# Wisconsin Vegetable
# Insect Pest Management Research
# Summer Field Trials

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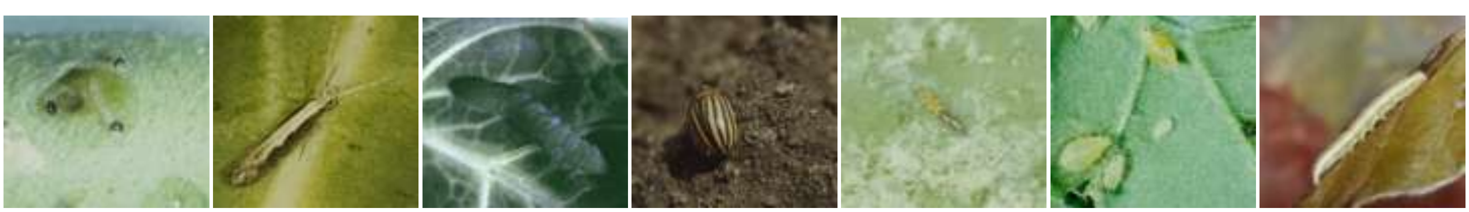

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# Evaluation of foliar insecticides for the control of Lepidopteran insect pests in cabbage

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

**Materials and Methods**

This experiment was conducted at the Arlington Agricultural Experiment Station, Arlington, WI in 2013. Cabbage, *Brassica oleracea* cv. 'Katlin', transplants were planted 3 June. 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 1 untreated control were arranged in a randomized complete block design. All foliar treatments were applied 2 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. 6-9 (4-7 DAT), Aug.13 (11 DAT) and Aug.26 (24 DAT). Means were separated using ANOVA with a Least Squared Difference (LSD) means comparison test (P=0.05).

During 2013 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 and pupae), Diamondback moth (DM - large and small larvae), and Cabbage looper (CL - large and small larvae) per cabbage head.

| Treatment[1] | Rate[2] | 6 –Aug (4 DAT) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | ICW-L | ICW-S | ICW-P | DB-L | DB-S | CL-L | CL-S |
| Untreated | - | 0.075 | 1.05 | 0.694 a | 0.301 | 1.171 a | 0.226 a | 0.702 a |
| Coragen 1.67 SC | 3.5 | 0.075 | 0.294 | 0.376 ab | 0 | 0.5 b-e | 0.075 ab | 0.420 a-c |
| Coragen 1.67 SC | 5 | 0 | 0.376 | 0.345 b | 0.075 | 0.406 cf | 0.194 ab | 0.389 a-c |
| Exp.1 | Rate 1 | 0 | 0.496 | 0.301 b | 0.15 | 0.806 ab | 0.25 a | 0.632 ab |
| Exp. 1 | Rate 2 | 0.075 | 0.376 | 0.150 b | 0 | 0.595 b-d | 0.075 ab | 0.464 a-c |
| RDS63 200SC | 150 g ai/ha | 0.075 | 0.464 | 0.194 b | 0 | 0.694 bc | 0.194 ab | 0.508 a-c |
| Avaunt 30WG | 3.5 | 0 | 0.325 | 0.376 ab | 0 | 0.508 b-e | 0 b | 0.194 cd |
| Exp.2 | Rate 1 | 0 | 0.25 | 0.150 b | 0 | 0.075 f | 0.075 ab | 0.301 bd |
| Exp.2 | Rate 2 | 0.075 | 0.075 | 0.301 b | 0.075 | 0.294 df | 0.075 ab | 0.194 cd |
| Radiant 1 SC | 8 | 0 | 0.314 | 0.270 b | 0 | 0.389 cf | 0.075 ab | 0.314 bd |
| Warrior II 2.08 CS | 1.92 | 0 | 0.194 | 0.119 b | 0 | 0.420 cf | 0 b | 0.226 cd |
| Brigade 2EC | 6.4 | 0 | 0.15 | 0.270 b | 0 | 0.150 ef | 0 b | 0 d |
| | P | 0.741 | 0.001 | 0.107 | 0.029 | 0.0001 | 0.222 | 0.017 |
| | LSD | 0.134 | 0.358 | 0.334 | 0.174 | 0.376 | 0.219 | 0.358 |

Means in a column followed by the same letter are not significantly different at $\alpha = 0.05$.

[1]All treatments except Untreated, Radiant, Warrior II and Brigade also had Induce 90 SL at 0.125% v/v

[2]Rate in oz/a unless noted

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

| Treatment[1] | Rate[2] | 13-Aug (11 DAT) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | ICW-L | ICW-S | ICW-P | DB-L | DB-S | CL-L | CL-S |
| Untreated | - | 0.345 | 1.099 a | 0.301 a | 0 | 1.254 a | 0.498 a | 0.924 a |
| Coragen 1.67 SC | 3.5 | 0.075 | 0.075 c | 0 b | 0 | 0.270 de | 0 c | 0.376 cd |
| Coragen 1.67 SC | 5 | 0.075 | 0.269 bc | 0.150 ab | 0 | 0.075 e | 0 c | 0.194 de |
| Exp.1 | Rate 1 | 0 | 0.345bc | 0.150 ab | 0.270 | 0.838 b | 0.389 ab | 0.721 ab |
| Exp. 1 | Rate 2 | 0 | 0.294 bc | 0.075 ab | 0 | 0.488 cd | 0.194 bc | 0.420 cd |
| RDS63 200SC | 150 g ai/ha | 0.075 | 0.314 bc | 0.075 ab | 0 | 0.345 ce | 0.389 ab | 0.369 cd |
| Avaunt 30WG | 3.5 | 0 | 0.301 bc | 0.150 ab | 0 | 0.588 bc | 0 c | 0.226 de |
| Exp.2 | Rate 1 | 0 | 0.075 c | 0.075 ab | 0 | 0.226 de | 0 c | 0.150 ce |
| Exp.2 | Rate 2 | 0.075 | 0 c | 0.226 ab | 0.045 | 0.075 e | 0 c | 0.270 de |
| Radiant 1 SC | 8 | 0.075 | 0.451 b | 0 b | 0.075 | 0.452 cd | 0.075 c | 0.464 bd |
| Warrior II 2.08 CS | 1.92 | 0 | 0.174 bc | 0.119 ab | 0 | 0.376 ce | 0.075 c | 0.286 de |
| Brigade 2EC | 6.4 | 0 | 0.194 bc | 0.175 ab | 0 | 0.226 de | 0 c | 0 e |
| | P | 0.019 | 0.0001 | 0.554 | 0.048 | <.0001 | <.0001 | <.0001 |
| | LSD | 0.176 | 0.360 | 0.266 | 0.158 | 0.310 | 0.214 | 0.288 |

Means in a column followed by the same letter are not significantly different at $\alpha = 0.05$.

[1]All treatments except Untreated, Radiant, Warrior II and Brigade also had Induce 90 SL at 0.125% v/v

[2] Rate in oz/a unless noted

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

| Treatment[1] | Rate[2] | 26-Aug (24 DAT) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | ICW-L | ICW-S | ICW-P | DB-L | DB-S | CL-L | CL-S |
| Untreated | - | 0.551 | 0.725 a | 0.508 | 0.411 | 0.632 | 0.362 a | 0.356 a |
| Coragen 1.67 SC | 3.5 | 0 | 0 c | 0 | 0.150 | 0 | 0 b | 0 b |
| Coragen 1.67 SC | 5 | 0 | 0 c | 0.075 | 0 | 0 | 0 b | 0.075 b |
| Exp.1 | Rate 1 | 0.150 | 0.194 bc | 0 | 0.075 | 0.075 | 0.194 ab | 0.075 b |
| Exp. 1 | Rate 2 | 0 | 0 c | 0.075 | 0 | 0.226 | 0 b | 0 b |
| RDS63 200SC | 150 g ai/ha | 0 | 0.270 b | 0.075 | 0.075 | 0.150 | 0.075 b | 0 b |
| Avaunt 30WG | 3.5 | 0.075 | 0 c | 0.075 | 0.075 | 0.194 | 0 b | 0 b |
| Exp.2 | Rate 1 | 0 | 0 c | 0.075 | 0.075 | 0.075 | 0 b | 0.075 b |
| Exp.2 | Rate 2 | 0 | 0.194 bc | 0.0119 | 0 | 0 | 0 b | 0.150 ab |
| Radiant 1 SC | 8 | 0.075 | 0.270 b | 0 | 0 | 0.238 | 0 b | 0.075 b |
| Warrior II 2.08 CS | 1.92 | 0.150 | 0.270 b | 0.075 | 0.075 | 0.226 | 0.150 ab | 0.075 b |
| Brigade 2EC | 6.4 | 0 | 0 c | 0 | 0 | 0 | 0 b | 0 b |
| | P | 0.0003 | <.0001 | 0.014 | 0.075 | 0.004 | 0.038 | 0.320 |
| | LSD | 0.210 | 0.236 | 0.244 | 0.240 | 0.287 | 0.222 | 0.266 |

Means in a column followed by the same letter are not significantly different at $\alpha = 0.05$.

