Wisconsin Vegetable Insect Pest Management Research Summer Field Trials

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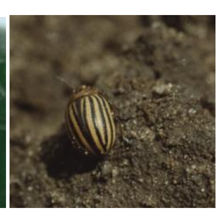

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Evaluation of foliar insecticides for the control of Lepidopteran insect pests in cabbage

Purpose: The objective of this experiment was to assess the efficacy of foliar insecticides to control Lepidopteran insect pests in cabbage.

Materials and Methods

This experiment was conducted at the Arlington Agricultural Experiment Station, Arlington, WI in 2014. Cabbage, *Brassica oleracea* cv. 'Katlin', transplants were planted 5 June. 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 (untreated) between plots. Plots were arranged into four replications with no alleys between replications. All plots were maintained according to standard commercial practices.

Four replicates of 7 experimental foliar treatments and 1 untreated control were arranged in a randomized complete block design. All foliar treatments were applied 6 Aug. Treatments were applied with a CO_2 backpack sprayer with a 6 foot boom operating at 30 psi delivering 20 gpa through four flat-fan nozzles (Tee Jet XR8002XR) spaced 18" apart while traveling at 3.5 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 (large larvae, "L" and small larvae, "S") per plant on 10 destructively sampled, randomly selected plants from the center two rows in each plot (5 random plants per row). Larval counts occurred on Aug. 8 (2 DAT), Aug.13 (7 DAT) and Aug.18 (12 DAT). Means were separated using ANOVA with a Least Squared Difference (LSD) means comparison test (P=0.05).

During 2014 Lepidopteran pressure was very low. DB populations were the most prevalent of all Lepidopteran pests. No signs of phototoxicity were observed among treatments.

Table 1. Mean counts of Imported cabbageworm (ICW - large and small larvae and pupae), Diamondback moth (DM - large and small larvae), and Cabbage looper (CL - large and small larvae) per cabbage head.

		8 -Aug					
Treatment[1]	**Rate[2]**	**ICW-L**	**ICW-S**	**DB-L**	**DB-S**	**CL-L**	**CL-S**
Untreated	-	0.5 a	2.25 ab	1.0 a	6.5 a	0.5 a	7.25 a
Cyclaniliprole 50SL	11	0.0 a	0.25 b	0.25 ab	5.25 ab	0.5 a	5.5 a
Cyclaniliprole 50SL	16.5	0.0 a	3.5 a	0.0 b	2.25 c	1.25 a	5.25 a
Exirel	10	0.25 a	1.0 ab	0.5 ab	2.5 bc	0.5 a	3.25 a
Warrior II	1.92	0.0 a	1.75 ab	0.0 b	3.75 ac	0.25 a	4.75 a
Radiant	8	0.0 a	1.0 ab	0.25 ab	4.0 ac	0.0 a	5.0 a
Brigade	6.4	0.25 a	1.0 ab	0.0 b	1.75 c	0.25 a	6.0 a
Coragen	5	0.25 a	2.0 ab	0.5 ab	5.75 a	0.25 a	8.0 a
	P	0.7513	0.2446	0.1756	0.0253	0.7505	0.5206
	LSD	0.1823	0.3890	0.1875	0.2653	0.2802	0.3361

Means in a column followed by the same letter are not significantly different at = 0.05.
[1]All treatments except Untreated and Exirel also had NIS at 0.5 % v/v, Exirel had MSO at 0.5 % v/v.
[2] Rate in fl oz/a unless noted
***Using "Letter Display" ls means from proc glimmix data

Table 2. Mean counts of Imported cabbageworm (ICW - large and small larvae and pupae), Diamondback moth (DM - large and small larvae), and Cabbage looper (CL - large and small larvae) per cabbage head.

		13-Aug					
Treatment[1]	**Rate[2]**	**ICW-L**	**ICW-S**	**DB-L**	**DB-S**	**CL-L**	**CL-S**
Untreated	-	1.5 a	1.75 a	2.25 a	3.0 a	1.0 a	5.75 a
Cyclaniliprole 50SL	11	0 b	0 b	0 b	0.25 b	0.25 b	0.75 b-d
Cyclaniliprole 50SL	16.5	0 b	0 b	0 b	1.0 ab	0.5 ab	0.75 b-d
Exirel	10	0.25 b	0.25 b	0 b	0.75 b	0 b	1.75 b
Warrior II	1.92	0 b	0 b	0.25 b	1.75 ab	0.25 b	0.75 cd
Radiant	8	0.25 b	0 b	0 b	1.0 ab	0 b	1.25 bc
Brigade	6.4	0 b	0 b	0.25 b	0.25 b	0 b	0 d
Coragen	5	0 b	0 b	0 b	0.5 b	0 b	1.75 b
	P	0.0157	0.0010	<.0001	0.0793	0.0183	0.0006
	LSD	0.1842	0.1678	0.1527	0.3043	0.1599	0.2526

Means in a column followed by the same letter are not significantly different at ? = 0.05.
[1]All treatments except Untreated and Exirel also had NIS at 0.5 % v/v, Exirel had MSO at 0.5 % v/v.
[2] Rate in fl oz/a unless noted

Table 3. Mean counts of Imported cabbageworm (ICW - large and small larvae and pupae), Diamondback moth (DM - large and small larvae), and Cabbage looper (CL - large and small larvae) per cabbage head.

Treatment[1]	Rate[2]	18-Aug					
		ICW-L	ICW-S	DB-L	DB-S	CL-L	CL-S
Untreated	-	2.0 a	1.5 a	0 a	1.25 a	1.5 a	1.5 ab
Cyclaniliprole 50SL	11	0 b	0 b	0 a	0.25 a	0 b	0 c
Cyclaniliprole 50SL	16.5	0 b	0.25 ab	0 a	0 a	0.25 b	0 c
Exirel	10	0 b	0 b	0 a	0 a	0 b	1.5 a
Warrior II	1.92	0 b	0.5 ab	0.5 a	0.5 a	0.25 b	1.0 ab
Radiant	8	0.25 b	0.25 ab	0 a	0.5 a	0.25 b	1.0 ab
Brigade	6.4	0 b	0 b	0 a	0 a	0 b	0.25 bc
Coragen	5	0 b	0.25 ab	0 a	0.25 a	0 b	0.75 a-c
	P	0.0003	0.2349	0.4553	0.4366	0.0006	0.0601
	LSD	0.1669	0.2429	0.1231	0.2539	0.1553	0.2663

Means in a column followed by the same letter are not significantly different at = 0.05.
[1]All treatments except Untreated and Exirel also had NIS at 0.5 % v/v, Exirel had MSO at 0.5 % v/v.
[2] Rate in fl oz/a unless noted

Evaluation of foliar insecticides for the control of onion thrips on 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*, on dry-bulb onion.

