**CALIFORNIA MELON RESEARCH BOARD**
***2011 Final Report***

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**PROJECT TITLE:**

# New Insecticide Alternatives for Insect Management in Melons

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**Objective 1.** To continue to evaluate the efficacy of insecticide alternatives and develop alternatives to endosulfan for whitefly adults and CYSDV in spring and fall melons.

**Objective 2.** To continue to evaluate new insecticide alternatives on melons in an attempt to develop *alternatives for diazinon* and other older chemistry for seed corn maggot, flea beetles, leafminers and Lepidopterous larvae.

**SUMMARY OF RESEARCH RESULTS**:


- Spring and fall cantaloupe trials identified several new experimental foliar insecticides with adult whitefly activity that may provide suppressive activity against CYSDV. Among these included NNI-0101 (pyrifluquinazon), Closer (sulfoxaflor), Exirel (cyazypyr) and Sivanto (*flupyradifurone)*. In most trials , these novel compounds controlled adult whiteflies comparable to industry standards such as Thonex, Assail and Venom. They also provided excellent control of whitefly nymphs. In addition, suppression of Cucurbit Yellows Stunting Disorder Virus (CYSDV) varied among the new compounds, but several of these new active ingredients appear to be strong candidates for whitefly and CYSDV management programs when they become registered.
- For a second year studies showed that the use of 2 soil applications of Venom (dinotefuron), the first at planting followed by a second at side-dress, significantly reduced whiteflies and significantly delayed the onset of CYSDV infection in the absence of foliar sprays. Furthermore, the combination treatment of Coragen and Belay (clothianidin) did not enhance whitefly control relative to Venom applied alone. Alias (imidacloprid), applied at planting and side-dress, controlled whitefly nymphs, but did not suppress CYSDV infection.
- Studies this year confirm previous research findings that spinosad seed treatments are effective alternatives to diazinon and bifenthrin for protection of seedling melons from seed corn maggot. In addition, preliminary results show that a number of insecticides can provide significant protection from seed corn maggot as in-furrow sprays including Radiant, Entrust, and Verimark (cyazypyr).
- Studies were set up to examine the cross-spectrum insecticidal activity of several new products against flea beetles, leafminers and cabbage looper. However, insect pressure was too low to collect any useful data to draw meaningful conclusions on the insecticidal activity of the new products.

## RESEARCH PROCEDURES AND RESULTS

## Objective 1. Whitefly Control and CYSDV Management

## I. Spring Cantaloupes

### *A. Conventional and Experimental Foliar Alternatives for Whitefly Adults / CYSDV*

*Research procedures*: Cantaloupe plots planted with 'Imperial Gold' were established at the Yuma Agricultural Center on 27 Apr, 2011 and managed similarly to local growing practices. Plots consisted of one 84-inch bed, 45 ft long with a 7 buffer between each plot. The study was designed as a randomized complete block design with 4 replicates / treatment. The treatments and rates are shown in the Table below. Three foliar spray treatments were applied on 7, 14 and 26 June with a $CO_2$ backpack sprayer that delivered 24 GPA at 40 psi, using 4 – TX18 ConeJet nozzles per bed as a broadcast spray. All spray treatments included an adjuvant, DyneAmic at 0.25% v/v.

Populations of whitefly adults were evaluated at 1, 3 and 7 day intervals following each application (DAA). Adult populations were estimated using a modified vacuum method that employed a DeWALT DC500 2-gallon portable vacuum fitted with 5 oz cloth-screened containers to capture and retain vacuumed adults. On each sample date, 5 separate plants from each replicate were sampled by vacuuming the terminal area of the plants for 3 seconds. Containers with adults were taken into the laboratory, placed in a freezer for 24 hours after which the number of adults/ plant was recorded. Immature densities were estimated at 7 days following the 2nd application and 12 days following the 3rd application , where 3 leaves were collected from each plant on the $10^{th}$, $15^{th}$ and $20^{th}$ nodes from the terminal on the primary vine. Leaves were taken into the laboratory where densities of eggs, and nymphs were counted on two, 2-$cm^2$ leaf discs of each leaf using a dissecting microscope. CYSDV incidence was estimated on 11 Jul by counting the number of leaves in 30 row ft within each plot that expressed yellow interveinal chlorosis (YIVC) symptoms.

*Research Results:* A number of new experimental compounds, applied alone and tank-mixed with a pyrethroid (Brigade), were evaluated for adult whitefly control compared to several industry standards. Adult pressure was light at the beginning of this trial, but reached moderate-high levels near the end of the trial. All of the new compounds (**Sivanto , NNI-0101, and Exirel**) provided significant knockdown (1 -3 DAA) of adults comparable to two of the standards; Brigade +Thionex and Venom+Thionex following each application (Table 1). Following the $2^{nd}$ and $3^{rd}$ sprays, these compounds provided significant control at 7 DAA compared to the untreated check. Only the Brigade+Vydate, Brigade +Lannate and Brigade alone treatments showed inconsistent adult control, particularly following the $1^{st}$ application. This was clearly evident when % control was averaged across the three sprays (Figure 1). Tank-mixing the pyrethroid (Brigade) with the experimental compounds did not appear to significantly enhance whitefly control or CYSDV incidence (Figure 2). Furthermore, two of new compounds (NNI-0101 and Sivanto) provided whitefly control /virus suppression comparable to the primary industry standard (Brigade+Thionex). Both of these active ingredients are believed to not only have contact toxicity against adults, but are believed to modify feeding behavior through ingestion. Although Exirel provided adult control comparable to the other new compounds, it did not appear to significantly suppress CYSDV symptoms in this trial. In contrast, the Lannate and Vydate tank mixtures did not provide the same level of adult whitefly control as Thionex, yet the treatments suppressed CYSDV incidence comparable to the standard. Results from this trial are not conclusive, and indicate that several alternatives for whitefly control and CYSDV need to be examined further in fall trials under heavy whitefly and virus conditions. It is important to note that all of the spray treatments provided significant control of nymphs (data not shown) following the 2nd and 3rd applications. Sivanto, Exirel, and NNI-0101 provided particularly good control with very few nymphs present on older leaves.

**Table 1.** Adult whitefly counts at 1, 3, and 7 days after each application (DAA).

| | | 1st application | | |
|---|---|---|---|---|
| | | *1-DAA* | *3-DAA* | *7-DAA* |
| **Treatment** | **Rate, oz/ac** | **8-Jun** | **10-Jun** | **14-Jun** |
| Brigade + Thionex | 6 oz +32 oz | 0.3 bc | 5.1 abc | 2.9 cd |
| Brigade + Vydate | 6 oz +4 pts | 0.6 ab | 7.5 ab | 9.5 a |
| Brigade + Lannate SP | 6 oz +0.8 lbs | 0.8 a | 5.8 abc | 7.9 ab |
| Brigade + Venom | 6 oz +4 oz | 0.2 c | 3.3 cd | 4.0 bcd |
| Brigade + Exirel | 6 oz +20 oz | 0.1 c | 6.1 abc | 5.3 abcd |
| Brigade + Sivanto | 6 oz +8.5 oz | 0.1 c | 3.6 cd | 5.8 abcd |
| Brigade + NNI-0101 | 6 oz +3.2 oz | 0.1 c | 3.1 cd | 2.4 d |
| Brigade | 6 oz | 0.3 c | 4.7 bcd | 5.4 abcd |
| Exirel | 20 oz | 0.2 c | 4.8 bcd | 2.8 cd |
| Sivanto | 8.5 oz | 0.2 c | 4.6 bcd | 5.2 abcd |
| NNI 0101 | 3.2 oz | 0.1 c | 1.8 d | 2.0 d |
| Untreated | - | 0.4 bc | 7.9 a | 7.1 abc |

