CALIFORNIA MELON RESEARCH BOARD

2013 Final Report

January 1, 2013 to December 31, 2013

PROJECT TITLE:

New Insecticide Alternatives for Insect Management in Melons

PRINCIPLE INVESTIGATOR:

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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 spring and fall melons in an attempt to develop *alternatives for diazinon* and other older chemistry for seed corn maggot.

SUMMARY OF RESEARCH RESULTS:

- Whitefly infestations and CYSDV incidence were very heavy this year and continue to cause problems in commercial production of fall cantaloupes in the desert. The need for foliar and soil alternatives for whitefly control are still great, particularly considering the recent loss of endosulfan, the heavy dependence on neonicotinoids, and issues surrounding pollinators.

- Spring and fall cantaloupe trials further demonstrated that several new experimental foliar insecticides with adult whitefly activity may provide suppressive activity against CYSDV. These include Pyrifluquinazon, Closer (sulfoxaflor), Exirel/Verimark (cyazypyr) and Sivanto (*flupyradifurone)*. As foliar sprays, these novel compounds controlled adult whiteflies comparable to the industry standards. They also provided excellent control of whitefly nymphs. In particular, Pyrifluquinazon (foliar) and Sivanto (soil) provided excellent adult knockdown and residual control in all trials. These treatments also provided the best suppression of CYSDV under heavy whitefly virus pressure.

- For a second straight year studies showed that Venom and Sivanto, applied at-planting and followed by a side-dress application, significantly reduced whiteflies and delayed CYSDV incidence. Furthermore, these two soil treatments incorporated within a foliar spray program using Exirel, Pyrifluquinazon and Closer, provided significant greater whitefly control and suppression of CYSD symptoms. Unfortunately, CYSDV and yield estimates at harvest were not possible due to premature vine decline.

- A number of experimental seed treatments were shown to be ineffective alternatives for protection of seedling melons from seed corn maggot. In contrast, in-furrow applications of bifenthrin, Entrust and Verimark provided significantly better control of SCM and stand emergence ranging from 80-90% compared to 60% in the untreated check.

RESEARCH PROCEDURES AND RESULTS

Objective 1. Whitefly Control and CYSDV Management

I. Spring Cantaloupes

A. Convention/Experimental Foliar Alternatives for Whitefly Adults / CYSDV

Research procedures: Cantaloupe plots planted with 'Sol Real' were established at the Yuma Agricultural Center on 18 Apr, 2013 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 are shown in the tables below. Three foliar spray applications treatments were made on May 27 and Jun 3 and 10. The foliar spray treatments were applied with a CO2 sprayer that delivered 20.5 GPA at 50 psi, using 2 – TX18 ConeJet nozzles per bed. All foliar treatments included an adjuvant Dyne-Amic at 0.25% v/v.

Adult populations were estimated using a modified vacuum method was used that employed a DeWALT DC500 2- gallon portable vacuum which was 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 by sampling 5 plants / plot, where on smaller plants leaves were collected near the crown. When plants had begun to vine out, 3 leaves / plant were collected at intervals from the terminal. 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 was recorded by recording the number of leaves that expressed symptoms of the virus and yellow interveinal chlorosis consistent with CYSDV infection in 40-45 ft within each plot. All data were analyzed were subjected to ANOVA and treatment means were separated using the LSMEANS test ($P < 0.05$). Because of heterogeneity of mean variances, data for whiteflies were log transform (mean+1) prior to ANOVA. Actual non-transformed

Research Summary: Adult pressure was low when the sprays were initiated, but increased to moderate levels by the end of the trial. Following the 1st spray, only the Pyrifluquinazon, Sivanto, and Exirel treatments provided significant residual activity (7 DAA) (Table 1). Following the 2nd spray, all spray treatments provided significant residual control compared to the untreated plot, but adult numbers were clearly lowest in the Pyrifluquinazon and Sivanto treatments. Following the 3rd application, adult numbers began to increase in the untreated plots. Again, all treatments provided significant knockdown activity, and most treatments showed significant activity at 7 DAA except for the Vydate +Brigade treatment. All treatments provided significant control of whitefly immatures similar to the standard (Assail) except Vydate +Brigade (Figure 1). CYSDV was present in the experimental plots, but due to variability in our experimental block (i.e., edge effects), statistical differences were not detected among treatments (Table 2). Overall, when compared to the standard, the most consistently performing products in this trial were Sivanto and Pyrifluquinazon. Both treatments provided control of adults and nymphs that was as good as, and often better than Assail.

Table 1. Knockdown and residual activity of insecticides against whitefly adults, Spring 2013

Spray # 1 ***(27 May)***

		Whitefly Adults/ Sample		
		1-DAA1	***3-DAA1***	***7-DAA1***
Treatment	**Rate**	28-May	30-May	3-Jun
Closer	5.7 oz	1.1	0.8abc	2.3abc
Movento	5 oz	1.1	1.4a	3.5ab
Exirel	15 oz	0.9	0.4c	1.1cd
Sivanto	14 oz	0.3	0.4c	1.2bcd
Sivanto+Requiem	14 oz+2 qts	0.2	0.4c	0.9de
Pyrifluquinazon	3.2 oz	0.3	0.3c	0.4e
Assail	5.3	0.5	0.5bc	2.3abc
Vydate+Brigade	3 pts+6 oz	0.7	1.1ab	2.8ab
Untreated	-	1.0	1.3a	4.2a

Spray # 2 ***(3 Jun)***

		Whitefly Adults/ Sample		
		1-DAA2	***3-DAA2***	***7-DAA2***
Treatment	**Rate**	4-Jun	6-Jun	10-Jun
Closer	5.7 oz	1.4bcd	2.6bcd	5.1c
Movento	5 oz	1.9abc	3.1bc	3.8c
Exirel	15 oz	0.9cde	1.5cd	4.1c
Sivanto	14 oz	0.4e	1.2d	1.4d
Sivanto+Requiem	14 oz+2 qts	0.7de	0.6e	1.7d
Pyrifluquinazon	3.2 oz	0.5e	1.4d	1.0d
Assail	5.3	2.7ab	3.0bcd	4.8c
Vydate+Brigade	3 pts+6 oz	1.6bcd	4.4b	11.9b
Untreated	-	4.2a	17.3a	23.7a

Spray # 3 ***(10 June)***

		Whitefly Adults/ Sample		
		1-DAA3	***3-DAA3***	***7-DAA3***
Treatment	**Rate**	12-Jun	14-Jun	19-Jun
Closer	5.7 oz	3.7d	4.2cde	6.8bc
Movento	5 oz	4.5cd	5.0cd	5.9bcd
Exirel	15 oz	2.1e	2.1fgh	6.5bcd
Sivanto	14 oz	1.6ef	1.7gh	3.8def
Sivanto+Requiem	14 oz+2 qts	0.9f	1.2h	3.2def
Pyrifluquinazon	3.2 oz	1.7ef	2.5efg	1.8f
Assail	5.3	4.1cd	5.5cd	9.8b
Vydate+Brigade	3 pts+6 oz	13.1b	12.2b	22.8a
Untreated	-	32.7a	30.3a	28.6a

Means followed by the same letter are not significantly different (P>0.05).

