**2014 Progress Report to the BC Cranberry Commission**

**Project Title: Assessment of new pest management tools that address priority needs of the BC Cranberry Industry**

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**Project Summary:** Efforts to screen new bio-herbicides were not successful and new attempts will be made in 2015. Numerous studies were conducted to assess insecticide efficacy against cranberry tipworm and blackheaded fireworm. Across all times, studies and farms, Sevin and bifenthrin provided the greatest and most consistent efficacy against tipworm. Grandevo, Venerate, Altacor and Pyganic had moderate efficacy on sites where the applications were made at the early larval stage, but otherwise they had poor efficacy. Cyazapyr and IKI-3106 did not have any efficacy against tipworm. For all chemistries, treatments made after larvae had pupated failed to provide any efficacy. For blackheaded fireworm control, Altacor, bifenthrin and IKI-3106 provided >99% efficacy. Entrust and Pyganic provided ~ 80 – 90% efficacy, and Grandevo, Venerate, and DiPel provided ~ 50% efficacy. Control of blackvine weevil with the commercial strain of *Metarhizium anisopliae*, strain F52 (MET 52G formulation), was assessed. Control was noted in both reduction of larvae and adult emergence in the summer. The level of field efficacy ranged from 65 to 89%. The infectivity period in the soil was 87% after 3 weeks and 57% after 2 months.

**Project Results and Discussion by Objectives:**

*Objective 1: Screening new herbicides for weed control in cranberries:*

The goal was to obtain efficacy and crop phytotoxicity data for MBI-005 and MBI-011. The registrant was unable/unwilling to provide research product for this project in 2014. We will make another request in 2015. Agriculture & Agri-Food Canada in Saskatchewan was not able to supply Phoma™ to the US. In 2015 efforts will be made to get cranberry plants to Dr. Bailey in order to obtain crop phytotoxicity data.

*Objective 2*: *Screening new insecticide chemistries for efficacy:*

*Tipworm efficacy:* Replicated field trials were conducted on grower beds to test the efficacy of new and existing chemistries against tipworm. Treatment timings focused on two early season (first generation) treatments. Efficacy was based on assessing 25 tips per plot for tipworm larvae and pupae for several generations. For any given chemical, there was a lot of variability in the level of control, based on the farm, the parameter assessed, and the date assessed. Results are presented by chemistry.

- Grandevo: Compared to the untreated control, two applications at 3 lb/a showed no control at Farm 1 (Table 1), reduced cupped tips and early larvae at Farm 2 (Table 2), and no control at Farm 3 (Table 3).
- Venerate: Compared to the untreated control, two applications at 8 qt/ac showed no control at Farm 1 (Table 1), reduced cupped tips and early larvae at Farm 2 (Table 2), and no control at Farm 3 (Table 3).

- Altacor: Compared to the untreated control, two applications at 4 oz/ac showed no control at Farm 1 (Table 1), reduced cupped tips and total tipworm at Farm 2 (Table 2), no control at Farm 3 (Table 3), and no control in Farms 5 & 6 (Table 5).
- Altacor + Delegate (6 oz/a): Compared to the untreated control, two applications of this combination showed no control at Farm 1 (Table 1), reduced cupped tips and early larvae at Farm 2 ( Table 2), and no control at Farm 3 (Table 3). It did not improve the control over Altacor alone.
- Sevin XLR: Compared to the untreated control, two applications at 2 qt/ac showed a trend for tipworm control at Farm 1 (Table 1), reduced cupped tips and total tipworm at Farm 2 (Table 2), a trend for reduced cupped tips and total tipworm Farm 3 (Table 3), and reduced cupped tips and tipworm in Farms 5 & 6 (Tables 5, 6 &7). The control in Farms 5 and 6, from two May treatments extended into mid-July (Table 6).
- Pyganic: Compared to the untreated control, two application of Pyganic showed no control at Farm 1 (Table 1), reduced cupped tips and early larvae at Farm 2 (Table 2), and no control at Farms 3, 5 or 6 (Tables 3 & 5).
- Pyrethroid B: Compared to the untreated control, two applications showed no control at Farm 3 (Table 1), and excellent short and long-term control at Farms 5 or 6 (Tables 5, 6 & 7).
- Cyantraniliprole: Compared to the untreated control, two applications at 20.5 oz/ac showed no control at Farms 4, 5 or 6 (Tables 4, 5, 6 & 7), reduced cupped tips and early larvae at Farm 2 (Table 2), and no control at Farm 3 (Table 3).
- IKI-3106: Compared to the untreated control, one application at 22 fl oz/ac showed no efficacy at Farm 4 (Table 4).

