Wisconsin Vegetable Insect Pest Management Research Summer Field Trials

2012

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

Bayer Crop Science	*Daren Bohannan, Steve Spangler*
Cerexagri-Nisso	*David Wenninger*
BASF	*Paul Vassalotti, Mike Tuss*
DuPont Crop Protection	*Mick Holm, Royce Brechler*
Gowan Company	*Paul David,*
Syngenta Crop Protection	*Jeffrey Krumm, Caydee Savinelli, Roy Boykin, Tony Burd*
Valent USA	*Gary Kirfmann, Carlos Granadino*
Dow AgroSciences	*Matthew Armson, Scott Ditmarsen, Jim Turner*
Nichino America	*James Adams*
AgraQuest	*Dennis Long, Paul Walgenbach*
Chemtura	*Jay Engel,*
FMC	*Sam Lockhart, Al Klug*
Lab Services	*James Steffel*
Pest Pros Inc	*Randy Van Haren, Linda Kotolski*

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:
Seth Abbott, Ryan Curtin, Kelly Kohrs, Trisha Pernsteiner, Adam Ruechel, and Cristina Stiff

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
Dennis Zeloski, Ron Krueger, Felix Zeloski Farms, Eagle River, WI
Mike Copas, William Wysocki, Russet Potato Exchange

The staff at the following research stations helped maintain the projects and assisted in evaluation of research results:
Arlington, Hancock, and Antigo Agricultural Research Stations, Thank you.

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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 2012. Cabbage, *Brassica oleracea* cv. 'Megaton', transplants were planted 24 May. Plants were spaced 18 inches apart within rows. Rows were 36 inches apart. The two-row plots were 6 ft wide by 30 ft long, for a total of 0.004 acres, and were separated by 2 guard rows (untreated) 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 2 untreated controls were arranged in a randomized complete block design. All foliar treatments were applied 21 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 plants per row). Larval counts occurred on Aug 29 (8 DAT). Means were separated using ANOVA with a Least Squared Difference (LSD) means comparison test (P=0.05).

During 2012 Lepidopteran pressure was very low. ICW populations were the most prevalent of all Lepidopteran pests. No signs of phytotoxicity were observed among treatments.

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

		29-Aug					
Treatment[1]	**Rate**	**ICW-L**	**ICW-S**	**DB-L**	**DB-S**	**CL-L**	**CL-S**
Untreated	-	2.8 a	2.65 a	0	0	0	0
Voliam Xpress 0.835 SC	9 fl oz/a	0.65 bc	0.3 b	0	0	0	0.5
Coragen 1.67 SC	3.5 oz/a	0.4 bc	0.4 b	0	0	0	0
Coragen 1.67 SC	5 oz/a	0.55 bc	0.75 b	0	0	0	0
Radiant 1 SC	10 oz/a	0.15 bc	0.1 b	0	0	0	0.5
Benevia 100 OD	10 oz/a	0.45 bc	0.45 b	0	0	0	0
Benevia 100 OD	13.5 oz/a	0.55 bc	0.35 b	0	0	0	0
Warrior II 2.08 CS	1.6 oz/a	0.35 bc	0.05 b	0	0	0	0
Entrust 2 SC	6 oz/a	0.45 bc	0.4 b	0	0	0	0
Crymax 15 WG	2 lb/a	0.2 bc	0 b	0	0	0	0
Javelin 85 WG	1.5 lb/a	0.1 c	0.2 b	0	0	0	0
EXP 40 WG	10 oz/a	0.75 b	0.3 b	0	0	0	0
	P	<0.001	0.001	-	-	-	0.535
	LSD	0.619	0.847	-	-	-	0.055

[1]All treatments except Untreated also had MSO 100 L at 0.25% v/v

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 2012. Onion, *Allium cepa* cv. 'Caprice', was direct seeded on 14 April. Plants were spaced 2.6 inches apart within rows. Rows were 9.8 inches apart. The six-row plots were 54 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 11 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 June and 29 June. 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 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 six times during June and July, on 25 Jun (3 DAT) and 29 Jun (7 DAT) after the first application and again on 5 Jul (6 DAT), 13 Jul (14 DAT), 20 Jul (21 DAT) and 26 Jul (27 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 phytotoxicity were observed among treatments.

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

Treatment	Rate	25-Jun	29-Jun	5-Jul	13-Jul	22-Jul	26-Jul
Untreated	-	4.025 a-d	8.425 a	23.8 a	27.825 cd	45.1 ab	62.275 a
[1]Warrior II 2.08 SC	1.92 fl oz/a	2.65 b-d	6.675 a-e	21.2 ab	40.775 ab	52.675 a	17.025 b
[2]Benevia 10 OD	10.1 fl oz/a	2.5 b-d	3.225 e-g	4.425 fg	20.625 d-f	17.05 c-h	12.85 b
[2]Benevia 10 OD	13.5 fl oz/a	3.825 a-d	2.55 fg	3.525 fg	14.9 e-h	21.65 c-g	11.05 b
[1]Radiant 1 SC	6 fl oz/a	2.3 cd	4.025 b-g	3.4 fg	21.1 d-f	23.025 c-f	11.325 b
[1]Radiant 1 SC	8 fl oz/a	1.85 d	2.225 g	3.95 fg	13.875 e-h	22.45 c-g	12.15 b
[2]Movento 2 SC	5 fl oz/a	4.925 ab	7.55 a-c	5.25 fg	4.275 gh	19.5 c-h	3.2 b
[1]Agri-Mek 0.7 SC	3.5 fl oz/a	4.1 a-d	6.125 a-f	5.55 e-g	25.575 c-e	24.95 c-e	7.1 b
[1]Agri-Mek 0.15 EC	16 fl oz/a	2.025 cd	5.7 a-g	5.525 e-g	24.95 c-e	32.825 bc	16.8 b
[1]Torac 4 EC	24 fl oz/a	4.225 a-d	3.425 d-g	6.225 e-g	29.325 b-d	26.95 b-d	8.4 b
[1]Lannate 2.4 SL	3 pt/a	2.95 b-d	7.35 a-c	12.8 cd	42.275 a	29.175 bc	58.45 a
[1]Assail 30 SG	4 oz wt/a	3.525 a-d	6.5 a-e	16.725 bc	33.275 a-c	52.8 a	11.55 b
	P	0.0314	0.004	<0.001	<0.001	<0.001	<0.001
	LSD	2.592	3.842	5.385	11.84	19.37	27.64