Materials and Methods

This experiment was conducted in a cooperating producer's onion field located 5.1 miles (8.1 km) west of Coloma, Wisconsin on a muck soil in 2014. Onion, *Allium cepa* cv. 'Safrane', was direct seeded on 5 May, 2014. Plants were spaced 2.6 inches apart within rows. Rows were 9.4 inches apart. The six-row plots were 60 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 19 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 29 July and 5 August. Treatments were applied with a CO_2 backpack sprayer with a 6 foot boom operating at 30 psi delivering 22.1 gpa through four flat-fan nozzles (Tee Jet XR8002XR) spaced 18" apart while traveling at 3.5 ft / sec.

Immature life stages 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 three times during August, on 8 Aug (10 DAT), after the first application and again 12 Aug (7 DAT) and 19 Aug (14 DAT) after the second application. Means were separated using ANOVA with a Fisher's Protected Least Squared Difference (LSD) means comparison test (P=0.05). Data are presented in **Table 1**.
No signs of phototoxicity were observed among treatments.

Table 1. Mean count of immature onion thrips per plant.

Treatment	Rate		8-Aug	12-Aug	19-Aug
Untreated	.	.	1.4 ab	3.125 a	1.125 a
Warrior II + NIS	1.92	fl oz/a	0.825 b-f	1.825 b-f	0.225 b
Exirel	10.1	fl oz/a	1.85 a	1.425 b-e	0.7 ab
Exirel	13.5	fl oz/a	1.3 ab	1.575 b-f	0.6 ab
Radiant + NIS	8	fl oz/a	0.75 b-f	0.875 c-f	0.425 b
Radiant + NIS	6	fl oz/a	0.625 b-f	0.35 f	0.3 b
Movento + MSO	4	fl oz/a	0.775 b-f	1.325 b-f	0.65 ab
Movento + MSO	5	fl oz/a	0.375 ef	2.325 a-d	0.375 b
Agri-Mek + NIS	3.5	fl oz/a	1.225 a-c	1.2 b-f	0.675 ab
Agri-Mek + NIS	2.5	fl oz/a	1.45 a-d	2.575 ab	0.475 ab
Agri-Mek	3.5	fl oz/a	1.05 a-e	0.6 c-f	0.775 ab
Agri-Mek	2.5	fl oz/a	0.975 a-e	1.825 a-c	0.55 ab
Agri-Mek + NIS	16	fl oz/a	1.05 b-f	1.5 b-f	0.45 ab
Lannate + NIS	2	pt/a	0.3 f	0.725 c-f	0.325 b
Lannate + NIS	3	pt/a	0.65 b-f	0.775 c-f	0.675 ab
Cyclaniliprol 50SL + MSO	5.5	fl oz/a	1.075 b-f	0.95 c-f	1.025 ab
Cyclaniliprol 50SL + MSO	11	fl oz/a	1.3 ab	2.025 a-c	0.35 b
Cyclaniliprol 50SL + MSO	16.4	fl oz/a	0.925 a-e	1.4 b-f	0.9 ab
Entrust + NIS	8	fl oz/a	0.675 b-f	0.55 ef	0.4 b
Entrust + NIS	6	fl oz/a	0.85 b-f	1.225 b-f	0.175 b
		P	0.0261	0.0236	0.5637
		LSD	0.1324	0.1786	0.1363

Means in columns followed by the same letter are not significantly different (Fisher's Protected Least Significant Difference Test, P = 0.05)
NIS 100 L added at 0.5% v/v
MSO 100 L added at 0.5% v/v

Registered and experimental foliar insecticides to control Colorado potato beetle and potato leafhopper on potato (HAES)

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*, and potato leaf hopper (PLH) adults, *Empoasca fabae*, on 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 2014. Potato, *Solanum tuberosum* cv. 'Superior', seed pieces were planted on 22 April. Seed pieces were spaced 12 inches apart within rows. Rows were 3 ft apart. Two-row plots were 6 ft wide by 20 ft long, for a total of 0.003 acres. Two untreated 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 28 experimental foliar treatments and 2 untreated controls 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 11 June for Rimon treatments, 19 and 27 June for all treatments. Treatments were applied with a CO_2 pressurized backpack sprayer with a 6 ft boom operating at 30 psi delivering 20 gpa through 4 flat-fan nozzles (Tee Jet XR8002) spaced 18" apart while travelling at 3.5 ft / sec.

CPB efficacy was assessed by counting the number of small larvae (SL), large larvae (LL), egg masses (EM) and adults (AD) per plant on 10 randomly selected plants from the center two rows in each plot. Percent foliage defoliation (%DF) ratings were assessed by visual observation of each plot. Control of potato leafhopper (PLH) 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 23 (4 DAT) and 25 (6 DAT), following the first application. The second set of counts occurred on June 30 (4 DAT), Jul 7 (11 DAT), and Jul 14 (18 DAT), following the second application. Insect count averages reflect time periods when specific CPB life stages peaked in the plots. Means were separated using ANOVA with a Fisher's Protected Least Squared Difference (LSD) mean separation test (P=0.05). No signs of phytotoxicity were observed among treatments.

Table 1. Mean Colorado potato beetle (CPB) counts per 10 plants of adults (AD), egg masses (EM), small (SL) and large (LL) larvae, percent defoliation and adult (AD) potato leafhoppers (PLH).

Treatment	Rate (oz/a)	CPB-AD	CPB-EM	CPB-SL	CPB-LL	% Defoliation	PLH (AD)	PLH (NY)	Aphids
		(Jul 8)	(Jul 8)	(Jul 8)	(Jul 8)	(Jul 8)	(Jul 8)	(Jul 8)	(Jul 8)
Untreated		3.5 a-e	0 b	18.5 a-c	50.25 a-c	2 bc	0.5 b-d	0 c	0 b
Exp 1+NIS	3.57	0.5 e	0 b	0 g	0.5 i-k	1 e	1.25 a-c	0.25 bc	0 b
Agrimek+NIS	3.42	4.25 a-c	0 b	0.25 g	0.25 jk	1 e	2.5 a	0.25 bc	0 b
Exp 2+Agrimek+NIS	3.57, 3.42	1.0 c-e	0 b	0 g	0.25 jk	1 e	0.5 b-d	1.0 a	0 b
Besiege+NIS	8.9	0.25 e	0 b	0.25 g	0 k	1 e	0.75 b-d	0.5 ab	0 b
Exirel+NIS	13.5	0.5 ef	0 b	0.25 g	0 k	1 e	0.75 b-d	0 c	0 b
Coragen	5	1.5 c-e	0 b	0.25 g	0.5 ik	1 e	1.0 a-d	0.5 ab	0 b
Coragen	4.5	2.25 a-e	0 b	0.75 g	0.5 ik	1 e	1.75 a-c	0 c	0 b
Exp 3	0.065	2.5 a-e	0 b	14.75 ab	22.75 d-f	1.75 b-d	0.75 b-d	0 c	0 b
Exp 4	0.11	6.0 a-d	0 b	15.5 ab	34.5 b-d	1 e	0.25 cd	0 c	0 b
Admire Pro	3.8	4.0 a-c	0.25 b	5.5 c-f	13.25 e-g	1.25 de	1.75 ab	0 c	0 b
Avaunt	0.11	4.0 a-e	0.25 b	13.0 a-c	40.75 a-d	1.5 c-e	0.75 b-d	0 c	0 b
Avaunt	0.065	4.75 a-c	0 b	21.5 a	73.75 a	1.75 b-d	0.5 b-d	0.25 bc	0.25 ab
Leverage 360	2.8	2.75 a-e	0.75 ab	13.0 a-c	14.25 e-g	1 e	0 d	0 c	0 b
Belay	3	5.75 a-f	0.5 ab	0.25 g	1.5 h-k	1.5 c-e	0.5 b-d	0 c	0 b
	P	0.0800	0.3516	<.0001	<.0001	<.0001	0.1698	0.0384	0.657
	LSD	0.4556	0.1623	0.0446	0.3363	0.0051	0.2822	0.1451	0.0985