To assure that treatments did not diminish production, yield from plots on two farms was obtained. There was no treatment effect on yield (Table 8).

In summary, across all times, studies and farms, Sevin and bifenthrin provided the greatest and most consistent efficacy. Grandevo, Venerate, Altacor and Pyganic all showed some moderate efficacy on beds when tipworm applications were timed for the early larval stage. Treatments made after larvae had pupated (Farm 3) failed to provide any efficacy, regardless of chemistry. Cyantraniliprole:, which showed efficacy in 2013 studies, did not show control in 2014 studies. IKI-3106 showed no efficacy, but there were not enough trials conducted to make any definitive inference. Based on these studies, two well-timed applications of Sevin or Pyrethroid B to control first generation tipworm prior to bloom could provide reasonable suppression of subsequent generations of tipworm populations and their effects on cranberry apical meristems.

*Fireworm efficacy:* Replicated field trials were conducted on grower beds to test the efficacy of new and existing chemistries against fireworm. Treatment timings focused on first and second generations. Efficacy was based on assessing 5 sweeps per plot. Results are presented by chemistry.

- Altacor: Compared to the untreated control, one early application of Altacor at 4 oz/ac provided 100% control of first generation fireworm at 5 and 13 days after treatment (Tables 9 and 10).
- Grandevo: Compared to the untreated control, two applications at 3 lb/a provided 25% control of first and second generation fireworm (Tables 9, 10, 11 & 12).

- Venerate: Compared to the untreated control, two applications at 2 gal/a showed good control of first generation fireworm (86%), but only 37% control of second generation larvae (Tables 9, 10, 11 & 12). Control for both generations took 11+ days before it was expressed.
- Pyrethroid B: Compared to the untreated control, one application at 6.4 oz/a provided 100% control of first generation fireworm at 5 and 13 days after treatment (Tables 9 and 10).
- IKI-3106: Compared to the untreated control, one application at 22 fl oz/a provided almost 100 % control of first generation fireworm at 5 and 13 days after treatment (Tables 9 and 10).
- Entrust: Compared to the untreated control, one application at 6 oz/a provided 87% control of second generation fireworm at both 4 and 8 days after treatment assessments (Tables 11 & 12). Less control was noted with small larvae than medium or large larvae.
- Pyganic: Compared to the untreated control, one application at 2 qt/a provided ~87% control of second generation fireworm at both 4 and 8 days after treatment assessments (Tables 11 & 12). Less control was noted with small larvae than medium or large larvae.
- DiPel: Compared to the untreated control, one application at 1 lb/a provided ~ 50% control of second generation fireworm at both 4 and 8 days after treatment assessments (Tables 11 & 12).

In summary, Altacor, Pyrethroid B and IKI-3106 all provided excellent control (>99%), Entrust and Pyganic provided good control of fireworm (~ 80 – 90%), and Grandevo, Venerate, and DiPel provided moderate efficacy (~ 50%) against fireworm. The grower standard, Altacor, is an exceptionally efficacious chemistry for fireworm. Registration of new chemistries, like bifenthrin and IKI-3106, would help with resistance management. Entrust, Pyganic, Grandevo, Venerate, and DiPel are all considered soft chemistries and all are certified for organic use. Both Entrust and Pyganic would provide good control. Growers using Grandevo, Venerate, or DiPel would need to carefully monitor their beds to assure damage levels were maintained below the economic threshold levels.