[1] NIS 100 L added at 0.5% v/v
[2]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 2012. Potato, *Solanum tuberosum* cv. 'Goldrush', seed pieces were planted on 26 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 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 27 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 14 June and 21 June. 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 18 (4 DAT) and 21 (7 DAT), following the first application. The second set of counts occurred on June 28 (7 DAT), Jul 3 (12 DAT), and Jul 10 (19 DAT), following the second application. Insect count averages reflect time periods during the summer when specific 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	CPB-AD (Jul 18)	CPB-EM (Jun 21)	CPB-SL (Jun 21)	CPB-LL (Jun 28)	% Defoliation (Jul 18)	PLH (AD) (Jun 28)
Untreated	-	1.0 f-i	0 e	234.75 ab	91.75 bcd	30.0 a	1.75 ef
[1]Belay 2.13 SC	3 oz/a	2.5 b-i	1.25 b-e	117 e-i	3.5 kl	5.0 k	1.25 ef
[1]Voliam Flexi 40 WG	5 oz/a	2.25 c-i	0 e	19.75 mno	0.5 l	5.0 k	0.25 ef
[1]Coragen 1.67 SC	4.5 oz/a	2.75 b-h	0.25 e	73.25 i-o	10.5 kl	6.25 jk	0.5 ef
Athena 0.87 EC	13 oz/a	0.5 ghi	0.5 de	76.75 i-n	17.5 i-l	6.25 jk	0.5 ef
Athena 0.87 EC	17 oz/a	0.75 f-i	0.75 de	69.75 i-o	22.25 h-l	5.0 k	0 f
Brigadier 2 SC	6.4 oz/a	1.5 d-i	1.75 a-d	155.5 d-h	49.5 f-i	12.5 g-k	0 f
[2]Blackhawk 36 WG	2.5 oz/a	2.25 c-i	2.5 ab	57.5 i-o	10 kl	8.75 h-k	4.25 c-f
[2]Blackhawk 36 WG	3.3 oz/a	3.25 a-f	1.0 c-e	40 k-o	13 jkl	7.5 i-k	12.75 bc
[2]Provado 1.6 F	3.75 oz/a	1.5 d-i	0.75 de	186 b-e	56.25 e-h	11.25 g-k	0.25 ef
EXP 30 WG	3.47 oz/a	0.25 hi	0.5 de	250 ab	126.25 a	17.5 c-g	1.0 ef
EXP 30 WG	5.87 oz/a	1.5 d-i	0 e	258.5 ab	67 d-g	12.5 g-k	1.5 ef
[1]Benevia 0.83 SC	5.1 oz/a	3.0 a-g	1.25 b-e	4.5 no	1.5 kl	5.0 k	7.75 b-f
[1]Benevia 0.83 SC	6.8 oz/a	4.75 abc	2.5 ab	3.25 o	0.5 l	5.0 k	7.25 b-f
Endigo 2.06 ZC	4 oz/a	5.5 a	2.33 abc	41.33 j-o	6.25 kl	7.5 i-k	0 f
Endigo 2.71 ZC	3.9 oz /a	5.0 ab	0.5 de	27.5 mno	1.5 kl	7.5 i-k	0.5 ef
Warrior II 2.08 SC	1.92 oz/a	1.75 d-i	0.5 de	114.5 e-j	46 g-j	15.0 e-i	0.5 ef
Actara 25 WDG	3 oz/a	1.5 d-i	0 e	86 g-m	3.0 kl	11.25 g-k	0.75 ef
EXP 40 WG	4 oz/a	4.75 abc	1.0 cde	2.0 o	0.25 l	12.5 g-k	0 f

Leverage 360 31.5 SC	2.8 oz/a		2.5 b-i	0.25 e	119.25 e-i	25 h-l	10.0 g-k	0.5 ef
[1]Coragen 1.67 SC	5 oz/a		4.0 a-d	1.0 cde	38.5 l-o	10 kl	7.5 i-k	12 bcd
[3]Avaunt 30 WG	3.47 oz/a		0.5 g-i	0 e	272.75 a	121.5 ab	21.25 b-f	3.75 c-f
[3]Avaunt 30 WG	5.87 oz/a		1.0 f-i	0 e	198.5 bcd	81.25 c-f	23.75 a-d	1.25 ef
Torac 4 EC	17 oz/a		2.5 b-i	0 e	58.0 i-o	27.75 h-l	12.5 g-k	13.5 bc
Torac 4 EC	21 oz/a		2.5 b-i	1.25 b-e	113.75 e-j	35 g-k	10.0 g-k	14.5 b
Torac 4 EC	24 oz/a		0.75 f-i	1.75 a-d	84.5 h-m	19.75 i-l	13.75 f-j	10 b-e
Rimon 0.83 EC	9,8,7 oz/a		3.75 a-e	3.0 a	86.0 g-m	9.5 kl	5.0 k	36.5 a
Rimon 0.83 EC	10,8 oz/a		1.0 f-i	0.5 de	59.25 i-o	13.25 jkl	10 g-k	32.5 a
		P	<0.0001	0.0006	<0.0001	<0.001	<0.001	<0.0001
		LSD	2.59	1.48	73.35	34.12	7.72	9.84

[1] MSO 100 MS added at 0.25% v/v

[2] Induce 100 L added at 0.5% v/v

3 NIS 100 XL added at 0.25% v/v

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), Arlington, WI in 2012. Potato, *Solanum tuberosum* cv. 'Superior', seed pieces were planted on 27 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. . The plots were managed according to commercial pest management (herbicide and fungicide) practices as well as fertility recommendations prescribed by AAES.

