CALIFORNIA MELON RESEARCH BOARD
2017 Final Report

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PROJECT TITLE:

Evaluation of Insecticide Alternatives for Whiteflies and CYSDV in Melons

PRINCIPLE INVESTIGATOR:

John C. Palumbo
Yuma Agricultural Center, Dept. of Entomology, University of Arizona, Yuma, Arizona

SUMMARY OF RESEARCH RESULTS:

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

- Management of whiteflies and CYSDV continues to be a research priority for fall cantaloupes and honeydews. Adult infestations and virus incidence were moderate-heavy in spring melon crops this year, and moderate on fall melons. Several trials were designed to exam new insecticide alternatives for whitefly control and virus suppression. The need for new insecticides remains critical considering the reliance on neonicotinoids and regulatory issues surrounding pollinator protection.
- We evaluated several novel foliar insecticides for knockdown and residual control of whitefly adults and nymphs on cantaloupes. Results from several spring and fall trials have allowed us to update and develop new guidelines to assist melon growers in using insecticides for whitefly control until new alternatives become available.
- Research this year showed that a number of core foliar insecticides continue to provide suppressive activity against whiteflies and CYSDV including Venom/Certador (both dinotefuron formulations), and Exirel. The efficacy of Assail (5.3 oz) was again inconsistent this year, but when applied at higher rates (8 oz), provided activity comparable to the standards. A new formulation of Sivanto (Sivanto prime) applied as a foliar spray provided excellent control and adequate crop safety at 10 oz/ac on smaller plants. However, it still does not have a foliar label on melons. The most promising foliar alternative is PQZ (pyrifluquinazone), which has consistently provided excellent adult control and CYSDV suppression. The manufacturer expects a US EPA registration by May 2018. Another new compound is BAS 440 which has shown good potential for both adults /CYSDV suppression and residual control of nymphs.
- Research with soil insecticides Venom and Sivanto in soil shank trials showed that Sivanto (28 oz) applied at-planting consistently controlled whiteflies and delayed CYSDV incidence comparable to the industry standard, Venom.

EVALUATION OF NEW FOLIAR INSECTICIDES

A. Spring Foliar Insecticide - *Trial I*

***Research procedures*:** Cantaloupe plots planted with 'Olympic Gold' were established on 19 Apr, 2017 at the Yuma Agricultural Center. The trial was managed similarly to local growing practices. Plots consisted of one 84-inch bed, 40 ft long with a 7 buffer between each plot. The studies were designed as a randomized complete block design with 4 replicates / treatment. The treatments and rates are shown in the tables below. Three foliar sprays were applied on 15, 13 and 22 Jun with a CO_2 operated boom sprayer at 50 psi and 23.5 gpa and applied as a full broadcast application. An adjuvant, Dyne-Amic, was applied at 0.25% v/v to all treatments.

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 following application (DAA), 5 separate plants from each replicate were sampled by vacuuming and containers with adults were taken into the laboratory, where the number of adults/ plant was recorded. Immature densities were estimated at 7 and 14 days following the 3rd application by sampling 10 plants / plot, where 3 leaves per plant were collected from various node locations on the primary 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 incidence was measure by recording the number of leaves that expressed symptoms of pale interveinal chlorosis (PIVC) and yellow interveinal chlorosis (YIVC) consistent with CYSDV infection in 40 ft of each plot at various intervals prior to harvest. Because of heterogeneity of mean variances, data were transformed using a $\log_{10}(x + 1)$ function before analysis and subjected to ANOVA; means were compared using Turkey's HSD test ($P \leq 0.05$). Means from non-transformed data are presented in the tables.

Summary: The objective of this trial was to compare the efficacy of two new experimental compounds (BAS440, a new AI with a unique mode of action; and Certador, a generic formulation of dinotefuron) against neonicotinoid and other insecticides used for control of whiteflies and CYSDV on melons. Table 1 shows that BAS440 did not provide knockdown or residual control of adults comparable to the standards (Venom, Exirel). In contrast, Certador provided as good or better control of adults as Venom following each application. Unlike our trials last season, Assail at the 5.3 oz rate provided good adult control. The only product that did not significantly provide adult control was Endigo. All of the products, except Endigo, significantly reduced whitefly nymph densities relative to the untreated check following the 3rd application (Table 2). CYSDV infection was high in this trial and all of the products significantly reduced the incidence of CYSDV symptoms comparable to Venom in the absence of any additional soil applications (Tables 3). This was expected for Certador due to its similarity with Venom, but we were unsure about BAS 440. However, given its proposed mode of action as a feeding blocker, the product appears to be an effective anti-feedant compound which is critical for suppression CYSDV. Certador is currently available, and BAS 440 will likely be available in late 2018 or early 2019.

Table 1. Knockdown and residual activity of new foliar insecticides against WF adults, Spring 2017

		Avg. Whitefly adults / Sample					
		1-DAA1	*3-DAA1*	*7-DAA1*	*1-DAA2*	*3-DAA2*	*7-DAA2*
Treatment	**Rate/ac**	**6-Jun**	**8-Jun**	**12-Jun**	**14-Jun**	**16-Jun**	**20-Jun**
BAS 440	7 oz	21.4bc	24.6b	16.9bc	21.4bc	24.6b	16.9bc
Venom	3 oz	4.3d	10.7b	26.9abc	4.3d	10.7b	26.9abc
Certador	26 oz	4.3d	7.8b	17.5c	4.3d	7.8b	17.5c
Assail	5.3 oz	7.9cd	16.6b	15.4bc	7.9cd	16.6b	15.4bc
Sivanto	10 oz	4.5d	7.8b	8.8c	4.5d	7.8b	8.8c
Exirel	20 oz	14.1a	1.5d	1.4c	1.4c	2.2c	2.9c
Endigo	4.5 oz	45.5ab	79.1a	52.7a	45.5ab	79.1a	52.7a
Untreated	-	61.9a	89.0a	49.5a	61.9a	89.0a	49.5a