*Objective 3: Blackvine weevil control with Metarhizium:* Blackvine weevil, *Metarhizium anisopliae* strain (MET), was soaked for 1 hour in a 0.05% v/v Silwet bath. This soaking released the spores from the granular and the rinsate was used to treat replicated plots of cranberry infested with blackvine weevil. Prior to treatment, vines were lifted up to assure that weevil larvae were present at each treatment site. Treatment rate was 100 lbs MET / acre rate (50#/ac ~ $5x10^9$ colony forming unit (CFU) per square meter). Treatments were applied at 4000 gpa application volume November to February on three farms. Efficacy was assessed by pulling up ¼ $m^2$ of vines and looking for infested larvae or pupae or by sweeping plots after adult emergence. Bioassays of treated soil were collected to assess the duration of spore viability of treated soil after 21 and 60 days, using fresh BVW larvae. For the 21 day samples, the soil was cultured on petri plates with a species-specific medium to determine the number of live colonies per gram of soil. MET at the 100 lb/ac rate of the granular was very effective on controlling BVW larvae (Table 13). This efficacy was obtained for November, January, February, or March application timings. Control was noted in both the reduction of larvae and adult emergence in the summer. The level of field efficacy ranged from 65 to 89%. The infectivity period in the soil was 87% after 3 weeks and 57% after 2 months (Table 14). For the soil cultured after 3 weeks in the field, a count of 30,000 colony forming units per gram of soil was obtained.

| Table 1. Insecticide efficacy for first generation tipworm control in 2014 (Experiment 1, Farm 1). | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | #/ 25 uprights | | | | | | | |
| | Cupped tips | Larvae | Pupae | Total tipworm | Cupped tips | Larvae | Pupae | Total tipworm |
| Treatment | 6/3/2014 | | | | 6/17/2014 | | | |
| Control | 7 | 2.3 | 1.7 | 3.7 | 6.7 | 1.3 | 3.9 | 5.3 |
| Grandevo 3 lb/a | 6.3 | 1 | 3.3 | 3.9 | 11.3 | 1.8 | 7.9 | 10.7 |
| Venerate 8 qt/a | 8.7 | 2.3 | 3.3 | 5.5 | 7 | 2.6 | 3.5 | 6.7 |
| Altacor 4 oz/a | 7.7 | 1.3 | 5 | 6.3 | 9 | 0.7 | 7.7 | 9 |
| Altacor 4 oz/a + Delegate 6 oz/a | 7.3 | 2 | 3.3 | 5.2 | 8 | 1.1 | 5.5 | 7 |
| Sevin XLR 2 qt/a | 6.7 | 1 | 1.7 | 2.5 | 10 | 1.9 | 5.5 | 7.7 |
| Pyganic 2 qt/a | 10.3 | 4.3 | 5.3 | 9.4 | 11.3 | 0.3 | 11.5 | 12 |
| LSD (0.05) | 4.49 | 2.23 | 4.32 | 0.87 | 4.15 | 0.48t | 0.70t | 4.24 |
| Treatment Prob(F) | 0.5 | 0.08 | 0.4 | 0.07 | 0.1 | 0.4 | 0.01 | 0.05 |

Applied 5/27/14 and 6/3/14 at 25 gpa, 6' by 6' plots, 3 replications.

| Table 2. Insecticide efficacy for first generation tipworm control in 2014 (Experiment 1, Farm 2). | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | #/ 25 uprights | | | | | | | |
| | Cupped tips | Larvae | Pupae | Total tipworm | Cupped tips | Larvae | Pupae | Total tipworm |
| Treatment | 6/11/2014 | | | | 6/17/2014 | | | |
| Control | 11.1 | 9.5 | 0.3 | 10.1 | 13.3 | 1.8 | 8.7 | 11.1 |
| Grandevo 3 lb/a | 6.3 | 2.3 | 0 | 2.3 | 7 | 0 | 5 | 5 |
| Venerate 8 qt/a | 5.8 | 2.6 | 0.6 | 3.2 | 8.3 | 1 | 4.3 | 7.1 |
| Altacor 4 oz/a | 5 | 1.5 | 0 | 1.7 | 6.3 | 0.2 | 3.3 | 3.6 |
| Altacor 4 oz/a + Delegate 6 oz/a | 6.1 | 2.2 | 0 | 2.5 | 6 | 0 | 3.7 | 3.6 |
| Sevin XLR 2 qt/a | 2.2 | 0.8 | 0 | 0.9 | 6.3 | 0.1 | 2.7 | 2.8 |
| Pyganic 2 qt/a | 2.7 | 1.3 | 0.3 | 1.6 | 7.7 | 1.3 | 2.7 | 4.6 |
| LSD (0.05) | 0.90 | 0.40 | 0.21 | 1.1 | 3.3 | 10.82 | 3.82 | 1.00 |
| Treatment Prob(F) | 0.02 | 0.05 | 0.33 | 0.02 | 0.01 | 0.58 | 0.06 | 0.06 |