[1]All treatments except Untreated, Radiant, Warrior II and Brigade also had Induce 90 SL at 0.125% v/v

[2] Rate in oz/a unless noted

# Evaluation of foliar insecticides for the control of onion thrips on Dry-bulb onion

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

**Materials and Methods**

This experiment was conducted in a cooperating producer's onion field located at Bobek's Trembling Prairie Farms, located near Markesan, WI on a muck soil. Onion, *Allium cepa* cv. 'Caprice', was direct seeded on 16 April, 2013. Plants were spaced 2.6 inches apart within rows. Rows were 9.4 inches apart. The six-row plots were 60 inches wide by 25 ft long on raised formed beds, for a total of 0.003 acres, and were separated by planted guard beds of the same dimensions between plots. All plots were maintained by the grower according to standard commercial practices.

Four replicates of 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 12 August and 19 August. Treatments were applied with a $CO_2$ backpack sprayer with a 6 foot boom operating at 30 psi delivering 22.1 gpa through four flat-fan nozzles (Tee Jet XR8002XR) spaced 18" apart while traveling at 3.5 ft / sec.

Immature 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 three times during August, on 15 Aug (3 DAT) , after the first application and again 21 Aug (3 DAT) and 27 Aug (8 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 | 15-Aug (3 DAT) | 21-Aug (3 DAT) | 27-Aug (8 DAT) |
|---|---|---|---|---|
| Untreated | . | 0.69 | 1.40 | 1.93 a |
| Warrior II +NIS[1] | 1.92 fl oz/a | 0.37 | 0.94 | 1.83 ab |
| Exirel + MSO[2] | 10.1 fl oz/a | 0.37 | 0.90 | 1.04 e |
| Exirel + MSO[2] | 13.5 fl oz/a | 0.47 | 0.97 | 1.44 d |
| Radiant + NIS[1] | 8 fl oz/a | 0.25 | 0.52 | 0.67 f |
| Radiant + NIS | 6 fl oz/a | 0.34 | 0.49 | 0.97 e |
| Movento + MSO[2] | 5 fl oz/a | 0.50 | 1.55 | 1.58 bcd |
| Agri-Mek + NIS[1] | 3.5 fl oz/a | 0.36 | 1.18 | 0.94 ef |
| Agri-Mek + NIS[1] | 16 fl oz/a | 0.38 | 0.88 | 0.91 ef |
| RDS63 + NIS[1] | 75 g ai/ha | 0.62 | 1.15 | 1.88 a |
| Lannate + NIS[1] | 3 pt/a | 0.39 | 0.72 | 1.56 cd |
| IKI 3106 + NIS[1] | 5.5 fl oz/a | 0.55 | 1.14 | 1.77 ac |
| | P | 0.58 | 0.0036 | <.0001 |
| | LSD | 0.39 | 0.39 | 0.28 |

Means in columns followed by the same letter are not significantly different (Fisher's Protected Least Significant Difference Test, P = 0.05)
[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. 'Superior', seed pieces were planted on 1 May. 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 31 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 21 June and 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 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 24 (3 DAT) and 27 (6 DAT), following the first application. The second set of counts occurred on July 1 (3 DAT), Jul 10 (12 DAT), and Jul 16 (18 DAT), following the second application. Insect count averages reflect time periods when specific CPB life stages peaked in the plots. Means were separated using ANOVA with a Fisher's Protected Least Squared Difference (LSD) mean separation test (P=0.05). No signs of phytotoxicity were observed among treatments.

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

| Treatment | Rate | CPB-AD (Jul 16) | CPB-EM (Jun 24) | CPB-SL (Jun 24) | CPB-LL (Jul 3) | % DF (Jul 16) | PLH (AD) (Jul 3) | Aphids (Jul 10) |
|---|---|---|---|---|---|---|---|---|
| Untreated | . | 0.58 deghj | 0.66 cfg | 0.92 c-f | 0.12 g-i | 0.06 c | 0.76 adf | 0.0 f |
| Benevia OD[1] | 5 oz/a | 0.95 bce | 0.54 g | 1.41 abd | 1.32 b | 0.37 b | 0.66 b-eg | 0.36 d-f |
| Exirel SE[1] | 5 oz/a | 0.30 i-k | 0.83 a-ch | 0.73 c-f | 0.0 i | 0.08 c | 0.93 ab | .019 ef |
| Exirel SE | 5 oz/a | 0.24 jk | 0.68 cfg | 0.76 c-f | 0.22 fhi | 0.05 c | 0.91 ac | 0.48 d-f |
| Exirel SE | 6.75 oz/a | 0.44 fhk | 0.95 abf | 0.54 cef | 0.0 i | 0.05 c | 0.91 ac | 0.08 fg |
| Coragen 1.67 SC | 4.5 oz/a | 0.08 k | 0.55 gh | 0.75 c-f | 0.43 di | 0.05 c | 0.89 ad | 0.78b-d |
| Coragen 1.67 SC | 5 oz/a | 0.58 deghj | 0.66 cg | 0.96 c-f | 0.17 fhi | 0.05 c | 0.94 ab | 0.43 d-f |
| EXP 1 | Rate 1 | 0.08 k | 0.76 ag | 0.41 ef | 0.0 i | 0.05 c | 1.05 a | 1.15 ac |
| EXP 1 | Rate 2 | 0.22 jk | 0.90 a-d | 1.00 d-f | 0.0 i | 0.05 c | 1.08 a | 1.32 ab |
| EXP 1 | Rate 3 | 0.24 jk | 0.93 a-c | 1.07 bf | 0.0 i | 0.05 c | 0.96 ab | 1.37 a |
| AdmirePro 4.6 FS | 1.3 oz/a | 0.66 cghj | 0.79 ag | 1.04 beg | 0.25 ehi | 0.05 c | 0.65 b-eg | 0.08 fg |
| Provado 1.6 F | 3.8 oz/a | 0.63 cghj | 0.83 ag | 1.01 bf | 1.20 bc | 0.18 c | 0.60 c-eh | .049 d-f |
| Leverage 360 3SC | 2.8 oz/a | 0.31 gk | 0.90 a-d | 0.77 c-f | 0.58 dh | 0.05 c | 0.19 jk | 0.0 f |
| Belay 2.13 SC | 3 oz/a | 1.04 ac | 0.84 a-ch | 0.34 fg | 0.22 fhi | 0.05 c | 0.89 eik | 0.0 f |
| EXP 2 | Rate 1 | 0.51 ehk | 0.94 a-c | 1.32 a-c | 0.60 d-g | 0.05 c | 0.71 b-e | 0.54 d-f |
| EXP 2 | Rate 2 | 0.34 hk | 0.95 a-c | 1.16 be | 0.08 hi | 0.05 c | 0.60 c-eh | 0.43 d-f |
| | P | <.0001 | 0.0395 | 0.0125 | <.0001 | <.0001 | <.0001 | <.0001 |
| | LSD | 0.4515 | 0.2927 | 0.8176 | 0.5151 | 0.1577 | 0.3328 | 0.5616 |

