



Wisconsin vegetable insect pest management research summer field trials

2010

Russell Groves

Assistant Professor, Entomology

Scott Chapman

Associate Researcher, Entomology

Sarah Schramm

Associate Research Specialist, Entomology

University of Wisconsin, Madison
Department of Entomology
1620 Linden Drive
Madison, WI 53706

groves@entomology.wisc.edu

(608) 262-3229

www.entomology.wisc.edu/vegento



Principle Investigators

Russell Groves
Scott Chapman

Additional Foliar PVY Management Principle Investigators

Alex Crockford, Langlade County Agricultural Extension Agent
Rick Hafner and Kevin Bula, Senior Field Inspectors, Wisconsin Seed Potato Certification Program, Antigo, WI
Robert Coltman, Director, Wisconsin Seed Certification Program, Antigo, WI

Acknowledgements

The following organizations and representatives partially supported the research summarized in this report:

<i>Bayer CropScience</i>	<i>Steve Spangler</i>
<i>DuPont Crop Protection</i>	<i>Mick Holm</i>
<i>Gowan Company</i>	<i>Nick VanderVort, Nathan Cross</i>
<i>Syngenta Crop Protection</i>	<i>Jeffrey Krumm</i>
<i>Valent USA</i>	<i>Gary Kirfmann</i>
<i>Dow AgroSciences</i>	<i>Scott Ditmarsen, Jim Turner</i>
<i>Nichino America</i>	<i>James Adams</i>
<i>AgraQuest</i>	<i>Dennis Long</i>

The following University of Wisconsin faculty and staff have contributed time and expertise to these projects:

Paul Bethke, Jed Colquhoun, and Alvin J. Bussan – Department of Horticulture
Amy Charkowski and Amanda Gevens – Department of Plant Pathology
Matthew Ruark, Birl Lowry and Sam Kung – Department of Soil Science

The following students assisted with implementing and evaluating the projects this summer:
Anders Huseeth, Ken Frost, Emily Mueller, Natalie Hernandez, David Lowenstein, Ryan Curtin, Abby Kalsheur, Elloise, Brittany, Jesse Leung, Matthew

The following people provided land and resources for this research:

Steve and Andy Dierks, Coloma Farms, Coloma, WI
Paul Phillippi, Shiprock Farms, Coloma, WI
Richard and Roderick Gumz, Gumz Muck Farms, Endeavor, WI
Ron Krueger, Felix Zeloski Farms, Eagle River, WI
John, Jim, and Joe Mattek, J.W. Mattek & Sons, Deerbrook, WI

Special thanks to the staff at the Arlington, Hancock, and Antigo Agricultural Research Stations who helped maintain the projects and assisted in evaluation of research results.

Thank you.

Table of Contents

Cabbage

- Evaluation of foliar insecticides for the control of lepidopteran insect pests in cabbage... 1-2
Foliar. *Imported cabbageworm, cabbage looper, diamondback moth*

Onion

- Evaluation of foliar insecticides for the control of onion thrips in dry-bulb onion..... 3-4
Foliar. *Onion thrips*

Pepper

- Foliar insecticide treatments for the control of European corn borer, in Wisconsin processing pepper production..... 5-6
Foliar. *European corn borer*

Potatoes

- Drip irrigation insecticide treatments to control Colorado potato beetle in Wisconsin potatoes..... 7-8
Drip Irrigation. *Colorado potato beetle, potato leafhopper, aphids*
- Registered and experimental foliar insecticides to control Colorado potato beetle and potato leafhopper in potato..... 9-10
Foliar. *Colorado potato beetle, potato leafhopper, aphids*
- Foliar insecticide treatments for the control of potato leafhopper in Wisconsin potato production..... 11-12
Foliar. *Potato leafhopper*
- Foliar insecticide treatments to limit the spread of *Potato virus Y* in Wisconsin seed potato production..... 13-14
Foliar. *PVY*
- Muck potato research..... 15-16
Systemic. *Colorado potato beetle, potato leafhopper, aphids*
- Evaluation of systemic insecticides for the control of the Colorado potato beetle, potato leafhopper, and aphids in potato..... 17-18
Systemic. *Colorado potato beetle, potato leafhopper, aphids*
- Large plot demonstration experiments of Colorado potato beetle in Wisconsin potatoes... 19-22
Full season treatment. *Colorado potato beetle, potato leafhopper, aphids*

Snapbean

- Foliar insecticide treatments for the control of European corn borer in Wisconsin snap bean production..... 23-24
Foliar. *European corn borer*
- Systemic insecticide treatments for the control of European corn borer in Wisconsin snap bean production..... 25-26
Systemic. *European corn borer*

Tomato

- Foliar insecticide treatments for the control of tomato fruitworm in Wisconsin fresh market tomato production..... 27-29
Foliar. *Tomato fruitworm*

Evaluation of foliar insecticides for the control of Lepidopteran insect pests in cabbage

Purpose: The objective of this experiment was to assess the efficacy of foliar insecticides applied at-threshold to control lepidopteran insect pests in cabbage.

Materials and Methods

This experiment was conducted at the Arlington Agricultural Experiment Station in Arlington, WI in 2010. Cabbage, *Brassica oleracea* cv. 'Hinova', transplants were planted 5 Jun. Plants were spaced 18 inches apart within rows. Rows were 36 inches apart. The two-row plots were 6 ft wide by 20 ft long, for a total of 0.003 acres, and were separated by 2 guard rows between plots. Plots were arranged into four replications with 5 ft alleys between replications. All plots were maintained according to standard commercial practices.

Four replicates of 11 experimental foliar treatments and 1 untreated control were arranged in a randomized complete block design. All foliar treatments were applied 12 July. Treatments were applied with a CO₂ backpack sprayer with a 6 foot boom operating at 30 psi delivering 20.1 gpa through four flat-fan nozzles (Tee Jet XR8003VS) spaced 18" apart while traveling at 4 ft / sec.

Immature life stages of imported cabbage worm (ICW), *Artogeia rapae*, cabbage looper (CL), *Trichoplusia ni*, and diamondback moth (DB), *Plutella xylostella*, were assessed by counting the number of larvae per plant on 10 randomly selected plants in each plot. Larval counts occurred four times throughout the summer, on Jul 16 (4 DAT), 20 (8 DAT), 27 (15 DAT), and Aug 4 (35 DAT). Count data were log₁₀ transformed prior to analysis. Means were separated using ANOVA with a Least Squared Difference (LSD) option (P=0.05).

Results and Discussion

Results are reported in **Table 1**. ICW and DB pressure was moderately low in this experiment with few observed differences in efficacy compared to the untreated check. Results showed significant treatment main effect differences in the populations of CL on cabbage heads. Nearly all treatments provided sufficient control of CL and ICW through 7 DAT and 14 DAT. No signs of phytotoxicity were observed.

Table 1. Mean larval count per plant.

Treatment ¹	Rate	16-Jul			20-Jul			27-Jul			4-Aug		
		ICW	CL	DB	ICW	CL	DB	ICW	CL	DB	ICW	CL	DB
Untreated		0.5 b	3.0 a	0.3	0.0	0.5	0.0	2.8 a	3.8	2.3	4.0	10.0 ab	0.3
Voliam Flexi 40 WG	7 oz/a	0.0 c	0.3 cd	0.0	0.0	0.0	0.0	0.0 c	0.5	0.3	2.0	6.3 ab	1.5
Voliam Xpress 1.25 ZC	9 oz/a	2.3 a	1.8 b-d	3.5	2.0	1.0	0.5	1.0 a	7.0	0.3	2.0	8.3 ab	0.0
Coragen 1.67 SC	5 oz/a	0.0 c	1.3 bc	0.0	0.0	0.5	0.0	0.0 c	1.0	2.3	2.8	5.8 ab	0.0
Durivo 2.5 SC	11.5 oz/a	0.0 c	0.3 cd	0.0	0.0	0.3	0.0	0.3 bc	0.8	0.0	2.5	3.3 b	2.5
Radiant SC	10 oz/a	0.0 c	0.0 d	0.0	0.0	0.0	0.0	1.0 a	1.0	0.3	3.0	8.0 ab	1.3
Cyazypyr 100 OD	13.5 oz/a	0.0 c	0.0 d	0.0	0.0	0.0	0.0	0.0 c	2.8	0.5	4.3	7.0 b	4.5
Brigade 2 EC	6.4 oz/a	0.0 c	0.3 cd	0.0	0.0	0.0	0.0	0.0 c	0.5	0.3	0.8	0.0 c	2.8
Warrior II 2.08 CS	1.6 oz/a	0.0 c	0.0 d	0.8	0.0	0.3	0.3	0.8 ab	1.8	0.0	2.5	4.3 b	1.0
Intrepid 2 F	12 oz/a	0.0 c	0.0 d	0.5	0.5	0.3	0.0	0.3 bc	2.8	0.3	1.3	3.0 b	0.8
Tesoro 4 EC	6.4 oz/a	0.3 bc	2.3 ab	0.0	0.5	1.3	0.0	0.5 a-c	5.0	0.8	4.5	16.5 a	2.3
DiPel 54 DF	1 lb/a	0.3 bc	0.8 cd	0.3	0.5	2.5	0.3	0.0 c	7.5	0.5	4.8	5.8 b	6.3
	P	<.0001	0.0003	0.0685	0.153	0.2352	0.1645	0.0048	0.0726	0.188	0.0591	0.0071	0.4465
	LSD	0.3272	0.624	0.6064	0.5209	0.6671	0.2619	0.4256	1.127	0.7098	0.8825	1.1242	1.2578

¹All treatments except Untreated and Dipel also had MSO 100% MS at 0.25 % v/v

Evaluation of foliar insecticides for the control of onion thrips in dry-bulb onion

Purpose: The objective of this experiment was to assess the efficacy of foliar insecticides applied at-threshold to control immature stages of onion thrips (OT), *Thrips tabaci*, in dry-bulb onion.

Materials and Methods

This experiment was conducted in a cooperating producer's field located 5.1 miles (8.1 km) west of Coloma, Wisconsin on a muck soil in 2010. Onion, *Allium cepa* 'Corona', was direct seeded on 20 May. Plants were spaced 2.2 inches apart within rows. Rows were 9.8 inches apart. The six-row plots were 56 inches wide by 25 ft long on raised formed beds, for a total of 0.003 acres, and were separated by planted guard beds of the same dimensions between plots. All plots were maintained by the grower according to standard commercial practices.