Four replicates of 15 experimental foliar treatments and 2 untreated controls were arranged in a randomized complete block design. The foliar treatments were applied 26 Jun. 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 15 sweeps per plot (**Table 1**). Insect counts occurred on three dates during June and July: 29 June (3 DAT), 6 Jul (10 DAT), and 11 Jul (15 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 15 sweeps per plot.

Treatment	Rate	PLH-AD	PLH-NY
Untreated	-	12.17 d-f	5.17 cd
[1]Belay 2.13 SC	3.0 oz/a	5.58 f-i	0.42 f
[1]Voliam Flexi 40 WG	5.0 oz/a	4.5 g-i	0.33 f
[1]Coragen 1.67 SC	4.5 oz/a	8.58 d-h	3.75 de
Athena 0.87 EC	13.0 oz/a	3.67 hi	0.67 f
Athena 0.87 EC	17.0 oz/a	1.67 i	0.33 f
Brigadier 2 SC	6.4 oz/a	6.08 f-i	0.25 f
Endigo 2.06 ZC	4.0 oz/a	4.42 g-i	0.17 f
Endigo 2.71 ZC	3.9 oz/a	7.25 e-i	0.92 ef
Warrior II 2.08 SC	1.92 oz/a	7.17 e-i	0.42 f
Actara 25 WDG	3.0 oz/a	7.17 e-i	0.17 f
EXP 40 WG	4.0 oz/a	14.58 cd	0.25 f
Leverage 360 31.5 SC	2.8 oz/a	2.08 hi	0.08 f
Torac 4 EC	17 oz/a	23.91 ab	5.0 d
Torac 4 EC	21 oz/a	24.67 ab	3.83 de
Torac 4 EC	24 oz/a	22.75 ab	5.08 d
	P	<0.0001	<0.0001
	LSD	6.58	2.93

[1]MSO 100 MS added at 0.25% v/v

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 2012. Potato, *Solanum tuberosum* cv. 'Russet Norkotah', seed pieces were planted on 4 May. Seed pieces were spaced 12 inches apart within rows. Rows were 3 ft apart. The six-row plots were 12 ft wide by 20 ft long, for a total of 0.006 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. To ensure an adequate and standard source of PVY inoculum for virus spread within plots maintained under different management regimes. PVY was established in each plot by sap-inoculating two separate plants in the third and fourth rows of each plot with a PVY^{O} strain collected in Wisconsin 2004-06. Inoculation occurred 01 June, approximately 1 week after plant emergence.

Four replicates of 17 experimental foliar treatments and 1 untreated control were arranged in a randomized complete block design. Foliar applications were initiated on 11 Jun 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)	Proportion US #1-A	Proportion US #1-B	CWT/A
UTC	-	-	-	81.9 ab	11 a-c	92.9 ab	107.5 ab	0.883 a	0.117	337.2 ab
Stylet Oil 100 SL	0.75 % v/v	11-Jun	1x weekly	82 ab	11.3 a-c	93.3 ab	103 a-c	0.877 a	0.123	338.8 ab
Stylet Oil 100 SL	1.5 % v/v	11-Jun	1x weekly	71.7 a-c	12.5 ab	84.2 a-c	93.4 a-c	0.832 a	0.168	305.9 a-c
[1]Benevia 10 OD	20.5 fl oz/a	13-Jul	[2]3x appl	75.2 a-c	11.7 a-c	86.8 a-c	97.1 a-c	0.854 a	0.146	315.4 a-c
Stylet Oil 100 SL	0.75 % v/v	13-Jul	1x weekly	72.7 a-c	13.1 a	85.8 a-c	99.8 a-c	0.833 a	0.167	311.6 a-c
Stylet Oil 100 SL	2 % v/v	13-Jul	2x weekly	67.6 a-c	11.5 a-c	79.1 a-c	88.1 a-c	0.836 a	0.164	287.2 a-c
Requiem 25 EC	1.7 fl oz/a	13-Jul	1x weekly	85.7 a	11.3 a-c	97 a	110.2 a	0.878 a	0.121	352.13 a
Stylet Oil 100 SL [1]Benevia 10 OD	0.75 % 10.1 fl oz/a	11-Jun 13-Jul	1x weekly [2]4x appl	72.2 a-c	10.5 bc	82.7 a-c	94.9 a-c	0.861 a	0.139	300.3 a-c
Stylet Oil 100 SL [1]Benevia 10 OD	0.75 % 13.5 fl oz/a	11-Jun 13-Jul	1x weekly [2]3x appl	58.5 c	10.1 c	68.5 c	80.0 c	0.850 a	0.150	248.8 c
Stylet Oil 100 SL [1]Benevia 10 OD	0.75 % 17 fl oz/a	11-Jun 13-Jul	1x weekly [2]3x appl	69.2 a-c	11 a-c	80.1 a-c	88.7 a-c	0.857 a	0.143	291.0 a-c
Stylet Oil 100 SL [1]Benevia 10 OD	0.75 % 20.5 fl oz/a	11-Jun 13-Jul	1x weekly [2]3x appl	72.6 a-c	11.1 a-c	83.6 a-c	96.4 a-c	0.852 a	0.148	303.74 a-c
Stylet Oil 100 SL [1]Movento 2 SC	0.75 % 5 fl oz/a	11-Jun 13-Jul	1x weekly [2]2x appl	80.9 ab	11.5 a-c	92.4 ab	101.8 a-c	0.871 a	0.129	335.43 ab
Stylet Oil 100 SL [1]Movento 2 SC	0.75 % 3.3 fl oz/a	11-Jun 13-Jul	1x weekly [2]3x appl	73.5 a-c	11.3 a-c	84.8 a-c	96.2 a-c	0.863 a	0.137	308.09 a-c
Aphoil 100 SL	2 %	11-Jun	1x weekly	63.6 bc	11.1 a-c	74.6 bc	82.6 c	0.835 a	0.165	270.96 bc
Aphoil 100 SL	4 %	13-Jul	1X weekly	76.5 a-c	11.5 a-c	87.9 a-c	97.9 a-c	0.858 a	0.142	319.35 a-c
Stylet Oil 100 SL Fulfill 50 WDG	0.75 % 3.67 oz/a	11-Jun 13-Jul	1x weekly [2]3x appl	77.3 a-c	11.7 a-c	89 a-c	101.7 a-c	0.866 a	0.134	323.08 a-c
Stylet Oil 100 SL Fulfill 50 WDG	0.75 % 5.5 oz/a	11-Jun 13-Jul	1x weekly [2]2x appl	61.8 bc	11.1 a-c	72.8 bc	84.4 bc	0.833 a	0.167	264.42 bc
Stylet Oil 100 SL Stylet Oil 100 SL	0.75 % 0.75 %	11-Jun 13-Jul	1x weekly 2X weekly	67.2 a-c	10.0 c	77.1 a-c	97.8 a-c	0.867 a	0.133	280.13 a-c
			P	0.506	0.704	0.459	0.556	0.644	0.644	0.459
			LSD	21.279	2.402	21.581	24.841	0.052	0.052	78.385