Means in columns followed by the same letter are not significantly different (Fisher's Protected Least Significant Difference Test, P = 0.05) (continued)
NIS 100 L added at 0.01% v/v

Table 1. (Continued) Mean Colorado potato beetle (CPB) counts per 10 plants of adults (AD), egg masses (EM), small (SL) and large (LL) larvae, percent defoliation and adult (AD) potato leafhoppers (PLH).

Treatment	Rate (oz/a)	CPB-AD	CPB-EM	CPB-SL	CPB-LL	% Defoliation	PLH (AD)	PLH (NY)	Aphids
		(Jul 8)	(Jul 8)	(Jul 8)	(Jul 8)	(Jul 8)	(Jul 8)	(Jul 8)	(Jul 8)
Untreated		9.5 a	0 b	9.5 b-d	47.25 a-c	2.25 ab	0.75 b-d	0 c	0 b
Blackhawk	2.5	1.75 c-e	1.25 a	1.0 fg	2.5 h-j	1 e	0.25 cd	0 c	0 b
Blackhawk	3.3	1.5 c-e	0 b	0 g	3.5 h	1 e	0 d	0.5 bc	0.25 ab
Actara	3	1.75 a-e	0.25 b	0.5 g	2.0 hi	1 e	0.5 b-d	0 c	0 b
Cyclaniliprole 50SL	11	0.75 b-f	0.25 b	0.25 g	0 k	1 e	0 d	0 c	0 b
Cyclaniliprole 50SL	16.4	1.5 c-e	0 b	0 g	0.25 jk	1 e	0.5b-d	0.25 bc	0.5 a
Agri-Flex	6	1.25 c-e	0 b	0.25 g	0 k	1 e	0.25 cd	0 c	0 b
Athena+Athena	17, 13	3.75 a-c	0 b	2.25 e-g	26.0 c-e	1 e	0. b-d	0.25 bc	0 b
Athena+Athena	17, 17	1.75 a-e	0 b	0.75 g	9.5 g	1 e	0.5 b-d	0 c	0 b
Gladiator+Gladiator	19, 12	8.0 a	0 b	8.5 b-e	26.5 c-e	1 e	0.25 cd	0 c	0.25 ab
Gladiator+Gladiator	19, 19	3.0 a-e	0 b	5.25 b-e	9.0 fg	1 e	1.0 b-d	0 c	0 b
Brigadier+Brigadier	6.4, 5	4.0 a-e	0 b	5.75 b-e	22.25 d-g	1 e	0.25 cd	0 c	0 b
Untreated		4.5 a-e	0 b	3.75 d-g	73.75 ab	0.03 a	0.25 cd	0 c	0 b
Rimon (4Xs)	6,6,6,6	1.5 c-e	0 b	0 g	0.5 i-k	1 e	0.75 b-d	0 c	0.25 ab
Rimon (3Xs)	10,8,8	2.5 c-e	0.5 ab	0.75 g	1.5 h-j	1 e	1.5 a-c	0.5 bc	0 b
	P	0.0800	0.3516	<.0001	<.0001	<.0001	0.1698	0.0384	0.657
	LSD	0.4556	0.1623	0.0446	0.3363	0.0051	0.2822	0.1451	0.0985

Means in columns followed by the same letter are not significantly different (Fisher's Protected Least Significant Difference Test, P = 0.05).

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 the Arlington Agricultural Experiment Station (AAES), Arlington, WI in 2014. Potato, *Solanum tuberosum* cv. 'Superior', seed pieces were planted on 6 May. 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. . The plots were managed according to commercial pest management (herbicide and fungicide) practices as well as fertility recommendations prescribed by AAES.

Four replicates of 14 experimental foliar treatments and 1 untreated control were arranged in a randomized complete block design. The foliar treatments were applied 8 July. Treatments were applied with a CO_2 pressurized backpack sprayer with a 6 ft boom operating at 30 psi delivering 20 gpa through 4 flat-fan nozzles (Tee Jet XR8002XR) spaced 18" apart while travelling at 3.5 ft/sec.

PLH efficacy was assessed by counting the number of PLH nymphs (NY) on 25 randomly selected leaves in each plot while PLH adults (AD) were assessed by using sweep samples consisting of 25 sweeps per plot (**Table 1**). Insect counts occurred on three dates during July: 11 July (3 DAT), 16 Jul (8 DAT), 22 July (14 DAT) and 29 Jul (21 DAT). Means were separated using ANOVA with a Fisher's Protected Least Squared Difference (LSD) mean separation test (P=0.05).
Aphid numbers were very low throughout the trial and were not included in the summary. No signs of phytotoxicity were observed.

Table 1. Mean adult (AD) and nymphal (NY) potato leafhoppers (PLH) per sample. PLH nymphs were assessed on 25 randomly selected leaves in each plot while adults were assessed by using sweep samples consisting of 25 sweeps per plot.

		11-Jul		16-Jul		22-Jul		29-Jul	
Treatment	**Rate**	**PLH-AD**	**PLH-NY**	**PLH-AD**	**PLH-NY**	**PLH-AD**	**PLH-NY**	**PLH-AD**	**PLH-NY**
Untreated	.	0.0 a	0 b	0.5 ab	0	0.25 ab	0	2.0 a	1.0 a
Athena	0.088 lb ai/a	0.0 a	0 b	0 b	0	0 b	0	0.25 bc	0 b
Brigadier	0.1 lb ai/a	0.0 a	0 b	0.25 ab	0	1.25 ab	0	0 c	0.5 ab
Endigo	0.0826 lb ai/a	0.25 a	0 b	0 b	0	2.25 ab	0	0.25 bc	0 b
Warrior II	0.0312 lb ai/a	0.0 a	0 b	0 b	0	0.25 ab	0	0 c	0 b
Actara	0.047 lb ai/a	0.0 a	0 b	0 b	0	0.75 ab	0	0.5 bc	0 b
LEVERAGE 360	0.138 lb ai/a	0.0 a	0 b	0.25 ab	0	0.5 ab	0	0 c	0.25 ab
Rimon	10 fl oz/a	0.0 a	0 b	0 b	0	0.5 ab	0	1.5 a-c	0.75 ab
Exp 1	0.065 lb ai/a	0.0 a	0 b	0.25 ab	0	0.75 ab	0	0.5 bc	0.25 ab
Exp 1	0.11 lb ai/a	0.20 a	0 b	0.40 ab	0	1.6 ab	0	0.75 bc	0 b
Avaunt	0.065 lb ai/a	0.0 a	0 b	1.32 ab	0	1.4 ab	0	0.5 bc	0.75 a
Avaunt	0.11 lb ai/a	0.0 a	0.5 a	0.75 a	0	3.0 a	0	1.5 ab	0 b
Gladiator	12 fl oz/a	0.0 a	0 b	0 b	0	1.25 ab	0	0.75 a-c	0 b
Baythroid	1.6 fl oz/a	0.0 a	0 b	0.25 ab	0	0.5 ab	0	0.25 bc	0 b
Brigade	2.1 fl oz/a	0.0 a	0 b	0.25 ab	0	0.25 ab	0	0 c	0 b
	P	0.5852	0.7271	0.5547	.	0.5805	.	0.0976	0.1945
	LSD	0.0769	0.091	0.2218	.	0.3727	.	0.269	0.2071

