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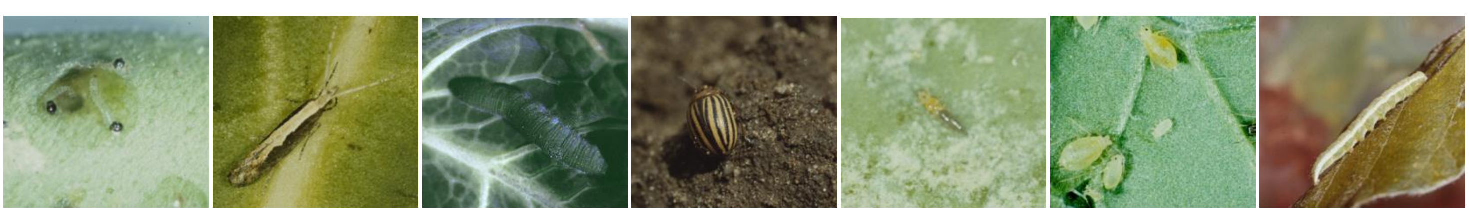

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Evaluation of foliar insecticides for the control of Lepidopteran insect pests in cabbage

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 2011. Cabbage, *Brassica oleracea* cv. 'Katlin', transplants were planted 13 Jun. 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 7 experimental foliar treatments and 1 untreated control were arranged in a randomized complete block design. All foliar treatments were applied 12 Aug. Treatments were applied with a CO_2 backpack sprayer with a 6 foot boom operating at 30 psi delivering 24 gpa through four flat-fan nozzles (Tee Jet XR8002VS) 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. Larval counts occurred twice during August, on Aug 16 (4 DAT), and Aug 22 (10 DAT). Count data were $\log_{10}$ transformed prior to analysis. Means were separated using ANOVA with a Least Squared Difference (LSD) means comparison test (P=0.05).

Results and Discussion

During 2011 all three pest species of lepidopteran larval found on cabbage in Wisconsin were collected from the trial while ICW-L larvae were the most frequently encountered (Table 1). All of the insecticides evaluated in the trial effectively reduced ICW, DBM, and CL larval numbers after application. All treatments provided effective control of ICW-L by 4 DAT compared to those observed in the untreated control plots. At 4 DAT there were few significant differences among treatments indicating a similar level of initial efficacy among the insecticides. At 10 DAT larval numbers had declined throughout the trial while numbers in the treated plots continued to be lower than the untreated plots. No signs of phytotoxicity were observed.

Table 1. Mean insect counts per cabbage head

		16-Aug						22-Aug					
Treatment[1]	**Rate[2]**	**ICW-L[3]**	**ICW-S**	**DB-L**	**DB-S**	**CL-L**	**CL-S**	**ICW-L**	**ICW-S**	**DB-L**	**DB-S**	**CL-L**	**CL-S**
Untreated	-	42.5a	22.3a	6.5	7.8	5.0a	5.8a	10.8	11.2a	0	2.3a	0.5	1.0
Coragen 1.67 SC	3.5	4.8ab	7.3ab	0.3	0	1.0ab	0.3b	0.5	0c	0	0b	0	0
Coragen 1.67 SC	5	5.0ab	8.0ab	0.5	0	1.3ab	0b	1.3	1.3b	0	0b	0	0.5
Dipel 54 DF	1 lb/a	3.8ab	7.5ab	2.0	0.8	4.0a	0b	1.5	1.8ab	0	1.0a	0.8	1.0
HGW86 100 OD	10	3.0b	4.5b	1.5	2.3	0b	0b	1.3	0.8bc	0.3	0b	0.3	0.5
HGW86 100 OD	13.5	2.8bc	4.8ab	0.8	2.8	0b	1.3b	0.5	0.3bc	0	0b	0	0.3
Radiant 1 SC	10	0.8c	1.5c	0.3	0	0b	0b	1.3	0.3bc	0	0b	0	0.5
Warrior II 2.08 CS	1.6	1.8b	2.0bc	0	1.3	0b	0b	3.8	1.8ab	0	0.3ab	0.8	0
	P	0.006	0.006	0.17	0.07	0.01	0.02	0.20	0.005	0.46	0.02	0.30	0.34
	LSD	2.34	1.61	3.76	3.65	3.21	2.61	3.42	3.27	1.19	2.49	2.77	3.33

[1]All treatments except Untreated and Dipel also had MSO 100 L at 0.25% v/v
[2] Rate in oz/a unless noted
[3]L = Large Larvae, S = Small Larvae

Evaluation of at-plant drench insecticides for the control of Lepidopteran insect pests on cabbage

Purpose: The objective of this experiment was to assess the efficacy of at-plant drench applied insecticides to control Lepidopteran insect pests on cabbage.

Material and Methods

This experiment was conducted at the Arlington Agricultural Experiment Station, Arlington, WI in 2011. Cabbage, *Brassica oleracea* cv. Katlin, transplants were planted 14 Jun. Plants were spaced 18 inches apart within rows with a 36 inch row spacing. 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 between plots. Plots were arranged into four replications with 5 ft alleys between replications. All plots were maintained according to standard commercial practices.

Four replications of 4 experimental drench treatments and 1 untreated control were arranged in a randomized complete block design. All insecticidal drench applications were made at transplant on 14 Jun. Treatments were applied with a CO_2 backpack sprayer with a single flat fan nozzle (Tee Jet XR8001VS) operating at 30 psi delivering 20 gpa. Thirty milliliters of solution were delivered to each transplant.

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, "L" and small, "S") per plant on 10 non-destructively sampled cabbage heads from the center two rows in each plot. Larval counts occurred four times during late July and early August, Jul 21 (37 DAT), Jul 26 (42 DAT), Aug 2 (49 DAT), and Aug 9 (56 DAT). Count data were $\log_{10}$ transformed prior to analysis. Means were separated using ANOVA with a Least Squared Difference (LSD) means comparison test (P=0.05).

Results and Discussion

During 2011 all three pest species of lepidopteran larval found on cabbage in Wisconsin were collected from the trial (Table 1). ICW and CL populations were low during July while ICW-L and ICW-S pressure was high in August at 49 and 56 DAT and none of the treatments were providing significant control of these pests compared to the untreated check. DB-L populations were highest during late July, and there was significant control of DB-L populations by Durivo and HGW86 at this period. No signs of phytotoxicity were observed.