Figure 1. Whitefly egg and nymph densities at 7 Days following the 3rd application, spring 2013

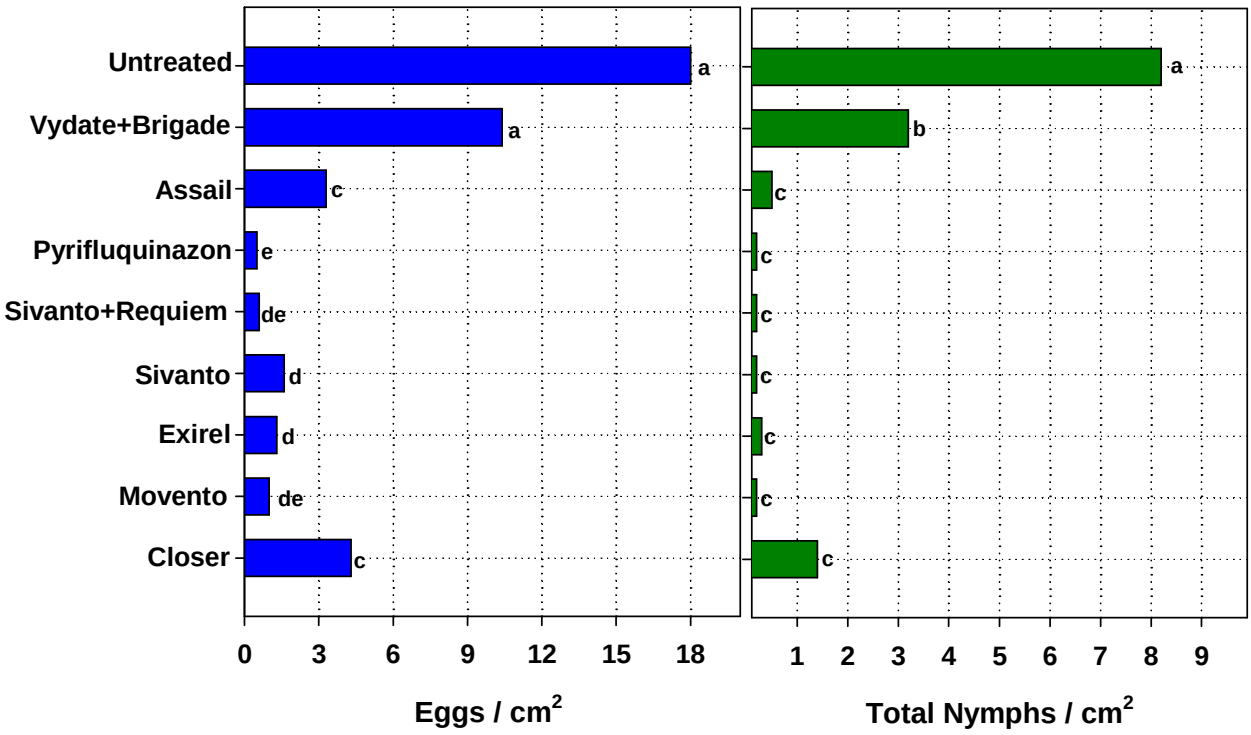

Table 2. Incidence of CYSDV following insecticide treatments on spring melons, 2013

		Avg. no. CYSDV Symptomatic leaves / 40 ft	
Treatment	**Rate**	**Total leaves**	**YIVC leaves**
Closer	5.7 oz	57.0a	14.0a
Movento	4.56 oz	82.0a	36.0a
Exirel	10 oz	76.2a	22.0a
Sivanto	14 oz	43.0a	14.8a
Sivanto+Requiem	14 oz + 2 qts	40.5a	13.8a
NNI-0101	3.2 oz	60.0a	16.8a
Assail	5.3	64.5a	14.3a
Vydate+Brigade	3 pts+6 oz	*85.0a*	*21.8a*
UTC		*111.8a*	*40.8a*

Means followed by the same letter are not significantly different (P>0.05).

I. Spring Cantaloupes

B. Sivanto as a Foliar and Soil Alternative for Whitefly Adult / CYSDV

Research procedures: Cantaloupe plots planted with 'Sol Real' were established at the Yuma Agricultural Center on 18 Apr, 2013 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. In the plots that received Venom and Sivanto soil applications, the insecticide was applied 3" directly below the seed line at planting in 10 GPA total volume. Two foliar spray applications treatments were made on May 16 and Jun 10 and products and rates can be found in the adjacent spray table. The foliar spray treatments were applied with a CO_2 sprayer that delivered 20.5 GPA at 50 psi, using 2 – TX18 ConeJet nozzles per bed. All foliar treatments included an adjuvant Dyne-Amic at 0.25% v/v. Whitefly adults and immatures and CYSDV incidence were evaluated at various intervals following each application using the sampling method described in the above study. Yields were estimated by harvesting all full-slip melons in 25 row ft within each plot. Plots were harvested 6 times over a 2 week period (Jun 28- Jul 8). Fruit yields were measured by harvesting and recording the number of mature melons /plot and classifying their numbers by carton size (9, 12, 15, and 18/23). % Sugar levels (Brix) for 3-5 randomly selected melons from each plot on each harvest date were recorded using a standard refractometer.