		Avg. Whitefly adults / Sample			
		1-DAA3	*3-DAA3*	*7-DAA3*	**Trial**
Treatment	**Rate/ac**	**23-Jun**	**25-Jun**	**29-Jun**	**Avg.**
BAS 440	7 oz	21.4bc	24.6b	16.9bc	16.7b
Venom	3 oz	4.3d	10.7b	26.9abc	7.0c
Certador	26 oz	4.3d	7.8b	17.5c	6.4c
Assail	5.3 oz	7.9cd	16.6b	15.4bc	6.9c
Sivanto	10 oz	4.5d	7.8b	8.8c	4.2c
Exirel	20 oz	3.3d	6.1b	11.9c	5.0c
Endigo	4.5 oz	45.5ab	79.1a	52.7a	35.9a
Untreated	-	61.9a	89.0a	49.5a	50.4a

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

Table 2. Whitefly immature densities at 14 days after the 3rd application, spring 2017

		Avg. Whitefly nymphs /cm^2 / leaf			
Tmt	**Rate/ac**	**5th leaf**	**10th leaf**	**15th leaf**	**Avg.**
BAS 440	7 oz	29.8b	7.4b	2.6b	13.3b
Venom	3 oz	20.1b	7.9b	0.6b	9.6b
Certador	26 oz	21.4b	4.3b	1.3b	9.0b
Assail	5.3 oz	14.9b	8.3b	2.3b	8.5b
Sivanto	10 oz	17.8b	5.4b	1.6b	8.3b
Exirel	20 oz	12.7b	1.8b	0.2b	4.9b
Endigo	4.5 oz	99.2a	32.1a	13.0a	48.1a
Untreated	-	118.6a	41.8a	15.0a	58.5a

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

Table 3. Incidence of CYSDV in melons treated with foliar insecticides, spring 2016.

Treatment	Rate/ac	Avg. Adults	CYSDV Incidence (No. symptomatic leaves / 40 ft) 22-Jun PIVC+YIVC	CYSDV Incidence (No. symptomatic leaves / 40 ft) Jul 1 YIVC
BAS 440	7 oz	16.7b	86.8 ab	52.7 b
Venom	3 oz	7.0c	63.0 b	40.8 b
Certador	26 oz	6.4c	110.5 ab	68.8 b
Assail	5.3 oz	6.9c	77.3 b	38.5 b
Sivanto	10 oz	4.2c	63.3 b	31.0 b
Exirel	20 oz	5.0c	68.3 b	38.0 b
Endigo	4.5 oz	5.0c	82.6 ab	60.0 b
Untreated	-	50.4a	156.5 a	121.3a

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

B. Spring Foliar Insecticide - *Trial II*

***Research procedures*:** Cantaloupe plots planted with 'Olympic Gold' were established at the Yuma Agricultural Center on 19 Apr, 2017 and managed similarly to local growing practices. Plots consisted of one 84-inch bed, 40 ft long with a 7 buffer between each plot. The study was designed as a randomized complete block design with 4 replicates / treatment. Two foliar sprays were applied on 31 May, and 14 Jun with a CO_2 operated boom sprayer at 40 psi and 23.5 gpa. A broadcast application was delivered through 2 TXVS-18 ConeJet nozzles per bed. An adjuvant, Dyne-Amic (Helena Chemical Co.), was applied at 0.25% vol/vol to all treatments. The Ecozin treatment was buffered to 5.5 pH using Neutralizer at 0.1% vol/vol. Assessments of whitefly adults and immatures, and CYSDV incidence were conducted similar to the trials above.

Summary: The objective of this trial was to compare new, and unregistered foliar insecticides against the conventional standards for control of whitefly adults and relative suppression of CYSDV symptoms. Most of the products provided excellent knockdown of adults and residual control up to 7 days following each application. Overall, Exirel at both rates, Sivanto Prime and PQZ (pyrfluquinazon) provided the most significant adult control (Tables 4), and when averaged across all sprays, PQZ provided the most consistent level of adult control. Control of adults with Agri-Mek and UAEXP_2800 was inconsistent following each spray. Minecto Pro (an in-can mixture of Exirel at 13.5 oz and Agric-Mek 4.3 oz) provided adult control comparable to Exirel at 13.5 oz. All products provided excellent control of nymphs (Table 5), and Exirel was especially effective, regardless of rate applied. In terms of CYSDV incidence, Sivanto Prime and PQZ were the only treatments to significantly reduce CYSDV incidence at harvest maturity (Table 6). Unfortunately, Sivanto is not labeled for foliar use on cantaloupe/honeydews due to potential phytotoxicity on melon foliage. In this trial we observed marginal phytotoxicity on older foliage at the 10 oz rate following the 3rd application. Minecto is currently labeled and offers a potential alternative to Exirel. PQZ is currently not registered for use on melons, but the manufacturer (Nichino America) expects an US EPA registration by May 2018, and an AZ/CA registration by fall 2018.