Table 1. Mean insect counts per 10 cabbage heads

		21-Jul (37 DAT)						26-Jul (42 DAT)					
Treatment	**Rate (fl oz/a)**	**ICW-L[1]**	**ICW-S**	**DB-L**	**DB-S**	**CL-L**	**CL-S**	**ICW-L**	**ICW-S**	**DB-L**	**DB-S**	**CL-L**	**CL-S**
Untreated	-	0.8	0.3	1.8ab	1.5	0.3	0	0.5	0.8	0.3	1.3	0	0.8
Coragen 1.67 SC	5.0	0.8	0.3	1.8a	0.8	0	0.3	0.3	0	0.3	2.5	0	1.8
HGW86 20 SC	10.3	0.8	0.8	0.5a-c	1.0	0	1.0	0.8	0	0.3	1.5	0	1.5
HGW86 20 SC	13.5	0.5	0.3	0d	0.3	0	0.3	0.5	0.3	0	2.8	0.3	1.5
Durivo 26.3 SC	13.0	0.8	0.8	0.3bc	1.3	0.3	1.0	0	0.3	0.3	3.3	0	0.8
	P	0.77	0.93	0.02	0.57	0.57	0.52	0.28	0.73	0.91	0.42	0.44	0.71
	LSD	3.14	3.84	3.01	4.09	2.20	3.62	3.36	2.92	3.11	2.01	1.56	3.58

[1]L = large larvae, S = small larvae

Table 1 continued

		2-Aug (49 DAT)						9-Aug (56 DAT)					
Treatment	**Rate (fl oz/a)**	**ICW-L**	**ICW-S**	**DB-L**	**DB-S**	**CL-L**	**CL-S**	**ICW-L**	**ICW-S**	**DB-L**	**DB-S**	**CL-L**	**CL-S**
Untreated	-	0.3	1.5	0.3	0.8	0.3	0	23	7.3	0.8	0.8	1.3	0.8
Coragen 1.67 SC	5.0	0	2.5	0.8	0.3	1.0	0	20.5	2.5	0	0.5	0	0.3
HGW86 20 SC	10.3	1.0	0.5	0	0	0.3	0.3	18.3	2.0	0.3	0	1.0	1.0
HGW86 20 SC	13.5	0.8	3.5	0.3	1.5	0	1.3	20.3	8.5	0	0	0.8	0.8
Durivo 26.3 SC	13.0	0.8	1.3	0	1.3	0.3	0	13.5	3.0	0.5	0.8	1.0	0.5
	P	0.57	0.39	0.09	0.90	0.60	0.57	0.14	0.35	0.73	0.33	0.42	0.70
	LSD	3.76	3.86	2.69	3.89	3.39	2.61	0.47	3.41	3.05	3.27	3.88	3.88

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 2011. Onion, *Allium cepa* cv. 'Cortland', was direct seeded on 02 May. 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 17 experimental treatments and 1 untreated control were arranged in a randomized complete block design. Applications were initiated when mean immature thrips populations had exceeded established thresholds of 3 immature thrips / leaf. All foliar treatments were applied on 25 Jul and 01 Aug. Treatments were applied with a CO_2 backpack sprayer with a 6 foot boom operating at 30 psi delivering 24 gpa through four flat-fan nozzles (Tee Jet XR8002VS) spaced 18" apart while traveling at 3.5 ft / sec.

Immature lifestages of onion thrips (OT) were assessed by counting the number of larvae per plant on 10 randomly selected plants in the central 2 rows of each plot. Larval counts occurred four times during July and August, on 28 Jul (3 DAT) and 01 Aug (7 DAT) after the first application and again on 8 Aug (7 DAT) and 17 Aug (16 DAT) after the second application. Count data were $\log_{10}$ transformed prior to analysis. 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**.

Results and Discussion

Initial efficacy from all the treatments was poor but after the second application 17 August (16 DAT) larval numbers were significantly reduced in many of the treatments (Table 1). Carzol and Radiant were the most effective at suppressing OT on this date. No obvious signs of phytotoxicity were observed after each application.

Onion thrips continue to be a tough insect to control on onions due to their ability to develop resistance to insecticides quickly. In this trial HGW86 (cyantraniliprole), Radiant, Movento, Agri-Mek, Tolfenpyrad, and Carzol all provided effective control of OT larvae.

Table 1. Mean count of immature OT per plant.

Treatment	Rate	28-Jul	1-Aug	8-Aug	17-Aug
Untreated	-	3.8	3.1	4.5	10.5 a
[1]Warrior II 2.08 SC	1.92 fl oz/a	1.5	9.3	5.5	8.8 ab
[2]HGW 86 10 OD	10.1 fl oz/a	3.5	5.4	3.1	2.0 b-g
[2]HGW 86 10 OD	13.5 fl oz/a	3.6	2.9	1.2	0.8 g-h
[1]Radiant 1 SC	8 fl oz/a	2.8	1.4	0.7	0.4 h-j
[2]Movento 240 SC	5 fl oz/a	4.8	4.2	1.8	5.1 a-d
[3]Movento 240 SC	5 fl oz/a	2.5	4.4	2.5	2.8 b-e
[4]Movento 240 SC	5 fl oz/a	1.6	4.5	2.6	3.9 a-e
[3]Movento 240 SC	4 fl oz/a	3.4	5.4	3.7	5.4 a-d
[1]Agri-Mek 0.7 SC	2.58 fl oz/a	3.2	4.4	2.1	0.8 f-i
[1]Tolfenpyrad 150 SC	21 fl oz/a	3.9	4.3	1.4	1.4 e-h
Carzol 92 SP	1.25 lb ai/a	2.3	2	1.4	0.3 j
Assail 70 WP	3.4 oz/a	2.8	3.7	2.1	6.6 a-c
Assail 70 WP (1st appl) M-Pede 100 SL (2nd appl)	2.1 oz/a 1% v/v	3.2	4.9	2.4	2.9 b-e
M-Pede 100 SL	2% v/v	3.0	7.0	4.9	5.2 a-d
Lannate 2.4 L (1st appl) M-Pede 100 SL (2nd appl)	2 pt /a 1% v/v	2.3	3.6	3.0	0.5 ij
Lannate 2.4 L (1st appl) M-Pede 100 SL (2nd appl)	3 pt/a 2% v/v	2.3	2.7	2.0	1.8 d-g
Lannate	3 pt/a	3.3	5.3	4.0	1.5 d-g
	P	0.95	0.82	0.15	<0.0001
	LSD	1.40	1.20	1.41	1.26

[1] NIS 100 L added at 0.25% v/v
[2]MSO 100 Ladded at 0.5% v/v
[3] MSO 100 L added at 0.5% v/v + N-Boost added at 2.5 pt/a.
[4] MSO 100 L added at 0.5% v/v + N-Boost added at 5.0 pt/a.