Research Results: Similar to the previous trial, adult pressure was initially light, but differences among the treatments were observed as the season progressed. Application of the Venom and Sivanto soil treatments alone did not provide control of adult whiteflies as good as the Soil/Foliar combinations or foliar sprays alone (Table 3). Similarly, the soil/foliar and foliar spray treatments provided the most consistent control of whitefly nymphs (Figure 2). In terms of melon yields, there were no significant differences among the treatments in the total number of fruit, however, the Venom and Sivanto foliar and soil treatments had a significantly greater number of large melons (carton 9s) than the untreated control (Table 4). Furthermore, all of the treatments had significantly higher sugar levels than the untreated, and the Venom soil/foliar treatment had consistently higher levels across all harvests. Differences in CYSDV levels were observed among treatments in this study. However, only the Sivanto and Venom soil/foliar combinations and the Venom foliar alone treatment significantly reduced virus incidence.

Table 3. Effect of Soil and Foliar insecticides against whitefly adults, spring 2013

		Adults / 3 sec vacuum Sample				
Soil Treatment	**Foliar Treatment**	***Pre-spray*** **15-May**	***7 DAA-1*** **23-May**	***14 DAA-1*** **30-May**	***21 DAA-1*** **7-Jun**	***10 DAA-2*** **20-Jun**
Sivanto, 28 oz	-	1.8	0.9ab	1.1a	3.3b	18.2b
Venom, 6 oz	-	2.0	0.4bc	0.9a	5.1b	21.6b
Sivanto, 28 oz	Venom, 6 oz	2.5	0.5bc	0.8a	3.3b	11.8c
Venom, 6 oz	Sivanto, 14 oz	2.0	0.5bc	0.8a	4.1b	8.2c
-	Venom, 6 oz	2.2	0.3c	0.7a	6.6b	10.8c
-	Sivanto, 14 oz	1.7	0.5bc	1.4a	2.9b	10.5c
Untreated	Untreated	2.0	1.4a	2.4a	15.2a	50.4a

Means followed by the same letter are not significantly different (P>0.05).

Table 4. Yield and quality of melons treated with various Sivanto/Venom treatments, spring 2013

Soil Treatment	Foliar Treatment	Avg. no. fruit / 25 row ft (by size) Cartons 9	Cartons 12	Cartons 15-23	Total	% Fruit with sooty mold	Avg. BRIX (% Sugar)
Sivanto, 28 oz	-	14.5 abc	18.0a	20.3ab	51.3a	0.0b	10.2b
Venom, 6 oz	-	18.0ab	21.0a	12.5c	51.5a	0.0b	10.1b
Sivanto, 28 oz	Venom, 6 oz	19.8a	19.8a	15.1bc	54.5a	0.0b	10.3ab
Venom, 6 oz	Sivanto, 14 oz	17.3ab	18.5a	14.4c	50.8a	0.0b	10.7a
-	Venom, 6 oz	17.8ab	19.0a	15.8bc	52.8a	0.0b	10.4ab
-	Sivanto, 14 oz	13.0bc	13.8a	21.3a	48.0a	0.0b	10.2b
Untreated	Untreated	9.5c	16.1a	22.3a	47.5a	14.2 a	9.5c

Means followed by the same letter are not significantly different (P>0.05).

Figure 2. Whitefly egg and nymph densities at 7 Days before harvest, Jun 20, 2013

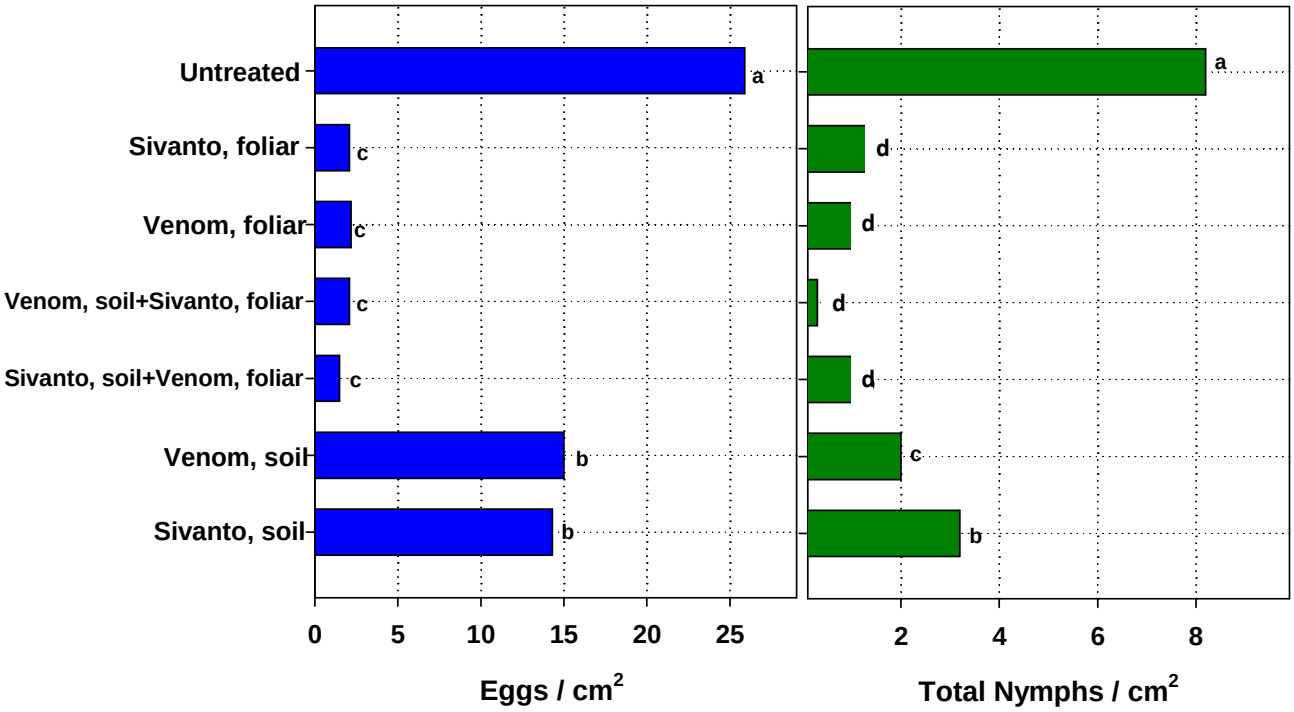

Table 5. Incidence of CYSDV at harvest, Spring 2013

Soil Treatment	Foliar Treatment	Avg. Whitefly Adults / sample	Avg. no. CYSDV Symptomatic leaves / 45 ft	
			Total leaves	YIVC leaves
Sivanto, 28 oz	-	5.1bc	44.3	8.8
Venom, 6 oz	-	6.0bc	91.1	28.8
Sivanto, 28 oz	Venom, 6 oz	4.1bc	32.3 *	7.8*
Venom, 6 oz	Sivanto, 14 oz	3.4c	20.8 *	2.0*
-	Venom, 6 oz	4.6bc	21.3 *	5.0*
-	Sivanto, 14 oz	3.8c	62.3	21.5
Untreated	Untreated	14.1a	76.8	22.3

Means followed by * are significantly different from the untreated control (<0.05).