Four replicates of 17 experimental treatments and 1 untreated control were arranged in a randomized complete block design. Applications were initiated when mean immature thrips populations had exceeded established thresholds of 3 immature thrips / leaf. All foliar treatments were applied on 22 and 29 Jun. Treatments were applied with a CO₂ backpack sprayer with a 6 foot boom operating at 30 psi delivering 24.9 gpa through four flat-fan nozzles (XR8003VS) spaced 18" apart while traveling at 3.5 ft / sec.

Immature lifestages of onion thrips (OT) were assessed by counting the number of larvae per plant on 10 randomly selected plants in the central 2 rows of each plot. Larval counts occurred four times throughout the summer, on June 25 (3 DAT) and 28 (6 DAT) after the first application and again on July 12 (13 DAT) and 27 (29 DAT) after the second application. Count data were log₁₀ transformed prior to analysis. Means were separated using ANOVA with a Fisher's Protected Least Squared Difference (LSD) option (P=0.05). Data are presented in **Table 1**.

Results and Discussion

Populations of OT were considered average to above-average as thresholds were initially exceeded in the experimental field by mid to late June. Increased levels of knockdown were achieved with higher rates of Radiant, Movento, Agri-Mek, and tolfenpyrad compared to the untreated check. Few registered or experimental compounds demonstrated longer term, residual levels of control lasting greater than 21 days post-treatment. No overt signs or symptoms of phytotoxicity were observed.

Table 1. Mean count of immature OT per plant.

Treatment	Rate	25-Jun	28-Jun	12-Jul	27-Jul
Untreated		4.6 a-e	5.3 ab	26.3 ab	12.2 c
¹ Warrior II 2.08 SC	1.92 fl oz/a	6.7 a-c	7.1 ab	29.4 a	21.4 bc
² HGW 86 10 OD	13.5 fl oz/a	4.6 a-c	4.2 b-e	18.5 b	27.8 ab
² HGW 86 10 OD	20.5 fl oz/a	3.2 c-f	3.7 b-e	14.5 c	15.0 bc
¹ Lannate 2.4 L	48 fl oz/a	3.3 a-f	4.8 b-e	23.7 ab	7.2 d
¹ Radiant 1 SC	6 fl oz/a	3.0 d-f	6.9 ab	11.1 cd	14.6 c
¹ Radiant 1 SC	8 fl oz/a	2.3 ef	2.0 c-e	8.0 e	25.7 a
¹ Movento 240 SC	4 fl oz/a	5.9 a	5.0 b-e	2.3 g	11.4 c
¹ Movento 240 SC	5 fl oz/a	3.7 a-d	3.7 b-d	3.7 f	14.9 c
³ Agri-Mek 0.15 EC	10 fl oz/a	2.6 f	3.4 b-e	9.9 de	15.3 c
³ Agri-Mek 0.15 EC	12 fl oz/a	3.2 d-f	8.0 a	14.2 c	15.3 c
¹ Tolfenpyrad 150 SC	17 fl oz/a	3.0 ef	2.1 de	11.6 cd	26.0 ab
¹ Tolfenpyrad 150 SC	21 fl oz/a	2.6 d-f	4.2 ab	15.2 c	29.1 a
¹ Radiant 1 SC (1st appl)	8 fl oz/a	3.0 d-f	1.7 e	10.5 cd	44.6 a
¹ Tolfenpyrad 150 SC (2nd appl)	17 fl oz/a				
¹ Carzol 92 SP (1st appl)	0.5 lb ai/a	3.4 b-f	4.6 ab	14.4 c	27.2 a
¹ Tolfenpyrad 150 SC (2nd appl)	17 fl oz/a				
³ Agri-Mek 0.7 SC	2 fl oz/a	3.6 a-f	3.8 b-e	11.1 cd	16.4 c
³ Agri-Mek 0.7 SC	2.58 fl oz/a	5.4 ab	3.7 a-c	16.8 c	19.9 a
² Agri-Mek 0.7 SC	2.58 fl oz/a	2.1 ef	2.4 c-e	9.5 de	15.5 c
	P	0.0024	0.0005	<.0001	<.0001
	LSD	0.4031	0.4325	0.3651	0.5139

¹ Activator 90 added at 0.25 % v/v, ²MSO added at 0.5% v/v, ³ Induce added at 0.25% v/v.

Foliar insecticide treatments for the control of European corn borer, in Wisconsin processing pepper production

Purpose: Evaluate various foliar-applied, registered insecticides targeting populations of ECB larvae in processing pepper, with the goal of developing efficacy data in support of future registration of novel insecticides.

Materials and Methods

This experiment was conducted at Arlington Agricultural Experiment Station in Arlington, WI in 2010. Pepper, *Capsicum annuum* cv. 'Wonderful', transplants were planted 25 May. Plants were spaced 24 inches apart within rows. Rows were 6 ft apart. Plots were single rows, 6 ft wide by 30 ft long, for a total of 0.004 acres. Replicates were separated by a 12 ft border of bare ground. The trial was established over black plastic and sprinkler irrigated over the growing season. Experimental plots were managed according to commercial herbicide and fungicide recommendations for weed control and control of the pepper blight resulting from *Phytophthora capsici*.

Each plot was infested with European corn borer (ECB), *Ostrinia nubilalis*, egg masses on 29 Jul. In each plot, five successive plants were infested, each with five egg masses for a total of 25 egg masses applied in each plot. Egg masses were attached to plants mid-canopy and onto stems with green fruit. Each egg mass contained approximately 20-30 eggs / mass.

Four replicates of 5 experimental foliar treatments and 1 untreated control were arranged in a randomized complete block design. The foliar treatments were applied 10 Aug when plant growth stage was at flowering and mature fruit set. Treatments were applied by a CO₂ pressurized backpack sprayer with a 6' boom operating at 42 psi delivering 29.4 gpa through 4 flat-fan nozzles (Tee Jet 8002VS-XR) spaced 18" apart @ 3.5 ft / sec. Subsequent sprays followed on weekly intervals following initial application.

Populations of ECB and associated damage estimates were surveyed 18 August following the third application of insecticide by counting (1) total number of fruit, (2) the weight in pounds of fruit (3) number of damaged fruit, and (4) the number of viable larvae observed in fruit. See **Table 1** for a summary of key field activity dates. Count data were log₁₀ transformed prior to analysis. Proportion data were arcsin transformed prior to analysis. Means were separated using ANOVA with a Least Squared Difference (LSD) option (P=0.05).

Table 1. Summary of key field activity dates.

Action	Planting	Infestation	Insecticide app.	Evaluation
Date	25 May	29 Jul	10 Aug	18 Aug
Days from last action		64	12	8

Results and Discussion

Natural populations of ECB at the experimental site are annually variable and require that experimental plots be artificially infested with test insects. Established infestation levels in the experimental plots and particularly the untreated control were considered to be above average for what is typically observed during annual trials (**Table 2**).

Table 2. Mean yield and damage estimates per plant in pepper.

Treatment	Rate	Total No. Fruit	Weight (lb)	No. Damage Fruit	Proportion Damaged Fruit	Total Larvae
Untreated	-	2.4	0.7	1.1	0.5	1.5
Rimon 0.83 EC	12 fl oz/a	2.2	0.5	0.7	0.3	1.4
Rimon 0.83 EC	12 fl oz/a	2.8	0.9	1.0	0.4	1.4
Warrior 1 CS	3.84 fl oz/a	1.5	0.5	0.8	0.4	0.8
Rimon 0.83 EC	9 fl oz/a	1.5	0.3	0.4	0.3	0.5
Warrior 1 CS	2.56 fl oz/a	1.7	0.6	0.6	0.3	0.8
Rimon 0.83 EC	9 fl oz/a					
Rimon 0.83 EC	12 fl oz/a					
Provado 1.6 F	3.8 fl oz/a					
	P	0.2204	0.1207	0.3157	0.5661	0.6278
	LSD	1.6755	1.3344	1.5683	0.3474	2.2305

Drip irrigation insecticide treatments to control Colorado potato beetle in Wisconsin potatoes

Purpose: The purpose of this experiment was to evaluate drip irrigation-applied insecticides targeting second generation Colorado potato beetle (CPB), *Leptinotarsa decemlineata*, adults and larvae in potato. The goal of the research is to develop efficacy data in support of product recommendations.

Materials and Methods

This experiment was conducted at Hancock Agricultural Experiment Station (HAES) in Hancock, WI in 2010. Potato, *Solanum tuberosum* cv. 'Russet Norkotah', seed pieces were planted on 3 May. Seed pieces were spaced 12 inches apart within rows. Rows were 3 ft apart. The two-row plots were 6 ft wide by 30 ft long, for a total of 0.004 acres. Two guard rows separated plots. The trial was established under silver reflective plastic and drip-irrigated according to ET demands of the crop. The drip irrigation tape was 0.38 thin-walled Netafim with integral pressure-compensating, anti-siphon in-line drippers operating at 10 psi. The plots were managed according to commercial pest management (herbicide and fungicide) practices as well as fertility recommendations prescribed by HAES.

Four replicates of 4 experimental treatments and 1 untreated control were arranged in a randomized complete block design. Insecticides were injected 28 June when second generation CPB adult populations had emerged from pupation and egg deposition was approximately 80-95% complete, and 12 July when the majority of larval populations were predominately in the first and second instar larval stage. Treatments were applied by a CO₂ pressurized bottle operating at 11 psi delivering 29.4 gpa delivering the contents in a total water volume of 2L.

Populations of CPB, potato leafhopper (PLH), *Empoasca fabae*, and colonizing aphid species were counted at intervals of 3 and 7 days post first application (1 and 8 July) and 21, 28, and 35 days post second application (2, 9, 16 Jul). Additionally, numbers of CPB in the following life stages were also recorded: adult, egg, small larvae, and large larvae. Counts per plant were taken from 10 randomly selected plants from each plot. Percent defoliation was also recorded as a measurement of adult and larval CPB feeding (**Table 1**). Yield and quality data were recorded after harvest (**Table 2**). Count data were log₁₀ transformed prior to analysis. Proportion data were arcsine transformed prior to analysis. Means were separated using ANOVA with a Least Squared Difference (LSD) option (P=0.05).

