ps). However, there are additional available slug management products in the marketplace that may provide control but local data evaluating efficacy of these products in soybeans is limited.

As a result, two small plot replicated research trials were established to evaluate efficacy of all the available slug control products to manage slugs in soybeans. A third large plot trial was established to evaluate the effectiveness of applying Deadline M-Ps as a rescue treatment when slug pressure is high. The first trial was established in a commercial soybean field located near Middletown, DE with severe above and below ground slug feeding. The objective of this trial was to evaluate each of the products ability to control slugs as a rescue treatment. The second trial was established in a soybean field located at the Delaware State University’s Smyrna Outreach and Research Center with a history of slug problems. The objective of this trial was to evaluate the efficacy of each of the products applied preventatively when conditions are favorable for slug activity and the likelihood of having a problem is high. The third trial was established in a commercial soybean field located near Cecilton, MD with a moderate to severe grey garden slug infestation. The objective of this trial was to evaluate the effectiveness of a broadcast application of Deadline M-Ps applied as a rescue treatment after planting as the soybeans germinate and begin to emerge.

In addition to the replicated research plots, a demonstration plot was established to evaluate the effectiveness of applying Deadline M-Ps preventatively when replanting is required. The demonstration plot was on a no-till soybean field located near Earleville, MD that experienced severe slug feeding damage and significant stand reductions. Slug pressure was high and the entire field needed to be replanted. Tillage is the most recommended control tactic when replanting is necessary due to stand loss from slugs; however, tillage is not always an option. Metaldehyde baits can significantly reduce slug pressure when applied as a rescue treatment to protect the plants that have

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emerged and the slugs are feeding above the soil surface but there is little information available about the effectiveness of the baits when applied in a replant situation.

(1) Soybean Trial 1: Rescue Treatment

Replicated research plots were established in a commercial no-tillage soybean field with severe slug pressure. At the time of treatment, there was below ground and above ground slug feeding on the soybean plants and substantial stand reductions had occurred. Plots were 15 ft wide x 20 ft long arranged in a randomized complete block design with four replications. Treatments included (1) Lannate LV at 1.5 pt/A, (2) Sluggo at 20 lb/A, (3) Iron Fist at 20 lb/A, (4) Ferroxx at 20 lb/A, (5) Deadline M-Ps at 10 lb/A, and (6) an untreated check. The Lannate LV treatment was applied on June 4 at 5:15 pm using a CO_2 pressurized backpack sprayer equipped with a 6 nozzle boom delivering 16.9 gpa at 40 psi. It was hot and sunny with an average wind speed of 4.7 mph, making the conditions unfavorable for slug activity at the time the Lannate LV application was made. The dry formulations were made using a hand seeder calibrated for each of the products. Pre-treatment and post-treatment evaluations included stand counts and percent damaged plants. Stand counts were determined by counting the total number of plants in the center two rows of each plot and reported as plants per acre. The percent damaged plants was determined by examining the number of plants within the center two rows with slug feeding damage on the newest growth. Yield was calculated by harvesting the center two rows from each plot and reported as grams per plot.

Table 4. Soybean Trial 1 (Rescue Treatment): Stand Counts and Yield

		Stand Count (plants per Acre)					
Treatment	Rate/A	June 4 Pre-Trt	June 10 6 DAT	June 13 9 DAT	June 18 14 DAT	June 26 22 DAT	Oct 14 Yield (grams)
Lannate LV	1.5 pt	83,823a	68,389a	80,150a	79,715a	68,389a	943.2a
Sluggo	20 lb	69,117a	77,972a	90,605a	87,991a	90,605a	901.5a
Iron Fist	20 lb	73,529a	63,162a	59,242a	79,715a	72,745a	844.5a
Ferroxx	20 lb	67,647a	84,942a	90,605a	90,605a	95,832a	881.2a
Deadline M-Ps	10 lb	67,647a	75,975a	87,991a	90,605a	95,832a	861.7a
Check	--	80,882a	56,193a	59,242a	60,984a	61,855a	882.4a

Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Table 5. Soybean Trial 1 (Rescue Treatment): Percent Slug Damaged Plants

		% Slug Damaged Plants				
Treatment	Rate/A	June 4 Pre-Trt	June 10 6 DAT	June 13 9 DAT	June 18 14 DAT	June 26 22 DAT
Lannate LV	1.5 pt	71.2a	83.4a	46.3a	42.0ab	34.2a
Sluggo	20 lb	92.6a	64.1a	20.5c	36.1b	21.8ab
Iron Fist	20 lb	79.9a	50.4a	22.1bc	35.0b	18.6ab
Ferroxx	20 lb	92.9a	58.4a	20.1c	30.8bc	21.3ab
Deadline M-Ps	10 lb	65.6a	55.0a	17.7c	15.2c	9.6b
Check	--	74.6a	88.1a	44.8ab	56.6a	28.8a

Means in the same columns followed by the same letter are not significantly different (Tukey's; P=0.05).