Table 4. Knockdown and residual activity of foliar insecticides against adults, Spring 2017

		Avg. Whitefly adults / Sample				
		2 DAA-1	5 DAA-1	7 DAA-1	12 DAA-1	1 DAA-2
Treatment	Rate/ac	2-Jun	5-Jun	7-Jun	12-Jun	15-Jun
Exirel	20 oz	5.1a	2.2d	2.8de	1.6d	2.1de
Exirel	13.6 oz	3.5ab	2.8cd	1.9de	1.4d	3.2cd
Minecto Pro	10 oz	4.0ab	3.6cd	2.9cde	3.2cd	6.7bcd
Agri-Mek SC	4.25 oz	5.3a	13.7abc	17.1abc	6.8bc	14.9ab
Sivanto Prime	10 oz	1.8bc	2.4cd	3.5cde	3.9bcd	2.4cde
PQZ	3.2 oz	1.1c	2.8cd	1.5e	1.1d	0.6e
UAEXP_2800	40 oz	5.9a	26.6ab	18.1ab	14.8ab	19.0ab
Untreated	-	7.1a	53.9a	37.6a	28.8a	45.2a

		Avg. Whitefly adults / Sample			
		4 DAA-2	8 DAA-2	14 DAA-2	
Treatment	Rate/ac	18-Jun	22-Jun	28-Jun	Avg.
Exirel	20 oz	3.6de	8.1cd	36.2a	7.7ef
Exirel	13.6 oz	4.6de	6.9d	27.6a	6.5ef
Minecto Pro	10 oz	6.8cd	11.6bcd	51.0a	11.2cde
Agri-Mek SC	4.25 oz	29.1ab	31.3ab	32.1a	18.8abc
Sivanto Prime	10 oz	5.1de	12.3bcd	20.2ab	6.4def
PQZ	3.2 oz	1.8e	2.6d	6.2b	2.2f
UAEXP_2800	40 oz	23.3abc	31.2ab	36.8a	22.6ab
Untreated	-	29.4ab	31.7ab	42.4a	23.5ab

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

Table 5. Whitefly immature densities at 14 days after the 3rd application, spring 2017.

		Whitefly nymphs /cm^2 / leaf			
Tmt	Rate/ac	5th leaf	10th leaf	15th leaf	Avg.
Exirel	20 oz	4.9d	2.9c	0.2d	2.7d
Exirel	13.6 oz	3.3d	2.3c	0.5d	2.0d
Minecto Pro	10 oz	7.5d	4.4c	2.1cd	4.7d
Agri-Mek SC	4.25 oz	31.5b	32.8b	14.5bc	26.3b
Sivanto Prime	10 oz	10.3d	4.7c	1.0d	5.3cd
PQZ	3.2 oz	8.3d	13.5bc	4.9bcd	8.9cd
UAEXP_2800	40 oz	11.5d	14.5bc	17.1ab	14.4bcd
Untreated	-	63.9a	62.1a	29.0a	51.7a

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

Table 6. Incidence of CYSDV in melons treated with foliar insecticides, spring 2017.

			CYSDV Incidence (No. symptomatic leaves / 40 ft)
Treatment	**Rate/ac**	**Avg. Adults**	**Jul 1**
Exirel	20 oz	7.7ef	51.8ab
Exirel	13.6 oz	6.5ef	54.5ab
Minecto Pro	10 oz	11.2cde	56.8ab
Agri-Mek SC	4.25 oz	18.8abc	58.0ab
Sivanto Prime	10 oz	6.4def	39.8b
PQZ	3.2 oz	2.2f	38.5b
UAEXP_2800	40 oz	22.6ab	65.8ab
Untreated	-	23.5ab	108.5a

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

C. Spring Foliar Insecticide - *Trial III*

***Research procedures*:** Cantaloupe plots planted with 'Olympic Gold' were established at the Yuma Agricultural Center on 19 Apr, 2017 and managed similarly to local growing practices. Plots consisted of one 84-inch bed, 40 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. Two foliar sprays were applied on 1 and 13 Jun with a CO_2 operated boom sprayer at 50 psi and 23.5 gpa. A broadcast application was delivered through 2 TXVS-18 ConeJet nozzles per bed. An adjuvant, Dyne-Amic was applied at 0.25% vol/vol to all treatments. Assessments of adults and immatures were conducted similar to the trials above. CYSDV was not evaluated in this trial.

Summary: The objective of this trial was to compare the newly registered insecticide Cormoran, and an experimental foliar compound UAEXP-101 against whitefly adults and nymphs relative to current standards. Cormoran is an in-can mixture of the neonicotinoid, Assail (5.3 oz) and an IGR, Diamond (12 oz). Not surprisingly, Cormoran provided the same level of adult control as the Assail treatment (Table 7). Unfortunately, the experimental compound UAEXP-101 does not appear to have significant activity against either whitefly adults or nymphs (Table 8). Similarly, Diamond did not provide significant reduction of either adults and nymphs even though the manufacture claims it is effective. However, Cormoran provided as good as or better control of whitefly nymphs as Assail (Table 8) indicating that the Assail is the active component of the Cormoran mixture, rather than the Diamond or combination of both. Another consistent result of this trial was the lack of efficacy provided by Endigo (in-can mixture of Actara+Warrior). We have observed this lack of whitefly control in previous trials as well and do not recommend its use in whitefly control.

