Arizona Department of Agriculture
AILRC Grants Program – Final Report for 2019
Project 19-02

<u>**Project title:**</u> **Evaluation of New Insecticides for Insect Management in Desert Head Lettuce**

<u>**Project Investigator:**</u> John C. Palumbo, University of Arizona, Yuma Ag Center

<u>**Location of Research**</u>**:** Yuma Valley Agricultural Center

<u>**Objective:**</u> *To continue to compare the knockdown and residual efficacy of several new insecticides for* thrips, aphid, and worm *control relative to the industry standards currently used in desert head lettuce production.*

Cost-effective insecticides are very important in the production of desert lettuce. New insecticides continue to be developed that have a fit for insect control in desert head lettuce, albeit at a slower rate than 5 years ago. Although most of the newly developed products that growers use are very effective against the key lettuce insect pests, they tend to be very expensive. Thus, it is critical that PCAs continue to explore how to use newer products more cost-effectively. In addition, there are several new, unregistered insecticides that are under development that will likely provide activity against on many of the key pests that infest lettuce. We continue to explore use patterns for existing products as well initiate research to determine how these new chemistries fit into existing insect management programs in our unique desert cropping system.

Key insecticides currently available for control of lettuce insect pests offer many favorable attributes to lettuce growers because they are very selective, environmentally friendly, and very effective against certain insect pests. Products such as Radiant and Proclaim have been the standards for worm control the past few years, but the recent registration of a Minecto Pro and Harvanta have recently provided more options. Similarly, Movento is clearly the most commonly used product for aphid control, but new products (Versys and PQZ) were just recently registered. Use of Admire and generic imidacloprid products as soil insecticides remains about the same, but their cost to the grower has dropped significantly. Finally, a number of new compounds with different modes of action have recently been or are currently under development that provides a wide spectrum of activity against many key insect pests. Based on trials conducted last year, we are gaining important information on their activity and how they might best fit in desert lettuce management programs.

With the growth in organic lettuce production in desert lettuce, we have begun to study organically approved products for insect control and particularly for aphids. Although numerous organically-allowed (OMRI approved) biopesticides are registered for insect control, there is much uncertainty among growers and PCAs whether the products will actually control insects as advertised. Many of the biopesticide manufacturer's claim that their organic products will safely provide broad spectrum insect control that is "as good as or better" than conventional pesticides. Many local PCAs and organic growers are skeptical of these claims because local scientific information to support the manufactures claims is not currently available. In spring 2019, we focused on determining the relative performance Venerate against worms and thrips.

This project is an on-going project and a continuation of the proposal submitted to the AILRC in 2015. Below are the results of a number of field trials conducted in fall of 2018 and spring 2019 that evaluated the efficacy of the new insecticide active ingredients shown in the figure above including lepidopterous larvae (beet armyworm and cabbage looper), sweet potato whiteflies, thrips and aphids, both for conventional and organic head lettuce.

New Reduced-risk Alternatives for Worm Control in Head Lettuce

Objective: The objective of this trial was to compare the activity of several key insecticides for control of Beet Armyworm and Cabbage Looper on Conventional Lettuce under fall growing conditions.

Methods: Head lettuce ' PYB 7101' was direct seeded on 5 Sep, 2018 at the Yuma Valley Agricultural Center, Yuma, AZ into double row beds on 42 inch centers. Stand establishment was achieved using overhead sprinkler irrigation, with furrow irrigation used thereafter. Plots were two beds wide by3ft long and bordered by two untreated beds. Four replications of each treatment were arranged in a RCB design. Formulations and rates for each treatment compound are provided in the tables. Three foliar spray applications were made 28 Sep, 16 Oct and 5 Nov with a CO_2 operated, back-pack sprayer that delivered a broadcast application through 2 TXVS-18 ConeJet nozzles per bed at 40 psi and 22.5 GPA. No adjuvants were added to any of the spray treatments. An adjuvant, Clarion, was applied at 0.25% vol/vol with these spray treatments. At various intervals after applications (DAA), 5-10 plants were randomly selected from each replicate and destructively sampled for the presence of each insect species. Beet armyworm (BAW), cabbage looper (CL) and corn earworm (CEW) control was based on the examination of whole plants for presence of live larvae by instar. Neonate and 1st instar larvae were not included because they had not yet consumed treated leaf tissue. Only large larvae (2nd instar and >) are presented in the tables. Because of heterogeneity of mean variances, insect data were transformed using a log10 (x-1) function before analysis. All data were subjected to ANOVA; means were compared using Turkey's HSD test (P=0.05). Means from non-transformed data are presented in the tables.