| | | 2nd application | | |
|---|---|---|---|---|
| | | *1-DAA* | *3-DAA* | *7-DAA* |
| **Treatment** | **Rate, oz/ac** | **8-Jun** | **10-Jun** | **14-Jun** |
| Brigade + Thionex | 6 oz +32 oz | 0.4 d | 2.4 cd | 4.2 c |
| Brigade + Vydate | 6 oz +4 pts | 3.1 b | 5.3 b | 7.9 ab |
| Brigade + Lannate SP | 6 oz +0.8 lbs | 1.6 cd | 4.5 bc | 5.2 bc |
| Brigade + Venom | 6 oz +4 oz | 0.3 d | 1.8 cd | 3.1 c |
| Brigade + Exirel | 6 oz +20 oz | 0.8 cd | 1.8 cd | 3.8 c |
| Brigade + Sivanto | 6 oz +8.5 oz | 0.4 d | 1.8 cd | 4.3 c |
| Brigade + NNI-0101 | 6 oz +3.2 oz | 0.5 d | 1.4 d | 2.4 c |
| Brigade | 6 oz | 2.1 bc | 4.3 bc | 5.1 bc |
| Exirel | 20 oz | 1.5 cd | 1.8 cd | 3.3 c |
| Sivanto | 8.5 oz | 1.3 cd | 1.8 cd | 3.7 c |
| NNI 0101 | 3.2 oz | 1.1 cd | 1.4 d | 2.6 c |
| Untreated | - | 6.1 a | 10.1 a | 10.9 a |

| | | 3rd application | | |
|---|---|---|---|---|
| | | *1-DAA* | *3-DAA* | *7-DAA* |
| **Treatment** | **Rate, oz/ac** | **8-Jun** | **10-Jun** | **14-Jun** |
| Brigade + Thionex | 6 oz +32 oz | 1.7 d | 5.1 bc | 17.6 c |
| Brigade + Vydate | 6 oz +4 pts | 10.1 b | 9.4 bc | 43.9 ab |
| Brigade + Lannate SP | 6 oz +0.8 lbs | 6.6 bc | 14.1 b | 51.9 ab |
| Brigade + Venom | 6 oz +4 oz | 1.8 d | 2.5 bc | 12.2 c |
| Brigade + Exirel | 6 oz +20 oz | 1.9 d | 1.5 c | 14.3 c |
| Brigade + Sivanto | 6 oz +8.5 oz | 1.8 d | 4.4 bc | 17.1 c |
| Brigade + NNI-0101 | 6 oz +3.2 oz | 0.9 d | 2.7 bc | 8.8 c |
| Brigade | 6 oz | 8.7 b | 11.8 bc | 40.6 b |
| Exirel | 20 oz | 3.4 cd | 2.9 bc | 8.0 c |
| Sivanto | 8.5 oz | 3.1 cd | 4.3 bc | 21.2 c |
| NNI 0101 | 3.2 oz | 2.0 d | 2.4 c | 8.5 c |
| Untreated | - | 27.1 a | 43.2 a | 61.1 a |

Means followed by the same letter are not significantly different ($P > 0.05$, *F*-protected LSD).

**Figure 1.** Percent adult whitefly control relative to the untreated check at 1, 3, and 7 DAA averaged across all 3 spray applications.

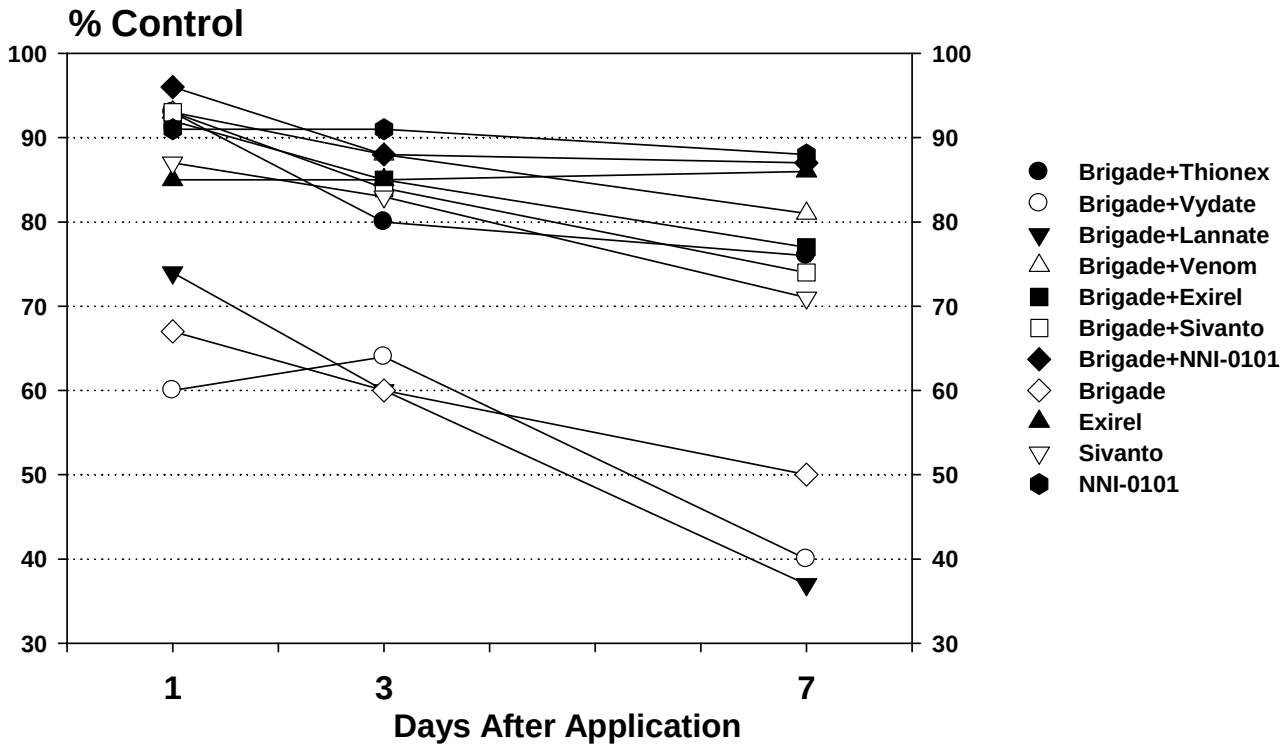
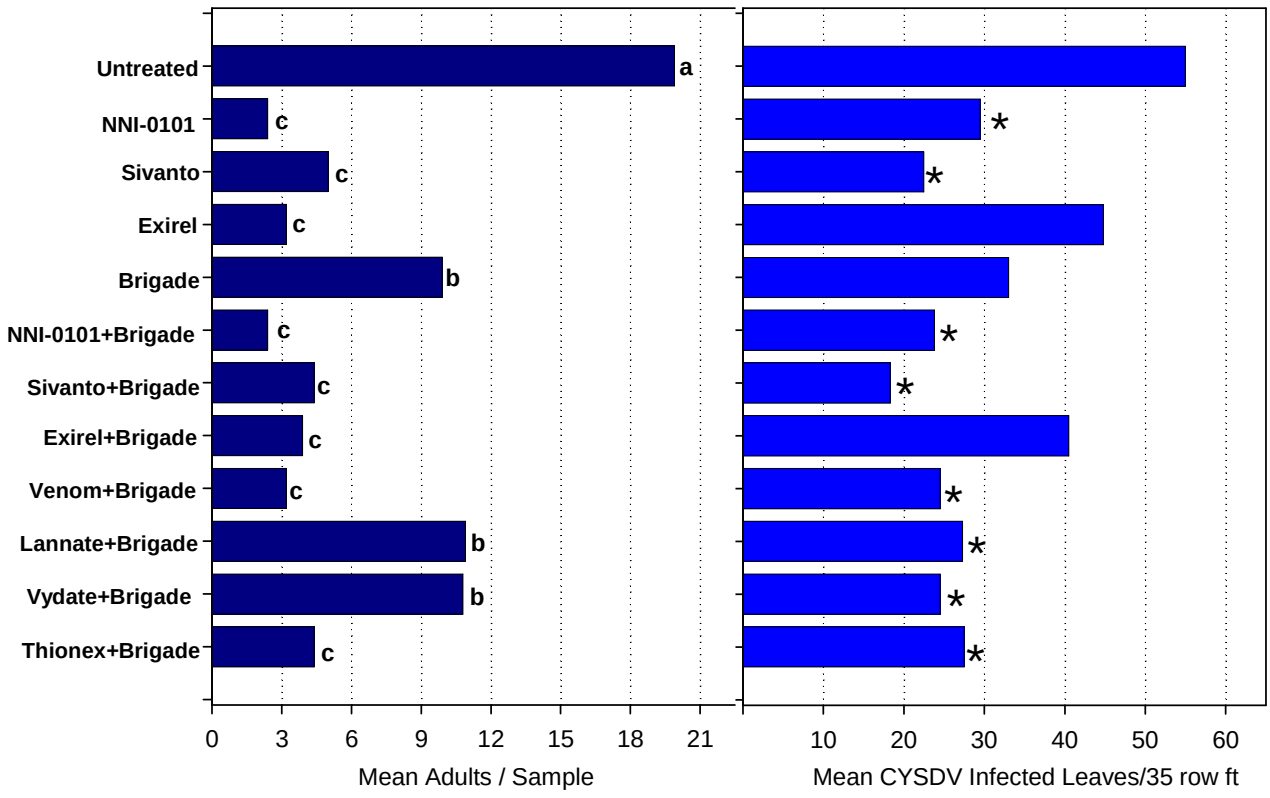