Applied 5/27/14 and 6/3/14 at 25 gpa, 6' by 6' plots, 3 replications.

| Table 3. Insecticide efficacy for early season tipworm control in 2014 (Experiment 1, Farm 3). | | | | | |
|---|---|---|---|---|---|
| | #/ 25 uprights | | | | |
| | Cupped tips | Larvae | Pupae | Total tipworm | % control |
| Treatment | 6/17/2014 | | | | |
| Control | 10 | 3.7 | 2.5 | 8 | |
| Grandevo 3 lb/a | 6.3 | 3.3 | 3.2 | 6.7 | 32.5 |
| Venerate 8 qt/a | 6.3 | 2.3 | 4.1 | 7 | 31.5 |
| Altacor 4 oz/a | 5.7 | 1.7 | 4.3 | 6.3 | 28.9 |
| Altacor 4 oz/a + Delegate 6 oz/a | 4 | 3 | 1.4 | 5.3 | 28.9 |
| Sevin XLR 2 qt/a | 2.3 | 0.7 | 0.8 | 1.7 | 9.2 |
| Pyganic 2 qt/a | 4 | 1.3 | 2 | 3.3 | 23.9 |
| LSD (0.05) | 4.8 | 2.6 | 0.5 | 5.6 | 0.4 |
| Treatment Prob(F) | 0.08 | 0.2 | 0.4 | 0.2 | 0.1 |

Applied 5/27/14 and 6/3/14 at 25 gpa, 6' by 6' plots, 3 replications.

| Table 4. Insecticide efficacy for mid-season tipworm control in 2014 (Experiment 2, Farm 4). | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | #/ 25 uprights | | | | | | | |
| | Cupped tips | Larvae | Pupae | Total tipworm | Cupped tips | Larvae | Pupae | Total tipworm |
| Treatment | 6/17/2014 | | | | 6/25/2014 | | | |
| Control | 8.3 | 4 | 4.8 | 8.8 | 15.8 | 0.8 | 4 | 4.8 |
| Pyrethroid B 6.4 oz/ac 2x 1000gpa | 14.5 | 2.3 | 9.3 | 11.5 | 16.8 | 0.8 | 6.3 | 7 |
| Cyantraniliprole: 20.5 oz/ac 2x 30 gpa | 14.3 | 1.8 | 10.5 | 12.3 | 15.8 | 0.5 | 10.8 | 11.3 |
| Cyantraniliprole: 20.5 oz/ac 2x 1000 gpa | 12 | 3.5 | 7.5 | 11 | 16.5 | 1.3 | 8.3 | 9.5 |
| IKI-3106 1x 22 fl oz/ac 1x | | | | | 14.3 | 1.8 | 8.5 | 10.3 |
| Lsd (0.05) | 6.8 | 3.3 | 7.0 | 9.1 | 4.7 | 1.6 | 4.8 | 4.6 |
| Treatment prob(F) | 0.2 | 0.4 | 0.3 | 0.8 | 0.8 | 0.5 | 0.08 | 0.06 |

1x- applied once, 2x – applied twice, applied 6/3/14 and 6/10/14. Plots were 6' by 6' plots, 4 replications per treatment, treatments applied at 100 gpa.

| Table 5. Insecticide efficacy for early season tipworm control in 2014 (Experiment 3, Farms 5 & 6). | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Farm 5 | | | | Farm 6 | | | |
| | #/ 25 uprights | | | | | | | |
| | Cupped tips | Larvae | Pupae | Total tipworm | Cupped tips | Larvae | Pupae | Total tipworm |
| Treatment | 6/3/2014 | | | | | | | |
| Control | 5.3 | 4.5 | 0.8 | 5.3 | 1.3 | 1.5 | 0.2 | 1.6 |
| Pyrethroid B 6.4 oz/ac 2x | 0 | 0 | 0 | 0 | 0.3 | 0 | 0.1 | 0.1 |
| Altacor 2x | 5.3 | 3.3 | 0 | 3.3 | 1.6 | 1.3 | 0.3 | 0.9 |
| Sevin XLR2 qt/a 2x | 2.5 | 0 | 0 | 0 | 3.1 | 0 | 0.2 | 0.2 |
| Pyganic 3x | 4.3 | 4 | 0 | 4 | 1.8 | 1.3 | 0.1 | 0.8 |
| Cyantraniliprole: 20.5 oz/ac 2x | 5 | 3.3 | 0.3 | 3.6 | 2.1 | 1 | 0.3 | 1.4 |
| Lsd (0.05) | 2.1 | 2.1 | 0.6 | 2.0 | 4.4 | 1.2 | 2.9 | 0.5 |
| Treatment prob(F) | 0.0006 | 0.0008 | 0.2 | 0.0002 | 0.05 | 0.05 | 0.8 | 0.06 |