Summary: Worm pressure was light-moderate prior to the first application, but declined rapidly following the 2nd and 3rd sprays. Averaged across sprays, all spray treatments provided comparable levels of BAW, CL and CEW control relative to the untreated control. The new products Minecto Pro and Harvanta showed potential for BAE and CL management on fall lettuce. This information may provide PCAs with additional cost-effective options for worm control in desert lettuce.

		Trial Average Mean Large Larvae / 10 plants			
Treatment	**Rate**	**CL**	**BAW**	**CEW**	**Total**
Radiant	5 oz	0.1b	0.1b	0.0a	0.2b
Intrepid + Sniper	10 oz + 5 oz	0.0b	0.1b	0.1a	0.1b
Exirel	13.5 oz	0.1b	0.1b	0.0a	0.1b
Minecto Pro	10 oz	0.1b	0.1b	0.0a	0.1b
Coragen	5 oz	0.5b	0.0b	0.0a	0.5b
Harvanta	10.9 oz	0.2b	0.0b	0.1a	0.2b
Harvanta	16.4 oz	0.1b	0.0b	0.1a	0.2b
Besiege	8 oz	0.1b	0.0b	0.1a	0.2b
Untreated	-	0.8a	0.7a	0.3a	1.8a

Conventional Insecticides Alternatives for Thrips Control in Fall Lettuce

Objective: The objective of this trial was to evaluate the efficacy of several conventional insecticides products against western flower thrips (WFT) in fall lettuce.

Methods: Romaine' Del Sol' was direct seeded on 26 Sep, 2018 at the Yuma Valley Agricultural Center, Yuma, AZ into double row beds on 42 inch centers. Stand establishment was achieved using overhead sprinkler irrigation, and irrigated with furrow irrigation thereafter. Plots were two beds wide by 35 ft long and bordered by two untreated beds. Four replications of each treatment were arranged in a RCB design. Formulations and rates for each compound are provided in the tables. Two foliar sprays were applied 25 Oct and Nov 6 . The applications were made with a CO_2 pressurized boom sprayer that delivered a broadcast application at 40 psi and 20.5 gpa through 2 TXVS-18 ConeJet nozzles per bed. Dyne-Amic was applied to each spray treatment at 0.125% v/v. Numbers of Bean thrips (BT) and Western flower thrips (WFT) from 5 plants per replicate were recorded at various sample dates following each application (DAT). Relative thrips numbers were measured by removing plants and beating them vigorously against a screened pan (12 inch x 7 inch x 2 inch) for a predetermined time (10 s). A 6 inch by 6 inch sticky card was placed inside of the pan to catch the dislodged WFT. Sticky cards were then taken to the laboratory where adult and larvae were counted. 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 WFT population levels were light. All of the products provided significant control of bean thrips, but Minecto Pro, Lannate and Radiant clearly provided the best control. Against WFT larvae, Radiant and Lannate provided the most significant control, and Exirel, Minecto and Torac provided suppression. The new products PQZ, Sefina, Sivanto and Harvanta were not effective against adults or larvae.

		Trial Average			
		Mean BT / Plant	Mean WFT / Plant		
Treatment	**Rate/ac**		**Adult**	**Larvae**	**Total**
Radiant	7 oz	0.4de	1.2de	0.5c	1.7c
Lannate+Sniper	0.8 lb+5 oz	0.4de	0.8e	0.4c	1.2c
Versys	1.5 oz	1.4ab	3.1abc	4.6a	7.7a
PQZ	3.2 oz	0.8cd	3.5ab	4.4a	7.9a
Sivanto HL	5 oz	0.5d	3.4ab	5.3a	8.7a
Exirel	20 oz	0.7cd	1.8cd	1.8b	3.6b
Harvanta	16.9 oz	0.7cd	3.2abc	4.8a	8.0a
Minecto Pro+Endigo	10 + 4.5 oz	0.2e	1.4de	1.3b	2.7b
Torac	21 oz	1.1bc	2.1bcd	2.2b	4.6b
Untreated	-	2.1a	3.8a	5.8a	9.6a

Conventional Insecticides Alternatives for Thrips Control in Spring Lettuce

Objective: The objective of this trial was to evaluate the efficacy of several conventional insecticides products against western flower thrips (WFT) in spring lettuce.