Means in columns followed by the same letter are not significantly different (Fisher's Protected Least Significant Difference Test, P = 0.05).

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 mineral oils, insecticides and feeding blockers 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, Antigo, WI in 2014. Potato, *Solanum tuberosum* cv. 'Russet Norkotah', seed pieces were planted on 23 May. Seed pieces were spaced 12 inches apart within rows. Rows were 3 ft apart. The four-row plots were 8 ft wide by 50 ft long, for a total of 0.009 acres. 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. Natural sources of PVY inoculum are present in the local environment, and thus no PVY sap, or seed-borne inoculations were supplemented in the current experiment.

Four replicates of 7 experimental foliar treatments and 1 untreated control were arranged in a randomized complete block design. Foliar applications were initiated on 2 July and were re-applied either once weekly or twice weekly depending on the treatment (see **Table 1** for application frequency). Treatments were applied with a CO_2 pressurized tractor-mounted sprayer with a 12 ft boom operating at 40 psi delivering 28.4 gpa through extended range flat fan nozzle tips (Tee Jet XVS8004) travelling at 4.5 mph.

Total plot yield was taken at harvest. Means were separated using ANOVA with a Fisher's Protected Least Squared Difference (LSD) mean separation test. 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. These data indicate that none of the treatments had negative effects on potatoes within 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 for various foliar products applied to the canopy of 'Russet Norkotah' to limit the spread of Potato virus Y.

Treatment	Rate		Start Date	Application Frequency	US #1-A (lbs)	US #1-B (lbs)	Total US #1-AB (lbs)	Total w/Culls (lbs)	PVY Incidence (%)
UTC			-	-	262.3 a	10.4 a	272.6 a	23.9 a	4.25 a
Stylet Oil (July 2)	1.5	% v/v	2-Jul	1x weekly	209.8 b	9.2 a	219.0 c	28.2 cd	1 b
Stylet Oil (July 16)	0.75	% v/v	16-Jul	1x weekly					
Aphoil (July 2)	4	% v/v	2-Jul	1x weekly	208.0 b	9.3 a	217.3 c	24.4 cd	1 b
Aphoil (July 16)	2	% v/v	16-Jul	1x weekly					
Stylet Oil (July 2)	0.75	% v/v	2-Jul	1x weekly	241.6 a	9.0 a	250.5 ab	15.3 bc	0 b
Aphoil (July 2)	2	% v/v	2-Jul	1x weekly	249.2 a	12.2 a	261.4 a	25.6 ab	0.75 b
Aphoil (July 2)	2	% v/v	2-Jul	1x weekly	212.1 b	11.1 a	223.2 c	28.5 cd	0.75 b
Actigard (July 16, 3X)	0.75	oz wt/a	16-Jul	3x appl					
Aphoil (July 2)	2	% v/v	2-Jul	1x weekly	217.0 b	11.6 a	228.6 bc	28.2 cd	0.75 b
Actigard (July 16, 3X)	1	oz wt/a	16-Jul	3x appl					
Stylet Oil (July 2)	0.75	% v/v	2-Jul	1x weekly	201.3 b	10.6 a	211.8 c	20.3 d	1 b
Actigard (July 16, 3X)	1	oz wt/a	16-Jul	3x appl					
				P	0.0001	0.5365	0.0001	0.0010	0.0125
				LSD	0.0444	0.1754	0.0431	0.0459	0.02693

Means in columns followed by the same letter are not significantly different (Fisher's Protected Least Significant Difference Test, P = 0.05).
Mean incidence of PVY as measured in post-harvest evaluations, Wailea, HI 2015.

Table 2. Mean yield and quality estimates for various foliar products applied to the canopy of 'Russet Norkotah' to limit the spread of Potato virus Y.

Treatment	Rate		Start Date	Application Frequency	Proportion US #1-A	Proportion US #1-B	CWT/A
UTC			-	0.96 ab	0.96 ab	0.038 ab	398.07 a
Stylet Oil (July 2) Stylet Oil (July 16)	1.5 0.75	% v/v % v/v	2-Jul 16-Jul	1x weekly 1x weekly	0.96 ab	0.042 ab	319.8 c
Aphoil (July 2) Aphoil (July 16)	4 2	% v/v % v/v	2-Jul 16-Jul	1x weekly 1x weekly	0.96 ab	0.043 ab	317.3 c
Stylet Oil (July 2)	0.75	% v/v	2-Jul	1x weekly	0.96 a	0.036 b	365.8 ab
Aphoil (July 2)	2	% v/v	2-Jul	1x weekly	0.95 ab	0.046 ab	381.6 a
Aphoil (July 2) Actigard (July 16, 3X)	2 0.75	% v/v oz wt/a	2-Jul 16-Jul	1x weekly 3x appl	0.95 b	0.050 ab	325.8 c
Aphoil (July 2) Actigard (July 16, 3X)	2 1	% v/v oz wt/a	2-Jul 16-Jul	1x weekly 3x appl	0.95 b	0.051 a	333.8 bc
Stylet Oil (July 2) Actigard (July 16, 3X)	0.75 1	% v/v oz wt/a	2-Jul 16-Jul	1x weekly 3x appl	0.95 b	0.050 ab	309.3 c
				P	0.3116	0.2695	<0.0001
				LSD	0.0558	0.0142	33.9822

Means in columns followed by the same letter are not significantly different (Fisher's Protected Least Significant Difference Test, P = 0.05).