2x- applied twice, 3x – applied three times. Bifenthrin, Altacor and Cyzapyr applied 5/6/14 and 5/21/14, Sevin and Pyganic applied 5/6/1, 5/21/14 and 5/27/14. Plots were 6' by 6' plots, 4 replications per treatment, treatments applied at 100 gpa.

| Table 6. Insecticide efficacy for early season tipworm control in 2014 (Experiment 3, Farm 5). | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | #/ 25 uprights | | | | | | | | |
| | Cupped tips | Larvae | Pupae | Total tipworm | Apical bud | Cupped tips | Larvae | Pupae | Total tipworm |
| Treatment | 6/17/2014 | | | | 7/16/2014 | | | | |
| Control | 9.4 | 3.3 | 4 | 7.7 | 13.5 | 10 | 1 | 2 | 3.8 |
| Pyrethroid B 6.4 oz/ac 2x | 0.2 | 0 | 0.2 | 0.2 | 19 | 1.5 | 0 | 1 | 0.5 |
| Sevin XLR 2 qt/a 3x | 1.4 | 0.3 | 0 | 0.2 | 20 | 2.3 | 0.6 | 0 | 1.8 |
| Cyantraniliprole: 20.5 oz/ac 2x | 9.2 | 3.5 | 4.8 | 8.6 | | | | | |
| Lsd (0.05) | 0.18 | 1.8 | 0.3 | 0.25 | 4.2 | 3.0 | 0.4 | 2 | 3.5 |
| Treatment prob(F) | 0.0001 | 0.002 | 0.0005 | 0.0001 | 0.01 | 0.0008 | 0.3 | 0 | 0.1 |

2x- applied twice, 3x – applied three times. Bifenthrin and Cyazapyr applied 5/6/14 and 5/21/14, Sevin applied 5/6/1, 5/21/14 and 5/27/14. Plots were 6' by 6' plots, 4 replications per treatment, treatments applied at 100 gpa.

| Table 7. Insecticide efficacy for early season tipworm control in 2014 (Farm 6). | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Treatment | #/ 25 uprights | | | | | | | | |
| | Cupped tips | Larvae | Pupae | Total tipworm | Apical bud | Cupped tips | Larvae | Pupae | Total tipworm |
| | 6/17/2014 | | | | 7/16/2014 | | | | |
| Control | 2.6 | 0.8 | 1.6 | 2.5 | 7.3 | 10.3 | 0.7 | 4.6 | 4.8 |
| Pyrethroid B 2x | 0.1 | 0 | 0 | 0 | 7 | 2.3 | 0 | 0.6 | 0.6 |
| Sevin XLR 3x | 1.4 | 0.4 | 0.1 | 0.6 | 7 | 9.5 | 1 | 1.7 | 2.2 |
| Cyantraniliprole: 20.5 oz/a 2x | 2.6 | 2.3 | 1.1 | 3.7 | | | | | |
| Lsd (0.05) | 7.3 | 6.7 | 7.8 | 9.6 | 4.8 | 6.7 | 2.3 | 0.4 | 0.5 |
| Treatment Prob(F) | 0.11 | 0.08 | 0.19 | 0.1 | 0.9 | 0.05 | 0.5 | 0.05 | 0.07 |

2x- applied twice, 3x – applied three times. Pyrethroid B and Cyazapyr applied 5/6/14 and 5/21/14, Sevin applied 5/6/1, 5/21/14 and 5/27/14. Plots were 6' by 6' plots, 4replications per treatment, treatments applied at 100 gpa.