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

[1] MSO 100 L added at 0.5% v/v

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

| Treatment | Rate | CPB-AD (Jul 16) | CPB-EM (Jun 24) | CPB-SL (Jun 24) | CPB-LL (Jul 3) | % Defoliation (Jul 16) | PLH (AD) (Jul 3) | Aphids (Jul 10) |
|---|---|---|---|---|---|---|---|---|
| Untreated | . | 1.07 ac | 1.04 a | 1.81 ab | 1.90 a | 0.47 b | 0.57 di | 0.61 ceg |
| Blackhawk 36 WG | 2.5 oz wt/a | 0.52 ehk | 0.86 a-d | 1.30a-c | 0.59 dh | 0.05 c | 0..53 efi | .078 b-d |
| Blackhawk 36 WG | 3.3 oz wt/a | 0.78 bch | 0.83 ag | 0.81 c-f | 0.66 d-f | 0.05 c | 0.38 g-ik | 0.74 ce |
| Warrior II 2.08 CS | 1.92 oz/a | 0.74 bcg-i | 0.88 a-d | 1.14 beg | 0.81 bd | 0.05 c | 0.25 ik | 0.5 d-f |
| Actara 25 WG | 3 oz wt/a | 0.73 cg-i | 0.99 ab | 0.98 c-f | 0.25 ehi | 0.05 c | 0.34 g-ik | 0.08 fg |
| Endigo 2.06 ZC | 4 oz/a | 0.72 cg-i | 0.71 beg | 0.34 fg | 0.29 ehi | 0.05 c | 0.43 efij | 0.24 d-f |
| Endigo 2.71 ZC | 4 oz/a | 0.90 bce | 0.81 ag | .058 cef | 0.43 di | 0.05 c | 0.19 jk | 0.0 f |
| Besiege 1.25 ZC | 9 oz/a | 0.76 bcgh | 0.85 a-d | 0.71 c-f | 0.32 di | 0.05 c | 0.08 k | 0.29 d-f |
| Agri-Flex 1.55 SC | 6 oz/a | 0.80 bcef | 0.94 a-c | 0.72 c-f | 0.08 hi | 0.05 c | 0.24 ik | 0.08 fg |
| Athena 0.87 EC | 13 oz/a | 1.03 acd | 0.71 bg | 0.96 c-f | 0.48 di | 0.05 c | 0.48 efij | 0.08 fg |
| Athena 0.87 EC | 17 oz/a | 0.62 cghj | 0.71 beg | 0.98 c-f | 0.36 di | 0.06 c | 0.08 k | 0.27 d-f |
| Gladiator 0.25 EC | 12 oz/a | 0.76 bcgh | 1.00 ae | 1.01 bf | 1.31 b | 0.11 c | 0.19 jk | 0.55d-f |
| Gladiator 0.25 EC | 18 oz/a | 0.77 bch | 0.61 dgh | 0.27 f | 0.83 bd | 0.09 c | 0.34 g-ik | 0.32 d-f |
| Brigadier 2 EC | 6.14 oz/a | 0.78 bch | 0.73 beg | 0.39 ef | 0.76 c-e | 0.09 c | 0.38 g-ik | 0.0 f |
| Untreated | . | 1.46 a | 0.61 dgh | 20.. A | 2.04 a | 0.88 a | 0.31hik | 0.0 f |
| Rimon .083 EC | 9,8,7 oz/a | 0.81 bcef | 0.86 a-d | 1.00 bf | 0.61 d-g | 0.05 c | 0.48 efij | 0.27 d-f |
| Rimon .083 EC | 6,6,6,6 oz/a | 1.20 ab | 0.78 ag | 1.31 a-c | 0.64 d-f | 0.05 c | 0.52 efij | 0.50 d-f |
| | **P** | <.0001 | 0.0395 | 0.0125 | <.0001 | <.0001 | <.0001 | <.0001 |
| | **LSD** | 0.4515 | 0.2927 | 0.8176 | 0.5151 | 0.1577 | 0.3328 | 0.5616 |

Means in columns followed by the same letter are not significantly different (Fisher's Protected Least Significant Difference Test, P = 0.05).
[1] MSO 100 L added at 0.5% 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 the Arlington Agricultural Experiment Station (AAES), Arlington, WI in 2013. Potato, *Solanum tuberosum* cv. 'Superior', seed pieces were planted on 6 May. Seed pieces were spaced 12 inches apart within rows. Rows were 3 ft apart. The two-row plots were 6 ft wide by 20 ft long, for a total of 0.003 acres. Two guard rows separated plots. . The plots were managed according to commercial pest management (herbicide and fungicide) practices as well as fertility recommendations prescribed by AAES.

Four replicates of 14 experimental foliar treatments and one untreated control were arranged in a randomized complete block design. The foliar treatments were applied 16 July. Treatments were applied with a $CO_2$ pressurized backpack sprayer with a 6 ft boom operating at 30 psi delivering 20 gpa through 4 flat-fan nozzles (Tee Jet XR8002XR) spaced 18" apart while travelling at 3.5 ft/sec.

PLH efficacy was assessed by counting the number of PLH nymphs (NY) on 25 randomly selected leaves in each plot while PLH adults (AD) were assessed by using sweep samples consisting of 25 sweeps per plot (**Table 1**). Insect counts occurred on three dates during July: 18 July (2 DAT), 25 Jul (9 DAT), and 31 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 25 sweeps per plot.

| | | 18-Jul | | 25-Jul | | 31-Jul | |
|---|---|---|---|---|---|---|---|
| **Treatment** | **Rate** | **PLH-AD** | **PLH-NY** | **PLH-AD** | **PLH-NY** | **PLH-AD** | **PLH-NY** |
| Untreated | - | 0.226 ab | 0.194 ab | 0 e | 0 b | 0.498 a-d | 0 b |
| Athena EC | 13 oz/a | 0 b | 0 b | 0.211 ce | 0 b | 0 e | 0.075 b |
| Brigadier SC | 6.4 oz/a | 0.194 ab | 0 b | 0 e | 0 b | 0 e | 0 b |
| Endigo ZC | 3.9 oz/a | 0.250 ab | 0.075 ab | 0 e | 0 b | 0.075 de | 0 b |
| Warrior II SC | 1.92 oz/a | 0 b | 0.075 ab | 0.075 e | 0 b | 0 e | 0 b |
| Actara WDG | 3 oz/a | 0.150 ab | 0 b | 0.119 de | 0 b | 0.420 be | 0 b |
| LEVERAGE 360 SC | 2.8 oz/a | 0.119 b | 0.119 ab | 0.075 e | 0.075 ab | 0 e | 0 b |
| Rimon EC | 10 oz/a | 0.260 ab | 0.349 ab | 0.400 ce | 0.075 ab | 0.551 a-c | 0.175 ab |
| Exp. 1 | Rate 1 | 0.380 ab | 0.376 ab | 0.911 ab | 0.270 a | 0.845 ab | 0.175 ab |
| Exp. 1 | Rate 2 | 0.406 ab | 0.398 a | 1.138 a | 0.175 ab | 0.917 a | 0.194 ab |
| Exp. 2 | Rate 1 | 0.594 a | 0.314 ab | 0.673 ac | 0.150 ab | 0.920 a | 0.345 a |
| Exp. 2 | Rate 2 | 0.075 b | 0.345 ab | 0.588 b-d | 0.194 ab | 0.720 ab | 0.075 b |
| Gladiator EC | 12 oz/a | 0 b | 0.119 ab | 0.119 de | 0 b | 0.075 de | 0.075 b |
| Baythroid EC | 1.6 oz/a | 0 b | 0 b | 0 e | 0 b | 0 e | 0 b |
| Brigade EC | 2.1 oz/a | 0.119 b | 0.075 ab | 0.199 de | 0 b | 0.270 ce | 0 b |
| | **P** | 0.322 | 0.263 | <.0001 | 0.089 | <.0001 | 0.099 |
| | **LSD** | 0.456 | 0.385 | 0.484 | 0.199 | 0.438 | 0.230 |