**Figure 2.** Trial average whitefly abundance and CYSDV Incidence for each treatment.



## I. Spring Cantaloupes

### *B. Experimental Foliar Alternatives for Whitefly Adult / CYSDV-* Closer (Sulfoxaflor)

*Research procedures*: Cantaloupe plots planted with 'Imperial Gold' were established at the Yuma Agricultural Center on 27 Apr, 2011 and managed similarly to local growing practices. Plots consisted of one 84-inch bed, 45 ft long with a 7 buffer between each plot. The study was designed as a randomized complete block design with 4 replicates / treatment. The treatments and rates are shown in Tables 2 and 3. Three foliar spray treatments were applied on 9, 17 and 29 June 24 as a broadcast spray at 24 GPA at 40 psi using 4 -TX18 Conejet nozzles per bed. All spray treatments included an adjuvant DyneAmic at 0.20% v/v. Populations of whitefly adults and immatures were evaluated at various intervals following each application using the sampling method described above. CYSDV incidence was estimated on 12 Jul by counting the number of leaves per 30 row ft with yellow interveinal chlorosis (YIVC) symptoms.

*Research Results:* Closer (*sulfoxaflor*) is a new experimental compound currently under development by Dow AgroSciences that has a novel mode of action and has shown translaminar activity against whiteflies and aphids. In this trial, both rates of the Closer provided comparable control of adult and immature whiteflies. Adult pressure was light in this trial, and Sulfoxaflor provided what appeared to be a 3-7 day knockdown of adults comparable to the Assail standard following each application (Table 2). However, after 7 days, adult numbers began to quickly rebound to unacceptable high levels. Both rates of the compound provided significant control of whitefly nymphs similar to that provided by Assail and Movento (Table 3). A significant reduction in the number of leaves with CYSDV symptoms was observed in the Assail and Closer treated plots relative to the untreated check and Movento (Figure 3). Under these light virus conditions in the spring, Closer appeared to significantly suppress CYSDV at levels as good as a standard treatment. It is anticipated that this compound will be available for use by melon grower in the fall of 2012.

**Table 2.** Adult whitefly counts at various days after application (DAA).

| | | Adults/ 3 sec vacuum sample | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1st Application | | | 2nd Application | | | 3rd Application | | |
| **Treatment** | **Rate/ac** | ***1 DAA*** | ***4 DAA*** | ***7 DAA*** | ***3 DAA*** | ***7 DAA*** | ***11 DAA*** | ***2 DAA*** | ***8 DAA*** | ***14 DAA*** |
| Closer | 4.3 oz | 1.0 b | 0.9 b | 2.2 b | 1.6 b | 6.9 ab | 18.1 b | 6.9 b | 16.1 b | 21.1 a |
| Closer | 5.7 oz | 0.5 b | 1.0 b | 3.5 ab | 1.6 b | 5.1 b | 16.7 b | 5.3 b | 15.7 b | 15.8 a |
| Assail | 4 oz | 1.0 b | 0.9 b | 2.0 b | 1.5 b | 4.0 b | 16.2 b | 6.0 b | 14.0 b | 16.7 a |
| Movento | 4 oz | 2.0 b | 2.2 b | 2.4 b | 2.7 b | 3.7 b | 12.1 b | 9.0 b | 16.6 b | 19.4 a |
| Untreated | - | 4.8 a | 6.0 a | 5.3 a | 6.0 a | 9.8 a | 48.6 a | 34.8 a | 34.4 a | 28.7 a |

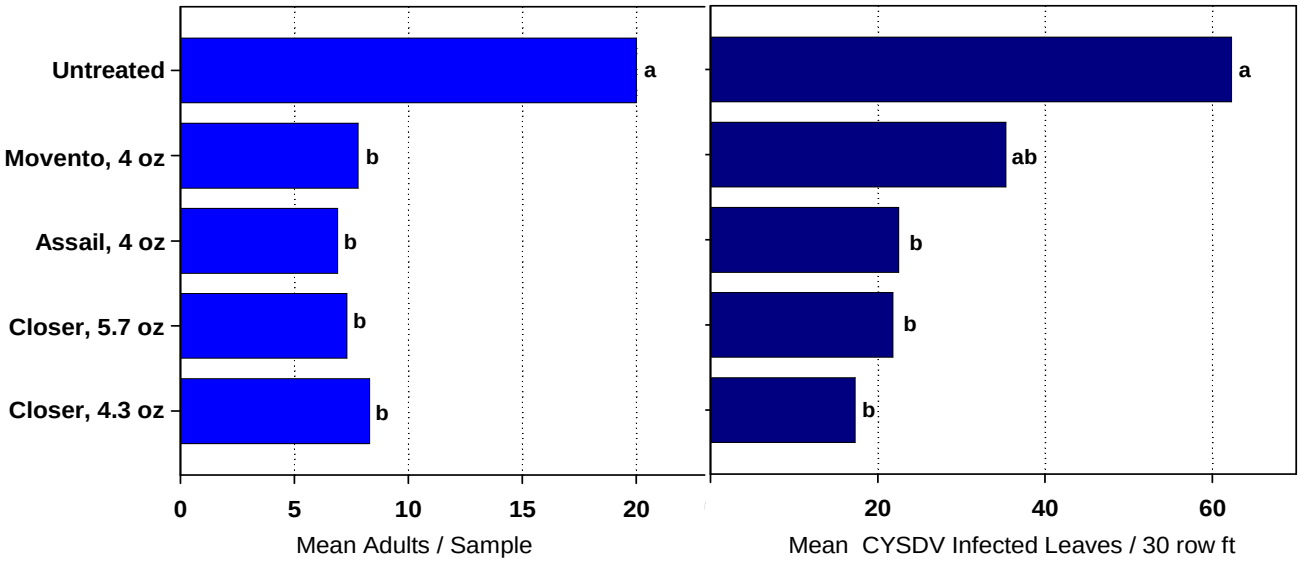
Means followed by the same letter are not significantly different ($P > 0.05$, *F*-protected LSD).

**Table 3.** Whitefly Nymph densities on leaves at various dates.

| | | Large Nymphs / $cm^2$ / leaf | | | | |
|---|---|---|---|---|---|---|
| **Treatment** | **Rate/ac** | **16-Jun** | **24-Jun** | **7-Jul** | **13-Jul** | **Avg.** |
| Closer | 4.3 oz | 0.00 | 0.1 b | 0.6 b | 1.2 b | 0.5 b |
| Closer | 5.7 oz | 0.00 | 0.0 b | 0.4 b | 0.9 bc | 0.3 bc |
| Assail | 4 oz | 0.00 | 0.1 b | 0.4 b | 0.3 c | 0.2 c |
| Movento | 4 oz | 0.00 | 0.0 b | 0.3 b | 0.5 c | 0.2 c |
| Untreated | - | 0.10 | 0.4 a | 1.3 a | 2.6 a | 1.1 a |

Means followed by the same letter are not significantly different ($P > 0.05$, *F*-protected LSD).