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

Purpose: The objective of this experiment was to assess the efficacy of at-plant systemic insecticides to control Colorado potato beetle (CPB), *Leptinotarsa decemlineata*, potato leafhopper (PLH), *Empoasca fabae*, and potato colonizing aphid species on 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 2014. Potato, *Solanum tuberosum* cv. 'Russet Burbank', seed pieces were planted on 2 May. 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 14 experimental treatments and 1 untreated control were arranged in a randomized complete block design. Seed treatments were applied in 130 ml of water per 50 lb of seed on 28 April using a single nozzle boom applying 9.1 gpa equipped with a Tee Jet XR8002VS flat fan spray tip powered by a CO_2 backpack sprayer at 30psi. In-furrow insecticides were applied at planting with a CO_2 pressurized backpack sprayer operating at 30 psi with a 2 nozzle boom with Tee Jet 8001 flat fan nozzles delivering 11 gpa. Furrows were cut using a commercial potato planter without closing discs attached. Immediately after the in-furrow treatments were applied and all seed piece treatments were placed in open furrows, all seed was covered by hilling. Foliar applications were made 19 and 27 June and were applied with a CO_2 pressurized backpack sprayer with a 6 ft boom operating at 30 psi delivering 20 gpa through 4 flat-fan nozzles (Tee Jet XR8002) spaced 18" apart while travelling at 3.5 ft / sec.

Stand counts were conducted on 3 June (32 DAP) by counting the number of emerged plants per 20 ft. section of row. CPB efficacy was assessed by counting the number of these insects per plant on 10 randomly selected plants in each plot. Defoliation ratings (% DF) were determined by visual observation of the entire plot. CPBs were recorded in the following life stages: adults (A), egg masses (EM), small larvae (SL), large larvae (LL). Potato leaf hoppers were recorded as nymphs (N) or adults (A). Adult PLH were sampled using sweep net techniques (15 sweeps per plot). PLH nymphs and aphids were assessed by visual inspection of 25 leaves per plot. Insect counts occurred on several dates throughout the summer, and insect count averages reflect time periods during the summer when specific life stages peaked in the plots (**Table 1**). Means were separated using ANOVA with a Fisher's Protected LSD means separation test (P=0.05). No signs of phytotoxicity were observed among experimental treatments.

Table 1. Mean Colorado potato beetle (CPB) counts per 10 plants of adults (AD), egg masses (EM), small (SL) and large (LL) larvae, percent defoliation and ad potato leafhoppers (PLH)

Treatment	Rate		Type[1]	CPB-A 10-Jun	CPB-EM 10-Jun	CPB-SL 23-Jun	CPB-LL 30-Jun	%DF 8-Jul	PLH-A 23-Jun	PLH-N 23-Jun
Untreated	.	.	-	8.75 ab	10.0 a	103.25 a-c	2.04 a	0.03 a	3.75 c-e	0 b
Verimark	0.47	fl oz/cwt	IF	11.5 ab	6.75 ab	117.25 ab	1.93 a	0.02 b	3.25 b-d	0 b
Verimark	0.62	fl oz/cwt	IF	10 ab	6.25 a	89.75 ab	1.75 ab	0.02 b	7.0 ab	0 b
AdmirePro	0.35	fl oz/cwt	IF	10.5 a-c	2.0 b-e	52.5 a-c	1.55 a-c	0.02 b	1.5 d-f	0 b
Cruiser	0.16	fl oz/cwt	IF	4.75 b-d	1.25 e	32.25 a-d	1.84 a	0.01 c	2.0 c-e	0 b
Belay	0.6	fl oz/cwt	IF	4.25 b-d	1.75 de	18.5 fg	0.72 de	0.01 c	0.25 f	0 b
Platinum	2.66	oz wt/a	S	4.5 d	1.5 de	2.25 g	0.32 e	0.01 c	1.75 d-f	0 b
Exp 1	10.3	fl oz/a	S	14.75 a	5.0 a-e	7.25 e-g	1.21 b-d	0.01 c	4.5 bc	0 b
Exp 1	13.5	fl oz/a	S	14.0 a	6.0 a-c	1.26 d-g	0.48 e	0.01 c	17.25 a	0.5 a
AdmirePro	8.7	fl oz/a	S	10.5 ab	4.25 a-d	11.75 c-f	1.26 b-d	0.01 c	0.75 ef	0 b
Belay	12	fl oz/a	S	9.75 a-d	2.75 c-e	3.25 fg	0.76 de	0.01 c	0.25 f	0 b
ASSAIL	4	oz/a	F	9.75 ab	4.25 a-d	147.5 a	0.79 de	0.01 c	2.5 cd	0 b
ASSAIL	4	oz/a	F	6.25 b-d	7.0 a-c	24.0 b-e	0.70 de	0.01 c	3.5 b-d	0 b
ASSAIL	2.5	oz/a	F	4.5 b-d	7.5 a	130.5 ab	0.82 de	0.01 c	2.5 cd	0 b
Vydate	32	fl oz/a	F	6.75 a-d	9.25 ab	148.25 a	1.16 cd	0.01 c	3.75 b-d	0 b
			P	0.0488	0.008	<.0001	<.0001	<.0001	<.0001	0.4696
			LSD	0.3626	0.3877	0.7708	0.5749	0.0047	0.3174	0.1556

Means in columns followed by the same letter are not significantly different (Fisher's Protected Least Significant Difference Test, P = 0.05).

[1] IF = In furrow, S = Seed treatment F= foliar

Full season insecticide management programs for Colorado potato beetle in Wisconsin potatoes

Purpose: The purpose of this experiment was to evaluate various full-season, reduced-risk, insecticide programs designed to manage Colorado potato beetle (CPB) on potatoes in Wisconsin. With developing nicotinoid insecticide tolerance among CPB populations in the potato production areas in Wisconsin, several systemic based and foliar based programs were designed to evaluate their effectiveness on managing the CPB on potato.

Methods and Materials

This experiment was conducted in 2014 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 2 May. Plants were spaced 12 inches apart within rows. Rows were 3 ft apart. The 8-row plots were 24 feet wide by 40 feet long, for a total of 0.025 acres/plot. Replicates were separated by a 5 ft border of bare ground.

Three replicates of 12 full-season insecticide programs were arranged in a randomized complete block design. Systemic insecticides were applied in-furrow at planting (2 May for treatments 1-6). The first application of Rimon (treatment 7) was made on 19 Jun. The first foliar insecticide applications were applied after peak egg hatch and prior to large larval population dominance (27 Jun, for treatments 7-12). Subsequent applications were made on 3 Jul (for treatments 3-6) and 10 Jul (for treatments 2, 3, 9-12). Second generation CPB foliar applications were made to treatments 1, 2,7,8,11,12 on 30 July. Treatment information is available in **Table 1**. All in-furrow treatments were applied at 11.0 gpa on 2 May using a two nozzle boom equipped with Tee Jet XR8001 flat fan spray nozzles powered by a CO_2 backpack sprayer at 30psi. Furrows were cut using a commercial potato planter without closing discs attached. Immediately after the in-furrow treatments were applied and all seed piece treatments were placed in open furrows, all seed was covered by hilling. Foliar insecticides were applied using a CO_2 pressurized sprayer with a 24 ft boom operating at 30 psi delivering 20 gpa through 16 Tee Jet XR8002XR flat fan nozzles spaced 18" apart while travelling at 4.0 ft/sec.