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

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

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

**Materials and Methods**
This experiment was conducted at Langlade County Research Station, Antigo, WI in 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) |
|---|---|---|---|---|---|---|---|
| UTC | - | - | - | 81.9 ab | 11 a-c | 92.9 ab | 107.5 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 |
| 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 |
| [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 |
| 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 |
| 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 |
| Requiem 25 EC | 1.7 fl oz/a | 13-Jul | 1x weekly | 85.7 a | 11.3 a-c | 97 a | 110.2 a |
| Stylet Oil 100 SL<br>[1]Benevia 10 OD | 0.75 %<br>10.1 fl oz/a | 11-Jun<br>13-Jul | 1x weekly<br>[2]4x appl | 72.2 a-c | 10.5 bc | 82.7 a-c | 94.9 a-c |
| Stylet Oil 100 SL<br>[1]Benevia 10 OD | 0.75 %<br>13.5 fl oz/a | 11-Jun<br>13-Jul | 1x weekly<br>[2]3x appl | 58.5 c | 10.1 c | 68.5 c | 80.0 c |
| Stylet Oil 100 SL<br>[1]Benevia 10 OD | 0.75 %<br>17 fl oz/a | 11-Jun<br>13-Jul | 1x weekly<br>[2]3x appl | 69.2 a-c | 11 a-c | 80.1 a-c | 88.7 a-c |
| Stylet Oil 100 SL<br>[1]Benevia 10 OD | 0.75 %<br>20.5 fl oz/a | 11-Jun<br>13-Jul | 1x weekly<br>[2]3x appl | 72.6 a-c | 11.1 a-c | 83.6 a-c | 96.4 a-c |
| Stylet Oil 100 SL<br>[1]Movento 2 SC | 0.75 %<br>5 fl oz/a | 11-Jun<br>13-Jul | 1x weekly<br>[2]2x appl | 80.9 ab | 11.5 a-c | 92.4 ab | 101.8 a-c |
| Stylet Oil 100 SL<br>[1]Movento 2 SC | 0.75 %<br>3.3 fl oz/a | 11-Jun<br>13-Jul | 1x weekly<br>[2]3x appl | 73.5 a-c | 11.3 a-c | 84.8 a-c | 96.2 a-c |
| Aphoil 100 SL | 2 % | 11-Jun | 1x weekly | 63.6 bc | 11.1 a-c | 74.6 bc | 82.6 c |
| Aphoil 100 SL | 4 % | 13-Jul | 1X weekly | 76.5 a-c | 11.5 a-c | 87.9 a-c | 97.9 a-c |
| Stylet Oil 100 SL<br>Fulfill 50 WDG | 0.75 %<br>3.67 oz/a | 11-Jun<br>13-Jul | 1x weekly<br>[2]3x appl | 77.3 a-c | 11.7 a-c | 89 a-c | 101.7 a-c |
| Stylet Oil 100 SL<br>Fulfill 50 WDG | 0.75 %<br>5.5 oz/a | 11-Jun<br>13-Jul | 1x weekly<br>[2]2x appl | 61.8 bc | 11.1 a-c | 72.8 bc | 84.4 bc |
| Stylet Oil 100 SL<br>Stylet Oil 100 SL | 0.75 %<br>0.75 % | 11-Jun<br>13-Jul | 1x weekly<br>2X weekly | 67.2 a-c | 10.0 c | 77.1 a-c | 97.8 a-c |
| | | | **P** | 0.506 | 0.704 | 0.459 | 0.556 |
| | | | **LSD** | 21.279 | 2.402 | 21.581 | 24.841 |

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

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

[2] Applications at 7 day intervals.

**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 | Proportion US #1-A | Proportion US #1-B | CWT/A |
|---|---|---|---|---|---|---|
| UTC | - | - | - | 0.883 a | 0.117 | 337.2 ab |
| Stylet Oil 100 SL | 0.75 % v/v | 11-Jun | 1x weekly | 0.877 a | 0.123 | 338.8 ab |
| Stylet Oil 100 SL | 1.5 % v/v | 11-Jun | 1x weekly | 0.832 a | 0.168 | 305.9 a-c |
| [1]Benevia 10 OD | 20.5 fl oz/a | 13-Jul | [2]3x appl | 0.854 a | 0.146 | 315.4 a-c |
| Stylet Oil 100 SL | 0.75 % v/v | 13-Jul | 1x weekly | 0.833 a | 0.167 | 311.6 a-c |
| Stylet Oil 100 SL | 2 % v/v | 13-Jul | 2x weekly | 0.836 a | 0.164 | 287.2 a-c |
| Requiem 25 EC | 1.7 fl oz/a | 13-Jul | 1x weekly | 0.878 a | 0.121 | 352.13 a |
| Stylet Oil 100 SL<br>[1]Benevia 10 OD | 0.75 %<br>10.1 fl oz/a | 11-Jun<br>13-Jul | 1x weekly<br>[2]4x appl | 0.861 a | 0.139 | 300.3 a-c |
| Stylet Oil 100 SL<br>[1]Benevia 10 OD | 0.75 %<br>13.5 fl oz/a | 11-Jun<br>13-Jul | 1x weekly<br>[2]3x appl | 0.850 a | 0.150 | 248.8 c |
| Stylet Oil 100 SL<br>[1]Benevia 10 OD | 0.75 %<br>17 fl oz/a | 11-Jun<br>13-Jul | 1x weekly<br>[2]3x appl | 0.857 a | 0.143 | 291.0 a-c |
| Stylet Oil 100 SL<br>[1]Benevia 10 OD | 0.75 %<br>20.5 fl oz/a | 11-Jun<br>13-Jul | 1x weekly<br>[2]3x appl | 0.852 a | 0.148 | 303.74 a-c |
| Stylet Oil 100 SL<br>[1]Movento 2 SC | 0.75 %<br>5 fl oz/a | 11-Jun<br>13-Jul | 1x weekly<br>[2]2x appl | 0.871 a | 0.129 | 335.43 ab |
| Stylet Oil 100 SL<br>[1]Movento 2 SC | 0.75 %<br>3.3 fl oz/a | 11-Jun<br>13-Jul | 1x weekly<br>[2]3x appl | 0.863 a | 0.137 | 308.09 a-c |
| Aphoil 100 SL | 2 % | 11-Jun | 1x weekly | 0.835 a | 0.165 | 270.96 bc |
| Aphoil 100 SL | 4 % | 13-Jul | 1X weekly | 0.858 a | 0.142 | 319.35 a-c |
| Stylet Oil 100 SL<br>Fulfill 50 WDG | 0.75 %<br>3.67 oz/a | 11-Jun<br>13-Jul | 1x weekly<br>[2]3x appl | 0.866 a | 0.134 | 323.08 a-c |
| Stylet Oil 100 SL<br>Fulfill 50 WDG | 0.75 %<br>5.5 oz/a | 11-Jun<br>13-Jul | 1x weekly<br>[2]2x appl | 0.833 a | 0.167 | 264.42 bc |
| Stylet Oil 100 SL<br>Stylet Oil 100 SL | 0.75 %<br>0.75 % | 11-Jun<br>13-Jul | 1x weekly<br>2X weekly | 0.867 a | 0.133 | 280.13 a-c |
| | | | **P** | 0.644 | 0.644 | 0.459 |
| | | | **LSD** | 0.052 | 0.052 | 78.385 |