Methods: Romaine' Fort Romi MI' was direct seeded on 24 Jan, 2019 at the Yuma Valley Agricultural Center, Yuma, AZ into double row beds on 42 inch centers. Stand establishment was achieved using overhead sprinkler irrigation and irrigated with furrow irrigation thereafter. Plots were two beds wide by 35 ft long and bordered by two untreated beds. Four replications of each treatment were arranged in a RCB design. Formulations and rates for each compound are provided in the tables. Three foliar sprays were applied 11 and 27 Mar, and 12 Apr. The applications were made with a CO_2 pressurized boom sprayer that delivered a broadcast application at 40 psi and 22.5 gpa through 2 TXVS-18 ConeJet nozzles per bed. Silwet was applied to each spray treatment at 0.25% v/v. Numbers of Western flower thrips (WFT) from 4-5 plants per replicate were recorded at various sample dates following each application (DAA). Relative thrips numbers were measured by removing plants and beating them vigorously against a screened pan (12 inch x 7 inch x 2 inch) for a predetermined time (10 s). A 6 inch by 6 inch sticky card was placed inside of the pan to catch the dislodged WFT. Sticky cards were then taken to the laboratory where adult and larvae were counted. Because of heterogeneity of mean variances, thrips 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 WFT population levels were heavy for this spring trial. The same products evaluated in the fall trial were tested in this trial, and results were essentially the same. Against WFT adults and larvae, Radiant and Lannate provided the most significant control, and Exirel, Minecto and Torac provided suppression. Like the fall trial PQZ, Sefina, Sivanto and Harvanta were not effective against wester flower thrips.

		Trial Average Mean Thrips/Plant		
Treatment	**Rate**	**Adult**	**Larvae**	**Total**
Radiant	7 oz	34.9cd	26.5d	61.4c
Lannate + Warrior II	0.75 lb+2 oz	34.8d	47.8c	82.6c
Sivanto	5 oz	45.9a	180.3a	226.2a
Versys	1.5 oz	44.1a	182.0a	226.0a
PQZ	3.2 oz	43.7ab	159.8a	203.6a
Exirel	20 oz	35.6cd	78.7b	114.2b
Harvanta	16.9 oz	39.5abc	150.7a	190.2a
Minecto Pro	10 oz	36.4cd	84.0b	120.4b
Torac	21 oz	37.2bcd	78.0b	115.2b
Untreated	-	40.3a	163.0a	203.3a

New Conventional Insecticides Alternatives for Whitefly Adult Control in Lettuce

Objective: The objective of this trial was to evaluate the efficacy of several new conventional insecticide products against whitefly adults in fall lettuce.

Methods: Lettuce ' *'PYB7101A'* was direct seeded into double row beds on 42 inch centers on 5 Sep, 2018. Plots were two beds wide by 35 ft long and bordered by two untreated beds. Stand establishment was achieved using overhead sprinkler irrigation and irrigated with furrow irrigation thereafter. Four replications of each treatment were arranged in a RCB design. Product formulations and rates for each compound are provided in the tables. Two foliar sprays were applied on 9 and 22 Oct with a CO_2 pressurized boom sprayer that delivered a broadcast application through 2 TXVS-18 ConeJet nozzles per bed at 40 psi and 20.5 gpa. An adjuvant, Dyne-Amic (Helena Chemical Co.), was applied at 0.25% vol/vol with these spray 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/ plants was recorded. 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 Whitefly adult populations were light and varied following each spray. Overall, the new products PQZ and Sivanto were the only insecticides that provided significant adult whitefly control on young lettuce. These products are currently available for use in lettuce.