CPB efficacy 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. Potato leafhopper (PLH), *Empoasca fabae*, efficacy was assessed by counting the number of adults collected from 15 sweep net samples in each plot. Aphid and potato leafhopper nymph populations were surveyed by visual assessment of 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 (11 Sep) (**Table 4**). Means were separated using ANOVA with a Fisher's Protected Least Squared Difference (LSD) mean separation test (P=0.05). No signs of phytotoxicity were observed.

Table 1. Full-season, integrated pest and resistance management programs for control of the Colorado potato beetle.

	1st generation CPB				2nd generation CPB			
Trt	**App Date**	**Insecticide**	**Rate**	**[†]Type**	**App Date**	**Insecticide**	**Rate**	**[†]Type**
1	2-May	Platinum 75 SC	2.67 fl oz/a	IF	30-Jul	[a]Besiege 1.25 ZC	9 fl oz/a	F
2	2-May	Belay 2.13 SC	12 fl oz/a	IF	30-Jul	[a]Agri-Mek 0.7 SC	3.5 fl oz/a	F
	10-July	Blackhawk 36WG	3.3 oz/a	F				
3	2-May	[a]Verimark 20 SC	7 fl oz/a	IF	No app			
	3-July	Blackhawk 36WG	3.3 oz/a	F				
	10-July	Blackhawk 36WG	3.0 oz/a	F				
4	2-May	[a]Verimark 20 SC	10 fl oz/a	IF	No app			
	3-July	Blackhawk 36WG	3.3 oz/a	F				
5	2-May	[a]Verimark 20 SC	13.5 fl oz/a	IF	No app			
	3-July	Blackhawk 36WG	3.3 oz/a	F				
6	2-May	Admire Pro 4.6SC	8.7 fl oz/a	IF	No app			
	3-July	Blackhawk 36WG	3.3 oz/a	F				
7	19-Jun	[c]Rimon 0.83 EC	10 fl oz/a	F	30-Jul	[d]Exirel 10 SE	6.75 fl oz/a	F
	27-Jun	[c]Rimon 0.83 EC	10 fl oz/a	F				
8	27-Jun	[d]Coragen 1.67 SC	5 fl oz/a	F	30-Jul	[c]Admire Pro 4.6SC	1.3 fl oz/a	F
	10-Jul	[d]Coragen 1.67 SC	3.5 fl oz/a	F				
9	27-Jun	[b]Agri-Flex 1.55 EC	8.5 fl oz/a	F	No app			
	10-Jul	[b]Agri-Flex 1.55 EC	6 fl oz/a	F				
10	27-Jun	[b]Blackhawk 36 WG	3.3 oz wt/a	F	No app			
	10-Jul	[b]Blackhawk 36 WG	2.5 oz wt/a	F				
11	27-Jun	[b]Radiant 1 SC	8 fl oz/a	F	30-Jul	[d]Actara 25WDG	3 oz wt/a	F
	10-Jul	[b]Radiant 1 SC	6 fl oz/a	F				
12	27-Jun	[a]Athena 0.87 EC	17 fl oz/a	F	30-Jul	[b]Admire Pro 550 SC	1.3 fl oz/a	F
	10-Jul	[a]Athena 0.87 EC	14 fl oz/a	F				

[†]F=foliar, IF=In furrow, [a]MSO 100 L added at 0.25% v/v, [b]NIS 100 L added at 0.25% v/v, [c]Silwet 100 L added at 0.25% v/v, [d]MSO 100L added at 0.5% v/v

Table 2. Mean lifestage counts per 10 plants of Colorado potato beetles and percent defoliation.

Trt	Adults	Egg Masses	Small Larvae	Large Larvae	% Defoliation
1	2.2 bc	0.3 bc	1.1 d	0.6 cd	1.0 a
2	1.8 bc	0.2 bc	3.9 bcd	0.9 bcd	1.0 a
3	2.1 bc	1.1 a	4.3 abc	0.4 d	1.0 a
4	1.8 c	0.1 c	4.6 ab	0.9 bcd	1.0 a
5	0.8 d	0.6 ab	1.7 cd	0.4 d	1.0 a
6	1.5 cd	0.2 c	3.5 a-d	1.3 ab	1.0 a
7	1.1 cd	0.3 bc	6.8 a	0.8 bcd	1.0 a
8	2.9 ab	0.5 ab	4.2 ab	1.5 ab	1.0 a
9	2.0 bc	0.5 bc	4.5 ab	1.2 bc	1.0 a
10	1.6 c	0.4 ab	3.7 bcd	0.8 bcd	1.0 a
11	1.7 cd	0.3 ab	5.4 ab	0.4 cd	1.0 a
12	3.2 a	0.5 ab	5.7 ab	2.0 a	1.0 a
P	0.0046	0.1767	0.0211	0.0062	0.000
LSD	0.45	0.15	0.42	0.45	0.00

Means in a column followed by the same letter are not significantly different at α = 0.05.
Means transformed (square root X +1) prior to separation.

Table 3. Mean potato leafhopper PLH and aphid counts per 10 plants

Trt	PLH adults	PLH nymphs	Aphids
1	0.3 e	0.0 f	0.0 bc
2	0.4 e	0.1 f	0.0 bc
3	3.9 bc	0.8 a	0.2 abc
4	7.5 a	1.6 a	0.2 abc
5	5.9 ab	0.6 ab	0.2 abc
6	1.6 de	0.1 ef	0.0 c
7	5.4 abc	0.4 bc	0.3 ab
8	3.2 cd	0.5 bc	0.4 a
9	1.3 e	0.0 f	0.0 c
10	5.6 ab	0.4 cd	0.2 abc
11	3.3 cd	0.3 cde	0.2 abc
12	0.8 e	0.2 def	0.1 bc
P	0.0001	0.0001	0.0751
LSD	0.43	0.08	0.03

Table 4. Mean yield estimates.

Trt	Total US #1 (lbs)	Proportion US #1s/A	CWT/A
1	130.1 a	92.1 b	435.4 acc
2	131.0 a	91.5 b	421.6 abc
3	115.4 a-e	94.0 ab	393.3 a-d
4	108.7 de	94.9 ab	374.2 bcd
5	115.3 a-e	94.1 ab	393.6 a-d
6	126.3 ab	95.3 a	436.6 a
7	112.9 b-e	95.1 ab	390.2 a-d
8	119.9 a-d	95.4 a	415.0 ab
9	125.4 abc	95.0 ab	432.9 ab
10	109.9 cde	95.0 ab	379.3 a-d
11	103.4 e	94.2 ab	354.0 d
12	108.1 de	94.5 ab	371.2 cd
P	0.0394	0.6513	0.0881
LSD	6.543	1.09	5.761

Means in a column followed by the same letter are not significantly different at α = 0.05.
Means transformed (square root X +1) prior to separation.

Foliar insecticide treatments for the control of European corn borer on 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 2014. Snap bean, *Phaseolus vulgaris* var. 'Hercules', was seeded on 11 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 0.003 acres. Replicates were separated by two untreated rows. All plots were managed per commercial management practices.