Results and Discussion

Injection treatments were applied on 28 June and 12 July. The second application had to be delayed from 7 to 10 days resulting from significant precipitation. CPB pressure at HAES was considered to be above average resulting from two successive years of moderate winter temperatures.

Table 1. Mean estimates of insect populations and damage.

Treatment	Rate	CPB Adults (Jul 1, 8, 15)	CPB Adults (Aug 2, 9, 16)	CPB Egg Masses (Jul 1, 8, 15)	CPB Egg Masses (Aug 2, 9, 16)
Untreated	-	0.6	11.3 ab	0.4	0.4
Platinum 75 SG	2.67 oz wt/a	0.5	13.7 ab	0.0	0.0
Coragen 1.67 SC	7 fl oz/a	0.4	7.3 b	0.1	0.2
Scorpion 35 SL	8 fl oz/a	1.3	20.6 a	0.0	0.3
Scorpion 35 SL	13 fl oz/a	0.3	9.8 b	0.1	0.1
	P	0.0983	0.0397	0.633	0.4202
	LSD	0.4494	1.0566	0.2157	0.2518

Table 1 continued

Treatment	Rate	CPB Small Larvae (Jul 1, 8, 15)	CPB Small Larvae (Aug 2, 9, 16)	CPB Large Larvae (Jul 1, 8, 15)	CPB Large Larvae (Aug 2, 9, 16)
Untreated	-	1.8 b	8.2 b	0.4 b	31.5 a
Platinum 75 SG	2.67 oz wt/a	0.7 b	8.9 b	0.8 b	9.9 b
Coragen 1.67 SC	7 fl oz/a	8.3 b	18.0 a	7.2 a	17.0 ab
Scorpion 35 SL	8 fl oz/a	0.0 b	10.2 ab	0.1 b	25.0 a
Scorpion 35 SL	13 fl oz/a	12.3 a	15.4 a	6.2 a	8.8 b
	P	0.0279	0.0464	0.0356	0.0113
	LSD	0.9261	1.2535	0.7798	1.3118

Table 1 continued

Treatment	Rate	Percent Defoliation (Jul 1, 8, 15)	Percent Defoliation (Aug 2, 9, 16)	PLH (Aug 2, 9, 16)	Aphids (Aug 2, 9, 16)
Untreated	-	1.9	24.6	0.0	0.0
Platinum 75 SG	2.67 oz wt/a	0.0	5.0	0.0	0.0
Coragen 1.67 SC	7 fl oz/a	1.3	9.2	0.0	0.3
Scorpion 35 SL	8 fl oz/a	1.3	11.8	0.0	0.0
Scorpion 35 SL	13 fl oz/a	1.9	4.6	0.0	0.0
	P	0.7702	0.0615	.	0.438
	LSD	0.1115	3.13	.	0.2336

Table 2. Mean yield and quality estimates.

Treatment	Rate	Proportion B & Cull	Proportion US #1	CWT/A	Specific Gravity
Untreated	-	0.26	0.74	223.2	1.053
Platinum 75 SG	2.67 oz wt/a	0.34	0.66	299.4	1.049
Coragen 1.67 SC	7 fl oz/a	0.18	0.82	330.9	1.048
Scorpion 35 SL	8 fl oz/a	0.17	0.83	246.7	1.050
Scorpion 35 SL	13 fl oz/a	0.28	0.72	342.9	1.047
	P	0.1948	0.1948	0.1325	0.2148
	LSD	0.1945	0.1945	0.8364	0.0027

Registered and experimental foliar insecticides to control Colorado potato beetle and potato leafhopper in potato

Purpose: The objective of this experiment was to assess the efficacy of foliar insecticides applied to early instar larvae of the first generation of Colorado potato beetle (CPB), *Leptinotarsa decemlineata*, in potato.

Materials and Methods

This experiment was conducted at Hancock Agricultural Experiment Station (HAES) located 1.1 mile (1.8 km) southwest of Hancock, Wisconsin on a loamy sand soil in 2010. Potato, *Solanum tuberosum* cv. 'Superior', seed pieces were planted on 28 April. Seed pieces were spaced 12 inches apart within rows. Rows were 3 ft apart. The two-row plots were 6 ft wide by 20 ft long, for a total of 0.003 acres. Two guard rows separated plots while 12 ft tilled alleys separated replications. All plots were maintained according to standard commercial practices conducted by HAES staff.

Four replicates of 18 experimental foliar treatments and 1 untreated control were arranged in a randomized complete block design. The foliar treatments were applied twice in succession when 75-90% of the first generation CPB was within the first and second instar larval stadia. The application dates were 7 and 17 June. Treatments were applied with a CO₂ pressurized backpack sprayer with a 6 ft boom operating at 30 psi delivering 20.1 gpa through 4 flat-fan nozzles (Tee Jet XR8003VS) spaced 18" apart while travelling at 3.5 ft / sec.

Control of CPB was assessed by counting the number of egg masses (EM), small larvae (SL), large larvae (LL) and adults per plant on 10 randomly selected plants in each plot. Percent foliage defoliation (%DF) ratings were assessed by visual observation of each plot. Control of potato leafhopper (PLH), *Empoasca fabae*, was assessed by counting the number of adults collected from 25 sweep net samples in each plot. Insect counts occurred on several dates throughout the summer and reported means were averaged across those dates (**Table 1**). Larval counts occurred five times during June and July. The first set of counts occurred on June 10 (3 DAT) and 14 (7 DAT) after the first application. The second set of counts occurred on July 21 (4 DAT), 25 (8 DAT), and 29 (12 DAT), following the second application. Count data were log₁₀ transformed prior to analysis. Proportion data were arcsine transformed prior to analysis. Means were separated using ANOVA with a Fisher's Protected Least Squared Difference (LSD) option (P=0.05).

Results and Discussion

Populations of CPB were considered average to above-average as measured defoliation in the UTC plots was nearing 5% by the time the initial foliar applications were applied. Increased levels of early larval CPB control were achieved with higher rates of DPX HGW86, Belay, Voliam Flexi, and Coragen compared to the untreated check. Lower than average levels of adult PLH were observed in the experimental plots as no significant differences were observed among registered or experimental compounds. No overt signs or symptoms of phytotoxicity were observed.

Table 1. Mean counts and percent defoliation

Treatment	Rate	CPB-EM	CPB-SL	CPB-LL	% Defoliation	PLH
		(Jun 10, 14, 21)	(Jun 10, 14, 21)	(Jun 21, 25, 29)	(Jun 29)	(Jun 10, 21)
Untreated		0.8	93.7 a	149.6 a	60.0 a	1.3
DPX-HGW86 100 OD	3.38 oz/a	3.1	9.6 d-g	1.5 g-i	7.5 c	0.5
DPX-HGW86 100 OD	6.76 oz/a	1.3	8.8 f-h	0.2 i	3.8 c	1.2
DPX-HGW86 100 OD	10.1 oz/a	2.3	7.9 gh	0.3 i	5.0 c	2.0
DPX-HGW86 100 OD	13.5 oz/a	1.7	3.4 h	0.3 i	3.8 c	0.5
Coragen 1.67 SC	3.45 oz/a	2.1	18.8 cd	2.3 e-h	6.3 c	0.7
Coragen 1.67 SC	5.06 oz/a	1.8	14.9 c-f	2.2 e-h	13.8 c	1.0
Coragen 1.67 SC	7 oz/a	1.6	12.6 d-g	1.8 f-h	6.3 c	0.8
Voliam Flexi 40 WG	4 oz/a	1.3	3.3 h	0.8 hi	6.3 c	0.7
Voliam Xpress 1.25 ZC	7 oz/a	1.6	7.6 f-h	18.0 c	11.3 c	0.0
Endigo 2.06 ZC	4 oz/a	1.0	11.7 f-h	4.3 de	7.5 c	0.0
Belay 2.13 SC	2 oz/a	0.5	5.5 gh	3.1 d-g	5.0 c	0.3
MSO 100 XL	14.4 oz/a					
Scorpion 35 SL	2 oz/a	1.0	64.8 ab	109.8 a	40.0 b	0.2
Scorpion 35 SL	2.75 oz/a	0.6	50.5 bc	84.3 a	32.5 b	0.2
Actara 25 WDG	3 oz wt/a	1.5	21.0 c-e	32.2 b	8.8 c	0.7
Belay 2.13 SC	2.8 fl oz/a	1.8	6.6 f-h	8.3 cd	9.5 c	1.0
Radiant 1 SC	8 fl oz/a	2.2	7.7 e-h	4.0 d-f	5.0 c	1.5
Rimon 0.83 EC	12 fl oz/a	1.3	23.3 f-h	0.9 hi	11.3 c	0.5
Rimon 0.83 EC	9 fl oz/a	0.8	42.3 bc	10.1 cd	10.0 c	0.8
	P	0.2893	<.0001	<.0001	<.0001	0.2096
	LSD	0.5704	1.0053	0.6398	0.2104	0.6003

Foliar insecticide treatments for the control of potato leafhopper in Wisconsin potato production

Purpose: The purpose of this experiment was to evaluate the efficacy of foliar insecticides applied to potato for control of potato leafhopper (PLH), *Empoasca fabae*.

Materials and Methods

This experiment was conducted at Arlington Agricultural Experiment Station (AAES) in Arlington, WI in 2010. Potato, *Solanum tuberosum* cv. 'Superior', seed pieces were planted on 21 April. Seed pieces were spaced 12 inches apart within rows. Rows were 3 ft apart. The two-row plots were 6 ft wide by 20 ft long, for a total of 0.003 acres. Two guard rows separated plots. Hilling occurred 17 May. The plots were managed according to commercial pest management (herbicide and fungicide) practices as well as fertility recommendations prescribed by AAES.

Four replicates of 16 experimental foliar treatments and 2 untreated controls were arranged in a randomized complete block design. The foliar treatments were applied 20 Jul. Treatments were applied with a CO₂ pressurized backpack sprayer with a 6 ft boom operating at 30 psi delivering 20 gpa through 4 flat-fan nozzles (Tee jet XR8003VS) spaced 18" apart while travelling at 3.5 ft / sec.