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

| Treatment | Rate | Type[1] | CPB-A 19 Jun | CPB-EM 19 Jun | CPB-SL 1 Jul | CPB-LL 8 Jul | %DF 15 Jul | PLH-A 8 Jul | PLH-N 8 Jul | Aphids 8 Jul |
|---|---|---|---|---|---|---|---|---|---|---|
| Untreated | - | - | 7.0 a | 13.8 ab | 200.3 ab | 153.0 a | 0.8 c | 6.0 a | 2.3 a | 55.0 a |
| Verimark 200 SC | 0.47 fl oz/cwt | S | 10.3 ab | 12.0 abc | 163.8 abc | 78.8 bc | 1.0 c | 0.5 cd | 0.0 b | 18.0 cd |
| Verimark 200 SC | 0.62 fl oz/cwt | S | 9.3 ab | 20.3 a | 179.5 abc | 56.3 bc | 3.0 bc | 2.5 a-d | 0.0 b | 16.3 c |
| AdmirePro 4.6 FS | 0.35 fl oz/cwt | S | 8.3 ab | 12.3 abc | 167.5 ab | 111.3 abc | 1.5 c | 0.0 d | 0.3 b | 12.5 cd |
| Cruiser 5 FS | 0.16 fl oz/cwt | S | 12.3 a | 10.5 bc | 280.8 a | 109.0 ab | 0.5 c | 0.0 d | 0.0 b | 34.3 b |
| Belay 2.13 SC | 0.6 fl oz/cwt | S | 11.0 ab | 4.3 d | 80.5 bc | 50.5 cd | 1.0 c | 0.0 d | 1.0 ab | 11.3 cd |
| Platinum 75 SG | 2.66 oz wt/a | IF | 9.3 ab | 7.3 c | 53.3 c | 26.5 de | 2.8 c | 0.8 bcd | 0.0 b | 3.8 cd |
| Verimark 200 SC | 10.3 fl oz/a | IF | 10.3 ab | 8.3 bc | 67.5 c | 19.0 e | 8.0 ab | 5.3 a | 0.0 b | 3.8 cd |
| Verimark 200 SC | 13.5 fl oz/a | IF | 8.0 ab | 10.5 bc | 60.3 c | 22.0 e | 10.5 a | 5.0 a | 1.0 ab | 3.8 cd |
| AdmirePro 4.6 FS | 8.7 fl oz/a | IF | 7.3 ab | 7.0 cd | 116.5 abc | 55.8 cd | 0.5 c | 0.0 d | 0.0 b | 11.8 cd |
| Belay 2.13 SC | 12 fl oz/a | IF | 6.0 b | 0.8 e | 14.5 d | 5.0 f | 2.8 c | 2.0 a-d | 0.0 b | 1.3 d |
| Untreated | | - | 5.5 b | 11.5 abc | 175.8 ab | 161.3 a | 1.3 c | 5.0 abc | 0.5 b | 37.5 b |
| | | **LSD** | 0.28 | 0.25 | 0.44 | 0.35 | 5.2 | 4.72 | 1.6 | 14.63 |
| | | **P** | 0.3602 | 0.0001 | 0.0001 | 0.0001 | 0.0054 | 0.0424 | 0.1569 | 0.0001 |

Means in columns followed by the same letter are not significantly different (Fisher's Protected Least Significant Difference Test, P = 0.05).
[1]IF = In furrow, S = Seed treatment

# 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 2013 on a loamy sand soil at Hancock Agricultural Research station (HAES) located 1.1 mile (1.8 km) southwest of Hancock, Wisconsin. Potato, *Solanum tuberosum* cv. 'Russet Burbank', seed pieces were planted on 2 May. Plants were spaced 12 inches apart within rows. Rows were 3 ft apart. The 8-row plots were 24 feet wide by 40 feet long, for a total of 0.025 acres/plot. Replicates were separated by a 5 ft border of bare ground.

Three replicates of 15 full-season insecticide programs were arranged in a randomized complete block design. Systemic insecticides were applied in-furrow at planting (2 May for treatments 1-6). The first application of Rimon (treatment 7) was made on 14 Jun. The first foliar insecticide applications were applied after peak egg hatch and prior to large larval population dominance (21 Jun, for treatments 7-15). Subsequent applications were made on 28 Jun (for treatments 7-15) and 25 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 2 May using a two nozzle boom equipped with Tee Jet XR8001 flat fan spray nozzles powered by a $CO_2$ backpack sprayer at 30psi. Furrows were cut using a commercial potato planter without closing discs attached. Immediately after the in-furrow treatments were applied and all seed piece treatments were placed in open furrows, all seed was covered by hilling. Foliar insecticides were applied using a $CO_2$ pressurized sprayer with a 24 ft boom operating at 30 psi delivering 20 gpa through 16 Tee Jet XR8002XR flat fan nozzles spaced 18" apart while travelling at 4.0 ft/sec.

CPB efficacy was assessed by counting the number of egg masses (EM), small larvae (SL), and large larvae (LL) per plant on 10 randomly selected plants in each plot. Percent defoliation (% DF) ratings were taken by visual observation of the entire plot. Potato leafhopper (PLH), *Empoasca fabae*, efficacy was assessed by counting the number of adults collected from 15 sweep net samples in each plot. Aphid and potato leafhopper nymph populations were surveyed by visual assessment of 25 leaves per plot. Insect counts occurred on several dates throughout the summer and reported means were averaged across those dates (**Tables 2, 3**). Insect count averages reflect time periods during the summer when specific life stages peaked in the plots. Yield and quality data were collected after harvest (11 Sep) (**Table 4**). Means were separated using ANOVA with a Fisher's Protected Least Squared Difference (LSD) mean separation test (P=0.05). No signs of phytotoxicity were observed.

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

| | 1st generation CPB | | | | 2nd generation CPB | | | |
|---|---|---|---|---|---|---|---|---|
| **Trt** | **AppDate** | **Insecticide** | **Rate** | **[†]Type** | **AppDate** | **Insecticide** | **Rate** | **[†]Type** |
| 1 | 2-May | Platinum 75 SC | 2.67 fl oz/a | IF | 28-Jun | [a]Besiege 1.25 ZC | 9 fl oz/a | F |
| | | | | | 25 Jul | [a]Besiege 1.25 ZC | 7.5 fl oz/a | F |
| 2 | 2-May | Belay 2.13 SC | 12 fl oz/a | IF | 28-Jun | [a]Agri-Mek 0.7 SC | 3.5 fl oz/a | F |
| | | | | | 25 Jul | [a]Agri-Mek 0.7 SC | 3.0 fl oz/a | F |
| 3 | 26-Apr | [a]Verimark 20 SC | 10 fl oz/a | IF | 28-Jun | Assail 30 SG | 4 oz wt/a | F |
| | 21 Jun | Blackhawk 36 WG | 3.3 oz wt/a | F | 25-Jul | Assail 30 SG | 3 oz wt/a | F |
| 4 | 26-Apr | Verimark | 13.5 fl oz/a | IF | 28-Jun | [a]Actara 25 WDG | 3 oz wt/a | F |
| | 21-Jun | [b]Agri-Mek 0.7 SC | 3.5 fl oz/a | F | 25-Jul | [a]Actara 25 WDG | 2.5 oz wt/a | F |
| 5 | 2-May | Admire Pro 4.6SC | 8.7 fl oz/a | IF | 28-Jun | [b]Radiant 1 SC | 8 fl oz/a | F |
| | 21-Jun | Agri-Mek 0.7 SC | 3.5 fl oz/a | F | 25-Jul | [b]Radiant 1 SC | 6 fl oz/a | F |
| 6 | 2-May | Scorpion 3.24 SC | 13.25 fl oz/a | IF | 28-Jun | [b]Athena 0.87 SC | 17 fl oz/a | F |
| | 21 Jun | Blackhawk 36 WG | 3.3 oz wt/a | F | 25-Jul | [b]Athena 0.87 SC | 17 fl oz/a | F |
| 7 | 14-Jun | [c]Rimon 0.83 EC | 10 fl oz/a | F | 25-Jul | [d]Exirel 10 SE | 6.75 fl oz/a | F |
| | 21-Jun | [c]Rimon 0.83 EC | 7 fl oz/a | F | | | | |
| | 28-Jun | [c]Rimon 0.83 EC | 7 fl oz/a | F | | | | |
| 8 | 21-Jun | [d]Coragen 1.67 SC | 5 fl oz/a | F | 25-Jul | [c]Admire Pro 4.6SC | 8.7 fl oz/a | F |
| | 28-Jun | [d]Coragen 1.67 SC | 3.5 fl oz/a | F | | | | |
| 9 | 21-Jun | [b]Agri-Flex 1.55 EC | 8.5 fl oz/a | F | 25 Jul | [d]Besiege 1.25 ZC | 9 fl oz/a | F |
| | 28-Jun | [b]Agri-Flex 1.55 EC | 6 fl oz/a | F | | | | |
| 10 | 21-Jun | [b]Blackhawk 36 WG | 3.3 oz wt/a | F | 25-Jul | [d]Exirel 10 SE | 5 fl oz/a | F |
| | 28-Jun | [b]Blackhawk 36 WG | 2.5 oz wt/a | F | | | | |
| 11 | 21-Jun | [b]Radiant 1 SC | 8 fl oz/a | F | 25-Jul | [d]Actara 25WDG | 3 oz wt/a | F |
| | 28-Jun | [b]Radiant 1 SC | 6 fl oz/a | F | | | | |
| 12 | 21-Jun | [a]Athena 0.87 EC | 17 fl oz/a | F | 25-Jul | [b]Admire Pro 550 SC | 1.3 fl oz/a | F |
| | 28-Jun | [a]Athena 0.87 EC | 14 fl oz/a | F | | | | |
| 13 | 21-Jun | [d]Actara 25 WDG | 3 oz wt/a | F | 25-Jul | [d]Besiege 1.25 ZC | 9 fl oz/a | F |
| | 28-Jun | [d]Actara 25 WDG | 1.5 oz wt/a | F | | | | |
| 14 | 21-Jun | [b]Belay 2.13 SC | 3 fl oz/a | F | 25-Jul | [d]Coragen 1.67 SC | 5 fl oz/a | F |
| | 28-Jun | [b]Belay 2.13 SC | 2.5 fl oz/a | F | | | | |
| 15 | 21-Jun | [a]Exirel 10 SE | 5 fl oz/a | F | 25-Jul | [a]Belay 2.13 SC | 3 fl oz/a | F |
| | 28-Jun | [a]Exirel 10 SE | 3 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 | 9.5 a | 2.1 a | 3.3 e | 3.5 cde | 0.1 d |
| 2 | 7.6 a | 1.4 a | 3.8 cde | 5.6 bcd | 0.1 d |
| 3 | 4.9 bc | 1.3 a | 7.9 abc | 4.0 bcd | 0.3 bcd |
| 4 | 2.5 de | 0.9 a | 2.7 de | 0.5 f | 0.1 d |
| 5 | 3.5 de | 2.2 a | 6.2 abc | 1.8 de | 0.1 d |
| 6 | 7.9 ab | 1.5 a | 18.0 abc | 7.9 ab | 1.3 a |
| 7 | 4.7 ab | 1.3 a | 13.9 ab | 5.2 bcd | 0.4 bcd |
| 8 | 6.7 ab | 1.6 a | 13.5 ab | 4.8 bcd | 1.1 ab |
| 9 | 2.2 de | 1.5 a | 12.5 abc | 1.2 ef | 0.3 cd |
| 10 | 6.5 ab | 1.3 a | 10.3 abc | 5.9 bcd | 0.4 bcd |
| 11 | 7.7 ab | 1.5 a | 12.1 abc | 5.2 bcd | 0.3 cd |
| 12 | 6.8 ab | 1.0 a | 11.4 abc | 6.2 a | 0.9 abc |
| 13 | 4.2 bc | 1.1 a | 5.1 bcd | 4.3 bcd | 0.2 d |
| 14 | 3.9 bc | 1.5 a | 7.2 abc | 3.7 bcd | 0.4 bcd |
| 15 | 1.6 e | 1.3 a | 3.5 cde | 1.8 ef | 0.2 d |
| P | 0.0001 | 0.7618 | 0.0024 | 0.0001 | 0.0305 |
| LSD | 0.147 | 0.146 | 0.185 | 0.157 | 0.157 |