Four replicates of 19 treatments and 1 untreated control were arranged in a randomized complete block design. The foliar treatments were applied 9 July and 16 July when plants had reached the flowering and pin-bean development stage. Treatments were applied with a CO_2 pressurized backpack sprayer with a 6' boom operating at 30 psi delivering 20 gpa through 4 flat-fan nozzles (Tee Jet XR8002XR) spaced 18" apart while travelling at 3.5 ft / sec.

Each plot was infested with ECB egg masses on 14 July between insecticide applications (9 and 16 July). In each plot, for each pinning date, five successive plants were infested, each with ten blackhead stage ECB egg masses for a total of 50 egg masses applied in each plot.

Populations of ECB and associated damage estimates were surveyed on 6 Aug, by counting (1) number of damaged stems, (2) number of damaged pods, and (3) the number of viable larvae observed in both stems and pods. The survey was done only on 25 plants per plot. See **Table 1** for a summary of key field activity dates. Means were separated using ANOVA with a Least Squared Difference (LSD) mean separation test (P=0.05). Data are presented in **Table 2**.

Table 1. Summary of key field activity dates.

Action	Planting	Insecticide app.	Infestation	Insecticide app.
Date	11 Jun	9 Jul	14 Jul	16 July
Days from last action		28	33	36

Natural populations of ECB at AAES are annually variable and require that experimental plots be artificially infested with test insects. No overt signs or symptoms of phytotoxicity were observed.

Table 2. Mean damage estimates of plants, stems, pods, and number of larvae associated with experimental treatments.

Treatment	Rate	#Damaged Stems	Proportion Damaged Pods	# Larve in Stems
Untreated	.	0.20 ab	0.003 ab	0.25 ab
Exirel (pre-bud)+MSO	13.5 fl oz/a	0.05 b	0.003 ab	0 b
Exirel (pre-bud)+MSO	20.5 fl oz/a	0 b	0 b	0 b
Brigade (pre-bud)	3 fl oz/a	0.23 ab	0.011 ab	0 b
Exirel (pre-bud)+MSO+Reflex+Basagran	13.5 fl oz/a	0.44 a	0.004 ab	0.75 a
Exirel (pre-bud)+MSO+Reflex+Basagran	20.5 fl oz/a	0.23 ab	0.002 b	0.5 ab
Brigade (pre-bud)+Reflex+Basagran	3 fl oz/a	0.15 b	0.006 ab	0.25 ab
Exirel (flower)+MSO	13.5 fl oz/a	0.05 b	0 b	0 b
Exirel (flower)+MSO	20.5 fl oz/a	0.21 ab	0.017 a	0 b
Brigade (flower)	3 fl oz/a	0.05 b	0 b	0 b
Exirel (flower)+MSO+Topsin	13.5 fl oz/a	0 b	0.003 ab	0 b
Exirel (flower)+MSO+Topsin	13.5 fl oz/a	0 b	0 b	0 b
Brigade (flower)	3 fl oz/a	0.05 b	0 b	0 b
Exirel (pin)+MSO	13.5 fl oz/a	0.15 b	0 b	0 b
Exirel (pin)+MSO	13.5 fl oz/a	0 b	0 b	0 b
Exirel (pin)+MSO	20.5 fl oz/a	0.05 b	0.003 b	0 b
Brigade (pin)	3 fl oz/a	0.05 b	0.004 ab	0 b
Exirel (pin)+MSO+Bravo	13.5 fl oz/a	0.05 b	0.003 b	0 b
Exirel (pin)+MSO+Bravo	20.5 fl oz/a	0.05 b	0.002 b	0 b
Brigade (pin)+Bravo	3 fl oz/a	0.05 b	0 b	0 b
	P	0.268	0.7568	0.1337
	LSD	0.2886	0.01427	0.123

MSO 100 L added at 0.5% v/v

No larvae were found in pods

Foliar insecticide treatments for the control of European corn borer on 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 the Del Monte Foods Experimental Plots, near Plover, WI in 2014. Snap bean, *Phaseolus vulgaris* var. DM04-88 was seeded on 19 May 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 0.003 acres. Replicates were separated by two untreated rows. All plots were managed per commercial management practices.

Four replicates of 9 treatments and 1 untreated control were arranged in a randomized complete block design. The foliar treatments were applied 10 July when plants had reached the flowering and pin-bean development stage. Treatments were applied with a CO_2 pressurized backpack sprayer with a 6' boom operating at 30 psi delivering 20.2 gpa through a flat-fan nozzle (Tee Jet XR8002VS) spaced 18" apart while travelling at 3.5 ft / sec.

Counts of emerged plants per row were taken from the center row of each plot on 12 June. Populations of ECB and associated damage estimates were surveyed 24 July from 25 plants from the center row of each plot by counting (1) total number of pods from 25 plants, (2) number of damaged stems, (3) number of damaged pods, and (4) the number of viable larvae observed in both stems and pods. Means were separated using ANOVA with a Least Squared Difference (LSD) option. Data are presented in **Table 1**. No overt signs of phytotoxicity were observed.

Table 1. Damage estimates of snap bean stems and pods from ECB

Treatment	Rate		Proportion Damaged Stems	Proportion Damaged Pods
Untreated			0.02 a	0.007 a
Exirel	13.5	fl oz/a	0 b	0 b
Exirel	20.6	fl oz/a	0.006 ab	0 b
Cyclaniliprole 50SL	11	fl oz/a	0 b	0 b
Cyclaniliprole 50SL	16.4	fl oz/a	0.005 ab	0 b
Coragen	5	fl oz/a	0.003 ab	0 b
Rimon	12	fl oz/a	0.013 ab	0.002 ab
Brigade	5	fl oz/a	0 b	0 b
Blackhawk	3.3	fl oz/a	0.013 ab	0.003 ab
Warrior II	1.92	fl oz/a	0 b	0 b
		P	0.2691	0.0876
		LSD	0.018	0.0048

Means in columns followed by the same letter are not significantly different (Fisher's Protected Least Significant Difference Test, P = 0.05).
MSO 100 EC was added at 0.125% v/v for all treatments except untreated

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 2014. Pepper, *Capsicum annuum* cv. 'Yankee Bell', transplants were planted 4 June. 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 12 Aug. In each plot, five successive plants were infested, each with 10 egg masses for a total of 50 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 3 experimental foliar treatments and 1 untreated control were arranged in a randomized complete block design. The foliar treatments were applied 9 Aug when plant growth stage was at flowering and mature fruit set. Treatments were applied by a CO_2 pressurized backpack sprayer with a 3' boom operating at 30 psi delivering 22 gpa through 2 flat-fan nozzles (Tee Jet 8002XR) spaced 18" apart @ 3.5 ft / sec.

Populations of ECB and associated damage estimates were surveyed on 20 Aug by counting (1) total number of fruit, (2) number of damaged fruit, and (3) the number of viable larvae observed in fruit. See **Table 1** for a summary of key field activity dates. 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	4 Jun	6 Aug	9 Aug	20 Aug
Days from last action		63	3	11

Natural populations of ECB at the experimental site are annually variable and require that experimental plots be artificially infested with test insects. No signs of phytotoxicity were observed.

Table 2. Mean yield and damage estimates per 5 plants in pepper.