**Figure 3.** Trial average whitefly abundance and CYSDV Incidence for each treatment.




## I. Spring Cantaloupes

### *C. Experimental Foliar and Soil Alternatives for Whitefly Adults/CYSDV - Sivanto (flupyradifurone)*

*Research procedures*: Cantaloupe plots planted with 'Imperial Gold' were established at the Yuma Agricultural Center on 27 Apr, 2011 and managed similarly to local growing practices. Plots consisted of one 84-inch bed, 45 ft long with a 7 buffer between each plot. The study was designed as a randomized complete block design with 4 replicates / treatment. The treatments and rates are shown in Tables 4 and 5. Foliar spray treatments of Sivanto (10.5 oz) and Venom (4 oz) were applied on 13 and 28 June as a broadcast spray at 24 GPA at 40 psi using 4 -TX18 Conejet nozzles per bed. All spray treatments included an adjuvant DyneAmic at 0.20% v/v. In addition, two soil treatments of Sivanto (28 oz) and Venom (6 oz) were applied prior to planting (16 Mar) by injecting each insecticide in 10 GPA final solution approximately 3" below the seed line. Populations of whitefly adults and immatures were evaluated at various intervals following each application using the sampling method described above. CYSDV incidence was estimated on 12 Jul by counting the number of leaves per 40 row ft with yellow interveinal chlorosis (YIVC) symptoms.

*Research Results*: Sivanto (flupyrdifurone) is an experimental compound with a new mode of action being developed by Bayer CropScience that has shown activity against whiteflies and aphids. The insecticide has translaminar activity when applied as foliar spray, and xylem-mobile systemic activity when applied as a soil treatment. In this trial, soil treatment of Sivanto did not appear to provide residual control of adults or nymphs realtive to Venom 6 oz standard (Table 4 and 5). However, the Sivanto foliar treatment showed adult and nymph control comparable to the Venom 4 oz standard and significantly better than the untreated control. Following 2 applications of the foliar Sivanto treatment, significant reduction in adult numbers for 7 days was observed, and significant suppression of CYSDV was observed. Surprisingly, the number of CYSDV infected leaves in the Sivanto soil treatment was comparable to the foliar treatments, even though the number of adults was significantly greater in the soil treatment. The manufacturer claims that Sivanto causes immediate cessation in feeding once the compound is ingested. The results of this study suggests to some extent that the Sivanto may have anti-feedant properties that were are not fully aware of. Thus, live adults counted in these plots during this study may not reflect the compounds activity and ability to suppress both feeding and virus transmission. Further study with this compound is needed to understand its potential as a soil insecticide for CYSDV management. As a foliar insecticide, it appears to show good potential for both adult control and virus suppression.

**Table 4.** Adult whitefly counts at various days after application (DAA).

| | | Adults / 3 sec vacuum sample | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Appl. | 1st Foliar Application | | | | 2nd Foliar Application | | | |
| Treatment | method | *1 DAA* | *4 DAA* | *7 DAA* | *14 DAA* | *1 DAA* | *3 DAA* | *7 DAA* | *14 DAA* |
| Venom, 6 oz | Soil | 3.7 c | 3.9 b | 6.3 b | 20.9 a | 53.5 c | 48.3 bc | 41.2 bc | 52.5 a |
| Sivanto, 28 oz | Soil | 8.4 b | 21.5 a | 12.3 a | 33.1 a | 83.5 b | 60.1 b | 69.4 ab | 58.1 a |
| Venom, 4 oz | Foliar | 1.4 c | 5.3 b | 9.3 a | 22.3 a | 7.5 d | 7.0 d | 8.5 c | 29.3 a |
| Sivanto, 10.5 oz | Foliar | 1.4 c | 2.0 b | 4.2 b | 20.9 a | 10.1 d | 13.4 cd | 14.3 c | 40.3 a |
| Untreated | - | 15.6 a | 21.9 a | 21.6 a | 41.5 a | 140.7 a | 117.2 a | 91.5 a | 46.2 a |

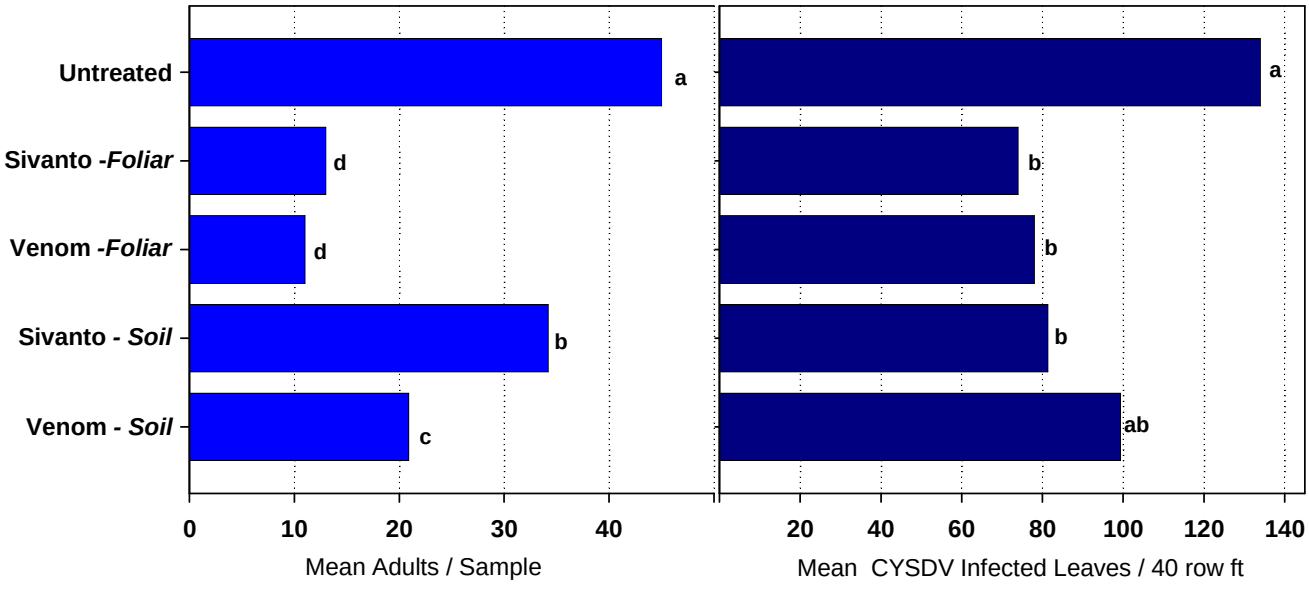
Means followed by the same letter are not significantly different ($P > 0.05$, *F*-protected LSD).

**Table 5.** Whitefly Nymph densities on leaves at various dates.

| | Appl. | Large Nymphs / $cm^2$ / leaf | | | | |
|---|---|---|---|---|---|---|
| Treatment | method | 20-Jul | 27-Jun | 6-Jul | 12-Jun | *Avg.* |
| Venom, 6 oz | Soil | 0.1a | 0.5 bc | 1.0 bc | 2.9 b | 0.9 c |
| Sivanto, 28 oz | Soil | 0.3 a | 1.4 ab | 1.3 b | 3.8 b | 1.4 b |
| Venom, 4 oz | Foliar | 0.1 a | 0.3 c | 0.5 bc | 0.6 c | 0.4 d |
| Sivanto, 10.5 oz | Foliar | 0.0 a | 0.2 c | 0.2 c | 1.2 c | 0.4 d |
| Untreated | - | 0.4 a | 2.2 a | 3.2 a | 5.7 a | 2.3 a |

Means followed by the same letter are not significantly different ($P > 0.05$, *F*-protected LSD).