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

| Trt | PLH adults | PLH nymphs | Aphids |
|---|---|---|---|
| 1 | 0.5 de | 0.1 cd | 0.1 a |
| 2 | 0.6 de | 0.0 d | 0.3 a |
| 3 | 3.5 a | 0.5 bc | 0.5 a |
| 4 | 3.5 a | 1.4 a | 0.4 a |
| 5 | 0.3 e | 0.1 cd | 0.0 a |
| 6 | 0.5 de | 0.6 ab | 0.5 a |
| 7 | 2.8 ab | 0.2 bcd | 0.9 a |
| 8 | 1.4 a-d | 0.2 bcd | 0.2 a |
| 9 | 0.7 de | 0.1 cd | 0.2 a |
| 10 | 1.5 b-e | 0.2 bcd | 1.0 a |
| 11 | 2.0 abc | 0.1 cd | 0.6 a |
| 12 | 0.4 e | 0.0 d | 1.7 a |
| 13 | 0.8 de | 0.0 d | 0.5 a |
| 14 | 0.9 cde | 0.3 bcd | 0.2 a |
| 15 | 2.4 abc | 0.2 bcd | 0.3 a |
| P | 0.0004 | 0.0023 | 0.141 |
| LSD | 0.158 | 0.0800 | 0.1012 |

**Table 4.** Mean yield estimates.

| Trt | Total US #1 (lbs) | Proportion US #1s/A | CWT/A |
|---|---|---|---|
| 1 | 98.8 a | 85.1 a | 38.6 a |
| 2 | 110.1 a | 90.4 a | 41.0 a |
| 3 | 92.6 a | 86.3 a | 39.2 a |
| 4 | 81.1 a | 78.3 a | 35.5 a |
| 5 | 94.0 a | 85.9 a | 39.0 a |
| 6 | 82.8 a | 83.3 a | 37.8 a |
| 7 | 96.6 a | 86.9 a | 39.4 a |
| 8 | 93.6 a | 87.4 a | 39.4 a |
| 9 | 102.2 a | 88.6 a | 40.2 a |
| 10 | 91.4 a | 88.0 a | 39.9 a |
| 11 | 92.6 a | 88.4 a | 40.1 a |
| 12 | 97.3 a | 88.7 a | 40.2 a |
| 13 | 99.4 a | 86.5 a | 39.3 a |
| 14 | 96.0 a | 85.6 a | 38.9 a |
| 15 | 90.3 a | 85.7 a | 38.9 a |
| P | 0.0959 | 0.0759 | 0.0759 |
| LSD | 15.4933 | 5.9718 | 2.71 |

# 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 2013. Snap bean, *Phaseolus vulgaris* var. 'Hercules,' was seeded on 11 Jun at a rate of 8 seeds per foot within rows. Rows were 30 inches apart. The two-row plots were 5 ft wide by 25 ft long, for a total of 0.003 acres. Replicates were separated by two untreated rows. All plots were managed per commercial management practices.

Four replicates of 12 treatments and 1 untreated control were arranged in a randomized complete block design. The foliar treatments were applied 24 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 (19 and 26 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 6 Aug, by counting (1) number of damaged stems, (2) number of damaged pods, and (3) the number of viable larvae observed in both stems and pods. The survey was done only on 25 plants per plot. See **Table 1** for a summary of key field activity dates. Means were separated using ANOVA with a Least Squared Difference (LSD) mean separation test (P=0.05). Data are presented in **Table 2**.

**Table 1.** Summary of key field activity dates.

| Action | Planting | First infestation | Insecticide app. | Second infestation | Evaluations* |
|---|---|---|---|---|---|
| Date | 11 Jun | 19 Jul | 24 Jul | 26 Jul | 6 Aug |
| Days from last action | | 38 | 5 | 2 | 11 |

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

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

| Treatment | Rate | #Damaged Stems | Proportion Damaged Pods | # Larve in Stems |
|---|---|---|---|---|
| CHK | . | 0.420 | 0 | 0 |
| Exirel SE (pre-bud)+MSO[1] | 13.5 oz/a | 0.345 | 0.005 | 0 |
| Brigade EC (pre-bud) | 3.0 oz/a | 0.238 | 0 | 0 |
| Exirel SE (pre-bud)+MSO[1]+Reflex+Basagran | 13.5 oz/a | 0.301 | 0 | 0 |
| Brigade EC (pre-bud)+Reflex+Basagran | 3.0 oz/a | 0.389 | 0.003 | 0 |
| Exirel SE (flower)+MSO[1] | 13.5 oz/a | 0 | 0.007 | 0 |
| Brigade EC (flower) | 3.0 oz/a | 0.369 | 0 | 0 |
| Exirel SE (flower)+MSO[1]+Topsin WP | 13.5 oz/a | 0.389 | 0.004 | 0 |
| Brigade EC (flower)+Topsin WP | 3.0 oz/a | 0.301 | 0.003 | 0 |
| Exirel SE (pin)+MSO[1] | 13.5 oz/a | 0 | 0 | 0.075 |
| Brigade EC (pin) | 3.0 oz/a | 0.270 | 0 | 0 |
| Exirel SE(pin)+MSO[1]+Bravo SL | 13.5 oz/a | 0.150 | 0 | 0 |
| Brigade EC (pin)+Bravo SL | 3.0 oz/a | 0.301 | 0 | 0 |
| | **P** | 0.960 | 0.569 | 0.467 |
| | **LSD** | 0.378 | 0.008 | 0.060 |

[1]MSO 100 L added at 0.5% v/v

No larvae were found in pods

# 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 2013. Snap bean, *Phaseolus vulgaris* var. 'DL Kennedy, was seeded on 22 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 8 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 XR8015VS) 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. In-furrow treatments were applied 22 May 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 XR8015VS) traveling at 3.5 ft/sec.