Control of PLH and aphids was assessed by counting the number of PLH nymphs (N) and the number of aphids per plant on 10 randomly selected plants in each plot while PLH adults (A) were assessed by using sweep samples consisting of 20 sweeps per plot (**Table 1**). Insect counts occurred on three dates throughout the summer: 30 Jun (10 DAT), 9 Jul (19 DAT), and 13 Jul (23 DAT). Count data were log₁₀ transformed prior to analysis. Means were separated using ANOVA with a Fisher's Protected Least Squared Difference (LSD) option (P=0.05).

Results and Discussion

Potato leafhopper and aphid populations did not significantly increase after establishment during early June (**Table 1**). Both aphid and leafhopper populations remained low throughout the trial and no significant differences among the treatments and untreated plots were observed.

Table 1. Mean insect count.

Treatment	Rate*	PLH A			PLH N			Aphids		
		30-Jun	9-Jul	13-Jul	30-Jun	9-Jul	13-Jul	30-Jun	9-Jul	13-Jul
Untreated	-	5.3	4.0	2.3	0.0	1.0	0.3	1.5	4.5	1.3
Voliam Flexi 40 WG	4	3.3	2.0	2.8	0.0	1.0	0.5	1.0	2.5	1.3
Voliam Express 1.25 ZC	7	2.5	2.5	2.3	0.0	0.5	1.0	0.8	2.5	0.8
Agri Flex 1.55 SC	0.79	3.8	3.0	3.8	0.0	2.0	0.8	0.3	3.0	1.8
¹ Endigo 2.06 SC	3	3.8	5.5	2.8	0.0	1.5	2.3	0.3	1.5	1.8
Endigo 2.06 SC	4	4.3	4.0	4.3	0.0	2.0	1.5	0.0	1.5	14.0
¹ Leverage 360 31.5 SC	2.4	3.8	8.5	2.8	0.0	1.0	2.5	0.8	1.5	3.0
¹ Leverage 360 31.5 SC	2.8	3.3	3.5	4.0	0.0	1.0	1.3	0.3	3.0	2.0
¹ AsanaXL 0.66 EC	2.9	2.8	3.5	6.5	0.0	0.5	0.8	0.3	0.0	1.8
² Belay 2.13 SC	2	2.8	2.5	2.8	0.0	0.5	1.3	0.3	3.0	5.0
² Coragen 1.67 SC	5	4.5	3.5	8.0	0.0	1.0	2.5	0.5	1.5	4.5
² HGW86 100 OD	10.1	6.0	6.0	1.8	0.0	2.0	1.3	0.5	4.0	4.0
Brigadier 2 EC	4.8	3.5	5.0	3.0	0.0	0.5	0.8	0.8	1.0	2.8
Untreated	-	5.3	2.0	6.5	0.0	1.0	2.0	0.5	2.0	5.8
Warrior 1 CS	2.85	4.0	9.0	5.0	0.0	4.0	3.5	0.8	6.0	3.5
Warrior II 2.08 SC	1.92	2.5	1.0	5.3	0.0	0.5	0.8	1.5	0.5	4.0
Dimethoate 4 E	1 pt/a	3.3	1.0	5.0	0.0	1.0	2.3	0.8	3.5	4.0
Actara 25 WG	1.5	4.5	3.0	4.5	0.0	0.0	1.5	1.5	3.0	1.8
	P	0.8571	0.5476	0.4292	.	0.8847	0.3428	0.8615	0.9314	0.4274
	LSD	0.9172	1.3868	0.9131	.	1.3136	0.835	0.7425	1.8428	1.1076

*Rate in oz/a unless otherwise noted

¹NIS 100 L added at 0.5 %v/v

²MSO 100 L added at 14 oz/a

Foliar insecticide treatments to limit the spread of *Potato virus Y* in Wisconsin seed potato production

Purpose: The purpose of this experiment was to evaluate the efficacy of varying rates of foliar-applied Aza-Direct in limiting the spread of Potato virus Y (PVY) to foundation and certified seed potato. The goal is the refinement of PVY best management practices' to limit current season spread of the virus in seed potato using different application timing, application intervals, and tank mixes of mineral oils and selected feeding blockers in the PVY susceptible variety, Russet Norkotah.

Materials and Methods

This experiment was conducted at Langlade County Research Station in Antigo, WI in 2010. Potato, *Solanum tuberosum* cv. 'Russet Norkotah', seed pieces were planted on 28 April. Seed pieces were spaced 12 inches apart within rows. Rows were 3 ft apart. The four-row plots were 12 ft wide by 20 ft long, for a total of 0.006 acres. Two guard rows of the PVY-resistant variety "Villetta Rose" separated plots. Replicates were separated by 12' alleys of bare ground. Drive rows for foliar applications were arranged to cover border rows and provide access for foliar applications to 4 row experimental plots. PVY was established in each plot by sap-inoculating the middle plant in the second and third rows of each plot with a PVY⁰ strain collected in Wisconsin 2004-06. Inoculation occurred 15 June, approximately 1 week after plant emergence.

Four replicates of 11 experimental foliar treatments and 1 untreated control were arranged in a randomized complete block design. Foliar applications were initiated on 2 Jul and were reapplied either once weekly or twice weekly depending on the treatment (see **Table 1** for application frequency). Treatments were applied with a CO₂ pressurized tractor-mounted sprayer with a 12 ft boom operating at 40 psi delivering 21.1 gpa through 13 Disc-Core type cone spray nozzles equipped with D3-DC25 spaced 12" apart while travelling at 3.5 ft / sec.

Total plot yield was taken at harvest and count data were log₁₀ transformed prior to analysis. Proportion data were arcsine transformed prior to analysis. Means were separated using ANOVA with a Fisher's Protected Least Squared Difference (LSD) option. Data are presented in **Table 1**. Incidence of PVY will be surveyed at the end of the experimental interval by counting all symptomatic plants in a sub-sample submitted to the University of Wisconsin's, Post-Harvest Grow-out Test in Homestead, FL.

Results and Discussion

Yield data from the trial show no significant differences among any of the treatments and the untreated control plots. This indicates that none of the treatments adversely affected the plots and the grow-out test in Florida will reveal the effects of the various oil treatments on virus transmission.

Table 1. Mean yield and quality estimates.

Treatment	Rate	Start Date	Application Frequency	US #1-A (lbs)	US #1-B (lbs)	Total US #1 (lbs)	Total w/Culls (lbs)	Proportion US #1-A	Proportion US #1-B	CWT/A
UTC	-	-	-	81.0	11.1	92.1	110.1	0.88	0.12	294.3
Aphoil	2 %	2-Jul	1x weekly	77.1	14.5	91.5	107.8	0.84	0.16	280.1
Stylet Oil	0.75 %	2-Jul	1x weekly	83.4	10.7	94.1	105.3	0.89	0.11	303.1
Aphoil	4 %	2-Jul	2x weekly	80.1	10.1	90.2	102.0	0.89	0.11	291.1
Stylet Oil	1.5 %	2-Jul	2x weekly	85.0	10.5	95.5	109.2	0.89	0.11	309.0
Requiem	1 %	2-Jul	2x weekly	86.1	12.1	98.3	116.2	0.87	0.13	313.0
Stylet Oil	0.75 %	2-Jul	2x weekly	72.7	11.8	84.5	99.3	0.86	0.14	264.2
Aza-Direct	2 pts/ac	2-Jul	2x weekly	77.6	10.4	87.9	102.6	0.87	0.13	281.9
Aphoil	2 %	2-Jul	2x weekly	77.6	10.4	87.9	102.6	0.87	0.13	281.9
Aza-Direct	2 pts/ac	2-Jul	2x weekly	90.9	10.8	101.7	116.8	0.89	0.11	330.4
Requiem	1 %	2-Jul	2x weekly	90.9	10.8	101.7	116.8	0.89	0.11	330.4
Aza-Direct	2 pts/ac	2-Jul	2x weekly	90.9	10.8	101.7	116.8	0.89	0.11	330.4
Aphoil	4 %	2-Jul	2x weekly	86.0	13.3	99.3	116.4	0.87	0.13	312.7
*NNI-0101	3.2 fl oz/a	20-Jul	1x weekly	86.0	13.3	99.3	116.4	0.87	0.13	312.7
Aphoil	4 %	5-Jun	1x weekly	66.7	12.7	79.4	89.4	0.83	0.17	242.4
Beleaf	2.8 oz/a	20-Jul	1x weekly	66.7	12.7	79.4	89.4	0.83	0.17	242.4
Aphoil	4 %	2-Jul	2x weekly	85.8	11.5	97.3	112.5	0.88	0.12	311.7
*Fulfill	3.67 fl oz/a	20-Jul	1x weekly	85.8	11.5	97.3	112.5	0.88	0.12	311.7
			P	0.7423	0.4583	0.5856	0.7878	0.3955	0.3955	0.7408
			LSD	0.3513	0.2707	0.2738	0.3086	0.0759	0.0759	0.3551

Muck Potato Research

Purpose: The purpose of this experiment was to evaluate candidate, new potential insecticide seed, in-furrow, and impregnation treatments with currently registered standards for the control of Colorado potato beetle (CPB), *Leptinotarsa decemlineata*, potato leafhopper (PLH), *Empoasca fabae*, and colonizing aphid species.

Materials and Methods

This experiment was conducted at Gumz Muck Farms in Endeavor, WI in 2010. Potato, *Solanum tuberosum* cv. ‘Superior’, seed pieces were planted on 28 April. Seed pieces were spaced 12 inches apart within rows. Rows were 3 ft apart. The four-row plots were 12 ft wide by 20 ft long, for a total of 0.006 acres. Two guard rows separated plots. Replicates were separated by 10 ft unplanted alleys. The experiment was conducted in a section of a commercial potato field with a history of known key insect pest species pressure.

Four replicates of 8 experimental treatments and 1 untreated control were arranged in a randomized complete block design. Systemic insecticides were applied at plant (April 28) with a CO₂ pressurized backpack sprayer with a 2 nozzle boom (one for each furrow) operating at 30 psi delivering 9.1 gpa through a pair of extended range flat-fan nozzles spaced 36” apart while travelling at 3.5 ft / sec. Seed treatments were applied 26 April with a CO₂ pressurized backpack sprayer with a single nozzle operating at 30 psi.