**Figure 4.** Trial average whitefly abundance and CYSDV Incidence for each treatment.



## II. Whitefly Adult Control and CYSDV Management - Fall Cantaloupes

### *A. Experimental Foliar Alternatives for Whitefly Adults/CYSDV - NNI-0101 (pyrifluquinazon) and Sivanto*

*Research procedures*: Cantaloupe plots planted with 'Gold Express' were established at the Yuma Agricultural Center on 10 Aug, 2011 and managed similarly to local growing practices. Plots consisted of one 84-inch bed, 45 ft long with a 7 buffer between each plot. The study was designed as a randomized complete block design with 4 replicates / treatment. The treatments and rates are shown below. Foliar spray treatments were applied on 22 Aug and 1 and 12 September as a broadcast spray at 25 GPA at 40 psi using 4 -TX18 Conejet nozzles per bed. All spray treatments included an adjuvant DyneAmic at 0.25% v/v. Populations of whitefly adults and immatures were evaluated at various intervals following each application using the sampling method described above. CYSDV incidence was estimated on 4 Oct (2 weeks before harvest) by counting the number of leaves per 40 row ft with yellow interveinal chlorosis (YIVC) symptoms. Harvest estimates were not made.

Research Results**:** In this fall trial, we evaluated the efficacy of NNI-0101 (pyrifluquinazon) a compound with translaminar activity known for its whitefly activity, along with Sivanto and Venom as foliar standards. Courier (an IGR with weak adult activity) was included to determine whether it had any significant activity on CYSDV suppression. Whitefly pressure was typically heavy and provided a realistic look at what growers can expect in whitefly/CYSDV pressure on fall melons. Following the 1st spray treatment, the experimental compounds NNI-0101 and Sivanto provided 3-day knockdown comparable to the Venom standard (Figure 5). By 7 days, whitefly adults had re-infested all plots. Following the 2nd and 3rd sprays, these compounds provided significant knockdown of adults for 7-8 days relative to the untreated control. By 8 days following the 3rd spray, whitefly adult number in the NNI-0101, Sivanto and Venom plots had been reduced by 90% or more. Furthermore, similar to the spring trial, both NNI-0101 and Sivanto provided virus suppression comparable to the Venom standard and significantly lower than the untreated check (Figure 6). Courier provided only marginal control of adults (primarily through nymph management) and did not provide a significant reduction in CYSDV incidence. All treatments provided significant control of nymphs (data not shown) following each applications.

**Figure 5.** Adult whitefly counts at various days after application (DAA).

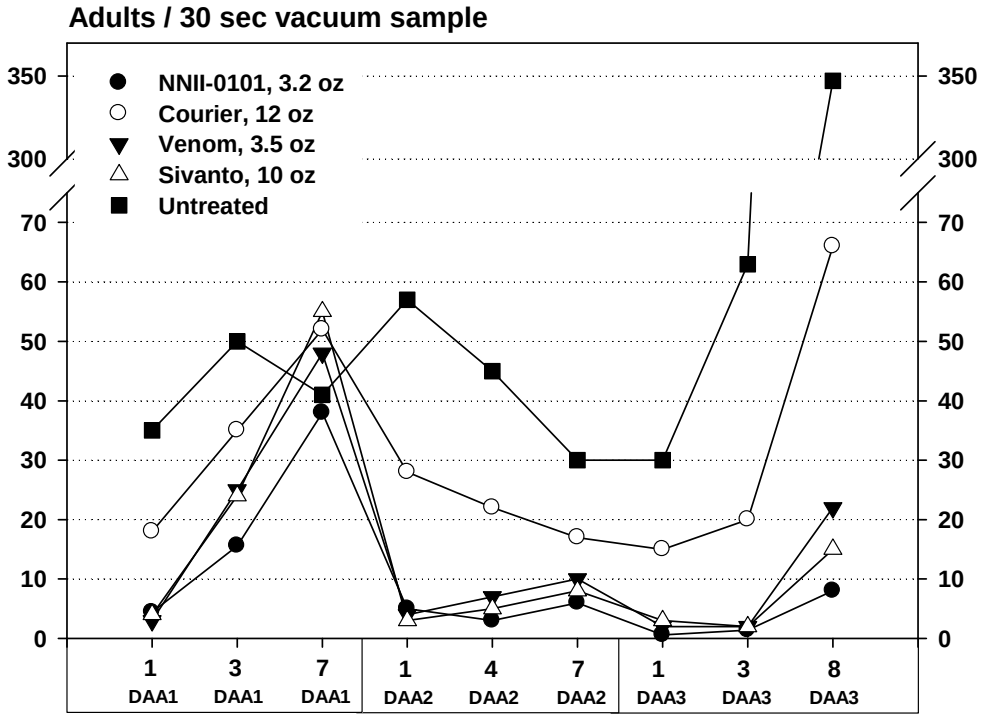
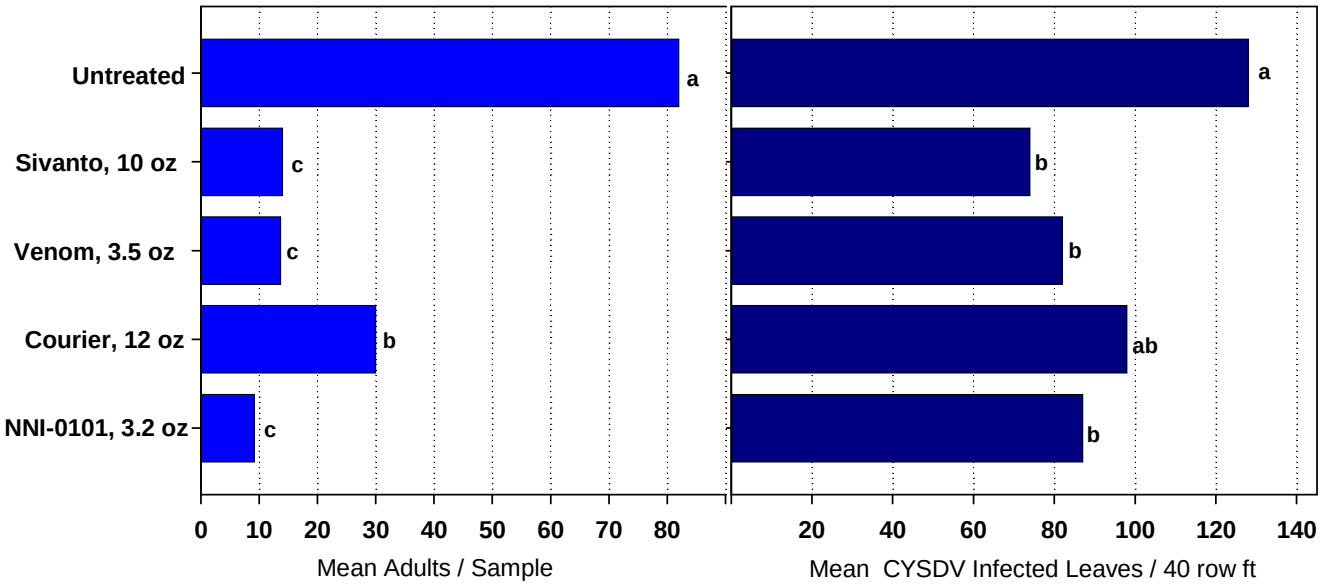


**Figure 6.** Trial average whitefly abundance and CYSDV Incidence ( 2 weeks pre-harvest) for each treatment.




## II. Whitefly Adult Control and CYSDV Management - Fall Cantaloupes

### *B. Experimental Foliar Rotations for Whitefly Adults/CYSDV - Closer, NNI-0101 and Sivanto*

*Research procedures*: Cantaloupe plots planted with 'Gold Express' were established at the Yuma Agricultural Center on 10 Aug, 2011 and managed similarly to local growing practices. Plots consisted of one 84-inch bed, 45 ft long with a 7 buffer between each plot. The study was designed as a randomized complete block design with 4 replicates / treatment. The treatments and rates are shown in the graphs below. Several foliar spray treatments were rotated over three sprays applied on 21 and 30 Aug and 8 Sep as a broadcast spray at 25 GPA at 40 psi using 4 -TX18 Conejet nozzles per bed. All spray treatments included an adjuvant DyneAmic at 0.25% v/v. Populations of whitefly adults and immatures were evaluated at various intervals following each application using the sampling method described above. CYSDV incidence was estimated on 4 Oct (2 weeks before harvest) by counting the number of leaves per 40 row ft with yellow interveinal chlorosis (YIVC) symptoms. Harvest estimates were not made.