| Table 8. Effect of cranberry tipworm control insecticides on yield (Farm 6 & 9). | | |
|---|---|---|
| Treatment | Yield (bbl/ac) | |
| | Farm 6 | *Farm 8* |
| Control | 105.8 | 80.9 |
| Pyrethroid B 6.4 oz/ac 2x | 145.8 | 80.3 |
| Altacor 2x | 119.0 | 72.2 |
| Sevin XLR2 qt/a 2x | 103.7 | 80.0 |
| Pyganic 3x | 135.4 | 75.2 |
| Cyantraniliprole: 20.5 oz/ac 2x | 95.4 | 78.1 |
| Lsd (0.05) | 45.0 | 39.0 |
| Treatment Prob (F) | 0.2 | 1.0 |

2x- applied twice, 3x – applied three times. Bifenthrin and Cyazapyr applied 5/6/14 and 5/21/14, Sevin applied 5/6/1, 5/21/14 and 5/27/14. Plots were 6' by 6' plots, 4 replications per treatment, treatments applied at 100 gpa.

Table 9. Insecticide efficacy for first generation fireworm control in 2014 at five days post treatment (Farm 7).

| | # of fireworm larvae per 5 sweep on 5/7/2014 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Small | | Medium | | Large | | Total | |
| Treatment | Alive | Dead | Alive | Dead | Alive | Dead | Total | Alive |
| Control | 1.4 | 0.1 | 5.4 | 0 | 2.9 | 0 | 10.9 | 10.6 |
| Altacor 4 oz/a 1x | 0.3 | 1.3 | 0.1 | 1.6 | 0 | 0 | 4.9 | 0.6 |
| Grandevo 3 lb/a 2x | 1.4 | 0.2 | 3.7 | 0.2 | 3.4 | 0.3 | 11.8 | 10 |
| Venerate 2 gal/a 2x | 0.5 | 0.2 | 1.2 | 0 | 2.2 | 0 | 5.4 | 4.3 |
| Pyrethroid B 6.4 oz/a 1x | 0 | 0 | 0 | 0 | 0 | 0 | 0.3 | 0.1 |
| IKI-3106 22 fl oz/a 1x | 0 | 0.1 | 0 | 0.6 | 0.2 | 0 | 1 | 0.1 |
| LSD (0.05) | 4.3 | 4.2 | 5.3 | 0.3 | 0.3 | 0 | 7.5 | 7.5 |
| Treatment Prob(F) | 0.01 | 0.1 | 0.0001 | 0.04 | 0.0001 | 1 | 0.0003 | 0.0001 |

1x- applied once, 2x – applied twice. All products applied 5/2/14, with Grandevo and Venerate plots getting a second application 5/7/14. Plots were 6’ by 7’ plots, 6 replications per treatment, treatments applied at 100 gpa.

Table 10. Insecticide efficacy for first generation fireworm control in 2014 at two weeks post treatment (Farm 7).

| | # of fireworm larvae per 5 sweep on 5/15/2014 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Small | | Medium | | Large | | Total | |
| Treatment | Alive | Dead | Alive | Dead | Alive | Dead | Total | Alive |
| Control | 0 | 0.5 | 1.8 | 0 | 4 | 0 | 6.5 | 6 |
| Altacor 4 oz/a 1x | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Grandevo 3 lb/a 2x | 0.3 | 0 | 0.7 | 0 | 1.5 | 0 | 2.5 | 2.5 |
| Venerate 2 gal/a 2x | 0 | 0 | 0 | 0 | 1 | 0 | 0.9 | 0.9 |
| Pyrethroid B 6.4 oz/a 1x | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| IKI-3106 22 fl oz/a 1x | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lsd (0.05) | 0 | 0 | 3.9 | 0 | 1.2 | 0 | 0.2 | 0.2 |
| Treatment Prob(F) | 1 | 1 | 0.002 | 1 | 0.0001 | 1 | 0.0001 | 0.0001 |

1x- applied once, 2x – applied twice. All products applied 5/2/14, with Grandevo and Venerate plots getting a second application 5/7/14. Plots were 6’ by 7’ plots, 6 replications per treatment, treatments applied at 100 gpa.