[1] MSO 100 L added at 0.25% v/v
[2] Applications at 7 day intervals.

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 2011. Potato, *Solanum tuberosum* cv. 'Russet Burbank', seed pieces were planted on 26 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 24 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 25 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.

Stand counts were conducted on 5 June (40 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 adult (AD) and nymphal (NY) potato leafhoppers (PLH)

Treatment	Rate	Type[1]	CPB-A	CPB-EM	CPB-SL	CPB-LL	%DF	PLH-A	PLH-N	Aphids
Untreated	-	-	7.65 ef	1.08 b	36.13 a	29.05 a	66.25 a	8.8 c	8.9 b	0.3 a
Verimark 200 SC	0.47 fl oz/cwt	S	19.7 a-d	1.88 ab	20.23 bcd	8.95 c-g	39.85 bcd	13.63 b	12.5 a	0.18 ab
Verimark 200 SC	0.62 fl oz/cwt	S	13.53 b-f	2.2 ab	20.68 bc	5.93 e-h	37.08 bcd	13.18 b	10.13 ab	0.05 bc
Verimark 200 SC Cruiser 5FS	0.47 fl oz/cwt 0.12 fl oz/cwt	S	19.75 a-d	1.93 ab	6.53 ef	4.33 gh	30.43 cde	2.15 d	0.2 c	0 c
AdmirePro 4.6 FS	0.26 fl oz/cwt	S	10.28 c-f	1.98 ab	26.35 ab	16.53 bc	43.88 bc	2.88 d	0.9 c	0.1 bc
AdmirePro 4.6 FS	0.35 fl oz/cwt	S	15.63 a-f	1.95 ab	16.3 b-e	13.87 cd	42.48 bcd	2.58 d	0.55 c	0 c
Cruiser 5 FS	0.12 fl oz/cwt	S	10.1 c-f	2.2 ab	11.5 c-f	4.75 fgh	40.58 bcd	2.2 d	0.3 c	0 c
Cruiser 5 FS	0.16 fl oz/cwt	S	24.4 ab	1.5 ab	4.1 f	1.3 gh	34.38 b-e	1.8 d	0.33 c	0 c
Belay 2.13 SC	0.6 fl oz/cwt	S	19.73 a-d	1.4 ab	1.5 f	0.48 h	29.5 def	1.9 d	0.33 c	0 c
EXP 480 FS	0.08 fl oz/cwt	S	9.45 def	1.88 ab	26.03 ab	22.38 ab	61.63 a	6.8 c	7.6 b	0.03 c
EXP 420 FS	0.22 fl oz/cwt	S	9.93 c-f	1.85 ab	21.08 bc	12.6 cde	46.25 b	1.85 d	0.33 c	0.05 bc
EXP 420FS + EXP 600FS	0.22+0.15 fl oz/cwt	S	26.03 a	2.38 a	7.78 ef	1.98 gh	39.93 b-e	1.85 d	0.4 c	0.03 c
EXP 420FS + EXP 600FS	0.22+0.2 fl oz/cwt	S	21.68 abc	2.25 ab	4.25 ef	1.23 gh	22.7 efg	2.0 d	0.25 c	0 c
EXP 435.7FS+EXP 600FS	0.31+0.26 fl oz/cwt	S	19.23 a-e	1.18 ab	3.0 f	0.63 h	22.6 e-g	1.88 d	0.43 c	0 c
EXP 435.7 FS	0.31 fl oz/cwt	S	16.48 a-e	1.85 ab	7.88 ef	2.87 gh	33.03 b-e	1.63 d	0.2 c	0 c
EXP 435.7FS+EXP 500FS	0.31+0.08 fl oz/cwt	S	18.85 a-e	1.53 ab	9.75 c-f	2.93 gh	31.63 cde	2.43 d	0.3 c	0 c
Moncoat Mz 7.5 DP Admire Pro 4.6 SC	12 oz/cwt 0.35 fl oz/cwt	S	17.33 a-e	1.63 ab	20.18 bcd	12.38 c-f	42.33 bcd	2.65 d 1.9 d	0.63 c 0.38 c	0 c 0 c
EXP 40 WG	6.5 oz wt/a	IF	11.88 c-f	1.95 ab	4.68 ef	1.03 h	9.63 gh	2.6 d	0.23 c	0 c
EXP 40 WG	10 oz wt/a	IF	9.08 def	1.58 ab	4.7 ef	1.0 h	5.88 h	2.4 d	0.25 c	0 c
Platinum 75 SG	1.68 oz wt/a	IF	11.53 c-f	1.73 ab	6.38 ef	3.08 gh	8.63 h	1.93 d	0.28 c	0 c
Platinum 75 SG	2.66 oz wt/a	IF	10.5 c-f	2.15 ab	5.98 ef	2.15 gh	8.63 gh	18.15 a	7.75 b	0.1 bc
Verimark 200 SC	10.3 fl oz/a	IF	4.23 f	1.73 ab	5.85 ef	2.28 gh	8.25 h	9.18 c	2.35 c	0.18 ab
Verimark 200 SC Maxim 4 FS	13.5 fl oz/a 0.08 fl oz/a	IF IF	11.55 c-f	1.65 ab	3.48 f	1.83 gh	9.75 gh	3.35 d	0.3 c	0 c
AdmirePro 4.6 FS	8.7 fl oz/a	IF	14.35 a-f	1.9 ab	8.35 def	4.7 fgh	16 fgh	2.53 d	0.18 c	0 c
Belay 2.13 SC	12 fl oz/a	IF	10.45 c-f	2.13 ab	10.33 c-f	6.17 d-h	11.28 gh	<0.0001	<0.0001	0.0004
		P	0.02	0.98	<0.0001	<0.0001	<0.0001	2.83	3.13	0.14
		LSD	11.93	1.27	12.12	7.73	13.85			