Research Results**:** In this trial, Closer was compared to Assail when used in a rotational program to determine how effective rotations were on controlling whitefly adults and nymphs. An additional treatment of Sivanto and NNI-0101 used in rotation was compared. All spray treatment rotations provided significant control of nymphs following each application (Table 6), although the Closer rotation was less consistent.
Among the treatments, the Sivanto/NNI-0101 rotation provided the most consistent control of adults, although all three rotation treatments significantly reduced adult numbers relative to the untreated check (Figure 7 and 8). However, only the Sivanto/NNI-0101 rotation significantly suppressed CYSDV symptoms (~50%). This is encouraging given that applications were initiated at the 2-3 leaf stage and sprayed at 8 and 11 day intervals. The other treatment rotations did not sufficiently suppress CYSDV and may in part be due to the inclusion of Movento, which is a poor adulticide. These results further suggest that Sivanto and NNI-0101 may be good candidates for CYSDV management when integrated into a fall program that includes soil insecticide and rotated with alternative foliar products (e.g., Assail, Venom, Lannate, Vydate).

**Table 6.** Whitefly Nymph densities on leaves at various days after application (DAA).

| Treatment Rotations | | | Large Nymphs / $cm^2$ / leaf | | | | |
|---|---|---|---|---|---|---|---|
| ***1st Spray*** | ***2nd Spray*** | ***3rd Spray*** | **8 DAA1** | **7 DAA2** | **7 DAA3** | **14 DAA3** | **21 DAA3** |
| Closer, 5.7 oz | Movento, 5 oz | Assail, 4 oz | 0.9 b | 2.6 ab | 0.2 b | 0.4 b | 1.6 b |
| Assail, 4 oz | Venom, 4 oz | Movento, 5 oz | 1.0 b | 0.2 b | 0.2 b | 0.1 b | 0.7 b |
| Sivanto, 10 oz | Sivanto, 10 oz | NNI-0101, 3.2 oz | 0.2 b | 0.2 b | 0.5 b | 0.5 b | 0.4 b |
| Untreated | Untreated | Untreated | 2.7 b | 5.4 a | 7.5 a | 4.3 a | 11.6 b |

Means followed by the same letter are not significantly different ($P > 0.05$, *F*-protected LSD).

**Figure 7.** Adult whitefly counts at various days after application (DAA).

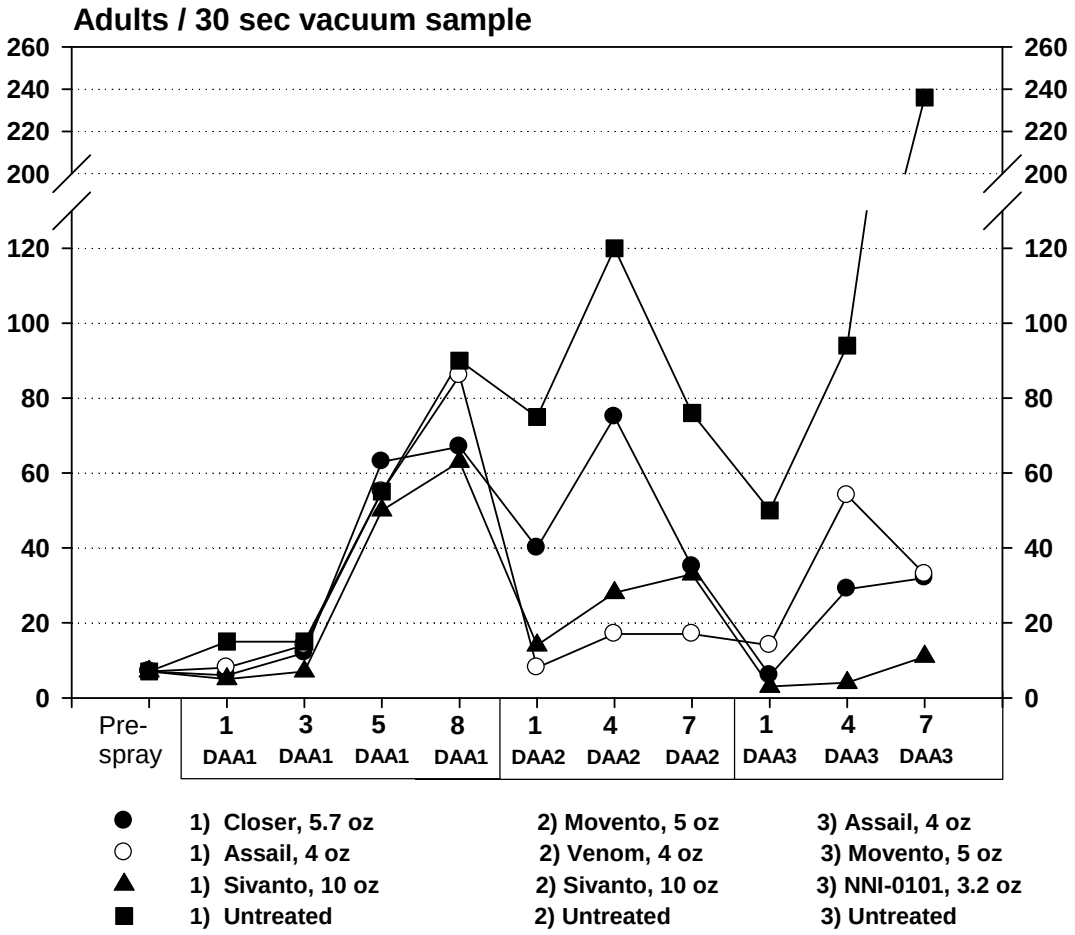
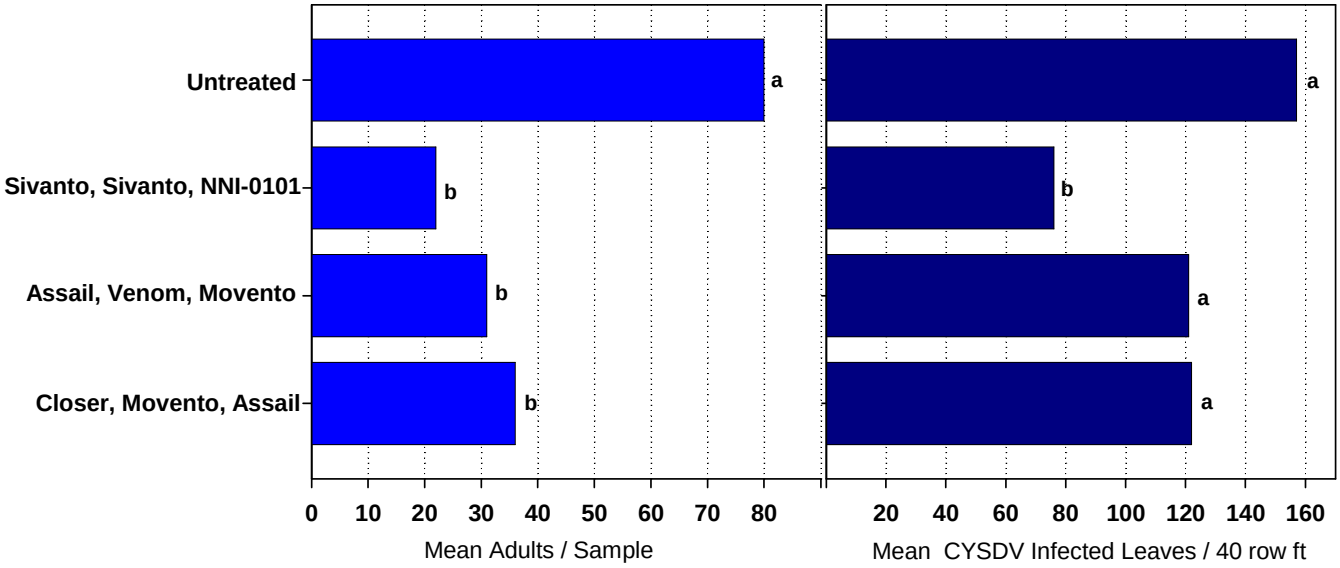