II. Fall Cantaloupes

A. Experimental Foliar Alternatives for Whitefly Adults/CYSDV-I

Research procedures: Cantaloupe plots planted with 'Sol Dorado' were established at the Yuma Agricultural Center on 15 Aug, 2013 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 tables below. All treatments except the untreated control were treated with a Venom soil application at planting time applied 3" directly below the seed line in 20 GPA total volume. All foliar spray treatments were applied on 31 August, and 8 and 16 September as a broadcast spray at 25 GPA at 40 psi using 4 -TX18 Conejet nozzles per bed. All spray treatments included an adjuvant Dyne-Amic at 0.25% v/v. Whiteflies and CYSDV incidence were evaluated at various intervals using the sampling methods described above. Yield estimates were not made due to collapse of the untreated plots to *Monosporascus cannonballus* and heavy whitefly feeding about two weeks prior to harvest.

Research Results: In this fall trial, we evaluated the efficacy of two new compounds, Closer and Exirel, for control of both adults and nymphs. Assail was included as a standard. Figure 3 shows that both Closer and Exirel provided knockdown and residual control of whitefly adults comparable to Assail. All of the foliar treatments provided significantly better control than the Venom soil treatment applied alone. Similarly, all three foliar treatments provided similar control of nymphs following 3 spray applications (Table 6). Nymph densities in the Venom soil treatment were significantly lower than the untreated check, but densities were much higher than in plants that received the additional foliar insecticide sprays. Although, all of the insecticide treatments had significantly lower incidence of CYSDV relative to the untreated check, the foliar spray treatments did not suppress CYSDV at a lower level than the Venom soil alone (Table 7). This suggests that even though fewer whiteflies were observed on sprayed plots, the addition of foliar insecticide sprays of these compounds did not provide any additional virus suppression greater than the Venom soil treatment alone.

Figure 3. Adult whitefly numbers at 3 and 7 days after application (DAA), fall 2013

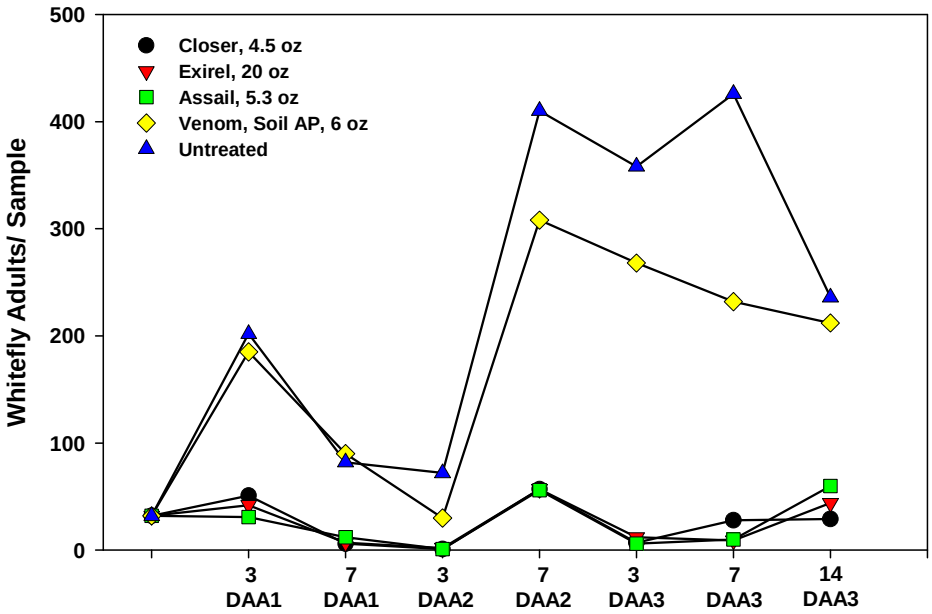

Table 6. Whitefly immature at 14 days after application 3, Fall 2013

		Avg. whitefly immatures / cm^2	
Treatment	**Rate**	**Eggs**	**Nymphs**
Closer	4.5 oz	5.1 b	6.9 c
Exirel	20 oz	15.7 b	1.1 c
Assail	5.3 oz	8.6 b	3.3 c
Venom -at plant	6 oz	91.7 a	59.6 b
Untreated	-	83.3 a	102.8 a

Table 7. Incidence of CYSDV at 21 days after application 3, Fall 2013

Treatment	**Rate**	**Avg. Whitefly Adults / sample**	**Avg. no. CYSDV Symptomatic leaves / 40 ft**
Closer	4.5 oz	25.4 a	102.3 b
Exirel	20 oz	24.1 a	113.5 b
Assail	5.3 oz	25.2 a	103.5 b
Venom-at plant	6 oz	163.9 b	117.5 b
Untreated	-	221.3 c	178.8 a

All plots except the untreated check were treated with Venom, 6 oz applied at-planting; Means followed by the same letter are not significantly different (P>0.05).

II. Fall Cantaloupes

B. Experimental Foliar Alternatives for Whitefly Adults/CYSDV-II

Research procedures: Cantaloupe plots planted with 'Sol Dorado' were established at the Yuma Agricultural Center on 15 Aug, 2013 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 tables below. All treatments, except the untreated control, were treated with a Venom soil application at planting time applied 3" directly below the seed line in 20 GPA total volume. All foliar spray treatments were applied on 1, 9 and 17 September as a broadcast spray at 25 GPA at 40 psi using 4 -TX18 Conejet nozzles per bed. All spray treatments included an adjuvant Dyne-Amic at 0.25% v/v. Whiteflies and CYSDV incidence were evaluated at various intervals using the sampling methods described above. Yield estimates were not made due to collapse of the untreated plots to *Monosporascus cannonballus* and heavy whitefly feeding about two weeks prior to harvest.