		Mean Whitefly Adults / Vacuum Sample						
		1-DAA1	***3-DAA1***	***7DAA1***	***1-DAA2***	***3-DAA2***	***7-DAA2***	**Trial**
Treatment	**Rate/ac**	10-Oct	12-Oct	16-Oct	23-Oct	25-Oct	29-Oct	**Avg.**
PQZ	3.2 oz	1.2b	1.0a	0.3a	0.5b	0.1b	0.2a	0.5c
Lannate + Sniper	0.8lb+5 oz	1.3b	2.1a	0.6a	1.2ab	0.5ab	0.8a	1.1ab
Versys	1.5 oz	2.0ab	1.9a	0.9a	1.0ab	0.7a	0.5a	1.1ab
Sivanto HL	5 oz	1.2b	0.7a	0.4a	0.6b	0.4ab	0.5a	0.6bc
Untreated	-	3.7a	2.1a	1.7a	1.9a	0.9a	0.7a	1.8a

New Conventional Insecticides for Control of Aphids on Head Lettuce

Objective: The objective of the trial was to evaluate the efficacy of new aphicides (Versys and PQZ) against aphids when compared to industry standards under desert growing conditions.

Methods: Two trials were conducted in 2019. Head lettuce 'Magosa SK' was direct seeded on 14 Nov, and again on 5 Dec, 2018 at the Yuma Valley Agricultural Center, Yuma, AZ into double row beds on 42-inch centers. Stand establishment was achieved using overhead sprinkler irrigation, with furrow irrigation used thereafter. Plots were two beds wide by 35 ft long and bordered by two untreated beds. Four replications of each treatment were arranged in a RCB design. Formulations and rates for each treatment compound are provided in the tables. Two foliar applications were made on 17 Jan and 1 Feb in the first trial, and 4 and 19 Feb in the second planting with a CO_2 operated sprayer that delivered a broadcast application through 2 TXVS-18 ConeJet nozzles per bed at 40 psi and 22.5 GPA. Dyne-Amic (0.125%) v/v was applied to all treatments. Evaluations of green peach aphid (GPA), foxglove aphid (FGA) and lettuce aphid (LA) populations were assessed by estimating the number of aphids / plant in whole plant, destructive samples. On each sample date, 6 plants were randomly selected from each plot and placed individually into large 5-gal tubs. Each plant was sampled by visually examining all plant foliage and counting the number of live aphids present. Only GPA and FGA data was analyzed due to the low incidence of FGA and LA. At harvest, 10 plants were randomly selected from each plot and sampled by visually examining all foliage within a harvested head and 4 wrapper leaves. In the 2nd trial, the numbers were low and highly variable among reps, and the harvest data was not analyzed. Because of heterogeneity of mean variances, data for all insect were transformed using a log10 (x+1) function before analysis. All data were subjected to ANOVA; means were compared using Turkey's HSD test (P=0.05). Means from non-transformed data are presented in the tables.

Summary: Aphid pressure was light during both trials and consisted mainly of green peach aphid. Foxglove aphid was present but at much lower numbers and their data is not reported. These trials were designed to evaluate both knockdown and residual control following a single spray application. In both trials, all products significantly provided knockdown and residual control of GPA, with Sequoia and Beleaf providing the most consistent level of control. Fulfill provided significantly better control in the first trial; it was inconsistent in the second trial. This study further demonstrated that the new insecticides Versys and PQZ, which have recently been registered for use in lettuce, can be used to effectively manage GPA in desert lettuce.