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 2011. Potato, *Solanum tuberosum* cv. 'Superior', seed pieces were planted on 28 April. Seed pieces were spaced 12 inches apart within rows. Rows were 3 ft apart. 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 24 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 24 June and 1 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 XR8002VS) 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) and adults per plant on 10 randomly selected plants from the center two rows in each plot. Egg mass numbers were very low during the trial period so were not included in the data analyses. 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 27 (3 DAT) and 30 (6 DAT) after the first application. The second set of counts occurred on July 5 (4 DAT), 11 (10 DAT), and 20 (19 DAT), following the second application. Count data were $\log_{10}$ transformed prior to analysis. Means were separated using ANOVA with a Fisher's Protected Least Squared Difference (LSD) mean separation test (P=0.05).

Results and Discussion

First generation CPB populations were established and most of the egg masses had hatched by the first foliar application on June 24 and defoliation estimates were over 10% in most plots (Table 1). A good indicator of CPB insecticide efficacy is plant defoliation. On July 20 (19 DAT) defoliation had reached 55.4% in the untreated plots while many of the treated plots had no defoliation. Several of the most effective treatments with no defoliation included DPX-HGW86, Coragen, Voliam flexi, Agri-flex, and Endigo. Many of the other treatments limited larval feeding to less than 10%. No signs of phytotoxicity were observed.

Table 1. Mean insect counts and percent defoliation

Treatment	**Rate**	**CPB-AD** (Jun 15,27)	**CPB-SL** (Jun 30, Jul 5, 11)	**CPB-LL** (Jun 30 Jul 5, 11)	**% Defoliation** (Jul 20)	**PLH** (Jul 11, 20)
Untreated	-	1.7	46.9 a	84.8 a	55.4 a	0.8 b-f
[1]Leverage 360 31.5 SC	2.8 oz/a	1.1	17.3 a-e	15.6 b-g	15 cd	0.8 c-f
DPX-HGW86 100 OD	3.38 oz/a	1.5	3.4 g-k	1.7 m-o	0 d	1.5 ab
DPX-HGW86 100 OD	6.76 oz/a	2.4	2.2 k	6.5 h-m	0 d	0.5 c-f
DPX-HGW86 100 OD	10.1 oz/a	3.6	1.7 i-k	0.4 o	0 d	1.6 a-d
Provado 1.6 SC	3.8 oz/a	1.9	11.5 a-d	14.1 c-g	2 cd	0.4 d-f
[2]Coragen 1.67 SC	4.5 oz/a	1.5	5.5 e-h	4.3 l-o	2.5 cd	2.3 a-c
[2]Coragen 1.67 SC	5 oz/a	1.9	6.3 e-i	7.2 e-j	0 d	1.1 a-d
Coragen 1.67 SC	7 oz/a	2.4	5.1 e-i	5.7 j-o	0 d	1.0 a-d
[2]Voliam Flexi 40 WG	5 oz/a	1.8	1.9 k	1.2 m-o	0	0.4 ef
[3]Agrimek 0.7 SC	2.57 oz/a	1.6	2.7 f-j	2.3 i-n	3.8 cd	2.3 a
[3]Agri-Flex 1.55 SC	5.55 oz/a	2.0	2.3 jk	3.9 k-o	0 d	0.1 f
Endigo 2.71 ZC	4 oz/a	0.8	1.8 g-k	0.4 no	0 d	1.3 a-d
Warrior II 2.08 SC	1.92 oz/a	0.8	7.6 e-h	12.7 c-g	5 cd	1.4 a-d
Actara 25 WDG	3 oz /a	2.8	2.5 jk	3.0 i-n	1.3 cd	0.1 f
Athena 0.87 EC	13 oz/a	2.1	14.9 a-d	13.7 a-d	5.0 cd	0.1 f
Athena 0.87 EC	17 oz/a	1.8	7.4 c-g	8.4 c-h	3.8 Cd	0.8 c-f
Brigadier 2 SC	6.4 oz/a	4.3	12.8 b-f	19.6 a-e	6.3 cd	0.4 d-f
Scorpion 35 SL	2.75 oz/a	1.2	30.3 ab	57.3 ab	42.3 ab	0.6 c-f
Radiant 1 SC	6 oz/a	2.2	8.7 d-h	10.0 i-l	2.5 cd	0.8 a-d
Radiant 1 SC	8 oz/a	1.5	2.8 e-i	1.8 i-n	13.8 cd	1.1 a-f
Rimon 0.83 EC	12 oz/a	3.8	9.8 c-h	10.7 f-k	5 cd	0.9 a-f
[1]Fastac 2 EC	4 oz/a	1.5	35.0 ab	58.4 ab	36.3 b	0.4 ef
Voliam Xpress 1.3 SC	9 oz/a	1.5	5.0 c-g	7.5 h-m	2.5 cd	0.6 d-f
	P	0.56	<0.0001	<0.0001	<0.0001	0.0037
	LSD	2.72	2.10	2.11	15.5	2.38

[1] NIS 100 XL added at 0.5% v/v

[2] MSO added at 0.25% v/v

[3]NIS 100 XL added at 0.25% v/v

Registered and experimental foliar insecticides to control Colorado potato beetle (AAES)

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 the Arlington Agricultural Experiment Station (AAES) in Arlington, Wisconsin in 2011. Potato, *Solanum tuberosum* cv. 'Superior', 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.

Four replicates of 24 experimental foliar treatments and 2 untreated controls were arranged in a randomized complete block design. The foliar treatments were applied when 75-90% of the first generation CPB was within the first and second instar larval stadia. The application date was 28 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 XR8002VS) spaced 18" apart while travelling at 3.5 ft / sec.

CPB efficacy was assessed by counting the number of egg masses, small larvae (SL), large larvae (LL) and adults 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. Insect counts occurred on several dates throughout the summer and reported means were averaged across those dates (**Table 1**). Egg, larval and adult counts occurred four times during July. The counts occurred on 1 Jul (3 DAT), 5 Jul (7 DAT), 15 Jul (17 DAT) and 21 Jul (23 DAT). Count data were $\log_{10}$ transformed prior to analysis. Means were separated using ANOVA with a Fisher's Protected Least Squared Difference (LSD) mean separation test (P=0.05).

Results and Discussion

CPB egg mass numbers were very low in this study and no significant effects by treatment were observed. Numbers of adult CPB and small (CPB-SL) and large (CPB-LL) larvae reflected significant differences in treatments. Fastac and Rimon provided the least effective control of CPB-SL and CPB-LL relative to the untreated control. Actara, Provado, and Radiant (at a rate of 8 oz/a) had the greatest effect on CPB-SL populations as compared to the untreated control. While, Agri-Flex, Coragen (at a rate of 5 oz/a), Provado, and Radiant (at a rate of 8 oz/a) provided the most effective control of CPB-LL. At the final sampling date, %DF was significantly lower in all treatments as compared to the untreated control. All treatments knocked down CPB-adult populations by at least half as compared to the untreated control. However, HGW86 (at a rate of 6.76 oz/a), Voliam-Flexi, Endigo, and Coragen (at a rate of 5 oz/a) provided the most effective control of adult populations. No signs of phytotoxicity were observed.