Control of CPB was assessed by counting the number of egg masses (EM), small larvae (SL), large larvae (LL) per plant on 10 randomly selected plants in each plot. Percent defoliation (%DF) was evaluated by visual observation of each plot. Control of PLH, was assessed by counting the number of adults and nymphs collected from 25 sweep net samples in each plot. Insect counts occurred on several dates throughout the summer and reported means were averaged across those dates. Yield and quality data were taken after harvest. Count data were log₁₀ transformed prior to analysis. Proportion data were arcsine transformed prior to analysis. Means were separated using ANOVA with a Fisher’s Protected Least Squared Difference (LSD) option (P=0.05).

Results and Discussion

Historically, at plant systemic insecticides have had limited efficacy on muck soils. Potato insect management with systemic insecticides has been limited due to the high binding capacity of organic matter which ties up the active ingredients and limits plant availability. Similar trends were observed in 2010 with the at plant treatments providing a limited amount of CPB efficacy when compared to the untreated plots (Tables 1 and 2). CPB larval numbers were reduced in all the seed and in furrow treatments; however there were no significant statistical differences among treatments. Defoliation was significantly reduced in at plant treatments when compared to the untreated plots.

Table 1. Means of CPB in various life stages, percent defoliation, PLH, and aphids

Treatment	Rate	Type	Adults	Egg Masses	Small Larvae	Large Larvae	Percent Defoliation	PLH Adults	PLH Nymphs	Aphids
			(Jun 28, Jul 9, 16, 23)	(Jun 7, 16, 21)	(Jun 21, 28, Jul 9, 16)	(Jun 28, Jul 9, 16, 23)	(Jul 9, 16)	(Jun 21, 28, Jul 16)	(Jul 16)	(Jul 16)
UTC			5.6	0.7	6.6	28.4	33.8 a	5.1 a	3.5	1.4
Platinum 75 SG	2.67 oz/a	IF	5.8	0.3	5.8	9.1	9.4 b	0.9 b	0.5	0.3
Coragen 1.67 SC	7.0 oz/a	IF	7.7	0.3	5.3	13.8	14.4 b	6.5 a	1.0	2.0
Belay 2.13 SC	12.0 oz/a	IF	5.6	0.4	3.4	10.1	9.4 b	1.0 b	0.0	0.8
DPX-HGW86 20 SC	13.5 oz/a	IF	5.0	0.5	5.2	11.1	10.6 b	4.3 a	1.5	1.6
DPX-HGW86 5 FS	0.14 oz/cwt	S	3.7	0.5	4.9	10.4	10.0 b	4.5 a	0.8	0.9
DPX-HGW86 5 FS	0.14 oz/cwt	S	3.9	0.5	9.6	10.9	8.1 b	1.1 b	0.0	0.5
Titan 600 FS	0.10 oz/cwt	S								
Poncho 600 FS	0.20 oz/cwt	S	2.4	0.2	2.6	10.2	6.3 b	1.1 b	0.0	0.8
Cruiser 600 FS	0.09 oz/cwt	S	3.5	0.3	6.1	12.5	8.8 b	1.0 b	0.3	0.5
		P	0.9897	0.8927	0.8136	0.7010	<.0001	<.0001	0.2873	0.5956
		LSD	0.7764	0.3366	0.8755	0.9393	0.1354	0.5191	0.8954	0.6368

Table 2. Mean yield and quality data.

Treatment	Rate	Type	Proportion US#1	CWT/A	Specific Gravity
UTC			0.8	176.9	1.051
Platinum 75 SG	2.67 oz/a	IF	0.9	239.7	1.055
Coragen 1.67 SC	7.0 oz/a	IF	0.9	199.2	1.049
Belay 2.13 SC	12.0 oz/a	IF	0.9	223.9	1.051
DPX-HGW86 20 SC	13.5 oz/a	IF	0.9	216.0	1.049
DPX-HGW86 5 FS	0.14 oz/cwt	S	0.9	204.9	1.052
DPX-HGW86 5 FS	0.14 oz/cwt	S			
Titan 600 FS	0.10 oz/cwt	S	0.9	221.6	1.049
Poncho 600 FS	0.20 oz/cwt	S	0.9	192.9	1.052
Cruiser 600 FS	0.09 oz/cwt	S	0.9	207.2	1.049
		P	0.7952	0.9131	0.1049
		LSD	0.1259	0.4668	0.002

IF = In furrow S = Seed treatment

Evaluation of systemic insecticides for the control of the Colorado potato beetle, potato leafhopper, and aphids in potato

Purpose: The objective of this experiment was to assess the efficacy of at-plant insecticides to control Colorado potato beetle (CPB), *Leptinotarsa decemlineata*, potato leafhopper (PLH), *Empoasca fabae*, and potato colonizing aphid species in potatoes.

Materials and Methods

This experiment was conducted at Hancock Agricultural Experiment Station (HAES) located 1.1 mile (1.8 km) southwest of Hancock, Wisconsin on a loamy sand soil in 2010. Potato, *Solanum tuberosum* cv. 'Russet Burbank', seed pieces were planted on 28 April. Seed pieces were spaced 12 inches apart within rows. Rows were 3 ft apart. The four-row plots were 12 ft wide by 20 ft long, for a total of 0.006 acres. Two untreated guard rows separated plots. Plots were arranged in an 8 tier design with 12 ft alleys between tiers. All plots were maintained according to standard commercial production practices by HAES staff.

Four replicates of 21 experimental treatments and 2 untreated controls were arranged in a randomized complete block design. All in-furrow treatments were applied in 2.0 L of water at 11.0 gpa on 28 April using a two nozzle boom equipped with TeeJet XR8002VS flat fan spray nozzles powered by a CO₂ backpack sprayer at 30psi. Furrows were cut using a commercial potato planter without closing discs attached. Seed treatments were applied in 0.016 L of water on 27 April using a single nozzle boom applying 9.1 gpa equipped with an XR8002VS flat fan spray tip powered by a CO₂ backpack sprayer at 30psi. Immediately after the in-furrow treatments were applied and all seed piece treatments were placed in open furrows, all seed was covered by hilling.

Stand counts were conducted on 20 May (22 DAP) by counting the number of emerged plants per 20 ft. section of row. Control of CPB, PLH nymphs, and aphids was assessed by counting the number of these insects per plant on 10 randomly selected plants in each plot. Defoliation was evaluated by visual observation of each plot. Percent defoliation was determined for each plot through visual observation. CPB were recorded in the following life stages: adults (Ad), egg masses (EM), small larvae (SL), large larvae (LL). PLH were recorded as nymphs (N) or adults (A). Adult potato leafhoppers were sampled using sweep net techniques (20 sweeps per plot). Insect counts occurred on several dates throughout the summer, and means are reported as averages over dates (**Table 1**). Insect count averages reflect time periods during the summer when specific life stages peaked in the plots. Experimental plots were mechanically harvested from a single row of the four-row plots and weighed and graded at the HAES. Count data were log₁₀ transformed prior to analysis. Means were separated using ANOVA with a Fisher's Protected LSD (P=0.05).

Results and Discussion

Populations of CPB in this field trial were considered average to above average as defoliation in the UTC plots was nearing 10% by the time first generation CPB larval numbers began to peak in mid-June. Significant treatment effects with the DPX HGW86 5.22 FS seed and in-furrow treatments, Belay 2.13 SC seed treatments, Admire Pro 4.6 FS pre-mixes were observed relative to the untreated control including CPB larvae and % defoliation. All treatments except the DPX HGW86 alone provided effective control of PLH adults and nymphs. All treatments resulted in significantly higher tuber yields than the untreated check plots. No signs of phytotoxicity were observed following plant emergence.