1st Trial – Nov 14 wet date

		Green Peach Aphids / Plant									
		Pre-	4 DAA1	7 DAA1	11 DAA1	14 DAA1	3 DAA2	7 DAA2	14 DAA2	21 DAA2	Trial
Treatment	**Rate/ac**	*9-Jan*	*21-Jan*	*24-Jan*	*28-Jan*	*31-Jan*	*4-Feb*	*8-Feb*	*15-Feb*	*21-Feb*	**Avg**
Versys	1.5 oz	5.5	10.0a	8.5ab	6.8ab	4.4ab	3.9ab	2.9b	2.4a	1.1abc	5.0b
Beleaf	2.8 oz	5.5	6.9a	3.3ab	5.5abc	5.6ab	3.6ab	1.2b	0.4bcd	0.6abc	3.4bcd
Movento	5 oz	5.5	10.3a	5.7ab	5.6abc	2.8bc	1.6abc	0.8b	1.8ab	3.1ab	4.0bc
Sequoia	2 oz	5.5	10.0a	3.1b	2.8bc	0.7c	0.8bc	0.7b	0.0d	0.3bc	2.3d
Sivanto HL	5 oz	5.5	10.5a	6.2ab	3.2bc	2.5bc	0.8bc	0.6b	1.0abc	0.9abc	3.2bcd
Fulfill	2.8 oz	5.5	4.0a	3.1b	2.1c	1.4bc	0.6c	0.5b	0.1cd	0.7abc	1.7d
PQZ	3.2 oz	5.5	5.7a	4.1ab	5.85abc	2.0bc	0.8bc	0.6b	0.2cd	0.1c	2.4cd
Untreated	-	5.5	14.3a	12.9a	16.2a	14.0a	7.3a	11.6a	5.3a	7.0a	11.2a

1st Trial - Harvest Evaluation

		Harvest Contamination							
		Mean Aphids / Head				% Head infested with > 5 aphids			
Treatment	**Rate/ac**	**GPA**	**FGA**	**LA**	**Total**	**GPA**	**FGA**	**LA**	**Total**
Versys	1.5 oz	1.6ab	0.13	0.00	1.7ab	10.0ab	2.5	0.0	10.0ab
Beleaf	2.8 oz	0.6b	0.00	0.08	0.7ab	2.5b	0.0	0.0	2.5b
Movento	5 oz	0.9ab	0.00	1.58	2.5ab	7.5b	0.0	2.5	10.0ab
Sequoia	2 oz	0.4b	0.05	0.15	0.6ab	0b	0.0	2.5	2.5b
Sivanto HL	5 oz	0.9ab	0.00	0.00	0.9ab	5.0b	0.0	0.0	5.0ab
Fulfill	2.8 oz	0.7b	0.18	0.18	1.1ab	0b	0.0	2.5	5.0ab
PQZ	3.2 oz	0.4b	0.03	0.05	0.5b	0b	0.0	0.0	2.5b
Untreated	-	3.1a	0.00	0.00	3.1a	25.0b	0.0	0.0	25.0a

2nd Trial – Dec 5 wet date

Treatment	Rate oz /ac	Green Peach Aphids / Plant							
		3 DAA1 *7-Feb*	**7 DAA1** *11-Feb*	**14 DAA1** *18-Feb*	**3 DAA2** *22-Feb*	**7 DAA2** *26-Feb*	**14 DAA2** *5-Mar*	**21 DAA2** *12-Mar*	**Trial Avg**
Versys	1.5 oz	9.0ab	6.2ab	7.1bc	4.4b	4.8bc	3.6ab	0.3	5.0bc
Beleaf	2.8 oz	5.3b	4.1b	2.2d	1.3bc	1.5cd	0.2c	0.4	2.1e
Movento	5 oz	9.6ab	4.5ab	4.4bcd	1.6bc	2.4bcd	1.2bc	0.3	3.4cd
Sequoia	2 oz	5.3b	4.1b	3.4cd	1.2bc	1.9cd	0.4c	1.0	2.4de
Sivanto HL	5 oz	8.4ab	6.1ab	5.3bcd	3.1bc	2.7bcd	1.0bc	1.2	3.9cd
Fulfill	2.8 oz	14.0ab	11.1ab	10.4ab	4.4b	7.4ab	3.9ab	1.1	7.4b
PQZ	3.2 oz	11.3ab	5.7ab	4.1ncd	0.8c	1.4d	0.6c	0.9	3.5de
Untreated	-	18.6a	22.0a	26.6a	17.9a	16.1a	5.6a	1.4	15.4a

Evaluation of an Experimental Insecticide for Control of Aphids on Lettuce

Objective: The objective of the trial was to evaluate the efficacy of an experimental aphicide against aphids when compared to industry standards under desert growing conditions.