Table 1. Mean insect counts and percent defoliation

Treatment	Rate	CPB-AD (Jul 15, 21)	Egg (Jul 1, 5)	CPB-SL (Jul 1, 5)	CPB-LL (Jul 1, 5)	% Defoliation (Jul 21)
Untreated	-	37.4 a	0.4	31.6 ab	69.1 a	64.4 a
[1]Leverage 360 31.5 SC	2.8 oz/a	10.1 a-e	1.1	6.6 d-g	2.5 g-h	4.4 b
DPX-HGW86 100 OD	3.38 oz/a	4.8 a-f	1.6	8.5 b-g	2.3 f-h	3.1 b
DPX-HGW86 100 OD	6.76 oz/a	1.9 e-g	1.1	4.1 b-g	2.5 g-h	1.9 b
DPX-HGW86 100 OD	10.1 oz/a	4.5 a-f	0.3	6.8 fg	1.8 e-h	1.9 b
Provado 1.6 SC	3.8 oz/a	6.6 c-g	0.9	0.9 e-g	0.4 g-h	2.5 b
[2]Coragen 1.67 SC	4.5 oz/a	2.0 b-g	0.6	9.6 a-c	8.6 a-c	1.5 b
[2]Coragen 1.67 SC	5 oz/a	1.3 g	0.1	4.3 a-f	0.8 g-h	2.5 b
Coragen 1.67 SC	7 oz/a	3.6 e-g	2.8	6.4 a-d	1.8 c-g	2.5 b
[2]Voliam Flexi 40 WG	5 oz/a	4.4 g	1.1	2.5 c-g	2.4 g-h	1.9 b
[3]Agrimek 0.7 SC	2.57 oz/a	3.0 b-g	1.3	10.1 a-c	8.5 c-f	1.9 b
[3]Agri-Flex 1.55 SC	5.55 oz/a	4.0 fg	0.1	3.6 b-g	0.1 i	0.9 b
Endigo 2.71 ZC	4 oz/a	2.9 g	0.9	9.3 a-f	1.4 g-h	1.3 b
Warrior II 2.08 SC	1.92 oz/a	7.1 b-g	0.4	4.6 b-g	3.8 c-g	2.5 b
Actara 25 WDG	3 oz /a	4.3 b-g	0.8	1.6 g	1.4 g-h	1.9 b
Athena 0.87 EC	13 oz/a	5.9 b-f	0.6	3.4 d-g	1.8 g-h	1.9 b
Athena 0.87 EC	17 oz/a	9.6 d-g	0.5	5.1 a-e	1.5 g-h	3.8 b
Brigadier 2 SC	6.4 oz/a	9.5 b-f	1.4	2.9 e-g	2.1 d-h	1.9 b
Scorpion 35 SL	2.75 oz/a	17.9 a-f	1.3	2.6 d-g	2.3 f-i	3.1 b
Radiant 1 SC	6 oz/a	18.9 a-c	1.5	14.6 a-e	11.4 a-d	6.9 b
Radiant 1 SC	8 oz/a	7.8 c-g	0.8	1.3 g	0.5 g-h	3.1 b
Rimon 0.83 EC	12 oz/a	13.8 a-d	0.5	19.0 a	33.4 ab	7.5 b
[1]Fastac 2 EC	4 oz/a	15.5 ab	0.3	14.1 a-c	17.8 b-e	8.8 b
Voliam Xpress 1.3 SC	9 oz/a	16.0 a-d	2.2	6.9 a-e	6.4 d-h	5.6 b
	P	<0.0001	0.56	<0.0001	<0.0001	<0.0001
	LSD	2.22	2.54	2.64	2.64	11.1

[1] NIS 100 XL added at 0.5% v/v
[2] MSO added at 0.25% 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 2011. Potato, *Solanum tuberosum* cv. 'Superior', seed pieces were planted on 26 April. Seed pieces were spaced 12 inches apart within rows. Rows were 3 ft apart. The two-row plots were 6 ft wide by 20 ft long, for a total of 0.003 acres. Two guard rows separated plots. Hilling occurred 23 May. The plots were managed according to commercial pest management (herbicide and fungicide) practices as well as fertility recommendations prescribed by AAES.

Four replicates of 13 experimental foliar treatments and 2 untreated controls were arranged in a randomized complete block design. The foliar treatments were applied 14 Jul. Treatments were applied with a CO_2 pressurized backpack sprayer with a 6 ft boom operating at 30 psi delivering 24 gpa through 4 flat-fan nozzles (Tee Jet XR8002VS) spaced 18" apart while travelling at 3.5 ft/sec.

PLH and aphid efficacy was assessed by counting the number of PLH nymphs (N) and the number of aphids per plant on 10 randomly selected plants in each plot while PLH adults (A) were assessed by using sweep samples consisting of 20 sweeps per plot (**Table 1**). Insect counts occurred on four dates during July and August: 18 July (4 DAT), 21 Jul (7 DAT), 26 Jul (12 DAT), and 2 Aug (19 DAT). Count data were $\log_{10}$ transformed prior to analysis. Adult populations are pre-application. Means were separated using ANOVA with a Fisher's Protected Least Squared Difference (LSD) mean separation test (P=0.05). Aphid numbers were not significant during the trial and were not included in the analyses.

Results and Discussion

Potato leafhopper nymph numbers were high during July and August, peaking at 29.5 nymphs per sample on July 26 (Table 1). There was a significant difference in control of PLH nymphs on all three dates. Coragen provided the least effective control, while Actara and Leverage 360 provided the most effective control. PLH adult populations were similar in all plots prior to applications and remained low throughout the research trial. No signs of phytotoxicity were observed.

Table 1. Mean potato leafhoppers per sample.