Treatment	Rate		Total No. Fruit/ 5 plts	Proportion Damaged Fruit	# Larvae
Untreated			23.5	0.29 a	5.0 a
Cyclaniliprole 50SL + NIS	11	fl oz/a	21.5	0.12 ab	0 b
Cyclaniliprole 50SL + NIS	16.5	fl oz/a	22.75	0.11 ab	0.5 b
Exirel + MSO	10	fl oz/a	25.5	0.09 b	1 b
		P	0.6692	0.118	0.0026
		LSD	7.3217	0.1937	0.3171

Means in columns followed by the same letter are not significantly different (Fisher's Protected Least Significant Difference Test, P = 0.05).

NIS 100 L added at 0.5% v/v

MSO 100 L added at 0.5% v/v

EVALUATION OF IN-FURROW INSECTICIDES FOR THE CONTROL OF LEAFHOPPER AND APHIDS IN CARROT

Purpose: To assess the efficacy of in-furrow insecticides applied at planting with and without liquid starter fertilizer on the control of Aster Leafhopper (ALH): *Macrosteles fascirons* in carrot .

Materials and Methods

This experiment was conducted on a loamy sand soil at Hancock Agricultural Research station (HAES) located 1.1 mile (1.8 km) southwest of Hancock, Wisconsin in 2014. Carrot, *Daucus carota var* . 'Heritage' was direct seeded on 20 May. . Experimental plots consisted of 24 inch (0.61 m) raised formed beds containing 3 rows of carrots spaced 6 inches (15.2 cm) between. Experimental plots measured 18 ft (6.1 m) in length with planted beds on either side acting as guard rows. All plots were maintained to standard commercial practices.

Four replicates of 11 treatments and 1 untreated control were arranged in a randomized complete block design with four experimental replicates. All foliar treatments were applied in 1.5 L of water at an application rate of 20.2 gpa using a four nozzle, 6 foot (1.8m) boom equipped with an 8002XR flat fan spray tip powered by a CO2 backpack sprayer operating at 30 psi. Successive applications were initiated when mean immature thrips populations had exceeded established thresholds of 3 immature thrips / leaf. The in-furrow applications were applied at plant on 20 May between 11:00 -12:00 hours.

Sweeps were made on 2, 7, 15, 19, 22, 28, 31 July, and 4, 12, and 18 August. Ten sweeps per plot.

Above and below ground evaluation and root weights were taken on 7 October.

Count data were $\log_{10}$ transformed prior to analysis. Data were analyzed using ANOVA and means were separated with a Fisher's Protected LSD.

In the experimental field, (Table 1). No overt signs of phototoxicity were observed.

Table 1. Mean Aster leafhopper adults per sweep on carrot.

Treatment	Rate	19-Jul	22-Jul	28-Jul	31-Jul	4-Aug	12-Aug	18-Aug
Untreated	.	0.25 c	1.5 ab	0.5 ab	0.0 b	0.75 ab	0.25 b	0.0 a
Verimark	6.75 fl oz/acre	2.5 b	1.0 ab	0.0 b	0.25 a	0.25 ab	0.5 ab	0.0 a
Verimark	10.2 fl oz/acre	2.5 ab	2.25 a	0.25 ab	0.0 b	1.0 a	0.25 b	0.0 a
Verimark	13.5 fl oz/acre	0.75 bc	0.75 ab	0.75 ab	0.0 b	0.5 ab	0.0 b	0.0 a
AdmirePro	10.5 fl oz/acre	1.0 bc	1.25 ab	0.0 b	0.0 b	0.75 ab	0.25 b	0.0 a
Platinum	3 oz wt/acre	0.75 bc	0.75 ab	0.25 ab	0.0 b	0.25 ab	0.0 b	0.25 a
Platinum	4.01 oz wt/acre	1.0 bc	0.0 b	0.0 b	0.0 b	1.0 ab	0.0 b	0.0 a
Verimark	10.2 fl oz/acre	0.5 a-c	1.75 ab	0.25 ab	0.0 b	0.5 ab	0.5 ab	0.0 a
Verimark	13.5 fl oz/acre	1.25 bc	0.0 b	1.25 a	0.0 b	0.75 ab	0.5 ab	0.25 a
AdmirePro	10.5 fl oz/acre	1.0 bc	0.25 ab	0.5 ab	0.0 b	0.75 ab	0.5 ab	0.0 a
Platinum	3 oz wt/acre	0.75 bc	2.25 ab	0.0 b	0.0 b	0.5 ab	0.0 b	0.0 a
Platinum	4.01 oz wt/acre	0.75 bc	1.0 ab	0.75 ab	0.0 b	0.0 b	1.0a	0.0 a
	P	0.4561	0.638	0.285	0.4653	0.7849	0.1624	0.5416
	LSD	0.348	0.4213	0.246	0.0623	0.2656	0.2186	0.0881

Means in columns followed by the same letter are not significantly different (Fisher's Protected Least Significant Difference Test, P = 0.05).

No Aphids found in 2014 Carrot Trial

Table 3. Mean damage and yield on carrot.

Proportions						
		Below Ground		**Above Ground**		
Treatment	**Rate**	**Fork**	**Damaged**	**AY**	**Normal**	**Tons/acre**
Untreated	.	0.21 ab	0.05 ab	0.02 ab	0.72 a-c	30.91 a-c
Verimark	6.75 fl oz/acre	0.14 ab	0.04 bc	0 c	0.82 a	33.62 a
Verimark	10.2 fl oz/acre	0.18 ab	0.04 a-c	0.01 a-c	0.76 a-c	34.82 a
Verimark	13.5 fl oz/acre	0.17 ab	0.07 ab	0.01 a-c	0.75 a-c	32.93 ab
AdmirePro	10.5 fl oz/acre	0.15 ab	0.07 ab	0.01 bc	0.77 a-c	29.32 a-c
Platinum	3 oz wt/acre	0.13 b	0.04 bc	0.04 a	0.79 ab	33.04 a
Platinum	4.01 oz wt/acre	0.16 ab	0.07 ab	0.0 bc	0.76 a-c	32.54 a-c
Verimark	10.2 fl oz/acre	0.23 ab	0.11 a	0 c	0.66 c	28.62 a-c
Verimark	13.5 fl oz/acre	0.18 ab	0.06 ab	0.0 bc	0.75 a-c	28.69 a-c
AdmirePro	10.5 fl oz/acre	0.23 a	0.07 ab	0.01 a-c	0.69 bc	26.18 bc
Platinum	3 oz wt/acre	0.21 ab	0.01 c	0.02 a-c	0.76 a-c	26.61 bc
Platinum	4.01 oz wt/acre	0.21 ab	0.02 bc	0 c	0.77 ab	29.96 a-c
	P	0.4551	0.1091	0.091	0.2407	0.1457
	LSD	0.1269	0.1531	0.1041	0.1261	6.4213

Means in columns followed by the same letter are not significantly different (Fisher's Protected Least Significant Difference Test, P = 0.05).
AY = Aster Yellows