Research Results**:** Whitefly pressure was heavy during this trial. We evaluated the efficacy of several new compounds currently being developed including, Pyrifluquinazon, Sivanto, Exirel and Closer. Assail was included as a standard, and all the melon plots, except for the untreated control, had been treated with Venom at planting. Our goal was to determine how effective each compound was in controlling whiteflies and CYSDV when used following a Venom soil treatment alone. Following each spray application, Pyrifluquinazon was clearly the most consistently performing product in the trial and provided significantly better knockdown and residual adult control than both the Venom at-plant only and the untreated check (Table 8). Statistically it was comparable to Sivanto and to the standard (Assail) in all post-treatment evaluations of adult control. Other compounds such as Closer, Exirel and Fulfill+Actiguard were less consistent and often did not differ statistically from the unsprayed Venom treatment. In most cases, the Venom treatment provided significantly better control than the untreated check. All treatments provided excellent control of the whitefly adults and nymphs (Figure 4). We were only able to conduct a single CYSDV evaluation before the plants in the untreated check plots collapsed from heavy whiteflies and *cannoballis.* Among the treatments, Pyrifluquinazon and Sivanto provided the greatest suppression of virus incidence (Table 9). On the second evaluation following the collapse of the untreated plants, these two treatments provided >60% suppression of virus relative to the Venom at plant only treatment. Of the other treatments, only Exirel failed to provide significantly lower CYSDV incidence than the Venom treatment. This is surprising since it provided good control of adults throughout the trial. For the second consecutive season, Pyrifluquinazon and Sivanto have demonstrated better adult whitefly control and CYSDV suppression than the standard. Unfortunately, the manufacturer of Sivanto (Bayer Crop Sciences) has indicated that they do not plan to purse a foliar label for this product due to concerns with phytotoxicity and will only register soil applied uses in melons. However, as is shown in the next 2 studies, it has excellent soil activity against whiteflies and virus.

Table 8. Knockdown and residual activity of insecticides against whitefly adults, Spring 2013

Spray # 1 (24 May)

		Whitefly Adults/ Sample		
		1-DAA1	***3-DAA1***	***7-DAA1***
Treatment	**Rate**	*2-Sep*	*4-Sep*	*8-Sep*
Closer	4.5 oz	100.2 bc	38.6 b	13.7 a
Assail	5.3 oz	63.3 bc	13.4 bcd	3.6 a
Fulfill+Actiguard	3 oz + 1 oz	76.1 bc	14.5 bc	3.5 a
Exirel	20 oz	65.8 bc	14.8 bc	4.7 a
Sivanto	14 oz	57.9 c	6.2 cd	3.4 a
Pyrifluquinazon	3.2 oz	52.0 c	5.5 d	2.9 a
Venom, At plant only	6 oz	99.8 b	20.4 b	4.0 a
Untreated	-	310.6 a	165.3 a	22.7 a

Spray # 2 (31 May)

		Whitefly Adults/ Sample		
		1-DAA2	***3-DAA2***	***7-DAA2***
Treatment	**Rate**	*10-Sep*	*12-Sep*	*16-Sep*
Closer	4.5 oz	3.3 b	1.9 bc	188.1 b
Assail	5.3 oz	0.9 c	2.6 bc	23.6 c
Fulfill+Actiguard	3 oz + 1 oz	1.3 b	4.4 bc	34.5 bc
Exirel	20 oz	2.7 b	4.6 bc	48.5 bc
Sivanto	14 oz	1.1 bc	4.0 bc	29.6 c
Pyrifluquinazon	3.2 oz	0.4 c	2.2 c	32.0 bc
Venom, At plant only	6 oz	2.7 b	5.8 b	33.0 bc
Untreated	-	14.1 a	34.1 a	273.3 a

Spray # 3 (12 June)

		Whitefly Adults/ Sample		
		1-DAA2	***3-DAA2***	***7-DAA2***
Treatment	**Rate**	*18-Sep*	*20-Sep*	*24-Sep*
Closer	4.5 oz	73.1 b	28.1 b	119.4 b
Assail	5.3 oz	6.5 de	2.6 cd	11.1 cd
Fulfill+Actiguard	3 oz + 1 oz	12.5 bcd	12.7 b	22.0 bc
Exirel	20 oz	20.4 bc	2.3 cd	20.6 bc
Sivanto	14 oz	11.2 cde	0.8 d	15.3 bcd
Pyrifluquinazon	3.2 oz	3.8 e	0.9 d	6.0 d
Venom, At plant only	6 oz	22.2 bc	14.3 b	36.1 b
Untreated	-	176.0 a	366.0 a	357.2 a

All plots except the untreated check had soil treatment of Venom, 6 oz applied at-planting
Means followed by the same letter are not significantly different (P>0.05).

Figure 4. Whitefly egg and nymph densities at 7 Days after the 3rd application, fall 2013