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

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 2012 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 April. 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 14 full-season insecticide programs were arranged in a randomized complete block design. Systemic insecticides were applied in-furrow at planting (26 April for treatments 1-6). The first application of Rimon (treatment 7) was made on 8 Jun. The first foliar insecticide applications were applied after peak egg hatch and prior to large larval population dominance (14 Jun, for treatments 7-14). Subsequent applications were made on 21 Jun (for treatments 7-15) and 27 Jul (for all treatments, including at plant treatments). Treatment information is available in **Table 1**. All in-furrow treatments were applied at 11.0 gpa on 26 April 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 6 ft boom operating at 30 psi delivering 20 gpa through 4 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 (14 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	**AppDate**	**Insecticide**	**Rate**	**[†]Type**	**AppDate**	**Insecticide**	**Rate**	**[†]Type**
1	26-Apr	Platinum 75 SC	2.67 fl oz/a	IF	27-Jul	[a]Benevia 10 OD	5 fl oz/a	F
2	26-Apr	Belay 2.13 SC	12 fl oz/a	IF	27-Jul	[b]Agri-Mek 0.15 EC	14 fl oz/a	F
3	26-Apr	[a]Verimark 20 SC	10 fl oz/a	IF	27-Jul	Assail 30 SG	4 oz wt/a	F
4	26-Apr	Verimark	13.5 fl oz/a	IF	27-Jul	[a]Actara 25 WDG	3 oz wt/a	F
5	26-Apr	EXP 40 WG	8 oz wt/a	IF	27-Jul	[b]Radiant 1 SC	8 fl oz/a	F
6	26-Apr	EXP 40 WG	10 oz wt/a	IF	27-Jul	[b]Agri-Mek 0.7 SC	3.5 fl oz/a	F
7	8-Jun	[c]Rimon 0.83 EC	10 fl oz/a	F	27-Jul	[a]Benevia 10 OD	5 fl oz/a	F
	14-Jun	[c]Rimon 0.83 EC	7 fl oz/a	F				
	21-Jun	[c]Rimon 0.83 EC	7 fl oz/a	F				
8	14-Jun	[d]Coragen 1.67 SC	5 fl oz/a	F	27-Jul	[b]Actara 25 SG	3 oz wt/a	F
	21-Jun	[d]Coragen 1.67 SC	3.5 fl oz/a	F				
9	14-Jun	[b]Agri-Mek 0.15 EC	14 fl oz/a	F	27-Jul	[d]Coragen 1.67 SC	5 fl oz/a	F
	21-Jun	[b]Agri-Mek 0.15 EC	12 fl oz/a	F				
10	14-Jun	[b]Blackhawk 36 WG	3.3 oz wt/a	F	27-Jul	[d]Benevia 10 OD	5 fl oz/a	F
	21-Jun	[b]Blackhawk 36 WG	2.5 oz wt/a	F				
11	14-Jun	[b]Radiant 1 SC	8 fl oz/a	F	27-Jul	[d]Voliam Xpress 1.25 SC	9 fl oz/a	F
	21-Jun	[b]Radiant 1 SC	6 fl oz/a	F				
12	14-Jun	[a]Athena 0.87 EC	17 fl oz/a	F	27-Jul	[b]Admire Pro 550 SC	1.3 fl oz/a	F
	21-Jun	[a]Athena 0.87 EC	14 fl oz/a	F				
13	14-Jun	[d]Actara 25 WDG	3 oz wt/a	F	27-Jul	[d]Voliam Xpress 1.25 SC	7 fl oz/a	F
	21-Jun	[d]Actara 25 WDG	1.5 oz wt/a	F				
14	14-Jun	[b]Belay 2.13 SC	3 fl oz/a	F	27-Jul	[d]Coragen 1.67 SC	5 fl oz/a	F
	21-Jun	[b]Belay 2.13 SC	2.5 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	3.03 abc	1.67 ab	6.53 abc	1.47 cd	1.0
2	2.53 a-e	1.03 abc	7.87 ab	1.47 cd	1.0
3	1.8 c-f	0.6 abc	1.93 bc	0.2 d	1.0
4	1.43 def	0.83 abc	1.93 bc	0.13 d	1.0
5	1.5 def	0.7 abc	2.03 bc	1.5 cd	1.0
6	0.97 f	0.47 c	0.63 c	0.2 d	1.0
7	2.03 b-f	1.23 a	4.87 abc	0.73 d	1.0
8	1.3 def	0.77 abc	5.53 abc	0.73 d	1.0
9	1.13 ef	0.53 bc	2.77 bc	0.4 d	1.0
10	2.7 a-d	0.77 abc	2.83 bc	1.17 cd	1.17
11	2.43 a-e	1.03 abc	5.83 abc	1.5 cd	1.0
12	3.67 a	0.6 abc	6.87 ab	5.37 a	1.0
13	3.07 abc	0.63 abc	7.77 ab	2.5 bc	1.0
14	3.43 ab	0.7 abc	7.8 ab	3.43 b	1.17
P	0.00014	0.4801	0.0687	<0.0001	0.9993
LSD	1.419	0.680	6.027	1.631	1.083