Table 7. Knockdown and residual activity of foliar insecticides against adults, Spring 2017

		Avg. No. Whitefly Adults / Sample			
		1-DAA1	*4-DAA1*	*7-DAA1*	*1-DAA2*
Treatment	**Rate**	**2-Jun**	**5-Jun**	**8-Jun**	**14-Jun**
Cormoran	12 oz	3.4b	6.1a	10.2b	9.8bc
Diamond	12 oz	4.0ab	15.2a	26.4ab	30.0a
Assail	5.3 oz	4.3ab	7.8a	9.1b	4.9c
Endigo	4.5 oz	4.2ab	27.7a	61.4a	42.3a
Actara+Warrior II	5.5 + 1.9 oz	3.3b	16.9a	45.1ab	22.6ab
UAEXP-101	28 oz	8.5a	13.9a	27.0ab	37.9a
Untreated	-	6.9ab	22.0a	36.2ab	59.3a

		Avg. No. Whitefly Adults / Sample			
		3-DAA2	*7-DAA2*	*14-DAA2*	
Treatment	**Rate**	**16-Jun**	**20-Jun**	**27-Jun**	**Avg.**
Cormoran	12 oz	4.9c	14.8b	18.2b	9.6b
Diamond	12 oz	48.7a	48.7a	28.3ab	27.7a
Assail	5.3 oz	5.0c	18.1b	32.2ab	11.6b
Endigo	4.5 oz	28.9ab	45.3a	80.3a	41.4a
Actara+Warrior II	5.5 + 1.9 oz	17.1b	32.5ab	60.4a	28.2a
UAEXP-101	28 oz	47.9a	63.1a	54.4ab	36.1a
Untreated	-	49.4a	46.4a	42.7ab	37.5a

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

Table 8. Whitefly immature densities at 14 days after the 2nd application, spring 2017.

		Whitefly nymphs /cm^2 / leaf			
Tmt	**Rate/ac**	**5th leaf**	**10th leaf**	**15th leaf**	**Avg.**
Cormoran	12 oz	9.3b	10.3c	4.8bc	8.1c
Diamond	12 oz	52.4a	31.2b	31.0a	38.2a
Assail	5.3 oz	6.7b	8.3c	2.6c	5.9c
Endigo	4.5 oz	56.6a	59.7a	25.6a	47.3a
Actara+Warrior II	5.5 + 1.9 oz	36.8a	25.4b	11.2ab	24.5b
UAEXP-101	28 oz	52.5a	45.6ab	21.6a	39.9a
Untreated	-	40.7a	28.6b	20.4a	29.9a

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

D. Spring Foliar Insecticide - *Trial IV*

***Research procedures*:** Cantaloupe plots planted with 'Olympic Gold' were established at the Yuma Agricultural Center on 19 Apr, 2017 and managed similarly to local growing practices. Plots consisted of one 84-inch bed, 40 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. Three foliar sprays were applied on 30 May, and 7, and 15 Jun with a CO_2 operated boom sprayer at 50 psi and 23.5 gpa. A broadcast application was delivered through 2 TXVS-18 ConeJet nozzles per bed. An adjuvant, Dyne-Amic was applied at 0.25% vol/vol to all treatments. Assessments of adults, immatures, and CYSDV incidence were conducted similar to the trials above.

Summary: The objective of this trial was to evaluate whether a higher rate or different formulation of Assail could provide improved efficacy against whiteflies in melons. Table 9 shows that Assail provided comparable control of nymphs regardless of rate or formulation. Overall, Exirel and PQZ provided the most consistent control of nymphs. Similarly, the use of the higher rates (8 oz - 3.4 oz) of the Assail formulations did provide for improved knockdown or residual control of adults (Table 10). When averaged across the three sprays, the Assail treatments did not provide as consistent adult control as PQZ or Venom. In terms of virus infection, only the Assail 30SC formulation at the higher 8 oz rate and PQZ, Venom and Exirel provided significant suppression of CYSDV. The lower rates of Assail 30SG and 70WP which are currently labeled for use in melons did not significantly reduce CYSDV incicdence compared to the untreated check. The manufacture (UPI) is planning to submit for a SLN label change to allow the use of the higher rate (8 oz) of 30SC on melons

Table 9. Whitefly immature densities at 14 days after the 3rd application, spring 2017.

		Whitefly nymphs /cm² / leaf			
Tmt	**Rate/ac**	**5th leaf**	**10th leaf**	**15th leaf**	**Avg.**
Assail 30SC	8	9.4b	7.9b	3.4b	6.9b
Assail 30SC	5.3	8.0bc	7.3b	1.8bc	5.7b
Assail 70WP	3.4	6.8bc	6.7b	1.4bcd	5.0b
Assail 70WP	2.3	16.2b	6.6b	3.7b	8.8b
PQZ	3.2	2.9d	2.8c	0.3e	2.0b
Venom	4	15.9b	8.1b	0.6cde	8.2b
Exirel	20	4.6cd	4.3bc	0.8de	3.2b
Untreated	-	65.4a	47.4a	24.0a	45.6b

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

Table 10. Knockdown and residual activity of foliar insecticides against adults, Spring 2017

		Avg. Whitefly adults / Sample				
		1-DAA1	**3-DAA1**	**7-DAA1**	**1-DAA2**	**4-DAA2**
Treatment	**Rate/ac**	31-May	2-Jun	6-Jun	8-Jun	11-Jun
Assail 30SC	8	1.9bcd	3.7ab	10.3b	2.82.8b	0.9bc
Assail 30SC	5.3	2.0abcd	3.7ab	8.7b	1.7b	0.9bc
Assail 70WP	3.4	1.8bcd	4.9ab	6.9b	1.7b	0.5bc
Assail 70WP	2.3	2.5abc	2.7ab	6.8b	2.2b	1.5b
PQZ	3.2	0.7d	1.5b	2.5c	2.2b	0.6bc
Venom	4	1.0cd	1.9ab	6.6b	2.5b	0.3c
Exirel	20	6.1a	4.2ab	3.9bc	1.4b	0.4bc
Untreated	-	4.2ab	5.7a	40.6a	44.3a	12.2a