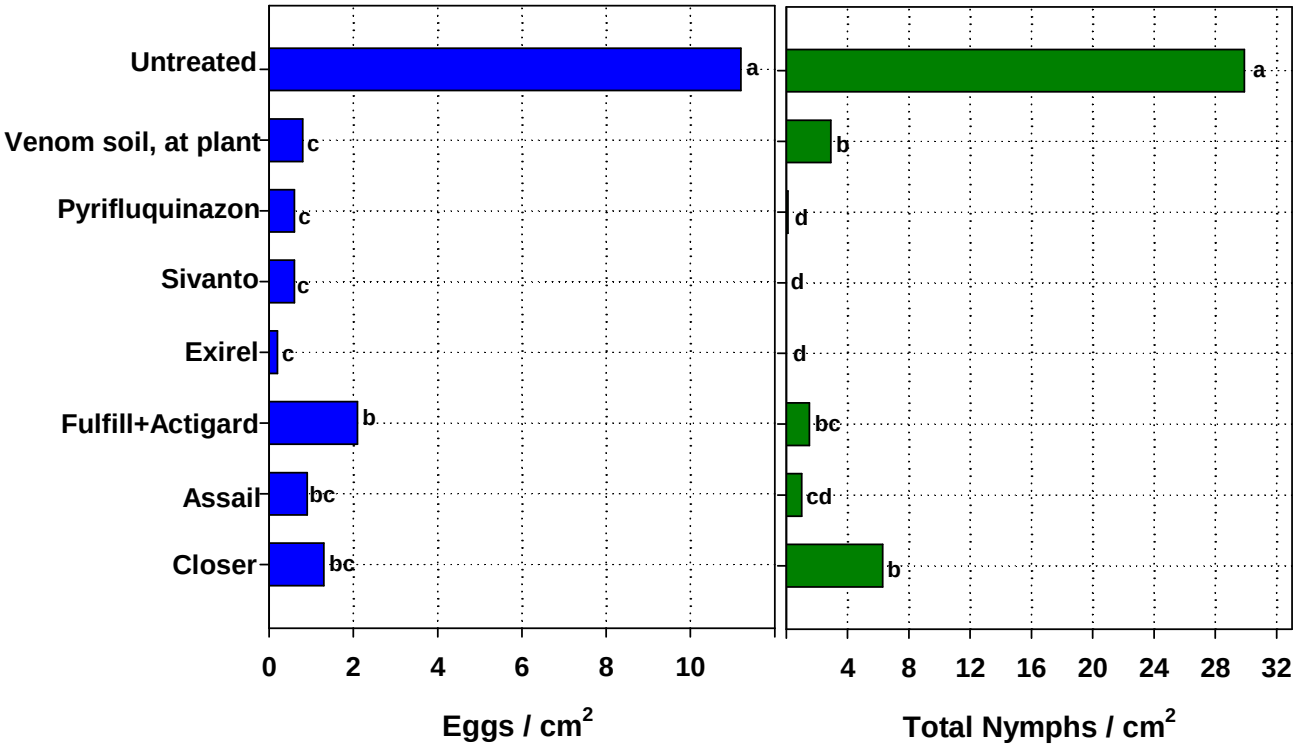

Table 9. Incidence of CYSDV at 17 and 24 days after the 3rd application , Fall 2013

			Mean leaves with CYSDV symptoms / 40 ft	
Treatment	**Rate/ac**	**Avg. WF Adults per sample**	**4-Oct**	**11-Oct**
Closer	4.5 oz	63.6 b	41.8 bc	143.3 bc
Assail	5.3 oz	14.4 cd	42.0 bc	120.0 c
Fulfill+Actiguard	3 oz + 1 oz	20.2 bc	28.3 cd	142.3 bc
Exirel	20 oz	20.5 bc	47.0 bc	182.8 ab
Sivanto	14 oz	14.2 d	11.5 e	66.5 d
Pyrifluquinazon	3.2 oz	11.7 d	18.8 de	76.3 d
Venom, At plant only	6 oz	26.5 b	71.8 b	201.3 a
Untreated	-	191.1 a	118.8 a	*

Means followed by the same letter are not significantly different (P>0.05). All plots except the untreated check had soil treatment of Venom, 6 oz applied at-planting

*** *all plants dead in the untreated plots***

II. Fall Cantaloupes

C. Experimental Soil Alternatives for CYSDV - Sivanto and Verimark

Research procedures: Cantaloupe plots planted with 'Sol Dorado' were established at the Yuma Agricultural Center on 15 Aug, 2013 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 tables below. All treatments, except the untreated control, were treated with soil application at planting time applied 3" directly below the seed line in 20 GPA total volume. A second soil application was made on 9 Sep as a side dress application and 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 foliar sprays were applied during the study. Whitefly adults were not monitored during the trial, but whitefly immatures and CYSDV incidence were evaluated at various intervals using the sampling methods described above.

Research Results**:** Whitefly pressure was heavy during this trial. The Venom and Sivanto soil treatments, either at plant alone or with the additional sidedress application, provided significant control of whitefly nymphs at 35 days after planting (Table 10). However, nymph densities in the Verimark soil treatments and the Venom sidedress only treatments were not significantly different from the untreated check. This is consistent with previous trials we've conducted with Verimark soil treatments. We purposely did not over spray these treatments with foliar sprays to determine how effective the soil treatments alone were in suppressing CYSDV. We were only able to conduct a single virus evaluation because the plants in the untreated plots (and many plants in the Verimark and Venom sidedress treatments) had collapsed on Oct 12. Similar to what we observed with the nymph control, the Venom and Sivanto soil treatments had the lowest CYSDV incidence and particularly when both an at-plant and side dress application was applied (Table 11). This is encouraging since Sivanto is likely to be registered in the next year or so and will provide another soil alternative for fall melon production. Unfortunately, Verimark does not appear to be a viable soil alternative for fall melons.

Table 10. Whitefly egg and nymph densities at 35 Days after planting, Fall 2013

		Mean whitefly immatures/cm^2			
		3rd crown leaf		6th crown leaf	
Soil treatment, *At plant*	**Soil treatment, *Side dress***	**Eggs**	**Total nymphs**	**Eggs**	**Total nymphs**
Venom, 6 oz	-	1.8a	17.0b	4.4 a	5.9bc
Venom, 6 oz	Venom, 6 oz	0.1b	3.7cd	2.3 a	3.1c
Sivanto, 28 oz	-	0.1b	3.4d	1.8 a	6.8c
Sivanto, 28 oz	Sivanto, 28 oz	1.3ab	10.3bc	2.8 a	8.6bc
Verimark, 13.5 oz	-	2.6a	46.1a	11.8 a	34.3ab
Verimark, 13.5 oz	Verimark, 13.5 oz	1.2ab	39.7a	5.5 a	46.8a
-	Venom, 6 oz	2.8a	30.4ab	6.0 a	21.8abc
Untreated	Untreated	4.4 a	59.4a	9.4 a	35.5a

Means followed by the same letter are not significantly different (P>0.05).

Table 11. Incidence of CYSDV at 52 days following planting (27 days after side-dress) , Fall 2013

Soil Treatment, ***At plant***	**Soil Treatment,** ***Side dress***	**Avg. no. CYSDV symptomatic leaves / 45 ft**
Venom, 6 oz	-	140 cd
Venom, 6 oz	Venom, 6 oz	87.3 e
Sivanto, 28 oz	-	121.3 d
Sivanto, 28 oz	Sivanto, 28 oz	92.5 e
Verimark, 13.5 oz	-	154.3 bc
Verimark, 13.5 oz	Verimark, 13.5 oz	169.0 b
-	Venom, 6 oz	153.8 bc
Untreated	Untreated	203.8 a

Means followed by the same letter are not significantly different (P>0.05).

II. Fall Cantaloupes

D. Conventional and Experimental Alternatives for Whiteflies and CYSDV – Soil and Foliar Programs

Research procedures: Cantaloupe plots planted with 'Sol Dorado' were established at the Yuma Agricultural Center on 15 Aug, 2013 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 tables below. The soil treatments were applied prior at planting by injecting each insecticide in a 20 GPA final solution, 3" below the seed line. A second soil application of Venom was made on 9 Sep as a side dress application to all the soil treatments. The compounds were shanked into the soil at 20 GPA on both sides of the plants (14" from seed-line) at a depth of 6" and immediately incorporated via furrow irrigation. Foliar spray treatments were applied on 27 Aug 1 Sep, 7 Sep, 13 Sep, 20 Sep and 28 Sep as a broadcast spray at 25 GPA at 40 psi using 4 -TX18 Conejet nozzles per bed. All spray treatments included an adjuvant Dyne-Amic at 0.25% v/v.