Treatment	Rate	PLH A (Jul 7)	PLH N (Jul 21)	(Jul 26)	(Aug 2)
Untreated	-	4.9	14.0 a	29.5 a	15.8 ab
Actara 25 WDG	0.047 lb ai/a	4.0	0 c	0 b	0 d
Leverage 360 SC	0.0656 lb ai/a	4.3	0 c	0 b	0 d
Endigo 2.06 SC	0.0644 lb ai/a	3.3	1.8 a-c	0 b	4.8 b-d
Endigo 2.71 ZC	.085 lb ai/a	4.0	2.3 a-c	0 b	0.8 cd
Warrior II 2.09 CS	0.0314 lb ai/a	3.3	2.8 bc	0 b	0.8 cd
[1]Coragen 1.67 SC	0.059 lb ai/a	3.3	12.3 ab	12.0 a	15.8 a
Brigadier 2 SC	0.1 lb ai/a	4.5	0 c	0.5 b	0 d
Athena 0.87 EC	0.088 lb ai/a	6.0	2.5 a-c	0 b	0 d
Athena 0.87 EC	0.116 lb ai/a	3.8	2.5 c	0 b	2.8 b-d
[1]Voliam Flexi 40 WG	0.125 lb ai/a	6.0	0 c	0 b	4.0 b-d
[2]Fastac 2 EC	0.0625 lb ai/a	6.0	0 c	0.5 b	0.8 cd
[2]Agri-Flex 1.55 SC	0.067 lb ai/a	2.5	0.8 c	0 d	1.0 b-d
[2]Agrimek 0.7 SC	0.014 lb ai/a	4.3	1.5 a-c	6.5 a	10.8 a-c
	P	0.65	0.004	<0.0001	0.003
	LSD	3.49	3.70	2.46	3.84

[1]MSO 100 MS added at 0.25% v/v
[2]NIS 100 XL 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 2011. Potato, *Solanum tuberosum* cv. 'Russet Norkotah', seed pieces were planted on 13 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 guard rows of the PVY-resistant variety "Villetta Rose' separated plots. Replicates were separated by 12' alleys of bare ground. Drive rows for foliar applications were arranged to cover border rows and provide access for foliar applications to 4 row experimental plots. 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 the middle plant in the second and third rows of each plot with a PVY^O strain collected in Wisconsin 2004-06. Inoculation occurred 10 June, approximately 1 week after plant emergence.

Four replicates of 10 experimental foliar treatments and 1 untreated control were arranged in a randomized complete block design. Foliar applications were initiated on 6 Jul and were reapplied either once weekly or twice weekly depending on the treatment (see **Table 1** for application frequency). Treatments were applied with a CO_2 pressurized tractor-mounted sprayer with a 12 ft boom operating at 30 psi delivering 30 gpa through 13 nozzle bodies equipped with Tee Jet XR8003 nozzle tips spaced 12" apart while travelling at 3.5 ft / sec.

Total plot yield was taken at harvest and count data were $\log_{10}$ transformed prior to analysis. Proportion data were arcsine transformed prior to analysis. Means were separated using ANOVA with a Fisher's Protected Least Squared Difference (LSD) 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.

Results and Discussion

Yield data from the trial showed no significant differences among any of the treatments and the untreated control plots. 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.

Treatment	Rate		Start Date	Application Frequency	US #1-A (lbs)	US #1-B (lbs)	Total US #1 (lbs)	Total w/Culls (lbs)	Proportion US #1-A	Proportion US #1-B	CWT/A
UTC	-		-	-	119.4	4.9	124.3	138.5	0.96	0.04	502.8
Aphoil	2	%	6-Jul	1x weekly	121.0	5.0	125.0	134.9	0.97	0.03	489.7
Stylet Oil	0.75	%	6-Jul	1x weekly	97.4	4.9	102.3	115.4	0.95	0.05	419.2
Aphoil	4	%	6-Jul	2x weekly	113.6	3.5	117.1	126.6	0.97	0.03	459.5
Stylet Oil	1.5	%	6-Jul	2x weekly	95.1	5.5	100.6	121.0	0.94	0.06	439.2
Requiem 25 EC	1.7	fl oz/a	6-Jul	2x weekly	105.3	4.8	110.1	124.2	0.96	0.04	450.8
Aphoil + HGW86 10 OD	2 10.1	% fl oz/a	6-Jul 22-Jul	1x weekly [1]3x appl	104.5	2.8	107.3	119.5	0.97	0.03	433.9
Aphoil + HGW86 10 OD	2 13.5	% fl oz/a	6-Jul 22-Jul	1x weekly 3x appl	91.8	4.0	95.8	105.9	0.96	0.04	384.5
Aphoil + Sulfoxaflor 50 WG	2 0.714	% oz/a	6-Jul 22-Jul	1x weekly 3x appl	98.6	4.4	103.0	114.4	0.96	0.04	415.1
Aphoil + Beleaf 50 SG	2 2.8	% oz/a	6-Jul 20-Jul	1x weekly 3x appl	103.4	3.6	106.9	114.3	0.96	0.04	414.8
Aphoil + Fulfill 50 WDG	2 3.67	% fl oz/a	6-Jul 20-Jul	1x weekly 3x appl	114.0	4.4	118.4	123.6	0.96	0.04	448.6
				P	0.18	0.61	0.19	0.22	0.42	0.42	0.22
				LSD	23.2	2.52	23.1	22.8	0.02	0.02	82.9

[1] Three 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. 'Russett Burbank', seed pieces were planted on 28 April. Seed pieces were spaced 12 inches apart within rows. Rows were 3 ft apart. The four-row plots were 12 ft wide by 20 ft long, for a total of 0.006 acres. Two untreated guard rows separated plots. Plots were arranged in an 8 tier design with 12 ft alleys between tiers. All plots were maintained according to standard commercial production practices by HAES staff.

Four replicates of 16 experimental treatments and 3 untreated controls 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 a Tee Jet TXVS-4 hollow cone nozzle delivering 9.3 gpa. Seed treatments were applied in 0.016 L of water on 27 April using a single nozzle boom applying 9.1 gpa equipped with an Tee Jet XR8002VS flat fan spray tip powered by a CO_2 backpack sprayer at 30psi. Seed pieces were placed onto a plastic bag in a single layer and all of the solution was applied evenly over the entire lot. Dust seed piece treatments were applied by adding pre-weighed dry formulation materials to pre-weighed, cut and suberized potato seed pieces in plastic bags. Bags were shaken thoroughly and seed pieces were hand placed (12" spacing) into open furrows. Furrows were cut using a commercial potato planter without closing discs attached. In-furrow insecticides were applied in a 4-6" band over suberized seed pieces using a CO_2 pressurized backpack sprayer with a single hollow cone nozzle (Tee Jet TXVS-6) delivering 4.7 gpa at 30 psi. 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 7 June (40 DAP) by counting the number of emerged plants per 20 ft. section of row. CPB, PLH nymphs, and aphid 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). PLH were recorded as nymphs (N) or adults (A). Adult potato leafhoppers were sampled using sweep net techniques (20 sweeps per plot). Insect counts occurred on several dates throughout the summer, and means are reported as averages over dates (**Table 1**). Insect count averages reflect time periods during the summer when specific life stages peaked in the plots. Count data were $\log_{10}$ transformed prior to analysis. Means were separated using ANOVA with a Fisher's Protected LSD means separation test (P=0.05).