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

Trt	PLH adults	PLH nymphs	Aphids
1	1.07 cd	0.07 d	0 b
2	0.8 d	0 d	0.03 b
3	5.77 ab	2.7 a	0.03 b
4	6.23 a	1.8 ab	0.03 b
5	0.7 d	0.13 cd	0.03 b
6	0.97 d	0.23 cd	0 b
7	5.07 ab	2.07 ab	0.17 ab
8	5.5 ab	1.3 bcd	0.07 b
9	4.57 abc	1.43 abc	0.17 ab
10	2.7 bcd	0.3 cd	0.47 a
11	1.53 cd	0.13 cd	0.23 ab
12	0.57 d	0.03 d	0.07 b
13	0.87 d	0.07 d	0.03 b
14	0.53 d	0.1 d	0.07 b
P	<0.0001	<0.0001	0.5179
LSD	3.505	1.314	0.352

Table 4. Mean yield estimates.

Trt	Total US #1 (lbs)	Proportion US #1s	CWT/A
1	78.67 bc	0.96 abc	377.6 bc
2	78.12 bc	0.98 ab	374.96 bc
3	81.85 b	0.98 a	392.88 b
4	76.65 bc	0.95 abc	367.92 bc
5	90.75 a	0.94 bc	435.6 a
6	81.7 b	0.98 ab	392.16 b
7	81.67 b	0.96 abc	392 b
8	75.22 bc	0.96 abc	361.04 bc
9	71.33 c	0.96 abc	342.4 c
10	80.48 b	0.96 abc	386.32 b
11	78.28 bc	0.93 c	375.76 bc
12	74.77 bc	0.96 abc	358.88 bc
13	74.68 bc	0.94 bc	358.48 bc
14	78.8 bc	0.94 c	378.24 bc
P	0.0094	0.227	0.0094
LSD	7.88	0.036	37.834

Evaluation of systemic insecticides for the control of white grub in Wisconsin potato production

Purpose: The objective of this experiment was to assess the efficacy of at-plant insecticides to control white grub, *Phyllophaga* spp. in potato.

Materials and Methods

This experiment was conducted in 2012 in Nekoosa, Wisconsin. Potato, *Solanum tuberosum* cv. 'Russet Norkotah', seed pieces were planted on 23 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. Plots were arranged in an 11 tier design with 12 ft alleys between tiers. All plots were maintained according to standard commercial practices.

Four replicates of 10 experimental treatments and 1 untreated control were arranged in a randomized complete block design. In-furrow insecticides were applied at planting with a CO_2 pressurized backpack sprayer operating at 30 psi with two TeeJet 8001VS nozzles spaced at 18 inches, delivering 11 gpa. Furrows were cut using a commercial potato planter without closing discs attached. Seed treatments were applied in 0.13 L insecticide per 50 lb batch of seed.

Two row stand counts were conducted on 8 June (46 DAP) by counting the number of emerged plants per 20 ft section of row. Yield and quality data were collected after harvest (28 Sep). The total weight (lbs), total number of tubers and the number of damaged tubers were assessed for each treatment. No signs of phytotoxicity were observed.

Table 1. Mean percent damage associated with infestation of Phyllophaga spp. including yield estimates.

Treatment	Rate	Application Type	Total # Tubers	Proportion of Damaged Tubers	Total plot weights (lbs)
Untreated	-	-	190.75 ab	0.081 a	40.5 abc
Verimark 200 SC	0.62 fl oz/cwt	Seed	174.25 b	0.077 ab	31.3 c
EXP 2SC	0.88 fl oz/cwt	Seed	179.75 b	0.02 ab	31.5 c
Regent 4 SC	3.2 fl oz/a	In-furrow	166 b	0.067 ab	34.1 bc
EXP 40 WG	6.5 oz wt/a	In-furrow	202 ab	0.01 b	35.4 bc
EXP 40 WG	10 oz wt/a	In-furrow	205.75 ab	0.042 ab	45.4 a
Platinum 75 SG	2.66 oz wt/a	In-furrow	195.25 ab	0.009 b	38 abc
Verimark 1.67 SC	13.5 fl oz/a	In-furrow	223.5 a	0.039 ab	46.1 a
Movento 2 SC	4 fl oz/a	In-furrow	205.25 ab	0.019 ab	42.6 ab
Movento 2 SC	5 fl oz/a	In-furrow	183.25 ab	0.016 ab	39.6 abc
Belay 2.13 SC	12 fl oz/a	In-furrow	191.75 ab	0.056 ab	31.5 c
		P	0.286	0.319	0.016
		LSD	41.841	0.071	9.6