**Figure 8.** Trial average whitefly abundance and CYSDV Incidence ( 2 weeks pre-harvest) for each treatment.




## II. Whitefly Adult Control and CYSDV Management - Fall Cantaloupes

### *C. Conventional Soil Alternatives for Whiteflies - Venom+Belay Sidedress Applications*

*Research procedures*: Cantaloupe plots planted with 'Gold Express' were established at the Yuma Agricultural Center on 10 Aug, 2011 and managed similarly to local growing practices. Plots consisted of one 84-inch bed, 45 ft long with a 7 buffer between each plot. The study was designed as a randomized complete block design with 4 replicates / treatment. The treatments and rates are shown in Table 7. The soil treatments were applied prior to planting by injecting each insecticide in 10 GPA final solution, 3" below the seed line. A second soil application was made on 1 Sep as a side dress application. The compounds were shanked into the soil on both sides of the plants (14" from seed-line) at a depth of 6" and immediately incorporated via furrow irrigation. No other insecticides were applied. Adult populations were estimated using a modified vacuum method as described above. Similarly, immature densities were evaluated at various intervals following each application using the sampling method described above. CYSDV incidence was estimated on 10 Oct (1 week before harvest) by counting the number of leaves per 40 row ft with yellow interveinal chlorosis (YIVC) symptoms. Harvest estimates were not made.

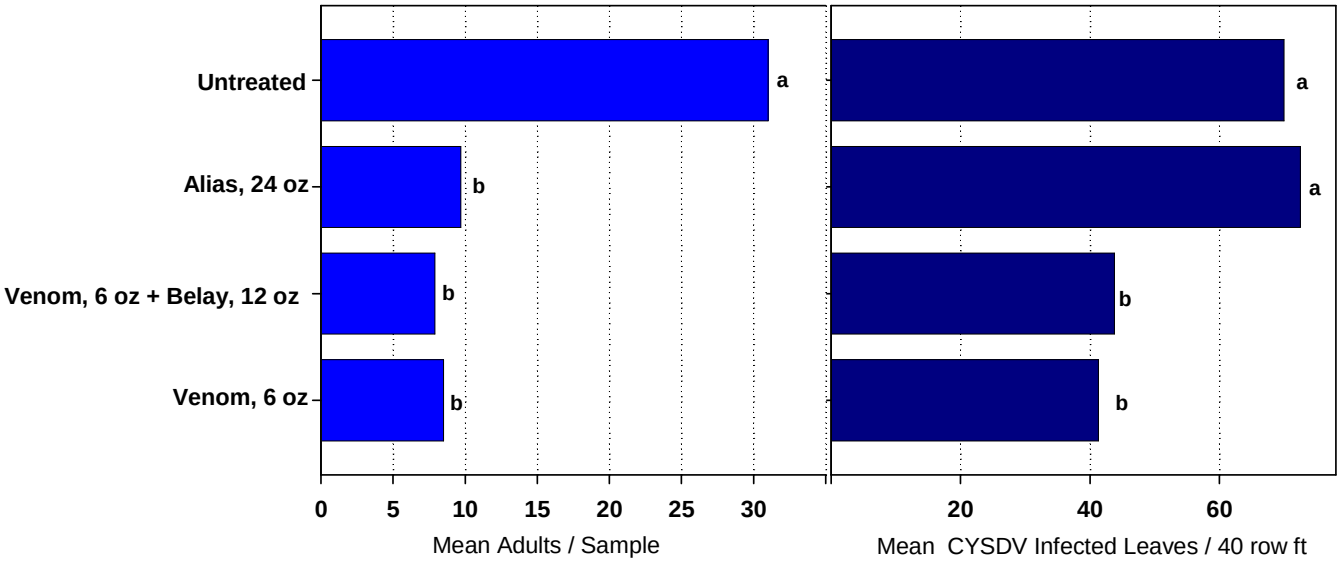
*Research Results*: The purpose of this trial was to evaluate whether the addition of Belay (clothianidin) with Venom soil treatments, as both at-planting and side-dress applications, would provide significantly better control of whiteflies than applying Venom alone, which is the current grower standard in the desert. Alias (imidacloprid) was also included in the trial. Large nymphs populations did not begin to colonize plants until about 23 days after planting (DAP) at which time all treatments provided excellent control of nymphs (Table 7). Thereafter, no differences in nymph numbers were observed between the Venom and Venom +Belay treatments. A similar trend was observed for adult counts (Table 7), where when averaged across all sample dates, the Venom+Belay combination provided the same level of control as Venom applied alone. Both of the Venom treatments provided significant suppression of CYSDV symptoms, whereas like we've observed in previous years, Alias appeared to be ineffective in suppressing CYSDV incidence. Based on these and previous results, it is clear that the addition of other soil insecticide to Venom soil treatments do not consistently enhance the control of whiteflies relative to the application of Venom alone. Unlike previous studies though, Venom applied to fall melons as both an at-planting treatment with an additional soil application made at side-dress did provide some significant suppression of CYSDV symptoms in the absence of foliar sprays.

**Table 7.** Whitefly Nymph densities on leaves at various dates.

| | | Large Nymphs / $cm^2$ / leaf | | | | | |
|---|---|---|---|---|---|---|---|
| **Treatment** | **Rate/ac** | **15 DAP*** | **23 DAP** | **13 DASD** 35 DAP** | **21 DASD** 44 DAP** | **32 DASD** 55 DAP** | **Avg.** |
| Venom | 6 oz | 0.00 | 0.02 b | 0.3 b | 0.1 b | 0.4 b | 0.1 b |
| Venom+Belay | 6 oz+12 oz | 0.00 | 0.01 b | 0.4 b | 0.1 b | 0.4 b | 0.2 b |
| Alias | 24 oz | 0.00 | 0.07 b | 0.6 b | 0.3 b | 1.2 b | 0.5 b |
| Untreated | | 0.00 | 3.6 a | 4.1 a | 2.7 a | 10.0 a | 4.1 a |

Means followed by the same letter are not significantly different ($P > 0.05$, *F*-protected LSD).
* Days after Planting; ** Days after Side-dress