Results and Discussion
First generation CPB populations were typically high during 2011 and peak defoliation occurred between July 11 and 18 when it reached 54.6% in the untreated plots (Table 1). A good indicator of CPB insecticide efficacy is plant defoliation. Most of the at-plant insecticides provided effective CPB control through July 18 and limited defoliation to less that 10%. Only the lower

rates of DPX-HGW86 and Admire Pro allowed defoliation of greater than 10%. No signs of phytotoxicity were observed

PLH and aphid pressure were low (Table 1), but HGW86 + Cruiser and Admire Pro at 8.7 fl oz/a provided the most effective control of PLH aphids and nymphs. No signs of phytotoxicity were observed.

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

Treatment	Rate	Type[1]	CPB-A (Jun 10,16)	CPB-EM (Jun 10,16)	CPB-SL (Jun 16,23,28)	CPB-LL (Jun 21,28, Jul 6)	%DF (Jul 11, 18)	PLH-A (Jun 16, 21, 29)	PLH-N (Jun 21, 29)	Aphids (Jun 21, 29)
Untreated	-	-	3.1	12.4 a-c	36.3 a	70.8 a	54.6 a	2.5 a-e	1.9 a-c	1.6
DPX-HGW86 200 SC	0.47 fl oz/cwt	S	4.6	11.1 ab	31.9 a	44.8 a-c	16.9 bc	6.0 a	6.1 a	2.1
DPX-HGW86 200 SC	0.62 fl oz/cwt	S	6	12.7 a	19.9 ab	27.3 a-c	16.3 b-d	4.8 ab	1.5 ab	1.9
DPX-HGW86 200 SC Cruiser 5FS	0.47 fl oz/cwt 0.12 fl oz/cwt	S	4.3	7.8 a-e	5.1 ab	3.8 d-f	5.6 c-e	0.4 e	0 c	0.6
AdmirePro 4.6 FS	0.26 fl oz/cwt	S	5.4	4.4 b-e	17.8 a	17.6 b-e	24.4 b	1.0 b-e	0 c	0.1
AdmirePro 4.6 FS	0.35 fl oz/cwt	S	6	5 b-e	21.8 a	39.5 ab	8.1 c-e	1.5 b-e	0.5 a-c	0.6
Cruiser 5 FS	0.12 fl oz/cwt	S	6.9	3.3 b-e	6.0 ab	15.4 a-e	5.6 c-e	0.3 e	0.1 bc	0.6
Cruiser 5 FS	0.16 fl oz/cwt	S	6.9	4.5 a-e	8.8 ab	17.6 a-d	1.9 e	1.0 b-e	0.1 bc	0.4
Belay 2.13 SC	0.6 fl oz/cwt	S	3.8	3.3 e-g	10.1 ab	13.0 b-e	3.1 e	0.7 b-e	0.3 bc	0.1
A16901 40 WG	6.5 oz/a	IF	6.1	5.4 a-c	7.3 ab	14.4 a-e	1.9 e	0.9 c-e	0 c	0.1
A16901 40 WG	10 oz/a	IF	2.1	1.8 g	6.7 bc	8.0 ef	0.6 e	0.5 de	0.1 bc	0.8
Platinum 75 SG	1.68 oz/a	IF	2.9	3 d-g	6.3 bc	4.8 c-e	3.1 e	0.8 c-e	0 c	0.1
Platinum 75 SG	2.66 oz/a	IF	5.1	3.8 c-g	5.3 bc	2.8 fg	3.1 e	2.5 a-e	0 c	0.1
DPX-HGW86 1.67 SC	10.3 fl oz/a	IF	4.3	6.1 b-f	10.7 ab	7.4 a-e	3.1 e	3.1 a-d	1.1 bc	1.0
DPX-HGW86 1.67 SC	13.5 fl oz/a	IF	3.3	5.1 a-e	14.9 ab	14.3 a-e	6.9 c-e	4.5 a-c	0.9 bc	0.9
AdmirePro 4.6 FS	8.7 fl oz/a	IF	6.8	6.8 a-d	13.7 a	19.5 a-d	3.8 de	0.6 c-e	0 c	0.3
Belay 2.13 SC	12 fl oz/a	IF	3.8	2.3 fg	3.8 c	4.5 g	1.9 e	0.9 c-e	0.1 bc	0.5
		P	0.19	0.0001	<0.0001	<0.0001	<0.0001	0.02	0.009	0.33
		LSD	2.09	1.94	2.19	2.09	13.04	2.56	2.00	2.41

[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 2011 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 28 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 13 full-season insecticide programs were arranged in a randomized complete block design. Systemic insecticides were applied in-furrow at planting (28 Apr for treatments 1-6). The first foliar insecticide applications were applied after peak egg hatch and prior to large larval population dominance (20 Jun for treatments 7-14). Subsequent applications were made on 8 Jul (1^{st} generation, second foliar application) and 3 Aug (2^{nd} generation foliar application). Treatment information is available in **Table 1**. All in-furrow treatments were applied in 2.0 L of water at 11.0 gpa on 28 April using a two nozzle boom equipped with Tee Jet XR8002VS 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 12 ft boom operating at 30 psi delivering 20 gpa through Tee Jet XR8003VS nozzles spaced 18" apart 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 25 sweep net samples in each plot. Aphid and potato leafhopper nymph populations were surveyed by assessing 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 (29 Sep) (**Table 4**). Count data were log_{10} transformed prior to analysis. Proportion data were arcsine transformed prior to analysis. Means were separated using ANOVA with a Fisher's Protected Least Squared Difference (LSD) mean separation test (P=0.05).

Results and Discussion

Populations of CPB were considered average to above average in this field trial (Table 2). Weather conditions during the 2011 spring months were cooler than normal which caused CPB populations to peak later than normal in the plots. In this trial the bottom line is yields and how do systemic based programs compare to foliar based programs. Overall hundred-weight per acre (cwt/a) among plots did not significantly differ but there were differences among treatments in proportions of US #1 A's. Total cwt/a ranged from a high of 393.4 in treatment 12 to a low of 308.0 in treatment 3, however this was not statistically significant. The proportion of US #1 A's was highest in treatment 8 with 82% (1st generation application of Coragen, and 2nd generation application of Assail) and the lowest in treatment 10 with 62% (1st generation application of Brigadier, and 2nd generation application of HGW86).

Most treatments provided adequate control of CPB and PLH. First generation applications of Admire-Pro and Brigadier provided the least effective control of CPB-LL and CPB-SL while treatments receiving Agri-flex and A-16901 had the lowest percentage of defoliation. Second generation applications did not provide effective control against CPB-AD or CPB-SL. PLH populations were quite low, and there were no significant differences in control of PLH adults. No overt signs or symptoms of phytotoxicity were observed.