Methods: Head lettuce 'Magosa SK' was direct seeded on 24 Jan, 2019 at the Yuma Valley Agricultural Center, Yuma, AZ into double row beds on 42 inch centers. Stand establishment was achieved using overhead sprinkler irrigation, with furrow irrigation used thereafter. Plots were two beds wide by 35 ft long and bordered by two untreated beds. Four replications of each treatment were arranged in a RCB design. Formulations and rates for each treatment compound are provided in the tables. Two foliar applications were made on 1 and 8 Mar with a CO_2 operated sprayer that delivered a broadcast application through 2 TXVS-18 ConeJet nozzles per bed at 40 psi and 22.5 GPA. Dyne-amic (0.25%) v/v was applied to all treatments. Evaluations of green peach aphid (GPA), foxglove aphid (FGA) and lettuce aphid (LA) populations were assessed by estimating the number of aphids / plant in whole plant, destructive samples. On each sample date, 5-6 plants were randomly selected from each plot and placed individually into large 5-gal tubs. Each plant was sampled by visually examining all plant foliage and counting the number of live aphids present. Only GPA and LA data was analyzed due to the low incidence of FGA. Because of heterogeneity of mean variances, data for all insect were transformed using a log10 (x+1) function before analysis for aphid data and an arcsine transformation for % heads infested. All data were subjected to ANOVA; means were compared using Turkey's HSD test (P=0.05). Means from nontransformed data are presented in the tables.

Summary: Aphid pressure was moderate during the trial and consisted of green peach aphid and lettuce aphid. This trial was designed to evaluate both knockdown and residual control after each spray application. Following the 1st spray, Sivanto and Versys provided the most significant knockdown efficacy, whereas the experimental compound UA231-A1 failed the provided significant residual control. A similar trend was observed following the 2nd application. Overall, Movento provided the most consistent control at 21 DAA the 2nd spray. Averaged across both spray, UA231-A1 did not control aphids realtibe to the untreated check, whereas Movento, Sivanto and Versys provided the best control. Although lettuce aphid was present, the numbers were too variable to estimate treatment differences.

Treatment	Rate, oz /ac	Green Peach Aphids / Plant				
		7 DAA1 *7-Mar*	7 DAA2 *15-Mar*	14 DAA2 *22-Mar*	21 DAA2 *28-Mar*	Trial Avg
UA 234-A1	-	11.0ab	4.4ab	2.1bcd	0.7	4.5ab
UA 234-A1	-	12.3ab	3.8abc	2.1bcd	0.4	4.6ab
UA 234-A1	-	11.5ab	3.3bcd	2.7ab	1.0	4.6ab
Sivanto HL	5	2.9d	1.2cd	0.8d	0.3	1.3d
Movento	5	5.3bcd	1.1d	1.0cd	1.7	2.3cd
Actara	3	5.7bcd	1.7bcd	2.0bcd	0.9	2.5c
Versys	3	4.4cd	3.1bcd	1.7bcd	1.1	2.6bc
Acephate	12 oz	7.7bc	5.4bcd	5.8a	1.7	5.1ab
Untreated	-	20.0a	14.0a	3.5ab	1.1	9.6a

Treatment	Rate, oz /ac	Lettuce Aphids / Plant				
		7 DAA1 *7-Mar*	7 DAA2 *15-Mar*	14 DAA2 *22-Mar*	21 DAA2 *28-Mar*	Trial Avg
UA 234-A1	-	0.0	0.0	0.0	0.1	4.5
UA 234-A1	-	0.0	0.0	0.3	0.8	4.6
UA 234-A1	-	0.0	0.0	0.1	3.8	4.6
Sivanto HL	5	0.0	0.0	0.7	0.3	1.3
Movento	5	0.0	0.0	0.0	0.0	2.3
Actara	3	0.0	0.0	0.1	0.2	2.5
Sefina	3	0.0	0.0	0.0	0.2	2.6
Acephate	12 oz	0.0	0.0	0.3	0.2	5.1
Untreated	-	0.4	0.3	0.0	9.5	9.6

New Conventional Insecticide for Control of Aphids on Baby Spinach

Objective: The objective of the trial was to evaluate the efficacy of new aphicides against aphids when compared to industry standards under desert growing conditions.