**Figure 8.** Trial average whitefly abundance and CYSDV Incidence ( 1 week pre-harvest) for each treatment.



## Objective 2. Evaluation of Alternative Insecticides for Diazinon and Bifenthrin

### A. *Seed Corn Maggot Efficacy -Spring Trial I*

*Research Procedures:* The purpose of this study was to evaluate the efficacy of spinosyns applied as a seed treatment and in-furrow sprays against seed corn maggots (SCM) in spring melons. This experiment was conducted at UA's Yuma Agricultural Center in the spring of 2011. Three weeks before planting, a 0.5 acre block of cauliflower was incorporated into the soil so that the decaying plant matter would attract SCM females to infest the test site. The field was planted with melon seed 'Gold Express' at a precise density on 17 Mar. Seeds were hand planted at a seed spacing of 6 in. for a total 40 seeds per row. Plots consisted of one row 20-ft long and rows were spaced 84 inches apart (n=160 seeds / treatment). An attempt was made to ensure that depth of seeds was consistent at 0.75-1.0". Plots were separated within rows by a 7-ft section of bare ground. Immediately after seeds were planted and covered with soil, a combination of bone and meat meal was placed in a narrow band over the row to further attract SCM females at a rate of 320 g per 20-ft row. Seeds were treated with insecticides by a seed company (Syngenta, Inc) and included UAEXP21 (thiamethoxam @ 0.75 mg ai/seed) and UAEXP22 (thiamethoxam @ 0.75 mg ai/seed + spinosad @ 0.2 mgai/seed). Entrust (spinosad, WP formulation), Blackhawk (spinosad, WG formulation), Radiant (spinetoram) and Durivo (thiamethoxam+rynaxypyr) were applied as in-furrow spray treatments at planting using a single-row-boom equipped with 1 flat fan nozzle (8004VS) and calibrated to deliver 8.5 gallons of spray per acre at 40 psi. The experimental design included these treatments plus an untreated control arranged in a randomized complete block design replicated 4 times. Stand counts were taken in the entire length of each plot on 8 and 18 Apr to assess plant emergence and survival. Only emerged seedling plants were counted and classified as either healthy (cotyledons green and fully expanded), or dead (cotyledons severely wilted or stem brown and dried out). Additionally, seeds were dug up along with the soil surrounding them in 6 areas within each row to inspect for SCM damaged seeds and un-emerged plants, and SCM larvae and pupae.

*Research Results:* Conditions were ideal for maggot pressure and the beds were irrigated twice prior to emergence. Stand counts taken on 8 Apr showed that damage to seeds and seedling by SCM was moderately high in the untreated control plots (Table 8). Both dead plants and SCM damaged seed was observed in untreated plots. In contrast, SCM control was significantly more effective in plots planted with the seed treatments, and where the in furrow sprays were applied. Plant stands in these treatments exceeded 80% in most cases. Counts taken on 18 Mar showed that all treatments except the thiamethoxam seed treatment (UAEXP21) had significantly more plants than the untreated check. The most consistent treatments in the trial were the Blackhawk 6.6 oz treatment and the UAEXP22 (spinosad + thiamethoxam) seed treatment. No dead plants were observed in these two treatments. Overall this trial further demonstrates that the spinosyns appears to be a very efficacious insecticide treatments for control of SCM whether applied in-furrow or as a seed treatment.

**Table 8**. Stand counts for melons treated for seed corn maggot

| | | | **Stand Counts** (% seedling emergence) | | | |
|---|---|---|---|---|---|---|
| | | | **8-Apr** | | **18-Apr** | |
| ***Treatment*** | ***Rate*** | ***Application*** | **Healthy** | **Dead** | **Healthy** | **Dead** |
| Entrust | 1.5 oz | In furrow spray | 87.4 a | 0.8 a | 81.7 ab | 3.7 a |
| Entrust | 3.0 oz | In furrow spray | 84.4 a | 0.0 a | 84.4 ab | 0.0 b |
| BlackHawk | 3.33 oz | In furrow spray | 81.9 a | 0.6 a | 76.3 ab | 3.3 a |
| BlackHawk | 6.66 oz | In furrow spray | 90.0 a | 0.6 a | 90.6 a | 0.0 b |
| Radiant | 5 oz | In furrow spray | 87.5 a | 0.0 a | 86.9 ab | 0.6 b |
| Radiant | 4 oz | In furrow spray | 85.6 a | 1.3 a | 85.0 ab | 1.0 b |
| Durivo | 10 oz | In furrow spray | 85.0 a | 0.6 a | 85.0 ab | 0.0 b |
| UAEXP21 | - | Seed Treatment | 78.1 a | 0.6 a | 73.8 bc | 3.0 a |
| UAEXP22 | - | Seed Treatment | 90.0 a | 0.0 a | 90.0 a | 0.0 b |
| Untreated | - | - | 59.4 b | 2.5 a | 58.8 c | 1.2 b |

***B. Seed Corn Maggot Efficacy-Spring Trial II***

*Research procedures:* This experiment was conducted at UA's Yuma Agricultural Center near Yuma, AZ in the spring of 2011 to examine the efficacy of various in-furrow insecticide sprays against SCM. Broccoli had been grown and disked under 3 weeks prior. The field was planted with melon seed 'Imperial Gold' at a precise density of 2 seeds per ft on 20 Mar, and germinated using sprinkler irrigation. Seeds were hand planted at a seed spacing of 6 in. for a total 40 seeds per row. Plots consisted of one row, 20-ft , and were planted and prepared similar to the study above. All insecticides were applied as in-furrow spray treatments at planting using a single-row-boom equipped with 1 flat fan nozzle (8004VS) and calibrated to deliver 8.5 gallons of spray per acre at 40 psi. The experimental design included these treatments plus an untreated control arranged in a randomized complete block design replicated 4 times. Stand counts were taken in the entire length of each plot on 8 and 18 Apr to assess plant emergence and survival. Only emerged seedling plants were counted and classified as either healthy (cotyledons green and fully expanded), or dead (cotyledons severely wilted or stem brown and dried out). Additionally, seeds were dug up along with the soil surrounding them in 6 areas within each row to inspect for SCM damaged seeds and un-emerged plants, and SCM larvae and pupae.

*Research Results:* Similar to the previous trial, conditions were ideal for SCM pressure. At seedling emergence (8 Apr), there were significant differences among the treatments and the untreated check in plant stand density (Table 9). All the treatments had higher stand counts than the check, and seedling death was only observed in the untreated check. Among the in-furrow insecticide treatments, the pyrethroids Capture LFR (bifenthrin) and Hero (bifenthrin+zeta-cypermethrin) provided the most consistent SCM control where seedling emergence exceeded 90%. The 10 oz rate of Verimark (cyazypyr 20SC) also provided good control with seedling emergence exceeding 85%. By 18 Apr, the plants had grown to the 1 true leaf stage and a similar trend in activity was observed (Table 9). Seedling death was minimal and varied among the treatments. Overall, the pyrethroid in-furrow spray treatments provided the most consistent stands. The Verimark high rate treatment provided significant activity against SCM (~85% stand) and this was expected since these compounds are active against leafminer maggots. The remaining treatments all provided significantly better stands than the untreated, but did not perform as well ias they did in our 2010 trials. However, these results show that melon growers potentially have several new options for replacing diazinon and bifenthrin (Brigade) for controlling SCM. Although Radiant is not currently labeled for soil usage, a supplementary label could potentially be pursued. Belay, Durivo and Coragen are currently labeled for soil uses in melons and Verimark will be in about 2 years.

**Table 9.** Stand counts for melons treated for seed corn maggot

| *Treatment* | *Rate* | **Stand Counts** (% seedling emergence) | | | |
|---|---|---|---|---|---|
| | | **8-Apr** | | **18-Apr** | |
| | | **Healthy** | **Dead** | **Healthy** | **Dead** |
| Capture LFR | 8 oz | 93.8 a | 0.0 b | 93.8 a | 0.0 b |
| Hero EW | 10 oz | 91.3 a | 0.0 b | 88.8 ab | 2.0 a |
| Radiant | 5 oz | 78.1 bc | 0.0 b | 76.3 cd | 1.5 ab |
| Durivo | 10 oz | 71.9 c | 0.0 b | 69.4 d | 1.0 b |
| Durivo | 7 oz | 80.0 bc | 0.0 b | 75.0 cd | 3.5 a |
| Coragen | 4.0 oz | 76.9 bc | 0.0 b | 78.1 cd | 0.0 b |
| Coragen | 3.0 oz | 75.0 bc | 0.0 b | 76.3 cd | 0.0 b |
| Belay | 6 oz | 73.8 c | 0.0 b | 72.5 cd | 0.0 b |
| Belay | 9 oz | 71.9 c | 0.0 b | 72.5 cd | 0.0 b |
| Verimark | 5 oz | 78.1 bc | 0.6 b | 71.9 cd | 2.8 a |
| Verimark | 10 oz | 85.1 ab | 0.0 b | 83.6 bc | 0.0 b |
| UTC | | 45.0 d | 3.8 a | 42.0 e | 2.5 a |