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

**Table 1**. Mean damage estimates of stems and pods from European corn borer and Corn earworm larvae on snap beans.

| | | ECB | | CEW |
|---|---|---|---|---|
| **Treatment** | **Rate** | **Proportion Damaged Stems** | **Proportion Damaged Pods** | **Proportion Damaged Pods** |
| Untreated | . | 0.122 a | 0.004 a | 0.047 a |
| Verimark SC | 10.2 oz/a | 0.030 b | 0 b | 0.047 a |
| Verimark SC | 13.5 oz/a | 0.020 b | 0 b | 0.037 a |
| Coragen SC | 5 oz/a | 0.030 b | 0.0005 b | 0.021 a |
| Coragen SC | 7 oz/a | 0 b | 0 b | 0.011 a |
| Verimark SC | 10.2 oz/a | 0 b | 0 b | 0.024 a |
| Verimark SC | 13.5 oz/a | 0 b | 0 b | 0.046 a |
| Coragen SC | 5 oz/a | 0 b | 0 b | 0.051 a |
| Coragen SC | 7 oz/a | 0 b | 0 b | 0.041 a |
| | **P** | 0.054 | 0.09 | 0.598 |
| | **LSD** | 0.076 | 0.002 | 0.045 |

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

# Foliar insecticide treatments for the control of 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. 'DM Kennedy' was seeded on 22 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 13 treatments and 1 untreated control were arranged in a randomized complete block design. The foliar treatments were applied 3 July when plants had reached the flowering and pin-bean development stage. Treatments were applied with a $CO_2$ pressurized backpack sprayer with a 6' boom operating at 30 psi delivering 20.2 gpa through a flat-fan nozzle (Tee Jet XR8002VS) spaced 18" apart while travelling at 3.5 ft / sec.

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

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

| Treatment | Rate | Proportion Damaged Stems | Proportion Damaged Pods |
|---|---|---|---|
| Untreated | . | 0.001 ab | 0 b |
| Exirel SE | 13.5 oz/a | 0 b | 0.004 a |
| Exirel SE | 20.5 oz/a | 0.003 a | 0 b |
| Exirel SE + MSO | 13.5 oz/a | 0.0006 ab | 0 b |
| Exirel SE + MSO | 20.5 oz/a | 0.0008 ab | 0 b |
| Benevia OD + MSO | 13.5 oz/a | 0.0007 ab | 0 b |
| Brigade EC | 4.5 oz/a | 0.0007 ab | 0 b |
| Brigade EC | 6.4 oz/a | 0 b | 0 b |
| Fastac EC | 3.8 oz/a | 0 b | 0 b |
| Warrior II CS | 1.92 oz/a | 0 b | 0 b |
| Endigo ZC | 4.5 oz/a | 0 b | 0 b |
| Actara WG | 5.5 oz wt/a | 0 b | 0 b |
| Besiege ZC | 10 oz/a | 0 b | 0 b |
| Coragen SC + MSO | 5 oz/a | 0 b | 0 b |
| | **P** | 0.061 | 0.468 |
| | **LSD** | 0.002 | 0.001 |

Means in columns followed by the same letter are not significantly different (Fisher's Protected Least Significant Difference Test, P = 0.05).
MSO 100 EC was added at 0.25% 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 2013. Pepper, *Capsicum annuum* cv. 'Yankee Bell', transplants were planted 4 June. Plants were spaced 24 inches apart within rows. Rows were 6 ft apart. Plots were single rows, 6 ft wide by 30 ft long, for a total of 0.004 acres. Replicates were separated by a 12 ft border of bare ground. The trial was established over black plastic and sprinkler irrigated over the growing season. Experimental plots were managed according to commercial herbicide and fungicide recommendations for weed control and control of the pepper blight resulting from *Phytophthora capsici*.

Each plot was infested with European corn borer (ECB), *Ostrinia nubilalis*, egg masses on 12 Aug. In each plot, five successive plants were infested, each with 10 egg masses for a total of 50 egg masses applied in each plot. Egg masses were attached to plants mid-canopy and onto stems with green fruit. Each egg mass contained approximately 20-30 eggs / mass.

Four replicates of 5 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. | Evaluation |
|---|---|---|---|---|
| **Date** | 4 Jun | 12 Aug | 9 Aug | 22 Aug |
| **Days from last action** | | 69 | 3 | 13 |

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.

| Treatment | Rate | | Total No. Fruit | Proportion Damaged Fruit | # Larvae |
|---|---|---|---|---|---|
| CHK | Untreated | - | 8.6 ab | 0.238 ab | 0.075 |
| Warrior II SE + NIS | 2.08 | fl oz/a | 9.2 ab | 0.307 a | 0.099 |
| ExirelvSC + MSO | 10 | fl oz/a | 9.3 ab | 0.256 ab | 0.015 |
| Radiant SC + NIS | 1 | fl oz/a | 7.9 b | 0.188 b | 0.078 |
| Radiant SC + NIS | 1 | fl oz/a | 8.4 ab | 0.20. ab | 0.069 |
| Exp 1 + NIS | 50 | fl oz/a | 9.4 a | 0.289 ab | 0.075 |
| | | P | 0.25 | 0.197 | 0.603 |
| | | LSD | 1.48 | 0.107 | 0.092 |

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

NIS 100 L added at 0.5% v/v

MSO 100 L added at 0.5% v/v

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

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

**Materials and Methods**

This experiment was conducted on a loamy sand soil at Hancock Agricultural Research station (HAES) located 1.1 mile (1.8 km) southwest of Hancock, Wisconsin in 2013. Carrot, *Daucus carota var* . Enterprise was direct seeded on 13 May. . Experimental plots consisted of 24 inch (0.61 m) raised formed beds containing 4 rows of carrots spaced 6 inches (15.2 cm) between. Experimental plots measured 20 ft (6.1 m) in length with planted beds on either side acting as guard rows. All plots were maintained to standard commercial practices.

Four replicates of 14 treatments and 1 untreated control were arranged in a randomized complete block design with four experimental replicates. All foliar treatments were applied in 1.5 L of water at an application rate of 20.2 gpa using a four nozzle, 6 foot (1.8m) boom equipped with an 8002XR flat fan spray tip powered by a CO2 backpack sprayer operating at 30 psi. Successive applications were initiated when mean immature thrips populations had exceeded established thresholds of 3 immature thrips / leaf. The in-furrow applications were applied at plant on 13 May between 11:00 -12:00 hours.

Sweeps were made on 1, 16, 25 July, and 1, 5, 12, 20, 26 August. Ten sweeps per plot.
Above and below ground evaluation and root weights were taken on 26 September.
Count data were $\log_{10}$ transformed prior to analysis. Data were analyzed using ANOVA and means were separated with a Fisher's Protected LSD.