		Avg. Whitefly adults / Sample				
		7-DAA2	**1-DAA3**	**4-DAA3**	**7-DAA3**	**Trial**
Treatment	**Rate/ac**	14-Jun	16-Jun	19-Jun	22-Jun	**Avg**
Assail 30SC	8	3.0b	1.8b	5.4b	10.8b	4.5b
Assail 30SC	5.3	5.6b	2.1b	6.1b	7.5bc	4.2b
Assail 70WP	3.4	5.7b	1.3b	3.6b	6.4bc	3.6bc
Assail 70WP	2.3	6.7b	2.2b	5.9b	10.3b	4.5b
PQZ	3.2	1.0b	0.5b	1.5b	4.4bc	1.5d
Venom	4	1.8b	0.6b	3.2b	6.2bc	2.4d
Exirel	20	2.0b	2.3b	2.5b	2.6c	2.8cd
Untreated	-	48.2a	41.2a	58.9a	47.9a	33.7a

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

Table 11. Incidence of CYSDV in melons treated with foliar insecticides, spring 2017.

		CYSDV Incidence (No. symptomatic leaves / 40 ft)	
		22-Jun	**30-Jun**
Treatment	**Rate/ac**	**PIVC + YIVC**	**YIVC**
Assail 30SC	8	44.8a	36.5b
Assail 30SC	5.3	58.8a	69.0ab
Assail 70WP	3.4	50.0a	61.5ab
Assail 70WP	2.3	44.0a	53.5ab
PQZ	3.2	17.5b	27.8b
Venom	4	24.0a	32.5b
Exirel	20	21.3a	32.5b
Untreated	-	75.0a	103.8a

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

E. Fall Foliar Insecticide - *Trial I*

***Research procedures*:** Cantaloupe plots planted with 'Expedition' were established at the Yuma Agricultural Center on 4 Aug, 2017 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. Three foliar sprays were applied on 24 and 31 Aug and 12 Sep with a CO_2 operated boom sprayer at 50 psi and 23.5 gpa. A banded (50%) broadcast application was delivered through 2 TXVS-18 ConeJet nozzles per bed on the first two sprays, followed by full broadcast application on the third spray. An adjuvant, Dyne-Amic was applied at 0.25% vol/vol to all treatments. Assessments of adults, immatures and CYSDV were conducted similar to the trials above.

Summary: The objective of this fall trial was to further evaluate the efficacy of several insecticides that we compared in the spring against whiteflies and CYSDV. Similar to the spring results, all of the foliar spray treatments significantly reduced whitefly adults compared to the untreated check, except for Agri-Mek and Endigo (Table 12). Assail applied at the high rate (8 oz) provided similar activity to Exirel, PQZ, Sivanto prime and Venom – the leading treatments in most trials. Exirel at the 20 oz (top of the label rate) rate provide significantly better adult control than Minector Pro at 10 oz (top rate). CYSDV infection was moderate-heavy this fall, and didn't infect plants until later in the season (Table 13). Overall, the treatments that provided most significant reduction in CYSDV incidence were Assail, 8 zo, PQZ, Sivanto prime, and Venom. Similar to the spring trials, Agri-Mek and Endigo did not suppress CYSDV. Minecto Pro did not suppress CYSDV comparable to the Exirel at 20 oz, but this would be expected since the Exirel-equivalent rate in in the Minecto is only 13.5 oz. Consequently, we do not recommend Minecto Pro under heavy whitefly and CYSDV pressure, but rather growers should use Exirel at the high rate (20 oz). The enhanced consistency of Assail 30SG at the higher rate (8 oz) is encouraging and should be available for use at this rate in the near term assuming UPI is successful in their SLN request.

Table 12. Knockdown and residual activity of foliar insecticides against adults, fall 2017

		Avg. Whitefly adults / Sample				
		1-DAA1	4-DAA1	7-DAA1	1-DAA2	4-DAA2
Treatment	**Rate/ac**	***25-Aug***	***28-Aug***	***31-Aug***	***1-Sep***	***4-Sep***
Exirel	20 oz	2.6abcd	52ab	2.4abc	0.7ab	1.2bc
Minecto Pro	10 oz	6.7a	9.8a	3.7ab	0.9ab	4.0ab
Agri-Mek SC	4.25 oz	5.6ab	10.6a	2.6abc	0.7ab	3.3ab
Sivanto Prime	10 oz	0.5e	3.6ab	1.0bcd	0.1b	0.5c
PQZ	3.2 oz	0.9de	1.3b	0.3d	0.2b	0.2c
Assail 30SG	8 oz	0.6e	4.0ab	1.3bcd	0.4b	0.8bc
Assail 30SG	5.3 oz	1.8bcde	5.1ab	1.7abc	0.3b	1.2bc
Endigo	4.5 oz	4.3abc	7.3a	3.0abc	1.2ab	3.6ab
Venom	4 oz	1.0cde	3.2ab	1.3cd	0.4b	1.1bc
Untreated	-	8.5a	7.3a	3.6a	3.0a	6.4a

Table 12. continued

		Avg. Whitefly adults / Sample				
Treatment	**Rate/ac**	**7-DAA2** ***7-Sep***	**1-DAA3** ***13-Sep***	**3-DAA3** ***15-Sep***	**7-DAA3** ***19-Sep***	**Trial Avg.**
Exirel	20 oz	4.1cd	1.3c	1.5cd	1.1cde	2.2c
Minecto Pro	10 oz	12.5bc	7.2b	3.8bc	3.1bc	5.7b
Agri-Mek SC	4.25 oz	50.8ab	28.1ab	7.7ab	11.8ab	13.4ab
Sivanto Prime	10 oz	4.8cd	1.5c	0.4d	0.7e	1.4cd
PQZ	3.2 oz	3.2d	0.7c	0.3d	0.5e	0.8d
Assail 30SG	8 oz	5.8cd	1.1c	1.0cd	2.2cde	1.9cd
Assail 30SG	5.3 oz	11.3bcd	1.6c	1.1cd	2.5cd	2.9c
Endigo	4.5 oz	52.5a	21.9ab	39.9a	32.9a	18.5ab
Venom	4 oz	6.6cd	1.4c	0.4d	0.6de	1.8cd
Untreated	-	77.2a	38.1a	30.0a	14.1ab	20.9a

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

Table 13. Incidence of CYSDV in melons treated with foliar insecticides, fall 2017.