Table 1. Mean insect counts in various life stages and percent defoliation

Treatment ¹	Rate	Type	CPB-Ad	CPB-EM	CPB-SL	CPB-LL	%DF	PLH-A	PLH-N	Aphids
			(Jun 2, 7)	(Jun 2, 7)	(Jun 2, 7, 14)	(Jun 14, 22, 29)	(Jul 8, 15)	(Jul 8, 15)	(Jul 8, 15)	(Jul 8, 15)
Untreated	-	-	46.4	4.8 a-c	55.5 b	56.2 ab	62.5 a	1.1 d-f	0.0	0.2
DPX-HGW86 5.22 FS	4.56 fl oz/a	IF	20.6	1.8 c-g	2.6 c-e	1.2 c-e	7.9 cd	2.5 a	0.0	0.2
DPX-HGW86 1.67 SC	10.3 fl oz/a	IF	21.1	3.1 a-d	3.8 c-e	10.7 c-e	10.8 cd	2.7 ab	0.0	0.5
DPX-HGW86 1.67 SC	13.7 fl oz/a	IF	26.6	1.7 c-g	4.2 c-e	2.2 c-e	9.3 cd	2.0 a-d	0.0	0.1
AdmirePro 4.6 FS	7 fl oz/a	IF	18.1	2.0 a-f	8.3 cd	7.2 c-e	13.8 cd	0.8 f-i	0.0	0.3
AdmirePro 4.6 FS	8.7 fl oz/a	IF	20.7	2.0 b-g	10.8 c-e	14.5 c-e	9.2 cd	0.6 f-i	0.0	0.3
Belay 2.13 SC	12 fl oz/a	IF	19.9	0.9 fg	0.3 e	0.7 e	5.0 d	0.3 hi	0.0	0.0
Belay 2.13 SC	0.6 fl oz/cwt	S	16.9	1.1 d-g	3.2 de	0.8 de	13.8 cd	2.1 f-i	0.0	0.0
Moncoat 7.5 SS	0.75 lb/cwt	S								
Untreated	-	-	45.1	6.3 ab	72.8 a	61.5 a	36.7 b	1.2 d-f	0.0	0.1
DPX-HGW86 1.67 SC	0.62 fl oz/cwt	S	20.0	3.2 a-c	10.9 cd	9.3 c-e	10.8 cd	2.0 a-c	0.0	0.5
DPX-HGW86 5.22 FS	0.16 fl oz/cwt	S	26.1	2.9 b-g	8.5 cd	14.2 bc	15.8 c	2.2 ab	0.0	0.5
DPX-HGW86 5.22 FS	0.22 fl oz/cwt	S	21.4	2.8 a-e	8.7 cd	9.0 c-e	10.5 cd	1.3 c-f	0.0	0.2
DPX-HGW86 5.22 FS	0.16 fl oz/cwt	S	12.5	0.8 e-g	7.9 c-e	11.0 c-e	7.9 cd	0.2 i	0.0	0.1
Titan ST 5 FS	0.16 fl oz/cwt	S								
DPX-HGW86 5.22 FS	0.22 g/100 kg	S	18.7	0.5 g	12.2 c-e	7.2 c-e	13.5 cd	0.4 hi	0.0	0.1
Titan ST 5 FS	0.16 fl oz/cwt	S								
DPX-HGW86 5.22 FS	0.16 fl oz/cwt	S	17.6	1.1 c-g	15.6 cd	18.3 cd	16.7 c	1.1 d-f	0.0	0.3
Titan ST 5 FS	0.08 fl oz/cwt	S								
DPX-HGW86 5.22 FS	0.16 fl oz/cwt	S	16.3	1.2 c-g	26.6 c	11.7 c-e	11.3 cd	0.8 f-i	0.0	0.0
AdmirePro 4.6 FS	0.26 fl oz/cwt	S								
DPX-HGW86 5.22 FS	0.22 fl oz/cwt	S	31.8	0.9 d-g	7.7 c-e	7.2 c-e	15.8 c	1.0 d-g	0.0	0.2
AdmirePro 4.6 FS	0.26 fl oz/cwt	S								
DPX-HGW86 5.22 FS	0.22 fl oz/cwt	S	23.5	5.2 a	9.0 c-e	19.2 bc	12.1 cd	1.6 b-e	0.0	0.1
Titan ST 5 FS	0.16 fl oz/cwt	S	17.2	0.5 g	7.2 c-e	8.1 c-e	10.9 cd	0.4 g-i	0.0	0.0
AdmirePro 4.6 FS	0.26 fl oz/cwt	S	14.7	0.8 d-g	8.7 cd	7.1 c-e	16.7 c	0.9 e-h	0.0	0.0
AdmirePro 4.6 FS	0.35 fl oz/cwt	S	20.1	1.3 d-g	32.5 cd	11.5 c-e	15.8 c	0.9 e-h	0.0	0.3
Cruiser 5 FS	0.12 fl oz/cwt	S	14.1	1.3 d-g	20.1 cd	7.6 c-e	11.9 cd	0.2 i	0.0	0.2
Cruiser 5 FS	0.16 fl oz/cwt	S	11.2	0.6 fg	7.8 c-e	9.0 c-e	12.5 cd	0.4 hi	0.0	0.0
		P	0.6643	<.0001	<.0001	0.0004	<.0001	<.0001	0.4777	0.3572
		LSD	0.8871	0.5616	0.9689	0.9529	0.1474	0.3224	0.0169	0.198

IF = In furrow S = Seed treatment

Large plot demonstration experiments for control of Colorado potato beetle in Wisconsin potatoes.

Purpose: The purpose of this experiment was to evaluate various Colorado Potato Beetle (CPB), full-season, reduced-risk, insecticide programs.

Methods and Materials

This experiment was conducted in 2010 on a loamy sand soil at Hancock Agricultural Research station (HAES) located 1.1 mile (1.8 km) southwest of Hancock, Wisconsin. Potato, *Solanum tuberosum* cv. 'Russet Burbank', seed pieces were planted on 26 Apr. Plants were spaced 12 inches apart within rows. Rows were 3 ft apart. The 12-row plots were 36 feet wide by 30 feet long, for a total of 0.025 acres/plot. Replicates were separated by a 6 ft border of bare ground.

Three replicates of 15 full-season insecticide programs were arranged in a randomized complete block design. Systemic insecticides were applied either at plant (26 Apr) or at time of first hilling (5/17/10). The first foliar insecticide applications were at the appearance of early-instar CPB larvae (7 Jun for all treatments). Subsequent applications were made on 17 and 21 Jun, 19 Jul, and 6 Aug. Treatment information is available in Table 1. All in-furrow treatments were applied in 2.0 L of water at 11.0 gpa on 28 April using a two nozzle boom equipped with TeeJet XR8002VS flat fan spray nozzles powered by a CO₂ backpack sprayer at 30psi. Furrows were cut using a commercial potato planter without closing discs attached. Seed treatments were applied in 0.016 L of water on 27 April using a single nozzle boom applying 9.1 gpa equipped with an XR8002VS flat fan spray tip powered by a CO₂ backpack sprayer at 30psi. Immediately after the in-furrow treatments were applied and all seed piece treatments were placed in open furrows, all seed was covered by hilling. An application of Platinum 75SG occurred on 17 May with a tractor mounted insecticide injector. The insecticide was injected into the side of the potato hill. Platinum 75SG was also impregnated onto a polymer and applied in furrow at planting prior to hill closure. Foliar insecticides were applied using a CO₂ pressurized sprayer with a 12 ft boom operating at 30 psi delivering 22 gpa through TeeJet XR8003VS nozzles spaced 18" apart at 4.0 fps.

Control of CPB was assessed by counting the number of egg masses (EM), small larvae (SL), and large larvae (LL) per plant on 10 randomly selected plants in each plot. Percent defoliation (%DF) ratings were taken by visual observation of the entire plot. Control of potato leafhopper (PLH), *Empoasca fabae*, were assessed by counting the number of adults collected from 25 sweep net samples in each plot. Aphid and potato leafhopper nymph populations were surveyed using 25 leaves per plot. Insect counts occurred on several dates throughout the summer and reported means were averaged across those dates (**Tables 2, 3**). Insect count averages reflect time periods during the summer when specific life stages peaked in the plots. Yield and quality data were collected after harvest (9/14/10) (**Table 4**). Count data were log₁₀ transformed prior to analysis. Proportion data were arcsine transformed prior to analysis. Means were separated using ANOVA with a Fisher's Protected Least Squared Difference (LSD) option (P=0.05).

Results and Discussion

This trial was designed to demonstrate that there are various effective CPB control options available to the potato growers of Wisconsin. Season long CPB efficacy was achieved with all the programs evaluated and this is reflected in the yields obtained from the plots (Table 4). Most of the systemic programs in this trial provided effective first generation CPB control (Table 1). The application of Platinum 75SG at hilling proved ineffective and an application of Radiant SC was required to limit increasing defoliation in the treatment. Applications of Radiant SC were also required in the Coragen 1.67SC and Belay 2.13SC in furrow treatments to control first generation CPB larvae. A single application of foliar materials at the correct timing provided effective first generation CPB larval control in most of the foliar based programs. However, two foliar applications were required during peak second generation larval populations in all of the treatments during late July and early August.

(continued)

Table 1. Treatment list

Trt	1st generation CPB				2nd generation CPB			
	AppDate	Insecticide	Rate	[†] Type	AppDate	Insecticide	Rate	[†] Type
1	26-Apr	Platinum 75 SG	2.67 oz wt/a	IF	19-Jul	^a Voliam Xpress 1.25 ZC	7 fl oz/a	F
					6-Aug	^a Voliam Xpress 1.25 ZC	5 fl oz/a	F
2	26-Apr	Admire Pro 4.6 F	8.7 fl oz/a	IF	19-Jul	^b Coragen 1.67 SC	5 fl oz/a	F
					6-Aug	^b Coragen 1.67 SC	5 fl oz/a	F
3	26-Apr	Coragen 1.67 SC	7 fl oz/a	IF	19-Jul	^a Actara 25 WDG	3 oz wt/a	F
	17-Jun	Radiant 1 SC	8 fl oz/a	F	6-Aug	^a Actara 25 WDG	1.5 oz wt/a	F
4	26-Apr	Belay 2.13 SC	12 fl oz/a	IF	19-Jul	^a Voliam Xpress 1.25 ZC	7 fl oz/a	F
	17-Jun	Radiant 1 SC	8 fl oz/a	F	6-Aug	^a Voliam Xpress 1.25 ZC	5 fl oz/a	F
5	26-Apr	DPX-HGW86 20 SC	13.5 fl oz/a	IF	19-Jul	^a Actara 25 WDG	3 oz wt/a	F
					6-Aug	^a Actara 25 WDG	1.5 oz wt/a	F
6	17-May	Platinum 75 SG	2.67 oz wt/a	PM	19-Jul	^a Voliam Xpress 1.25 ZC	7 fl oz/a	F
					6-Aug	^a Voliam Xpress 1.25 ZC	5 fl oz/a	F
7	26-Apr	A16901 40 WG	10 oz wt/a	IF	19-Jul	^a Voliam Xpress 1.25 ZC	7 fl oz/a	F
					6-Aug	^a Voliam Xpress 1.25 ZC	5 fl oz/a	F
8	17-May	Platinum 75 SG	2.67 oz wt/a	H	19-Jul	^a Voliam Xpress 1.25 ZC	7 fl oz/a	F
	17-Jun	Agri-Mek 0.15 EC	12 fl oz/a	F	6-Aug	^a Voliam Xpress 1.25 ZC	5 fl oz/a	F
9	7-Jun	^b Coragen 1.67 SC	5 fl oz/a	F	19-Jul	^a Assail 30 SG	4 oz wt/a	F
	*	^b Coragen 1.67 SC	5 fl oz/a	F	6-Aug	^a Assail 30 SG	2.5 oz wt/a	F
10	7-Jun	^a Radiant 1 SC	8 fl oz/a	F	19-Jul	^a Agri-flex 1.55 SC	0.79 fl oz/a	F
	*	^a Radiant 1 SC	6 fl oz/a	F	6-Aug	^a Agri-flex 1.55 SC	0.6 fl oz/a	F
11	7-Jun	^a Agri-Mek 0.15 EC	12 fl oz/a	F	19-Jul	^a Endigo 2.06 ZC	4 fl oz/a	F
	*	^a Agri-Mek 0.15 EC	8 fl oz/a	F	6-Aug	^a Endigo 2.06 ZC	2.5 fl oz/a	F
12	7-Jun	^c Rimon 0.83 EC	12 fl oz/a	F	19-Jul	^b Coragen 1.67 SC	5 fl oz/a	F
	*	^c Rimon 0.83 EC	8 fl oz/a	F	6-Aug	^b Coragen 1.67 SC	3.5 fl oz/a	F
13	7-Jun	^a Actara 25 WDG	3 oz wt/a	F	19-Jul	^a Agri-Mek 0.7 SC	2.58 fl oz/a	F
	17-Jun	^a Actara 25 WDG	1.5 oz wt/a	F	6-Aug	^a Agri-Mek 0.7 SC	2 fl oz/a	F
14	7-Jun	^b Coragen 1.67 SC	5 fl oz/a	F	19-Jul	^a Radiant 1 SC	8 fl oz/a	F
	*	^b Coragen 1.67 SC	3.5 fl oz/a	F	6-Aug	^a Radiant 1 SC	6 fl oz/a	F
15	7-Jun	^a Agri-flex 1.55 SC	0.79 fl oz/a	F	19-Jul	^b Coragen 1.67 SC	5 fl oz/a	F
	17-Jun	^a Agri-flex 1.55 SC	0.6 fl oz/a	F	6-Aug	^b Coragen 1.67 SC	3.5 fl oz/a	F