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 2012. Snap bean, *Phaseolus vulgaris* var. 'Hercules,' was seeded on 04 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 14 treatments and 1 untreated control were arranged in a randomized complete block design. The foliar treatments were applied 17 Jul 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 two dates, 4 days pre and 3 days post the single insecticide treatment (13 and 20 Jul, respectively). 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 19 Jul, 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	First infestation	Insecticide app.	Second infestation	Evaluations*
Date	04 Jun	13 Jul	17 Jul	20 Jul	3, 6 Aug
Days from last action		39	4	3	21, 17

*Evaluations for 1st and 2nd pinnings, respectively.

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.

		Infested 13 Jul (4 days pre application)				**Infested 20 Jul** (3 days post application)			
Treatment	**Rate**	**# Damaged Stems**	**Proportion Damaged Pods**	**# Larvae in Pods**	**# Larvae in Stems**	**# Damaged Stems**	**Proportion Damaged Pods**	**# Larvae in Pods**	**# Larvae in Stems**
Untreated	-	1.25 a	0.005 ab	0.1 a	0.6 a	1.37 a	0.016 ab	0.11 a	0.58 a
HGW86 10 SE MSO 100 L	6.74 oz/a 0.25% v/v	0.32 b-d	0 b	0 b	0.05 de	0.26 b	0.0015 ab	0.05 ab	0.16 b
HGW86 10 SE MSO 100 L	13.5 oz/a 0.25% v/v	0.3 b-d	0.02 a	0 b	0.1 c-e	0.26 b	0 b	0 b	0.11 b
HGW86 10 SE MSO 100 L	20.5 oz/a 0.25% v/v	0.1 cd	0 b	0 b	0 e	0.26 b	0 b	0 b	0 b
HGW86 10 SE	13.5 oz/a	0.1 cd	0.004 b	0.05 ab	0.05 de	0.25 b	0.002 ab	0 b	0.05 b
Coragen 1.67 SC MSO 100 EC	3.0 oz/a 0.5% v/v	0 d	0 b	0 b	0 e	0.3 b	0.005 ab	0 b	0 b
Coragen 1.67 SC MSO 100 EC	5.0 oz/a 0.5% v/v	0.15 cd	0 b	0 b	0 e	0.11 b	0 b	0 b	0 b
Endigo 2.06 ZC	4.5 oz/a	0.4 b-d	0 b	0 b	0.3 b-d	0.45 b	0 b	0 b	0.15 b
Endigo 2.71 ZC	4.5 oz/a	0.67 b	0.006 ab	0.07 ab	0.33 bc	0.35 b	0.01 ab	0 b	0.1 b
Warrior II 2.08 SC	1.92 oz/a	0.25 b-d	0 b	0 b	0.1 c-e	0.1 b	0.014 ab	0.05 ab	0 b
Radiant 1 SC	8.0 oz/a	0.5 bc	0 b	0 b	0.2 c-e	0.42 b	0.012 ab	0 b	0.11 b
Actara 25 WG	5.5 oz/a	1.15 a	0 b	0 b	0.47 ab	1.6 a	0.015 ab	0.1 ab	0.55 a
Voliam Xpress 1.25ZC MSO 100 MS	9.0 oz/a 0.5% v/v	0 d	0 b	0 b	0 e	0.1 b	0.004 ab	0 b	0 b
Brigade 2 EC	5.13 oz/a	0.25 b-d	0 b	0 b	0 e	0.15 b	0 b	0 b	0.05 b
Brigade 2 EC	6.4 oz/a	0.15 cd	0 b	0 b	0.05 de	0.15 b	0.02 a	0.1 ab	0 b
	P	<0.0001	0.5229	0.1522	<0.0001	<0.0001	0.4078	0.1779	<0.0001
	LSD	0.481	0.014	0.072	0.265	0.438	0.02	0.102	0.243

In-furrow insecticide and fertilizer pre-mix 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 in-furrow treatments on European corn borer in snap bean.

Materials and Methods

This experiment was conducted at the Del Monte Foods Experimental Plots, near Plover, WI in 2012. Snap bean, *Phaseolus vulgaris* var. 'DMC 04-88', was seeded on 3 June 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 11 treatments and 1 untreated control were arranged in a randomized complete block design. In-furrow treatments were applied at planting with a CO_2 pressurized backpack sprayer with a single nozzle boom operating at 30 psi delivering 11.1 gpa through a flat-fan nozzle (Tee Jet XR8002VS) traveling at 3.5 ft/sec. Liquid fertilizer pre-mixes were applied at a rate of 35 lb nitrogen at 4.5 gpa through a Raven System. Dry fertilizer pre-mixes were applied at a rate of 225 lbs/a of starter and placed in a 2 x 2" arrangement relative to the seed furrow. Foliar treatments were applied 28 July with a CO_2 pressurized backpack sprayer with a single nozzle boom operating at 30 psi delivering 20.2 gpa through a flat fan nozzle (Tee Jet XR8002VS) traveling at 3.5 ft/sec.

Counts of emerged plants per row were taken from the center row of each plot on 13 June. Populations of ECB and associated damage estimates were surveyed 9 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 among treatments.

Table 1. Damage estimates of snap bean stems and pods, and total pod weights harvested.