Soil Treatment	**Side-dress Treatment**	**Foliar Treatment**
Venom, 6 oz	Venom, 6 oz	Conventional
Venom, 6 oz	Venom, 6 oz	Experimental
Verimark, 13.5 oz	Venom, 6 oz	Conventional
Verimark, 13.5 oz	Venom, 6 oz	Experimental
Sivanto, 28 oz	Venom, 6 oz	Conventional
Sivanto, 28 oz	Venom, 6 oz	Experimental
Untreated	Untreated	Untreated

Populations of whitefly adults and immatures were evaluated at various intervals following each application using the sampling method described above. CYSDV incidence was estimated twice prior to harvest, but yield estimates were not made due to collapse of all plots to *Monosporascus cannonballus* and heavy whitefly pressure in the untreated plots about two weeks prior to harvest.

Spray Date	Plant Stage	Conventional-Foliar	Experimental- Foliar
27-Aug	2 lf	Lannate, 1 lb +Brigade, 6.2 oz	Closer 4.5 oz +Brigade, 6.2 oz
1-Sep	4 lf	Closer, 4.5 oz +Brigade	Pyrifluquinazon (PFQ, 3.2 oz)
7-Sep	7-8lf	Fulfill, 3 oz +Assail, 5.3 oz +Brigade	PFQ + Brigade
13-Sep	Bloom	Fulfill+Actigard, 1 oz	Exirel, 20 oz
20-Sep	Fruit	Assail+Danitol, 12 oz	Exirel+Brigade
28-Sep	Netted	Assail+Vetica, 20 oz	PFQ+Vetica, 20 oz

Research Results: The purpose of this trial was to evaluate a standard fall whitefly/CYSDV management program with soil and foliar alternatives using both conventional and experimental insecticides. The standard consisted of at-plant and sidedress soil applications of Venom, followed by multiple spray applications with conventional insecticides at 6-7 d intervals. Whitefly populations and CYSDV incidence were heavy in this trial. Table 12 and Figure 5 show the adult abundance during the trial where the adults in the untreated check exceeded 200 adults /sample following the 4th foliar spray. After the 1st spray, control varied widely across all treatment, ranging from ~45% in the Verimark soil treatments sprayed with Lannate+Brigade to >80% in the Venom soil treatment sprayed with Closer+Brigade. Following the 2nd foliar spray and the side-dress applications, adult numbers were significantly reduced at levels around 90% control (Figure 5). This ultimately resulted in less CYSDV in some treatments as the season progressed (Table 13). Averaged across the trial, the Venom and Sivanto treatments (both with at plant and with side-dress applications) followed by the Experimental Foliar spray program provided the most consistent control of adults and suppression of CYSDV. Unfortunately, we were not able to carry the CYSDV estimates to harvest or measure yields and quality relative to management program due to the vine decline. However, this preliminary study provides further support for obtaining expedited registrations of Pyrifluquinazon and Sivanto. Closer and Exirel should be registered in California in 2014 should be a welcome addition to whitefly management programs in fall melons.

Table 12. Adult whitefly counts at various intervals following foliar and soil insecticide applications, fall 2013.

		Mean WF adults / sample					
		Pre-spray	***3 DAA-1***	***5 DAA-2***	***5 DAA-3***	***4 DAA-4***	***4 DAA-5***
Soil Treatment	**Foliar Treatment**	**27-Aug**	**30-Aug**	**6-Sep**	**12-Sep**	**17-Sep**	**24-Sep**
Venom	Conventional	31.9a	49.6 cd	7.0 cd	1.6 bc	15.9 c	3.2 b
Venom	Experimental	32.5a	34.4 d	2.4 e	0.6 c	11.2 c	2.6 b
Verimark	Conventional	45.0a	95.2 b	25.6 b	2.3 bc	31.3 b	4.3 b
Verimark	Experimental	44.6a	82.9 b	3.7 de	0.9 c	11.8 c	2.7 b
Sivanto	Conventional	34.5a	70.3 bc	18.7 bc	3.0 b	17.1 bc	3.2 b
Sivanto	Experimental	33.2a	47.5 cd	2.7 e	1.0 c	13.3 c	1.4 b
Untreated	Untreated	43.2a	175.8 a	60.0 a	21.9 a	202.4 a	39.1 b

Means followed by the same letter are not significantly different (P>0.05). All plots except the untreated check had soil treatment of Venom, 6 oz applied at sidedress.

Figure 5. % Whitefly control in plots treated with soil at-plant of Venom, Verimark and Sivanto and foliar sprays of conventional and experimental insecticides. Upper graph is number of whiteflies / sample in the untreated check; lower graph is % control of adults in each treatment.