Methods: A small-plot, field study was conducted in at the University of Arizona, Yuma Agricultural Center in the spring 2019 growing seasons. Spinach 'Amazon F1' was planted on 84 inch beds in a plant density of 32 seedlines per bed on 24 Jan, 2019. Stands were established with sprinkler irrigation and irrigated with sprinklers thereafter. Plots for each trial consisted of 1, 84" beds , 30' long with a 5 ft buffer within rows and a 1 bed untreated buffer between plots. Plots were arranged in a randomized complete block design with 4 replications. Formulations and rates for each compound are provided in the tables. Three applications were made on 28 Feb, 7 and 19 March. Foliar sprays were applied with a CO_2 operated boom sprayer at 50 psi and 20.5 gpa. A broadcast application was delivered through 4 TX-18 ConeJet nozzles per bed. No adjuvants were applied to any of the treatments. Green peach aphid (GPA) populations were assessed by estimating the number of aphids / plant in whole plant, destructive samples. On each sampling date, 5-6 plants were randomly selected from each plot and placed individually into large 5-gal tubs. Each plant was sampled by visually examining all plant foliage and counting the number of apterous (non-winged) aphids present. 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 table.

Summary: Aphid pressure was moderate following the first 2 applications, but following the third application, GPA numbers crashed in all treatments including the untreated check. This was due to a heavy abundance of lady beetles which were not affected by the insecticide sprays. Following the 1st spray PQZ and Sequoia were the only treatments to provide significant knockdown efficacy. A similar trend was observed following the 2nd application, where only Sequoia and Movento significantly reduced GPA numbers relative to the untreated check. Averaged across all 3 sprays, Sequoia, PQZ, Movento and Beleaf provided the most consistent control at 6 DAA.

		Avg Green Peach Aphids / Plant				
Treatment	**Rate** (oz/ac)	**Pre-spray** *27-Feb*	**6 DAA-1** *6-Mar*	**6 DAA-2** *13-Mar*	**6 DAA-3** *26-Mar*	**Trial Avg.**
Versys	**1.5**	2.0	2.3ab	3.4ab	0.1b	1.9bc
Beleaf	**2.8**	2.0	2.3ab	2.8abc	0.0b	1.7c
Movento	**5.0**	2.0	2.3ab	2.0bc	0.1ab	1.4c
Sequoia	**2.0**	2.0	1.4b	1.5c	0.2b	1.0c
Sivanto HL	**5.0**	2.0	3.3ab	7.4ab	0.0b	3.6bc
Fulfill	**2.8**	2.0	3.8ab	8.1ab	0.7b	4.2ab
PQZ	**3.2**	2.0	1.0b	4.4abc	0.1b	1.8c
UTC	**-**	2.0	7.4a	11.0a	0.6a	6.3a

Lepidopterous Larvae Control in Organic Head Lettuce Fall 2018

Objective: To compare the efficacy of organically approved biopesticidees currently being developed for use in organic lettuce production us.

Methods Head lettuce 'EXP1221 SK' was direct seeded on 5 Sep, 2018 at the Yuma Valley Agricultural Center, Yuma, AZ into double row beds on 42 inch centers. Stand establishment was achieved using overhead sprinkler irrigation, with furrow irrigation used thereafter. Plots were two beds wide by 45 ft long and bordered by two untreated beds. Four replications of each treatment were arranged in a RCB design. Formulations and rates for each treatment compound are provided in the tables. Two foliar applications were made on 27 Sep and 8 Oct with a CO_2 operated sprayer that delivered a broadcast application through 2 TXVS-18 ConeJet nozzles per bed at 40 psi and 22.5 GPA. An adjuvant, Silwet was applied as an adjuvant @ 0.125%. The pH of the spray water in the Aza-Direct and Azera treatments was lowered to a pH of 5.5-6 using Neutralizer at 0.1% v/v. Beet armyworm (BAW) and cabbage looper (CL) control was based on the examination of 10 whole plant at 3, and 7 days following each application (DAA) for the presence of large (2^{nd} or > instar) larvae. The number of plants in each plot with fresh feeding tracks on plants was also recorded. Because of heterogeneity of mean variances, insect data were transformed using a log10 (x-1) function before analysis. Data for percentage of plants with fresh feeding damage on leaves were subjected to an arcsine transformation before analysis. All data were subjected to ANOVA; means were compared using Turkey's HSD test (P=0.05). Means from non-transformed data are presented in the tables.