			19 July		
Treatment	**Rate**	**Application Type[1]**	**Proportion of Damaged Stems**	**Proportion of Damaged Pods**	**Pod weights (lbs)**
Untreated	-	-	0.15 a	0.005 a	5.13 b
Coragen 1.67 SC	3.5 fl oz/a	IF	0 b	0 b	6.05 ab
Coragen 1.67 SC	5 fl oz/a	IF	0.07 b	0 b	6.08 ab
Coragen 1.67 SC	7 fl oz/a	IF	0 b	0 b	6.3 ab
Verimark 20 SC	10 fl oz/a	IF	0 b	0 b	6.03 ab
Verimark 20 SC	13.5 fl oz/a	IF	0.01 b	0 b	6.8 ab
Coragen 1.67 SC	5 fl oz/a	F-Pre	0.01 b	0 b	6.8 ab
Coragen 1.67 SC	7 fl oz/a	F-Pre	0.01 b	0 b	5.8 ab
Verimark 20 SC	10 fl oz/a	F-Pre	0 b	0 b	6 ab
Verimark 20 SC	13.5 fl oz/a	F-Pre	0.01 b	0.002 b	7.13 a
Coragen 1.67 SC	5 fl oz/a	F	0.02 b	0 b	6.4 ab
Benevia 10 SE	13.5 fl oz/a	F	0.01 b	0 b	6.85 ab
		P	0.004	0.089	0.62
		LSD	0.07	0.003	1.76

[1]IF = In-Furrow; F-Pre = fertilizer pre-mix; F = foliar

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 2012. Snap bean, *Phaseolus vulgaris* var. 'DMC 04-88' was seeded on 3 June 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 5 treatments and 1 untreated control were arranged in a randomized complete block design. The foliar treatments were applied 9 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 XR8002XS) 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 13 June. Populations of ECB and associated damage estimates were surveyed 19 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, and total pod weights harvested.

		19 July		
Treatment	**Rate**	**Proportion of Damaged Stems**	**Proportion of Damaged Pods**	**Pod weights (lbs)**
Untreated	-	0.15 a	0	5.53 ab
[1]Exirel 10 SE	6.75 fl oz/a	0.05 b	0	5.63 ab
[1]Exirel 10 SE	13.5 fl oz/a	0 b	0	4.15 b
[1]Exirel 10 SE	20.5 fl oz/a	0.02 b	0	5.78 ab
Exirel 10 SE	13.5 fl oz/a	0.03 b	0	6.15 a
Brigade 2 EC	6.4 fl oz/a	0.04 b	0	4.5 ab
	P	0.005	0.64	0.22
	LSD	0.03	0	1.88

[1]MSO 100 EC was 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 2012. Pepper, *Capsicum annuum* cv. 'Bell Boy', transplants were planted 7 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 two separate dates, 6 Aug and 13 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 11 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 23 Aug (evaluation of first pinning) and 24 Aug (evaluation of second pinning) 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. 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	First Infestation	Insecticide app.	Second Infestation	Evaluation*
Date	7 Jun	6 Aug	9 Aug	13 Aug	23, 24 Aug
Days from last action		60	3	4	14, 11

*Evaluations for 1st and 2nd pinnings, respectively.

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 plant in pepper.

		Infested 6 Aug (pre-application)				**Infested 13 Aug** (post-application)			
Treatment	**Rate**	**Total No. Fruit**	**Weight (lb)**	**Proportion Damaged Fruit**	**# Larvae**	**Total No. Fruit**	**Weight (lb)**	**Proportion Damaged Fruit**	**# Larvae**
Untreated	-	8.8 ab	1.69	0.17 ab	0.5	7.2 a	1.53 a	0.296 a	0.4 a
HGW86 10 SE MSO 100 L	13.5 oz/a 0.25% v/v	7.3 b	1.42	0.16 ab	0.65	5.65 abc	1.01 bc	0.095 bc	0.05 b
HGW86 10 SE MSO 100 EC	20.5 oz/a 0.25% v/v	8.3 ab	1.59	0.19 ab	0.75	6.85 a	1.35 ab	0.03 c	0.05 b
Coragen 1.67 SC MSO 100 EC	3 oz/a 0.5% v/v	7.55 b	1.46	0.096 b	0.3	4.1 c	0.91 c	0.069 bc	0.05 b
Coragen 1.67 SC MSO 100 EC	5 oz/a 0.5% v/v	7.45 b	1.44	0.09 b	0.15	4.85 bc	1.14 abc	0.07 bc	0 b
Endigo 2.06 ZC	4.5 oz/a	8.7 ab	1.54	0.12 b	0.35	5.9 abc	1.22 abc	0.03 c	0 b
Endigo 2.71 ZC	4.5 oz/a	8.0 ab	1.49	0.17 ab	0.7	7.1 a	1.57 a	0.088 bc	0 b
Warrior II 2.08 SC	1.92 oz/a	9.7 a	1.80	0.19 ab	0.5	6.0 abc	1.37 ab	0.12 b	0 b
Radiant 1 SC	8 fl oz/a	8.2 ab	1.53	0.10 b	0.1	6.6 ab	1.27 abc	0.099 bc	0.1 b
Actara 25 WG	5.5 oz/a	7.35 b	1.62	0.16 ab	0.55	7.15 a	1.395 ab	0.066 bc	0.1 b
Voliam Xpress 1.25 ZC MSO 100 MS	9 oz/a 0.5% v/v	7.7 ab	1.57	0.31 a	0.65	6.75 ab	1.55 a	0.13 b	0.1 b
Brigade 2 EC	6.4 oz/a	8.8 ab	1.76	0.16 ab	0.7	5.75 abc	1.199 abc	0.024 c	0 b
	P	0.44	0.82	0.32	0.80	0.03	0.05	<0.0001	0.007
	LSD	2.05	0.44	0.15	0.77	1.92	0.43	0.088	0.199