		CYSDV Incidence (No. symptomatic leaves / 40 ft)		**% CYSDV Infection at Harvest**
Treatment	**Rate**	*21-Sep*	*29-Sep*	*17-Oct*
Exirel	20 oz	39.3 a	145.0 ab	62.5 bcd
Minecto Pro	10 oz	48.5 a	182.0 a	78.8 abc
Agri-Mek SC	4.25 oz	4.0 a	81.0 ab	85.0 ab
Sivanto Prime	10 oz	13.0 a	45.8 b	32.5 e
PQZ	3.2 oz	5.8 a	26.8 b	36.3 de
Assail 30SG	8 oz	7.5 a	42.0 b	33.8 e
Assail 30SG	5.3 oz	13.3 a	97.5 ab	53.8 cde
Endigo	4.5 oz	29.3 a	182.8 a	95.0 a
Venom	4 oz	17.5 a	49.8 b	35.0 de
UTC	-	28.8 a	140.3 a	93.8 a

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

F. Fall Foliar Insecticide - *Trial II*

***Research procedures*:** Cantaloupe plots planted with 'Expedition' were established at the Yuma Agricultural Center on 4 Aug, 2017 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. Venom (6 oz/ac) was applied to all plots (except the untreated check) using a single soil shank injection at planting time applied 3" directly below the seed line in 10.5 GPA total volume. A single spray application was applied on 28 Aug with a CO_2 operated boom sprayer at 50 psi and 23.5 gpa. A banded (50%) broadcast application was delivered through 2 TXVS-18 ConeJet nozzles per bed. An adjuvant, Dyne-Amic was applied at 0.25% vol/vol to all treatments. Assessments of adults and immatures were conducted similar to the trials above. CYSDV was not evaluated in this trial.

Summary: The objective of this trial was to compare the efficacy of the new insecticide BAS 440 against whitefly adults and nymphs under fall growing conditions. A single application was made in this trial to classify the residual control of this product compared to a variety of whitefly-active insecticides. BAS 440 provided adult residual activity comparable to the standard neonicotinoids (Certador and Assail), Exirel, Fulfill and Courier (Table 14). Similarly, BAS 440 provided excellent residual control of whitefly nymphs comparable to the industry standards (Table 15). Previous studies have shown that BAS 440 can suppress CYSDV, but BAS 440 is also a good candidate for use on spring and summer melons for residual control of nymphs prior to harvest.

Table 14. Knockdown and residual activity of foliar insecticides against adults on fall melons, 2017

		Avg. Whitefly Adults / 3 sec vacuum sample						
		1 DAA	*3 DAA*	*7 DAA*	*14 DAA*	*21 DAA*	*28 DAA*	
Treatment	**oz/ac**	**29-Aug**	**31-Aug**	**4-Sep**	**11-Sep**	**18-Sep**	**25-Sep**	**Avg.**
BAS 440	7	4.5ab	0.5c	0.4b	2.2b	2.0a	2.1a	1.9bc
Certador	26	0.9c	0.1c	0.3b	2.5b	1.5a	1.0a	1.0c
Assail	5.3	1.9bc	0.5c	0.5b	3.0b	3.2a	1.7a	1.8bc
Fulfill	2.75	6.1ab	3.2ab	0.7b	3.3b	2.3a	1.7a	2.9b
Courier	16	6.8ab	2.8ab	0.47b	3.0b	5.3a	2.2a	3.4b
Exirel	20	3.2bc	0.7bc	0.4b	2.9b	2.4a	1.3a	1.8bc
UTC	-	12.6a	3.3a	4.1a	25.0a	9.6a	7.5a	10.3a

Table 15. Residual control of Whitefly nymphs on fall melons, 2017

		Avg. Whitefly Nymphs / cm^2 / leaf				
Treatment	**oz/ac**	**7-DAA**	**14 DAA**	**21 DAA**	**28 DAA**	**Avg.**
BAS 440	7	1.6bc	0.6b	1.1b	2.9c	1.3bc
Certador	26	1.4bc	0.0c	1.3b	3.1c	1.1cd
Assail	5.3	1.7b	0.4b	1.5b	4.2bc	1.4bc
Fulfill	2.75	2.4b	0.8b	1.1b	6.0b	2.0b
Courier	16	1.9b	0.6b	0.8b	4.9bc	1.8b
Exirel	20	0.3c	0.0c	1.1b	3.9c	1.0d
UTC	-	18.5a	3.8a	8.4a	16.8a	10.0a

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

G. Fall Foliar Insecticide - *Trial III*

***Research procedures*:** Cantaloupe plots planted with 'Expedition' were established at the Yuma Agricultural Center on 4 Aug, 2017 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. Sivanto (28 oz/ac) was applied to all plots (except the untreated check) using a single soil shank injection at planting time applied 3" directly below the seed line in 10.5 GPA total volume. Three spray applications were applied on 24 and 31 Aug, and 12 Sep with a CO_2 operated boom sprayer at 50 psi and 23.5 gpa. A banded (50%) broadcast application was delivered through 2 TXVS-18 ConeJet nozzles per bed on the first two sprays, and a broadcast application was applied on the 3rd spray. An adjuvant, Dyne-Amic was applied at 0.25% vol/vol to all treatments. Assessments of adults and CYSDV were conducted similar to the trials above.