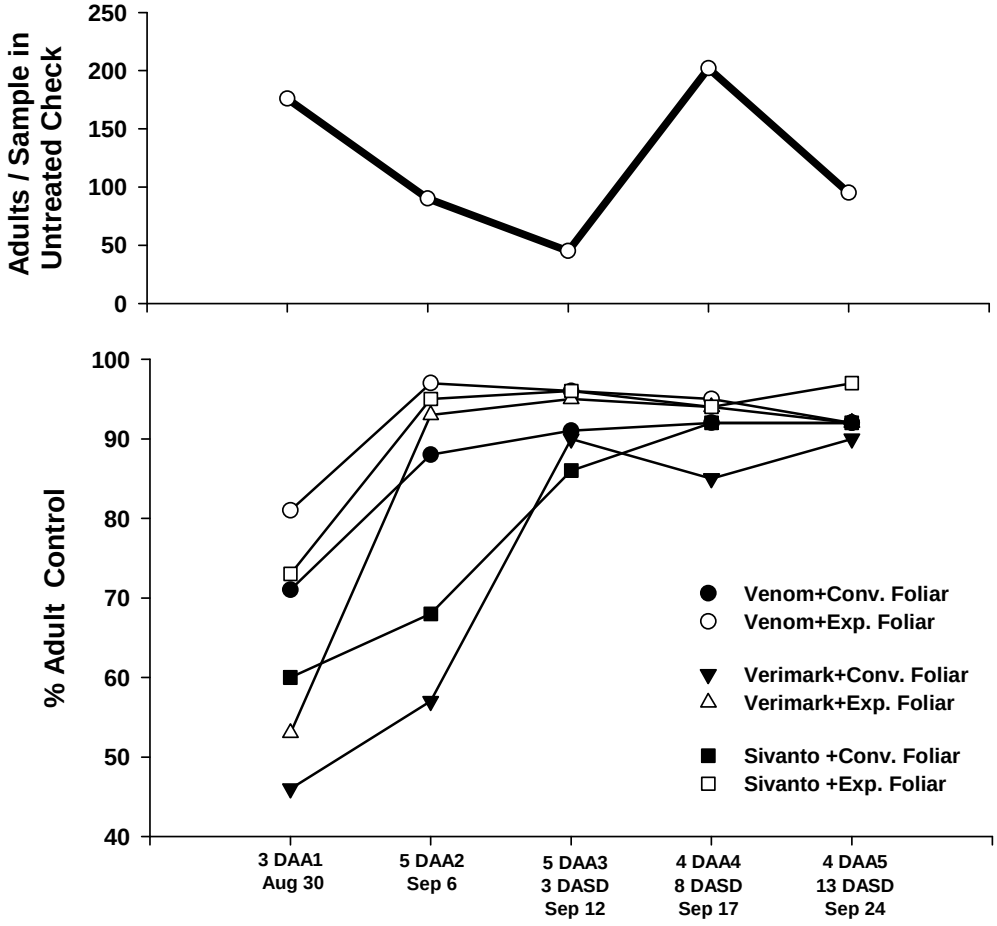

Table 13. Incidence of CYSDV at 52 days following planting , Fall 2013

Soil Treatment	Foliar Treatment	Avg. whitefly adults/sample	Avg. no. CYSDV symptomatic leaves / 45 ft	
			4-Oct	11-Oct
Venom	Conventional	18.2 cd	53.3 bc	141.8 c
Venom	Experimental	13.9 e	37.5 c	112.5 c
Verimark	Conventional	33.9 b	73.5 ab	171.3 b
Verimark	Experimental	24.4 de	66.3 b	172.3 b
Sivanto	Conventional	24.4 bc	55.3 bc	121.5 c
Sivanto	Experimental	16.5 e	37.3 c	116.5 c
Untreated	Untreated	90.5 a	117.3 a	258.2 a *

Means followed by the same letter are not significantly different (P>0.05). All plots except the untreated check had soil treatment of Venom, 6 oz applied at sidedress. * All plants in the Untreated plots were dead on Oct 12

Objective 2. Evaluation of Alternative Insecticides for Diazinon and Bifenthrin

A. *Seed Corn Maggot Efficacy - Experimental Seed Treatments*

Research Procedures: The purpose of this study was to evaluate the efficacy of several experimental insecticides applied as a seed treatment or as in-furrow sprays against seed corn maggots (SCM) in spring melons. This experiment was conducted at UA's Yuma Agricultural Center. Two weeks before planting, a 0.5 acre block of canola 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 11 Mar, 2013. Seeds were hand planted at a spacing of 6 in. for a total 50 seeds per row. Plots consisted of one row 20-ft long and rows were spaced 84 inches apart (n=200 seeds / treatment). An attempt was made to ensure that depth of seeds was consistent at 0.5-0.75 inches. 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 the seed company. Because of the confidential nature most of the products the names of the active ingredients cannot be provided at this time. Farmore FI-400 (thiamethoxam) was included as a standard. All insecticides were applied as in-furrow sprays 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 20, 23 28 Mar and 2 April 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). At 22 DAP the number of plants in each plot that had 2-fully expanded true leaves were recorded. 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 at each sample showed that damage to seeds and seedlings by SCM was moderately high in the untreated control plots (Figure 8). Both dead plants and SCM damaged seed was observed in untreated plots. None of the experimental seed treatments (UAD_EXP) provided significant protection against SCM compared to the untreated check. Initially at 9 DAP; emergence was very poor in the experimental seed treatments, likely due to phytotoxic effects of the insecticide. After 22 days, plant stands (% seedling emergence) were not significantly different among the experimental seed treatments and only ranged from 55-67 % emergence. In contrast, the Farmore FI400 seed treatment provided significantly better seedling emergence than the untreated and did not differ from in-furrow spray treatments. Seedling emergence in the experimental in-furrow treatments (Entrust and Verimark) did not differ statistically from the Capture LFR standard which overall had the highest seedling emergence (90.3% at 22 DAP). Counts of plants with 2 fully expanded true leaves at 22 DAP showed that plant growth among all treatments was greatest for plots treated with the in-furrow sprays (Figure 6). Among the seed treatments, the Farmore DI400 had a similar percentage of 2 leaf plants as the untreated check; but a smaller percentage of plants in the experimental seed treatments were as large as the untreated. Based on these and previous studies, in-furrow sprays offer the best protection for melons from SCM.

Table 14. Seedling emergence (%) of melons exposed to SCM and insecticide treatments, Spring 2013

		% Seedling Emergence			
Treatment	**Application**	**9 DAP**	**12 DAP**	**17 DAP**	**22 DAP**
UAD_EXP_00	Seed Treatment	12.7 d	38.8 c	55.1 c	55.6 d
UAD_EXP_16	Seed Treatment	18.4 cd	41.8 c	61.7 c	65.8 cd
UAD_EXP_33	Seed Treatment	29.1 c	47.9 bc	60.7 c	60.7 cd
UAD_EXP_40	Seed Treatment	15.3 d	37.8 c	52.6 c	54.6 d
UAD_EXP_48	Seed Treatment	21.4 cd	50.5 b	64.8 bc	67.9 bc
Farmore FI 400	Seed Treatment	18.4 cd	57.2 b	78.1 ab	79.6 ab
Capture LFR, 8.5 oz	In-furrow spray	82.7 a	91.3 a	92.4 a	90.3 a
Entrust SC, 7 oz	In-furrow spray	70.9 a	80.6 a	81.7 a	80.7 a
Verimark, 10 oz	In-furrow spray	70.4 a	82.2 a	84.7 a	81.6 a
Untreated	-	56.6 b	62.3 b	62.3 c	60.2 cd

Means followed by the same letter are not significantly different (P>0.05).

Figure 6. % Plants in each plot that had 2-fully expanded true leaves at 22 days after planting.