Table 11. Insecticide efficacy for second generation fireworm control in 2014 at two week post-treatment (Farm 8).

| Treatment | # of fireworm larvae per 5 sweeps on 7/7/2014 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Small | | Medium | | Large | | Total | |
| | Alive | Dead | Alive | Dead | Alive | Dead | Alive | Dead |
| Control | 8.5 | 0 | 18.5 | 0 | 16.7 | 0 | 43.8 | 0 |
| Entrust SC (6 oz/a) | 5.5 | 7.6 | 0.8 | 1.8 | 0.1 | 0 | 6.5 | 9.4 |
| Pyganic (2 qt/a) | 2.8 | 2.4 | 2.3 | 2.5 | 0.3 | 0.3 | 5.5 | 7.5 |
| Grandevo (3 lb/a) | 11 | 0.8 | 9.8 | 1.4 | 1.7 | 0.3 | 23 | 2.8 |
| Venerate (8 qt/a) | 10.8 | 0.3 | 18.3 | 1.6 | 12.1 | 0 | 41.3 | 1.9 |
| DiPel (1 lb/a) | 12.5 | 0.3 | 12.3 | 1.6 | 0.5 | 0 | 25.8 | 1.9 |
| LSD (0.05) | 8.9 | 0.5 | 4.3 | 0.5 | 5.8 | 0.4 | 12 | 0.5 |
| Treatment Prob(F) | 0.27 | 0.01 | 0.0001 | 0.3 | 0.0001 | 0.5 | 0.0001 | 0.004 |

Applied 7/3/14, plots were 6' by 6' plots, 4 replications per treatment, treatments applied at 30 gpa.

Table 12. Insecticide efficacy for second generation fireworm control in 2014 at one week post treatment (Farm 8).

| Treatment | # of fireworm larvae per 5 sweep on 7/11/2014 | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Small | | Medium | | Large | | Total | |
| | Alive | Dead | Alive | Dead | Alive | Dead | Alive | Dead |
| Control | 8.5 | 0 | 16 | 0 | 15.4 | 0 | 40 | 0 |
| Entrust SC (6 oz/a) | 3 | 0 | 1.8 | 0.8 | 0.1 | 0 | 5.3 | 0.8 |
| Pyganic (2 qt/a) | 4 | 0 | 2.7 | 0.5 | 0.3 | 0 | 6.9 | 0.5 |
| Grandevo (3 lb/a) | 5 | 0 | 8.1 | 0.3 | 3.2 | 0 | 16.1 | 1 |
| Venerate (8 qt/a) | 6.5 | 0 | 12.1 | 0 | 7 | 0 | 24.9 | 0.5 |
| DiPel (1 lb/a) | 15.3 | 0 | 8.6 | 0 | 5.9 | 0 | 29.2 | 0 |
| LSD (0.05) | 5.9 | 0 | 0.3 | 1.08 | 4.4 | 0 | 0.3 | 1.6 |
| Treatment Prob(F) | 0.006 | 1 | 0.002 | 0.5 | 0.0001 | 1 | 0.0001 | 0.7 |

Applied 7/3/14, plots were 6' by 6' plots, 4 replications per treatment, treatments applied at 30 gpa.

| Table 13. Blackvine weevil control with *Metarhizium anisopliae* (MET) in 2014. | | | | |
|---|---|---|---|---|
| Treatment | Site 1- applied 11/20/13 | Site -2 applied 1/7/14 | Site 3-applied 2/25/14 | Site 3 -applied 3/19/14 |
| | Ground dug & assessed 1/7/2014 | Ground dug & assessed 3/19/2014 | Ground dug & assessed 3/19/2014 | Plots swept 7/1/2014 |
| | # Larvae/0.25 $m^2$ | # larvae/0.25 $m^2$ | # larvae/0.25 $m^2$ | # adults / 20 sweeps |
| MET 100 lbs G/ac | 1.6 | 2.3 | 0.2 | 2 |
| Control | 5.4 | 5.8 | 1.7 | 7.7 |
| Treatment Prob(F) | 0.001 | 0.05 | 0.01 | 0.1 |

Product applied at 4200 gpa volume, dug plots were 0.25 $m^2$, swept plots were 3 $m^2$.

| Table 14. Soil bioassays of infectivity of *Metarhizium anisopliae* (MET ) for blackvine weevil larvae. | |
|---|---|
| Treatment | % larva mortality after 3 weeks incubation |
| MET - site 3 (3 weeks in field prior to collection) | 81 |
| MET -site 2 (2 months in field prior to collection) | 57 |
| Control | 1 |
| Treatment Prob(F) | 0.0008 |

Both sites similar soil type (old vines, sandy muck), freshly dug weevil larvae exposed in sterile containers to the top 8 cm of soil. Larvae mortality assessed after 3 weeks.

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