Summary: Research out of Florida has indicated that M-Pede has successfully suppressed whitefly transmitted viruses on tomatoes. The objective of this trial was to evaluate M-Pede (an insecticidal soap) used alone and in combination with other insecticides against whiteflies for suppression of CYSDV in fall melons. Results in melons showed that as a standalone spray, M-Pede significantly reduced whitefly adults compared to the untreated check (Table 16). Addition of M-Pede to Exirel and Assail did not enhance their activity against adults over that of either product applied alone. Surprising, the M-Pede spray significantly suppressed CYSDV comparable to all of the other spray treatments including PQZ. Of course, the application of Sivanto at planting may have also contributed to the suppression of CYSDV in all of the treatments. Nonetheless, these results are interesting and suggest that we should look more carefully at the potential of M-Pede and other insecticidal soaps for suppressing CYSDV.

Table 16. Knockdown and residual activity of foliar insecticides against adults, fall 2017

		Avg. Whitefly adults / Sample				
		1 DAA-1	*4 DAA-1*	*7 DAA-1*	*1 DAA-2*	*4 DAA-2*
Treatment	**Rate/ac**	**25-Aug**	**28-Aug**	**31-Aug**	**1-Sep**	**4-Sep**
M-Pede	2%	5.5a	6.0ab	3.1a	0.9ab	0.6ab
Exirel	20 oz	1.5ab	5.9abc	3.2a	1.2ab	0.7ab
Assail	5.3 oz	1.4ab	4.6abc	1.9ab	0.4ab	0.1b
Exire + M-Pede	20+2%	1.5ab	3.5bc	1.9ab	0.8ab	0.2b
Assail + M-Pede	5.3+2%	0.5b	3.7abc	1.9ab	0.2b	0.2b
PQZ	3.2 oz	0.7b	1.4c	0.8b	0.2b	0.1b
Untreated	-	7.1a	11.0a	2.7a	2.1a	1.3a

		Avg. Whitefly adults / Sample				
		7 DAA-2	*1 DAA-3*	*3 DAA-2*	*7 DAA-3*	**Trial**
Treatment	**Rate/ac**	**7-Sep**	**13-Sep**	**15-Sep**	**19-Sep**	**Avg.**
M-Pede	2%	5.1b	4.1b	2.2b	2.5ab	3.3b
Exirel	20 oz	4.1b	1.1c	1.8b	1.7ab	2.3bc
Assail	5.3 oz	2.8bc	0.6c	1.0b	1.5b	1.6cd
Exire + M-Pede	20+2%	4.8b	1.2c	1.8b	0.8b	1.7cd
Assail + M-Pede	5.3+2%	4.9b	0.6c	0.8b	3.4ab	1.8cd
PQZ	3.2 oz	1.9c	0.3c	0.5b	0.7b	0.7d
Untreated	-	66.3a	20.5a	11.6a	8.3a	14.5a

Table 17. Incidence of CYSDV in melons treated with foliar insecticides, fall 2017.

		CYSDV Incidence (No. symptomatic leaves / 40 ft)		% CYSDV Infection at Harvest
Treatment	**Rate**	**21-Sep**	**29-Sep**	*17-Oct*
M-Pede	2%	3.8a	17.8 a	40.0 b
Exirel	20 oz	8.3a	58.3a	37.5 b
Assail	5.3 oz	4.0a	24.8a	33.8 b
Exire + M-Pede	20+2%	2.8a	34.3a	35.0 b
Assail + M-Pede	5.3+2%	5.5a	28.3a	28.85 b
PQZ	3.2 oz	6.8a	23.5a	28.0 b
Untreated	-	4.0a	45.0a	80.0 a

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

SOIL AND FOLIAR INSECTICIDE PROGRAMS

*Fall Melons – Soil Insecticide * Variety Management Program*

***Research procedures*:** Cantaloupe plots planted with 'Expedition' and 'Caribbean King' were established on 4 Aug, 2017 at the Yuma Agricultural Center. Plots consisted of one 84-inch bed, 60 ft long with a 7 buffer between each plot. The study was designed as a randomized split-plot design with 4 replicates / treatment. Varieties were main plots and soil treatments were sub plots. The soil and foliar treatments and rates are shown in the tables below. All treatments, except the untreated control, were treated with a single soil shank injection at planting time applied 3" directly below the seed line in 10.5 GPA total volume (treatments listed below). A side dress application of Venom (6 oz) was 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 to all treatments but the non-treated check. Six foliar sprays were applied with a CO_2 operated boom sprayer at 50 psi and 23.5 gpa. A banded (50%) broadcast application was delivered through 2 TXVS-18 ConeJet nozzles per bed on the first 2 sprays, followed by full broadcast application on the final 4 sprays. An adjuvant, Dyne-Amic was applied at 0.25% vol/vol to all treatments (see tales below for products applied and timing).