Table 1. Treatment list

Trt	1st generation CPB					2nd generation CPB				
	AppDate	Insecticide	Rate		[†]Type	AppDate	Insecticide	Rate		[†]Type
1	28-Apr	Platinum 75 SC	2.67	fl oz/a	IF	3-Aug	[a]Voliam Xpress 1.25 SC	9	fl oz/a	F
	8-Jul	Radiant 1 SC	8	fl oz/a	F					
2	28-Apr	Admire Pro 550 SC	8.7	fl oz/a	IF	3-Aug	[b]Agri-Mek 0.15 EC	14	fl oz/a	F
	8-Jul	Radiant 1 SC	8	fl oz/a	F					
3	28-Apr	Coragen 1.67 SC	7	fl oz/a	IF	3-Aug	Admire Pro 550 SC	1.3	fl oz/a	F
	8-Jul	Radiant 1 SC	8	fl oz/a	F					
5	28-Apr	DPX-HGW86 20 SC	13.5	fl oz/a	IF	3-Aug	[b]Assail 30 SG	4	oz wt/a	F
6	28-Apr	A16901 40 WG	10	oz wt/a	IF	3-Aug	[b]Agri-Mek 0.7 SC	3.5	fl oz/a	F
7	20-Jun	[c]Rimon 0.83 EC	12	fl oz/a	F	3-Aug	[b]Actara 25 WDG	3	oz wt/a	F
	8-Jul	[c]Rimon 0.83 EC	10	fl oz/a	F					
8	20-Jun	[a]Coragen 1.67 SC	5	fl oz/a	F	3-Aug	[b]Assail 30 SG	4	oz wt/a	F
	8-Jul	[a]Coragen 1.67 SC	3.5	fl oz/a	F					
9	20-Jun	[b]Agri-Flex 1.55 SC	8.5	fl oz/a	F	3-Aug	[a]Coragen 1.67 SC	5	fl oz/a	F
	8-Jul	[b]Agri-Flex 1.55 SC	5.5	fl oz/a	F					
10	20-Jun	Brigadier 2 EC	6.14	fl oz/a	F	3-Aug	[a]DPXHGW86 10 OD	10.1	fl oz/a	F
	8-Jul	Brigadier 2 EC	5	fl oz/a	F					
11	20-Jun	[b]Radiant 1 SC	8	fl oz/a	F	3-Aug	[a]Voliam Xpress 1.25 SC	9	fl oz/a	F
	8-Jul	[b]Radiant 1 SC	6	fl oz/a	F					
12	20-Jun	[a]Athena 0.87 EC	17	fl oz/a	F	3-Aug	[b]Admire Pro 550 SC	1.3	fl oz/a	F
	8-Jul	[a]Athena 0.87 EC	14	fl oz/a	F					
13	20-Jun	[a]Actara 25 WDG	3	oz wt/a	F	3-Aug	[a]Voliam Xpress 1.25 SC	7	fl oz/a	F
	8-Jul	[a]Actara 25 WDG	1.5	oz wt/a	F					
14	20-Jun	[a]Agri-Mek 0.7 SC	3.5	fl oz/a	F	3-Aug	[a]Coragen 40 WG	5	oz wt/a	F
	8-Jul	[a]Agri-Mek 0.7 SC	2.75	fl oz/a	F					

[†]F=foliar, IF=In furrow,
[a]MSO 100 L added at 0.5 %v/v
[b]NIS 100 L added at 0.5 %v/v
[c]Silwet 100 L added at 0.23 %v/v

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

Trt	Adults (Aug 1, 10, 15)	Egg Masses (Jun 23, 29)	Small Larvae (Jun 23, 29, Jul 6)	Large Larvae (Jul 6, 12)	% Defoliation (Aug 10, 15)
1	6.0	4.0	7.3 a-d	2.8 a-c	13.3 de
2	4.3	7.3	51.6 a	29.3 a	27.5 ab
3	4.2	4.3	11 a	11.7 cd	17.5 a-d
5	3.4	2.5	5.0 ad	2.3 a-c	10.8 de
6	4.0	3.0	4.9 c-d	2.7 a-c	7.5 e
7	2.3	1.3	10.0 ab	5.2 bc	12.5 de
8	4.2	1.3	10.5 ab	3.8 cd	20 a-e
9	4.9	0.8	14.3 a-d	1.5 d	11.7 de
10	5.6	3.7	17.2 ab	19.3 ab	28.3 a
11	4.0	1.0	13.0 a-d	7.2 a-c	25.8 a-c
12	7.2	1.7	4.9 b-d	6.3 a-c	15.8 b-e
13	6.1	2.7	3.6 a-d	2.3 cd	16.7 a-e
14	4.3	1.7	11.5 ab	2.8 a-c	15 c-e
P	0.14	0.07	0.034	0.006	0.02
LSD	1.88	2.78	2.47	2.89	12.36

Table 3. Mean PLH and aphid counts per plant

Trt	PLH adults (Jul 1 8, Aug 1)	Aphids (Jul 18, Aug 1)
1	0.3	0 d
2	0.8	0.3 b-d
3	1.7	0.8 a-c
5	3.2	0.8 a-c
6	1.0	0 d
7	1.3	0.2 cd
8	1.8	0.7 cd
9	0.7	0.2 cd
10	0.8	0.8 b-d
11	0.7	1.2 ab
12	0.3	0 d
13	1.3	0 d
14	0.7	0.2 cd
P	0.59	0.002
LSD	3.13	2.28

Table 4. Mean yield data.

Trt	Total US #1 (lbs)	Proportion US #1-A	CWT/A
1	86.4	0.78 ab	369.2
2	77.7	0.69 cd	332.1
3	72.1	0.73 bc	308.0
5	82.7	0.74 a-c	353.6
6	91.6	0.79 ab	391.6
7	85.4	0.74 bc	365.0
8	83.6	0.82 a	357.3
9	91.2	0.78 ab	389.5
10	74.3	0.62 d	317.5
11	90.0	0.72 bc	345.9
12	92.1	0.76 a-c	393.4
13	81.0	0.77 ab	345.9
14	72.6	0.75 a-c	310.4
P	0.19	0.006	0.19
LSD	16.5	0.08	70.3

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 2011. Snap bean, *Phaseolus vulgaris* var. 'Hercules,' was seeded on 10 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 10 treatments and 2 untreated controls were arranged in a randomized complete block design. The foliar treatments were applied 25 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 24 gpa through 4 flat-fan nozzles (Tee Jet XR8002VS) spaced 18" apart while travelling at 3.5 ft / sec.