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

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

| **Treatment** | **Rate** | 16-Jul | 25-Jul | 1-Aug | 5-Aug | 12-Aug | 20-Aug | 26-Aug |
|---|---|---|---|---|---|---|---|---|
| Untreated | . | 0 | 0.119 | 0.345 ab | 0 b | 0.420 a | 0.675 a | 0 b |
| Verimark 200SC | 6.75 fl oz/a | 0.194 | 0.075 | 0.325 ab | 0 b | 0.075 ab | 0.496 ac | 0 b |
| Verimark 200SC | 10.2 fl oz/a | 0.075 | 0.075 | 0.150 bc | 0 b | 0.150 ab | 0.150 c | 0.194 a |
| Verimark 200SC | 13.5 fl oz/a | 0.15 | 0 | 0.075 bc | 0.075 ab | 0.455 a | 0.496 ac | 0 b |
| AdmirePro 4.6FS | 8 fl oz/a | 0.194 | .0.075 | 0.150 bc | 0 b | 0.270 ab | 0.226 bcd | 0 b |
| AdmirePro 4.6FS | 10.5 fl oz/a | 0 | 0 | 0 c | 0.075 ab | 0.420 a | 0.369 ac | 0 b |
| Platinum 75SG | 3 oz wt/a | 0.194 | 0 | 0 c | 0 b | 0.150 ab | 0.345 ac | 0.075 b |
| Platinum 75SG | 4.01 oz wt/a | 0.238 | 0.15 | 0 c | 0 b | 0.075 ab | 0.520 ad | 0.075 b |
| Verimark 200SC+fert. | 6.75 fl oz/a | 0.075 | 0.075 | 0.270 ac | 0 b | 0.150 ab | 0.194 cd | 0 b |
| Verimark 200SC+fert. | 10.2 fl oz/a | 0 | 0 | 0.496 a | 0 b | 0.150 ab | 0.580 ab | 0 b |
| Verimark 200SC+fert. | 13.5 fl oz/a | 0.194 | 0.075 | 0.194 bc | 0.150 a | 0.270 ab | 0.294 bcd | 0 b |
| AdmirePro 4.6FS+fert. | 8 fl oz/a | 0.075 | 0 | 0.226 ac | 0 b | 0 b | 0.40 ac | 0 b |
| AdmirePro 4.6FS+fert. | 10.5fl oz/a | 0.119 | 0.075 | 0.075 bc | 0.075 ab | 0.150 ab | 0.389 ac | 0 b |
| Platinum 75SG+fert. | 3 oz wt/a | 0.27 | 0 | 0.075 bc | 0 b | 0.150 ab | 0.226 bcd | 0 b |
| Platinum 75SG+fert. | 4.01 oz wt/a | 0.194 | 0.075 | 0.345 ab | 0 b | 0.250 ab | 0.345 ac | 0 b |
| | **P** | 0.774 | 0.784 | 0.016 | 0.183 | 0.536 | 0.198 | 0.078 |
| | **LSD** | 0.308 | 0.171 | 0.280 | 0.111 | 0.402 | 0.364 | 0.117 |

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

**Table 2.** Mean Aster leafhopper nymphs per sweep on carrot.

| **Treatment** | **Rate** | 16-Jul | 25-Jul | 1-Aug | 5-Aug | 12-Aug | 26-Aug |
|---|---|---|---|---|---|---|---|
| Untreated | . | 0.194 a | 0.119 | 0.345 ab | 0.194 a | 0 b | 0.075 ab |
| Verimark 200SC | 6.75 fl oz/a | 0 b | 0.075 | 0.325 ab | 0 b | 0 b | 0 b |
| Verimark 200SC | 10.2 fl oz/a | 0 b | 0.075 | 0.150 bc | 0 b | 0.075 a | 0 b |
| Verimark 200SC | 13.5 fl oz/a | 0 b | 0 | 0.075 bc | 0 b | 0 b | 0 b |
| AdmirePro 4.6FS | 8 fl oz/a | 0 b | 0.075 | 0.150 bc | 0 b | 0 b | 0 b |
| AdmirePro 4.6FS | 10.5 fl oz/a | 0 b | 0 | 0 c | 0 b | 0 b | 0 b |
| Platinum 75SG | 3 oz wt/a | 0 b | 0 | 0 c | 0 b | 0 b | 0 b |
| Platinum 75SG | 4.01 oz wt/a | 0.075 ab | 0.15 | 0 c | 0 b | 0 b | 0.119 a |
| Verimark 200SC+fert. | 6.75 fl oz/a | 0 b | 0.075 | 0.270 ac | 0 b | 0 b | 0 b |
| Verimark 200SC+fert. | 10.2 fl oz/a | 0.0119 ab | 0 | 0.496 a | 0 b | 0 b | 0 b |
| Verimark 200SC+fert. | 13.5 fl oz/a | 0 b | 0.075 | 0.194 ac | 0.075 ab | 0 b | 0 b |
| AdmirePro 4.6FS+fert. | 8 fl oz/a | 0.075 ab | 0 | 0.226 ac | 0 b | 0 b | 0 b |
| AdmirePro 4.6FS+fert. | 10.5fl oz/a | 0 b | 0.075 | 0.075 bc | 0 b | 0 b | 0 b |
| Platinum 75SG+fert. | 3 oz wt/a | 0 b | 0 | 0.075 bc | 0 b | 0 b | 0 b |
| Platinum 75SG+fert. | 4.01 oz wt/a | 0.075 ab | 0.075 | 0.345 ab | 0.150 ab | 0 b | 0 b |
| | **P** | 0.694 | . | . | 0.582 | 0.470 | 0.530 |
| | **LSD** | 0.193 | 0.171 | 0.280 | 0.189 | 0.055 | 0.104 |

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

**Table 3.** Mean damage and yield on carrot.

| Treatment | Rate | Below Ground | | Above Ground | | Tons/ac |
|---|---|---|---|---|---|---|
| | | Fork | Hairy | WB | Red | |
| Untreated | . | 0.1132 ab | 0.0788 ab | 0.0906 a | 0.0405 a | 35.15 a |
| Verimark 200SC | 6.75 fl oz/a | 0.0307 b | 0.0791 ab | 0.0312 bc | 0.0114 cd | 37.75 a |
| Verimark 200SC | 10.2 fl oz/a | 0.0460 b | 0.0130 b | 0.0422 bc | 0.0088 cd | 34.50 a |
| Verimark 200SC | 13.5 fl oz/a | 0.0765 ab | 0.0700 ab | 0.0199 bc | 0.0064 cd | 39.15 a |
| AdmirePro 4.6FS | 8 fl oz/a | 0.0337 b | 0.0337 bc | 0.0168 bc | 0.0071 cd | 40.13 a |
| AdmirePro 4.6FS | 10.5 fl oz/a | 0.0604 ab | 0.0618 ab | 0.0369 bc | 0.0230 c | 38.13 a |
| Platinum 75SG | 3 oz wt/a | 0.1431 ab | 0.0267 bc | 0.0302 bc | 0.0086 cd | 37.42 a |
| Platinum 75SG | 4.01 oz wt/a | 0.1522 ab | 0.0442 bc | 0.0154 c | 0.0072 cd | 38.34 a |
| Verimark 200SC+fert. | 6.75 fl oz/a | 0.1326 ab | 0.0668 ab | 0.0260 bc | 0.0205bc | 38.50 a |
| Verimark 200SC+fert. | 10.2 fl oz/a | 0.0789 ab | 0.1292 a | 0.0277 bc | 0.0097cd | 36.66 a |
| Verimark 200SC+fert. | 13.5 fl oz/a | 0.1302 ab | 0.0854 ac | 0.0461 b | 0.0000 d | 36.02 a |
| AdmirePro 4.6FS+fert. | 8 fl oz/a | 0.1408 ab | 0.0157 bc | 0.0239 bc | 0.0117 cd | 37.96 a |
| AdmirePro 4.6FS+fert. | 10.5fl oz/a | 0.1927 a | 0.0402 bc | 0.0214 bc | 0.0205 bc | 35.10 a |
| Platinum 75SG+fert. | 3 oz wt/a | 0.0803 ab | 0.0851 ac | 0.0243 bc | 0.0037 bd | 36.44 a |
| Platinum 75SG+fert. | 4.01 oz wt/a | 0.0643 ab | 0.0777 ab | 0.0203 bc | 0.0072 cd | 39.59 a |
| | **P** | 0.421 | 0.123 | 0.002 | 0.006 | 0.983 |
| | **LSD** | 0.137 | 0.072 | 0.030 | 0.018 | 8.269 |

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