Conclusions: There were no significant differences between treatments for stand count at any of the sampling dates (Table 4). In addition, no significant differences in yield were found between the treatments and the untreated check. At 9 days after treatment, the Sluggo, Ferroxx, and Deadline M-Ps treatments had significantly fewer plants with slug feeding damage compared to the untreated check (Table 5). At 14 days after treatment, the percentage of plants with new feeding damage was significantly less for all the treatments compared to the untreated check except the Lannate LV treatment. The weather conditions were not favorable for slug activity at the time the Lannate LV application was made. Experience suggests that Lannate LV only has contact activity on slugs which may explain the poor results. The Deadline M-Ps treatment provided the greatest length of control being the only treatment that was significantly different compared to the untreated check for the percentage of damaged plants at 22 days after treatment.

(2) Soybean Trial 2: Preventative Treatment

This trial was conducted to determine if a preventative treatment can be applied prior to plant emergence to reduce losses from slugs. This trial was established in a soybean field located at the Delaware State University's Smyrna Outreach and Research Center with a history of slug problems. The field was determined to be at risk for slug problems based on field history, pre-plant slug sampling results, and favorable weather conditions for slug activity at the time of planting. Plots were 15 ft wide x 20 ft long arranged in a randomized complete block design with four replications. The treatments included (1) Sluggo at 20 lb/A, (2) Iron Fist at 20 lb/A, (3) Ferroxx at 20 lb/A, (4) Deadline M-Ps at 10 lb/A and (5) an untreated check. Treatments were applied on June 25 prior to plant emergence using a hand seeder calibrated for each product. The percent damaged plants was determined by counting the total number of plants and the number of plants with new slug feeding damage in two random, three foot sections per plot. Slug pressure was low to moderate and shortly after plant emergence, the weather conditions quickly became less favorable for slug activity.

Table 6. Soybean Trial 2 (Preventative Treatment): Percent Damaged Plants

Treatment	Rate/Acre	Percent Damaged Plants		
		July 3 8 DAT	July 11 16 DAT	July 17 22 DAT
Sluggo	20 lb	6.8a	0a	0a
Iron Fist	20 lb	9.1a	0a	0a
Ferroxx	20 lb	3.7a	0a	0a
Deadline M-Ps	10 lb	3.2a	0a	0a
Check	--	35.8b	0a	0a

Conclusion: At 8 days after treatment, all of the treatments had significantly fewer damaged plants compared to the untreated check (Table 6). However, at 16 and 22 days after treatment, there was no new slug feeding damage on any of the plants, regardless of the treatment. The drastic reduction in slug activity is likely a result of the hot weather conditions that may have caused slugs to move deeper in the soil profile

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and caused the plants to grow rapidly. Additional data needs to be collected to determine if treating preventatively is a suitable management strategy when weather conditions are favorable for slug activity over prolonged periods of time and under heavy slug pressure.

(3) Soybean Trial 3: Evaluation of Metaldehyde as Rescue Treatment to Control Slugs on Soybeans (Large Plots)

Slugs are capable of reducing stand, potentially resulting in significant economic losses due to replanting costs and yield reductions. Identifying slug problems early, before and during plant emergence and applying a metaldehyde bait could prevent significant stand losses. Additional information is needed to evaluate the effectiveness of this control strategy in soybeans. The objective of this trial was to evaluate the effectiveness of applying a metaldehyde bait as a rescue treatment during soybean emergence when slug pressure is high and the weather conditions are conducive for slug activity.