Adult populations were estimated using a leaf turn method of counting all adults present on the 3rd - 4th terminal leaf. On each sample date flowing application (DAA), 5 separate plants from each replicate were sampled. CYSDV incidence was measure by recording the number of leaves that expressed symptoms of the virus and yellow interveinal chlorosis consistent with CYSDV infection in 60 ft within each plot at various interval after injection (DAA). At harvest, the percent of leaves in the plot infected with CYSDV were estimated. CYSDV incidence was estimated four times prior to harvest. Yields were estimated by harvesting all mature melons in 25 row ft within each plot. Plots were harvested 6 times over a 2-week period beginning Oct 15. Fruit yields were measured by harvesting and recording the number of mature melons /plot and classifying their numbers by carton size: (large - 6, 9, 12) and (small- 15, 18, 23). % Sugar levels (Brix) for 3-5 large fruit from each plot on each harvest date were recorded using a standard refractometer. Sooty mold (%) was also recorded for each melon.

At-plant, Soil Treatment (rate)	Side-dress (rate/ac)	Foliar Treatments
Venom (6 oz)	Venom (6 oz)	Sprayed 5 times
Sivanto (28 oz)		

Spray Date	Plant Stage	Foliar insecticides applied
16-Aug	2 lf	Venom 4 oz +Brigade 5 oz
22-Aug	4 lf	Exirel 20 oz + Sniper 5 oz
29-Aug	1st bloom	PQZ 3.2 oz + Dicipline- 6 oz
5-Sep	1st fruit	PQZ 3.2 oz
15-Sep	Fruit	Exirel 20 oz
21-Sep	Netted	Assail 5.3 oz

Summary: A similar trial was conducted last fall and provided some very useful information. The purpose of this trial was to evaluate for a second season a standard fall whitefly/CYSDV management program comparing Sivanto and Venom using the same conventional foliar insecticide spray regime. We conducted the trial on two different melon varieties (the western shipper 'Expedition'; and the harper LSL 'Caribbean King') to examine differences in CYSDV and yield responses. Whitefly populations were moderate, but stayed consistent during the trial. Prior to and after the 1st spray, whitefly adult numbers were significantly lower in the Sivanto and Venom treatments compared with the untreated check. Following the side-dress application adult numbers were reduced comparably in all soil-sprayed treatments relative to the non-treated check in both varieties (Table 20). Averaged across the trial, whitefly numbers did not differ significantly in the Venom and Sivanto treatments. Further, whitefly numbers did not differ between the two untreated varieties. Similarly, CYSDV incidence was significantly lower in the soil treated plots compared to the untreated, regardless of melon variety and CYSDV incidence did not differ among the two soil treatments.

The significant suppression of CYSDV symptoms resulted in yield differences between the soil treatments and the untreated control. Venom and Sivanto plots, regardless of variety, had significantly larger melons and higher Brix levels than the untreated check. The number of large fruit and Brix levels did not differ among the two soil treatments, but Brix Levels as expected were higher in the Caribbean King . From this study, in addition to similar studies in 2014 and 2016, we can conclude that Sivanto can now be considered a viable soil applied alternative to the standard Venom at-plant application. These results also show that the harper varieties provide an edge over the western shippers for maintaining sugar under similar levels of CYSDV and whitefly pressure.

Table 18. Activity of foliar and soil insecticides by variety against whitefly adults, Spring 2017

Soil Treatment	Variety	Adults / Leaf						
		2-DAA1	6-DAA1	5-DAA2	6-DAA3	6-DAA4	6-DAA5	Trial Avg.
Venom	**Expedition**	0.2b	1.4b	0.7b	1.3b	1.2b	0.8b	0.9b
Sivanto		0.2b	1.4b	0.9b	1.6b	1.2b	0.7b	1.0b
Untreated		8.5a	20.8a	18.2b	6.2a	15.0a	12.1a	13.4a

Soil Treatment	Variety	Adults / Leaf						
		2-DAA1	6-DAA1	5-DAA2	6-DAA3	6-DAA4	6-DAA5	Trial Avg.
Venom	**Caribbean King**	0.1b	0.9b	0.9b	1.6b	1.3b	0.8b	0.8b
Sivanto		0.1b	0.9b	0.7b	1.0b	1.2b	0.8b	0.8b
Untreated		7.5a	24.2a	19.3b	6.9a	14.3a	13.3a	14.3a

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

Table 19. Incidence of CYSDV in two melons varieties treated with foliar and soil insecticides, fall 2017.

Soil Treatment	Variety	CYSDV Incidence (No. symptomatic leaves / 60 ft)			% CYSDV Infection at Harvest
		18-Sep	26-Sep	4-Oct	
Venom	**Expedition**	24.3b	78.3b	89.5b	38.8b
Sivanto		38.0b	87.8b	138.2ab	52.5b
Untreated		122.8a	158.8a	203.8a	81.3a

Soil Treatment	Variety	CYSDV Incidence (No. symptomatic leaves / 60 ft)			% CYSDV Infection at Harvest
		18-Sep	26-Sep	4-Oct	
Venom	**Caribbean King**	43.0b	90.8b	66.8c	52.5b
Sivanto		19.0b	59.5b	54.3 c	40.5b
Untreated		118.3a	169.8a	178.3ab	83.8a

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

Table 20. Fruit yields and quality for two melons varieties treated with foliar and soil insecticides, fall 2017.

Soil Treatment	Variety	Avg. Fruit / 25 row ft			
		Large	Small	Total Fruit	Brix (%)
Venom	**Expedition**	25.4a	6.2b	31.6a	10.8a
Sivanto		26.3a	4.1b	30.4a	11.0a
Untreated		18.3b	8.5a	26.8b	8.2a

Soil Treatment	Variety	Avg. Fruit / 25 row ft			
		Large	Small	Total Fruit	Brix (%)
Venom	**Caribbean King**	27.0a	7.0a	34.0a	13.0a
Sivanto		28.5a	8.0a	36.5a	13.7.0a
Untreated		19.5b	15.5a	35.0a	10.8b

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