[†]F=foliar, H=1st hilling, IF=In furrow, PM=Polymer impregnated

* Intended spray was unnecessary because beetle count was below threshold

^aNIS 100 L added at 0.5 %v/v

^bMSO 100 L added at 0.5 %v/v

^cSilwet 100 L added at 0.23 %v/v

Table 2. Mean CPB counts per plant of different life stages and percent defoliation.

Trt	Adults	Egg Masses	Small Larvae	Large Larvae	% Defoliation
	(Jul 15, 23, Aug 2, 16)	(Jun 2, 7, 15, 22)	(Jun 7, 15, 22, Jul 1)	(Jun 15, 22, Jul 1, 8)	
1	9.5	0.8 c-e	5.3 c-e	5.3 cd	18.6 bc
2	11.2	1.1 b-e	12.5 b-e	25.6 ab	22.8 ab
3	5.7	3.3 a-c	34.7 a	14.7 a-d	19.2 bc
4	6.8	0.7 de	3.1 e	4.1 cd	10.8 c
5	7.3	0.9 b-e	9.5 b-e	9.8 a-d	13.5 c
6	9.4	0.7 e	2.4 de	3.5 d	13.9 bc
7	6.3	0.6 e	2.6 e	3.2 cd	15.0 bc
8	8.3	3.0 a-e	21.6 a	8.4 a-c	12.5 c
9	6.1	2.4 a-d	9.6 a	6.2 b-d	16.1 bc
10	5.6	2.4 ab	11.4 ab	7.8 cd	18.9 bc
11	3.4	2.6 a-d	8.3 a-c	5.7 cd	13.6 c
12	10.0	2.9 a	18.7 a	9.7 ab	31.1 a
13	3.9	3.0 ab	10.4 ab	4.7 cd	15.0 bc
14	3.9	2.1 a-e	4.1 a-d	6.7 a-d	18.1 bc
15	16.9	2.5 a-d	22.8 a	11.9 a	35.3 a
P	0.3301	0.0075	<.0001	0.0116	0.0004
LSD	0.9359	0.8595	1.3012	1.1021	0.1944

Table 3. Mean PLH and aphid counts per plant

Trt	PLH adults		Aphids	
	(Jun 15, 22)	(Jul 8, 15)	(Jun 22)	(Jul 8, 15)
1	0.3 e	0.3 b	0.0	0.2 ef
2	0.3 e	0.5 b	0.0	0.5 d-f
3	2.5 a-c	6.3 a	0.0	3.2 a
4	0.5 de	0.2 b	0.0	0.7 d-f
5	2.8 a-c	5.5 a	0.0	1.5 a-f
6	0.3 e	0.3 b	0.0	0.2 ef
7	0.7 de	0.8 b	0.0	0.0 f
8	1.3 c-e	0.3 b	0.0	1.0 b-f
9	1.8 b-d	4.8 a	0.0	4.0 ab
10	2.7 a-c	7.0 a	0.0	2.0 a-e
11	3.0 a-c	6.0 a	0.3	2.5 a-c
12	5.2 a	6.5 a	0.0	2.8 ab
13	1.3 c-e	3.5 a	0.0	0.8 c-f
14	3.3 ab	4.8 a	1.0	2.8 ab
15	2.7 a-d	5.0 a	0.0	2.5 a-d
P	<.0001	<.0001	0.6818	0.0005
LSD	0.6634	0.6491	0.4696	0.7111

Table 4. Mean yield and quality data.

Trt	Proportion US #1	CWT/A	Specific Gravity
1	0.8	484.5	1.075
2	0.9	460.2	1.074
3	0.9	498.5	1.075
4	0.8	486.8	1.078
5	0.9	506.0	1.075
6	0.9	489.5	1.077
7	0.8	426.1	1.074
8	0.9	509.7	1.075
9	0.8	515.3	1.072
10	0.9	491.9	1.074
11	0.9	607.0	1.076
12	0.9	424.1	1.071
13	0.9	583.0	1.077
14	0.9	505.7	1.075
15	0.8	395.3	1.072
P	0.3953	0.4103	0.4035
LSD	0.1212	0.333	0.0025

Foliar insecticide treatments for the control of European corn borer in Wisconsin snap bean production

Purpose: The purpose of this experiment is to evaluate various foliar-applied, registered and experimental insecticides targeting populations of European corn borer (ECB), *Ostrinia nubilalis*, larvae in snap beans.

Materials and Methods: This experiment was conducted at Arlington Agricultural Experiment Station (AAES) in Arlington, WI in 2010. Snap bean, *Phaseolus vulgaris* var. ‘Hercules’, was seeded on 14 Jun at a rate of 8 seeds per foot within rows. Rows were 30 inches apart. The two-row plots were 5 ft wide by 25 ft long, for a total of 0.03 acres. Replicates were separated by two untreated rows. All plots received an at-plant seed treatment application of thiamethoxam (Cruiser[®] 5FS), and were managed per commercial management practices.

Four replicates of 14 treatments and 1 untreated control were arranged in a randomized complete block design. The foliar treatments were applied 11 Jul when plants had reached the flowering and pin-bean development stage. Treatments were applied with a CO₂ pressurized backpack sprayer with a 6’ boom operating at 29.2 psi delivering 24 gpa through 4 flat-fan nozzles (XR8003VS) spaced 18” apart while travelling at 3.5 ft / sec.

Each plot was infested with ECB egg masses on two dates, one before and one after a single insecticide treatment (8 and 14 Jul, respectively). In each plot for each pinning date, five successive plants were infested, each with five egg masses for a total of 25 egg masses applied in each plot.

Populations of ECB and associated damage estimates were surveyed 30 Jul, 16 days after the second insect pinning by counting (1) total number of damaged plants, (2) number of damaged stems per plant, (3) number of damaged pods, and (4) the number of viable larvae observed in both stems and pods. The survey was done only on the five plants that had been infested. See **Table 1** for a summary of key field activity dates. Count data were log₁₀ transformed prior to analysis. Proportion data were arcsin transformed prior to analysis. Means were separated using ANOVA with a Least Squared Difference (LSD) option (P=0.05). Data are presented in **Table 2**.

Table 1. Summary of key field activity dates.

Action	Planting	First infestation	Insecticide app.	Second infestation	Evaluation
Date	14 Jun	8 Jul	11 Jul	14 Jul	30 Jul
Days from last action		24	3	3	16

Results and Discussion

Natural populations of ECB at AAES are annually variable and require that experimental plots be artificially infested with test insects. Established infestation levels in the experimental plots and particularly the untreated control were considered to be above average for what is typically observed during annual trials.

Table 2. Mean damage estimates of plants, stems, pods, and number of larvae.

Treatment	Rate*	Infested 8 Jul (before insecticide application)					Infested 14 Jul (after insecticide application)				
		Proportion Damaged Plants	Proportion Damaged Pods	# Larvae in Stem	# Larvae in Pods	US ton/a	Proportion Damaged Plants	Proportion Damaged Pods	# Larvae in Stem	# Larvae in Pods	US ton/a
Untreated		0.7	0.2	3.5	2.3	4.8	0.4	0.1	1.5	0.3	4.2
HGW 86 10 SE	0.134	0.5	0.1	0.8	1.3	5.3	0.2	0.1	0.5	0.0	4.5
MSO 100 L	0.5 %v/v										
Coragen 1.67 SC	0.059	0.2	0.1	0.3	0.5	3.1	0.2	0.1	0.3	0.3	5.0
MSO 100 EC	0.5 %v/v										
Coragen 1.67 SC	0.066	0.5	0.1	0.8	1.8	6.0	0.2	0.0	0.3	0.5	4.8
MSO 100 EC	0.5 %v/v										
Belt 4 SC	0.094	0.4	0.1	0.8	1.5	4.8	0.2	0.1	0.0	1.3	5.5
NIS 100 XL	0.25 %v/v										
Brigade 2 EC	0.1	0.5	0.0	1.3	0.8	4.8	0.1	0.0	0.0	0.0	3.7
Warrior II 2.08 SC	0.0312	0.3	0.0	0.3	0.5	5.5	0.2	0.1	0.0	0.0	5.5
Radiant 1 SC	0.0625	0.4	0.1	1.0	0.8	5.9	0.2	0.0	0.3	0.0	3.7
Orthene 97 SG	1	0.3	0.1	0.0	0.5	5.7	0.2	0.1	0.3	0.5	4.2
Rimon 0.83 EC	0.058	0.5	0.0	1.0	0.0	4.0	0.2	0.0	0.0	0.3	5.6
Rimon 0.83 EC	0.078	0.8	0.1	1.0	1.0	6.8	0.2	0.1	0.0	0.8	6.0
Rimon 0.83 EC	0.058	0.6	0.1	1.3	0.8	6.1	0.4	0.0	0.8	1.0	5.0
Warrior 1 CS	0.02										
Rimon 0.83 EC	0.078	0.7	0.2	1.5	2.3	6.0	0.3	0.1	0.5	0.8	1.2
Warrior 1 CS	0.03										
Mustang Max 0.8 EC	0.025	0.4	0.1	0.0	0.8	4.5	0.2	0.0	0.3	0.0	3.8
Hero 1.14 EW	0.075	0.4	0.1	0.0	1.5	6.8	0.3	0.1	0.3	0.5	5.6
	P	0.4359	0.2258	0.2470	0.5294	0.4968	0.9457	0.9420	0.7915	0.2948	0.0852
	LSD	0.7168	0.2610	3.5964	3.7707	1.3781	0.5038	0.2327	2.9516	3.0755	1.3910

*Rate unit is lb ai/a unless otherwise noted

Systemic insecticide treatments for the control of European corn borer in Wisconsin snap bean production

Purpose: The purpose of this experiment was to evaluate the efficacy of several seed treatments on soil and foliar insect pests on snap beans.