Plots were established on a no-till soybean field located near Cecilton, MD with high grey garden slug populations and moderate below ground feeding damage on the germinating/emerging soybeans. The plots were 30 ft wide by 50 ft long arranged in a randomized complete block design with three replications. Treatments consisted of (1) a broadcast application of Deadline M-Ps at 10 lb/A applied on June 11 and (2) an untreated check. Pre and post-treatment stand counts were determined by counting the total number of emerged plants in ten linear ft of row in three spots in each plot. The percentage of damaged plants was determined by recording the number of plants with slug feeding damage on the newest emerged leaves in each ten linear ft of row.

Table 7. Soybean Trial 3 (Evaluation of Metaldehyde): Stand Counts

		Stand Count (plants per Acre)		
Treatment	Rate/Acre	June 10 Pre-Trt	June 18 7 DAT	June 26 15 DAT
Deadline M-Ps	10 lb	103,772a	122,036a	111,244a
Check	--	91,320a	131,168a	116,778a

Table 8. Soybean Trial 3 (Evaluation of Metaldehyde): Percent Damaged Plants

		Percent Damaged Plants		
Treatment	Rate/Acre	June 10 Pre-Trt	June 18 7 DAT	June 26 15 DAT
Deadline M-Ps	10 lb	85.0a	16.1a	6.9a
Check	--	90.5a	26.3a	4.9a

Conclusion: There were no significant differences in stand between the Deadline M-Ps treatment and the untreated check on any of the sample dates (Table 7). At the time of application, most of the soybeans had already emerged, possibly explaining why no differences were observed for stand counts. There were also no significant differences for the percentage of damaged plants between treatments (Table 8). At 7 and 15 days after treatment, the percentage of damaged plants was relatively low despite the fact that the percentage of damaged plants was high prior to treatment. Weather conditions immediately after treatment may have had a positive effect on soybean growth, possibly explaining why no significant differences were observed.

(5) Demonstration Plot 2: Metaldehyde Applied in Replant Situations

Slugs are capable of causing significant stand reductions in soybeans, occasionally reducing plant populations to levels that would require replanting. Typically, when this is the case, tilling the field and replanting the entire field has been the most recommended approach. Tillage is often not an option due to enrollment in NRCS cost share programs, the inability to till fields due to the slope of the field, field moisture levels, and cost of seed. However, without tilling a field to reduce the slug population the replanted soybeans may once again be destroyed under severe slug pressure. The objective of this demonstration was to gain additional information on the effectiveness of metaldehyde bait applied at the time of replanting to protect the germinating soybeans from significant slug feeding damage.

Stand counts were taken on the initial planting, pre and post treatment, by counting the number of emerged soybeans per 30 ft of row in 15 random locations throughout the field. The percent damaged plants were determined by counting the number of plants with slug feeding damage on the newest emerged leaves in each of the 15 random sampling locations. The replanted soybean stand counts and percent damaged plants were evaluated post-treatment using similar methods.

The initial planting of the field had a plant population of 76,665 plants/A with 97 percent of the plants having slug feeding damage on June 18 (pre-treatment). On June 20, Deadline M-Ps were applied by air to the entire field at 10 lbs/A. On June 23, additional seed were inter-planted into the existing stand to boost the final plant population.

Table 9. Demonstration Plot 2 (Evaluation of metaldehyde Applied in Replanting Situations): Stand Counts and Percent Damaged Plants

	Initial Planting		Replant	
	June 18 Pre-trt	June 24 4 DAT	July 2 12 DAT	July 10 20 DAT
Stand Count (plants/A)	76,665	68,999	84,409	85,107
% Damaged Plants	97.1	11.6	5.78	2.91

Conclusion: The percentage of damaged plants for the initial planting was reduced from 97.1 (Pre-trt) to 11.6 percent 4 DAT (Table 9). The replanted soybeans had 5.8 and 2.9 percent damaged plants 12 and 20 DAT. Stand counts for the replanted stand also remained constant at 12 and 20 DAT suggesting the Deadline M-Ps reduced the slug population to levels that were no longer capable of significantly reducing the stand. While the application of Deadline M-Ps was successful in this demonstration plot at preventing significant stand losses and feeding damage from occurring on the replanted soybeans; the later planting date may have also played a role. The later plating date

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likely increased the rate of emergence of the replanted soybeans compared to the initial planting, allowing the soybeans to emerge before sustaining significant injury. Additional research needs to be conducted to determine if a metaldehyde bait can be applied in a replant situation and consistently be successful in reducing slug populations and preventing significant plant injury from occurring below ground.

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