Each plot was infested with ECB egg masses on two dates, 3 days pre and 4 days after the single insecticide treatment (22 and 29 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 5 Aug (for the early pinned plants), and on 12 Aug (for the late pinned plants), by counting (1) total number of damaged plants, (2) number of damaged stems per plant, (3) number of damaged pods, and (4) the number of viable larvae observed in both stems and pods. The survey was done only on the five plants that had been infested. See **Table 1** for a summary of key field activity dates. Count data were $\log_{10}$ transformed prior to analysis. Proportion data were arcsine transformed prior to analysis. 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	10 Jun	22 Jul	25 Jul	29 Jul	5, 12 Aug
Days from last action		42	3	4	14

Results and Discussion

Natural populations of ECB at AAES are annually variable and require that experimental plots be artificially infested with test insects. There was significant knockdown of ECB on pods and stems only during the first infestation trial. The number of damaged stems was low on both dates when infested plants were counted. For the first infestation, there were significant differences in the proportion of damaged pods evident with all insecticide treatments as compared to the untreated control. Application of HGW86 (at 0.134 lb ai/a) resulted in the lowest proportion of damaged pods. No overt signs or symptoms of phytotoxicity were observed.

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

Treatment	Rate*	**Infested 22 Jul** (3 days pre application)				**Infested 29 Jul** (4 days post application)			
		# Damaged Stems	Proportion Damaged Pods	# Larvae in Stems	# Larvae in Pods	# Damaged Stems	Proportion Damaged Pods	# Larvae in Stems	# Larvae in Pods
Untreated	-	0.5	1.0 a	4.0 a	0.1 a	0.4	0.7	1.0	0.1
HGW86 10 SE MSO 100 L	0.044 0.25% v/v	0.2	0.3 c-d	0.7 bc	0 b-d	0.2	0.3	0.3	0
HGW86 10 SE MSO 100 L	0.088 0.25% v/v	0.2	0.4 a-c	0.5 bc	0.1 ab	0.1	0.2	0.5	0.2
HGW86 10 SE MSO 100 L	0.134 0.25% v/v	0.1	0 d	0.3 c	0 d	0	0.1	0.4	0
Coragen 1.67 SC MSO 100 EC	0.039 0.5% v/v	0.3	0.4 c-d	0.6 bc	0 b-d	0	0.1	0.5	0
Coragen 1.67 SC MSO 100 EC	0.066 0.5% v/v	0.3	0.4 a-c	0.8 bc	0 b-d	0.2	0.4	0.7	0
Endigo 2.71 ZC	0.085	0.2	0.5 ab	0.6 bc	0 ab	0.2	0.1	0.3	0
Warrior II 2.08 SC	0.0312	0.1	0.2 cd	0.7 b	0 b-d	0.2	0.3	0.3	0
Radiant 1 SC	0.0625	0.3	0.5 a-c	0.7 bc	0 a-c	0.3	0.4	0.3	0
Orthene 97 SG	1	0.2	0.4 c-d	0.8 bc	0 b-d	0.2	0.3	0.3	0
Voliam Flexi 30 WG MSO 100 MS	0.094 0.25% v/v	0.3	0.4 c-d	0.6 bc	0 b-d	0.4	0.4	0.2	0
	P	0.15	0.008	<0.001	0.003	0.13	0.12	0.18	0.06
	LSD	1.10	1.27	1.40	0.71	0.99	1.18	1.35	0.66

*Rate unit is lb ai/a unless otherwise noted

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 2011. Snap bean, *Phaseolus vulgaris* var. 'Blue Lake', was seeded on 25 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 11 treatments and 1 untreated control were arranged in a randomized complete block design. 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.

All plots were infested with ECB egg masses at pin-bean stage on 29 June. In each plot for each pinning date, five successive plants were infested, each with five egg masses for a total of 25 egg masses applied in each plot.

Counts of emerged plants per row were taken from 2 rows on 14 June. Populations of ECB and associated damage estimates were surveyed 26 July by counting (1) total number of plants and pods, (2) number of damaged stem, (3) number of damaged pods, and (4) the number of viable larvae observed in both stems and pods. Count data were $\log_{10}$ transformed prior to analysis. Means were separated using ANOVA with a Least Squared Difference (LSD) option. Data are presented in **Table 1**.

Results and Discussion

The fewest number of damaged stems from ECB were present when using in-furrow applications of Coragen and HGW86 with no pre-mix fertilizer application. Dry fertilizer pre-mix applications resulted in the highest numbers of damaged stems. Coragen applied in-furrow with no additional fertilizer pre-mix application provided knockdown against ECB larvae on pods at all three rates tested. HGW86 applied with the dry fertilizer pre-mix was the least effective treatment at reducing the number of damaged stems. Overall, ECB levels were low in most treatments. No overt signs of phytotoxicity were observed.

Table 1. Mean damage estimates of stems, pods and number of larvae.

Treatment	Rate	Application Type[1]	26 July			
			Damaged Stems	# Larvae in Stems	Damaged Pods	# Larvae in Pods
Untreated	-	-	9.3 a	0.5 a	2 ab	2 a
Coragen 1.67 SC	3.5 fl oz/a	IF	0.5 bc	0.3 cd	0 c	0 c
Coragen 1.67 SC	5 fl oz/a	IF	0.8 bc	0 d	0.3 bc	0 c
Coragen 1.67 SC	7 fl oz/a	IF	0.5 c	0 d	0 c	0 c
HGW86 200 SC	10.2 fl oz/a	IF	0 c	0 d	0 c	0 c
Coragen 1.67 SC	3.5 fl oz/a	F-Pre (L)	3.8 a	1.5 ab	3.3 a	1.8 ab
Coragen 1.67 SC	5 fl oz/a	F-Pre (L)	6.5 ab	3.5 ab	2.3 ab	1 a-c
Coragen 1.67 SC	7 fl oz/a	F-Pre (L)	4.8 a	1.5 b-d	1.8 ab	1 ab
HGW86 200 SC	10.2 fl oz/a	F-Pre (L)	3 a	1.8 ab	1.5 ab	0.5 a-c
Coragen 1.67 SC	5 fl oz/a	F-Pre (D)	7.5 a	2.8 a	1.5 a-c	0.3 bc
Coragen 1.67 SC	7 fl oz/a	F-Pre (D)	8.5 a	2.5 ab	0.8 ab	0 c
HGW86 200 SC	10.2 fl oz/a	F-pre (D)	5 ab	1.7 a-c	0.7 bc	0.3 a-c
		P	<0.0001	<0.0001	0.0066	0.01
		LSD	2.89	2.72	3.24	2.93

[1]IF = In-Furrow; F-Pre (L) = liquid fertilizer pre-mix; F-Pre (D) = dry fertilizer pre-mix