Materials and Methods

This experiment was conducted at Arlington Agricultural Experiment Station in Arlington, WI in 2010. Snap bean, *Phaseolus vulgaris* var. 'Caprice', was seeded on 1 Jun at a rate of 8 seeds per foot within rows. Rows were 30 inches apart. The two-row plots were 5 ft wide by 20 ft long, for a total of 0.03 acres. Replicates were separated by two untreated rows. All plots were managed per commercial management practices.

Four replicates of 11 treatments and 1 untreated control were arranged in a randomized complete block design. The foliar treatments were applied 11 Jul when plants had reached the flowering and pin-bean development stage. Treatments were applied with a CO₂ pressurized backpack sprayer with a 6' boom operating at 29.2 psi delivering 24 gpa through 4 flat-fan nozzles (XR8003VS) spaced 18" apart while travelling at 3.5 ft / sec.

All plots were infested with ECB egg masses on 18 and 24 Jun and 8 Jul. In each plot for each pinning date, five successive plants were infested, each with five egg masses for a total of 25 egg masses applied in each plot.

Counts of emerged plants, fiddleheads and yellow plants per row were taken from 2 rows on 16 Jun. Counts of potato leafhopper (PLH), *Empoasca fabae*, nymphs (N) and adults (A), as well as aphid counts were taken from 20 sweeps in each plot on 13 Jul. Populations of ECB and associated damage estimates were surveyed 29 Jul, 18 days after the second insecticide application by counting (1) total number of damaged plants, (2) number of damaged stems per plant, (3) number of damaged pods, and (4) the number of viable larvae observed in both stems and pods. The survey was done only on the five plants that had been infested. Count data were log₁₀ transformed prior to analysis. Proportion data were arcsin transformed prior to analysis. Means were separated using ANOVA with a Least Squared Difference (LSD) option.

Results and Discussion

Seed corn maggot levels were above average in the trial with damaged seedling (fiddlehead) numbers reaching an average of 20 plants per row in the untreated plots. Among the treatments evaluated the seed treatments provided a higher level of efficacy when compared to the in-furrow treatments. The in-furrow treatments proved to be ineffective with fiddlehead numbers similar to the untreated plots. European corn borer efficacy was achieved with both seed and in-furrow treatments. Both plant and pod damage was reduced in the treated plots.

Table 1.

			a. Mean stand measurements			b. Mean sweep net counts			c. Mean damage, larval numbers and yield				
Trt	Rate	Type*	Stand Count	Fiddle-head	Yellow Plants	PLH A	PLH N	Aphids	Proportion Damaged Plants	Proportion Damaged Pods	# Larvae in Stem	# Larvae in Pod	Calculated Yield (ton/a)
Untreated			46.9 e	20.0 ab	0.8 b-d	2.5	3.8	0.5	1.0 a	0.1 ab	6.8 a	2.8	2.8
Coragen 625 FS	91 µg	S	69.3 cd	11.3 a-d	1.0 b-d	6.0	4.8	0.5	0.7 bc	0.1 a	1.8 ab	3.0	5.2
Coragen 625 FS	182 µg	S	67.6 cd	8.5 b-e	0.0 d	1.0	1.5	0.3	0.7 bc	0.0 bc	5.0 a	1.5	4.6
Coragen 625 FS	273 µg	S	98.4 bc	8.0 ef	0.0 d	3.3	1.5	2.5	0.7 b	0.1 ab	1.3 a-c	0.8	6.7
Coragen 625 FS	91 µg	S	100.1 ab	4.1 ef	2.0 ab	1.5	0.8	0.5	0.7 b	0.1 a	2.8 a	3.0	5.6
YX860 5 FS	91 µg												
HGW86 625 FS	91 µg	S	86.5 a-c	6.0 d-f	2.0 a	3.3	1.5	0.0	0.8 ab	0.1 ab	3.0 ab	1.5	4.9
HGW86 625 FS	273 µg	S	123.9 a	6.3 c-f	3.5 a	2.8	1.5	0.5	0.8 ab	0.1 a	4.0 a	3.0	6.1
Cruiser 5 FS	91 µg	S	113.5 ab	2.9 f	3.5 a	1.3	1.0	0.3	0.8 ab	0.1 a	3.5 a	3.0	6.4
Coragen 1.67 SC	0.066 lb ai/a	IF	60.5 de	13.5 a-c	1.0 a-c	3.3	3.3	0.5	0.3 d	0.0 c	0.3 cd	0.5	5.7
Coragen 1.67 SC	0.091 lb ai/a	IF	69.3 cd	14.8 a-c	0.3 cd	1.0	1.0	0.0	0.4 cd	0.0 c	0.3 cd	0.3	4.5
HGW 86 10 SE	10.1 oz/a	F	54.0 de	12.0 a-d	0.0 d	4.0	1.3	0.3	0.4 cd	0.0 c	1.0 b-d	0.0	4.0
MSO 100 L	0.5 % v/v												
Coragen 1.67 SC	3.5 oz/a	F	46.9 e	20.1 a	1.0 a-c	2.5	1.0	1.0	0.1 d	0.0 c	0.0 d	0.0	3.7
MSO 100 EC	0.5 % v/v												
P			<.0001	<.0001	<.0001	0.062	0.316	0.9232	<.0001	<.0001	<.0001	0.2617	0.2264
LSD			0.3213	0.8491	2.7047	2.2881	3.7004	3.5268	0.4949	0.1734	2.7662	3.8374	0.5882

*S = Seed treatment, IF = In furrow, F = Foliar

Foliar insecticide treatments for the control of tomato fruitworm in Wisconsin fresh market tomato production

Purpose: The purpose of this experiment was to evaluate various foliar-applied, registered insecticides targeting early larval instars of tomato fruitworm (TFW), *Helicoverpa zea*, infesting tomato fruit

Materials and Methods

This experiment was conducted at Arlington Agricultural Experiment Station in Arlington, WI in 2010. Tomato, *Solanum lycopersicon* cv. ‘Celebrity’, transplants were planted 25 May. Plants were spaced 36 inches apart within rows. Rows were 6 ft apart. Plots were single rows, 6 ft wide by 30 ft long, for a total of 0.004 acres. Replicates were separated by a 12 border of bare ground. The trial was established over black plastic and was trellised at regular intervals through the growing season using the Florida weave. The trial was sprinkler irrigated and plots managed according to commercial herbicide and fungicide recommendations for weed control and control of the late blight pathogen.

Each plot was infested with TFW egg masses on 29 Jul. In each plot, five successive plants were infested, each with five egg masses for a total of 25 egg masses applied in each plot. Egg masses were attached to plants mid-canopy and onto a fruit “hand” with green fruit. Each egg mass contained approximately 150-400 eggs / mass.

Four replicates of 6 experimental foliar treatments and 1 untreated control were arranged in a randomized complete block design. The treatments were applied 29 Jul when the crop development had reached maturation of the first fruit clusters in lower canopy positions. Treatments were applied by a CO₂ pressurized backpack sprayer with a 6’ boom operating at 42 psi delivering 29.4 gpa through 4 flat-fan nozzles (8002VS-XR) spaced 18” apart @ 3.5 ft / sec. Subsequent sprays followed on weekly intervals following initial application.

Populations of TFW and associated damage estimates were surveyed 18 August following the third application of insecticide by counting (1) total number of fruit, (2) the weight in pounds of fruit (3) number of damaged fruit, and (4) the number of viable larvae observed in fruit. Counts were taken from the five plants that had been pinned. See **Table 1** for a summary of key field activity dates. Count data were log₁₀ transformed prior to analysis. Proportion data were arcsin transformed prior to analysis. Means were separated using ANOVA with a Least Squared Difference (LSD) option (P=0.05). Data are presented in **Table 2**.

Table 1. Summary of key field activity dates.

Action	Planting	Infestation	Insecticide app.	Evaluation
Date	25 May	29 Jul	1 Aug	18 Aug
Days from last action			3	20

Results and Discussion

Natural populations of tomato fruitworm at the experimental site (AAES) are annually variable and require that experimental plots be artificially infested with test insects to ensure an adequate pest pressure. Established infestation levels in the experimental plots and particularly the UTC were considered adequate for the experimental trial.

Table 2. Mean larval counts and yield and damage estimates.

Treatment	Rate	Tot No. Fruit	Weight (lb)	No. damaged fruit	Proportion Damaged Fruit	Total Larvae
Untreated		57.1	28.0	9.0 a	0.2 a	0.7 a
Rimon 0.83 EC	12 fl oz/a	56.0	25.5	3.6 ab	0.1 bc	0.2 b
Rimon 0.83 EC	9 fl oz/a	50.8	22.6	4.6 ab	0.1 b	0.2 b
Rimon 0.83 EC	12 fl oz/a	50.8	25.8	1.8 c	0.0 cd	0.0 b
Warrior 1 CS	3.84 fl oz/a					
Rimon 0.83 EC	9 fl oz/a	55.2	27.4	2.4 bc	0.0 b-d	0.0 b
Warrior 2 CS	2.56 fl oz/a					
Rimon 0.83 EC	12 fl oz/a	56.2	25.5	1.2 c	0.0 d	0.0 b
Provado 1.6 F	3.8 fl oz/a					
Coragen 1.67 SC	5 fl oz/a	47.4	24.9	3.3 a-c	0.1 bc	0.0 b
	P	0.2248	0.1366	0.0068	<.0001	<.0001
	LSD	0.1978	0.2102	1.47	0.0845	0.802