Summary CL populations were light and no differences were observed among the spray treatments and the untreated control. In contrast, BAW numbers were moderate to heavy. Entrust provided the best BAW control. Venerate and Xentari significantly reduced BAW numbers relative to the untreated check. Aza-Direct, Azera, Dipel, and Grandivo did not provide significant BAW control.

		Trial Average Mean Larvae / 10 plants		
Treatment	**Rate**	**CL**	**BAW**	**Total**
Entrust	5 oz	0.2b	0.2c	0.2c
Dipel	1 lbs	0.5b	4.0ab	4.5b
Xentari	1 lbs	0.6b	2.41b	3.0b
Grandivo	2 lbs	2.5a	4.4ab	6.9ab
Venerate	2 qts	2.8a	1.8b	4.6b
Untreated		3.9a	6.2a	11.1a

Insecticide Alternatives for Thrips Control in Organic Lettuce

Objective: The objective of this trial was to evaluate the efficacy of several organically allowed products used in rotation against western flower thrips (WFT) in fall lettuce.

Methods: Romaine' Fort Romi MI' was direct seeded on 24 Jan, 2019 at the Yuma Valley Agricultural Center, Yuma, AZ into double row beds on 42 inch centers. Stand establishment was achieved using overhead sprinkler irrigation, and irrigated with furrow irrigation thereafter. Plots were two beds wide by 35 ft long and bordered by two untreated beds. Four replications of each treatment were arranged in a RCB design. Formulations and rates for each compound are provided in the tables. Three foliar sprays were applied 19 and 27 Mar, and 4 Apr. The applications were made with a CO_2 pressurized boom sprayer that delivered a broadcast application at 40 psi and 22.5 gpa through 2 TXVS-18 ConeJet nozzles per bed. Silwet was applied to each spray treatment at 0.125% v/v. The pH of the spray water in the Venerate and Azera treatments was lowered to ~6 using Neutralizer (TopChoice, Loveland) at 0.1% v/v. Numbers of Western flower thrips (WFT) from 4 plants per replicate were recorded at various sample dates following each application (DAA). Relative thrips numbers were measured by removing plants and beating them vigorously against a screened pan (12 inch x 7 inch x 2 inch) for a predetermined time (10 s). A 6 inch by 6 inch sticky card was placed inside of the pan to catch the dislodged WFT. Sticky cards were then taken to the laboratory where adult and larvae were counted. At harvest (Apr 20), a subjective damage rating was used to estimate relative differences in scarring among the treatments. Three plants were evaluated for thrips scarring in each replicate. Each plant was stratified into 3 areas: lower 1/3 of plant , middle 1/3 of plant and upper 1/3 of plant (heart). The following rating was used to evaluate damage:

0= 0-5% of leaves with thrips scarring;
1= 6-25% of leaves with thrips scarring,
2= 25-50% of leaves with thrips scarring
3= > 50% of leaves with thrips scarring.

Because of heterogeneity of mean variances, thrips 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 two Venerate rotations significantly reduced WFT larvae relative to the UTC but did not reduce adult abundance when averaged across all sample dates. However, neither of the Venerate rotations provided WFT control comparable with the conventional standard rotation. Similarly, the Venerate rotations did not prevent leaf scarring damage comparable with the conventional standard.

		Adult – WFT / Plant									
		4-DAA1	*7-DAA1*	*2-DAA2*	*5-DAA2*	*8-DAA2*	*4-DAA3*	*7-DAA3*	*11-DA3*	*14-DA3*	
Treatment	**Rate/ac**	**23-Mar**	**26-Mar**	**29-Mar**	**1-Apr**	**4-Apr**	**8-Apr**	**11-Apr**	**15-Apr**	**18-Apr**	**Avg**
Venerate~Radiant~Venerate	2 pt / 7 oz	22.5	18.8	12.0ab	17.6b	15.4ab	153.0a	80.4	82.5	60.4b	51.4ab
Venerate~Entrust~Venerate	2 pt / 10 oz	25.9	24.4	16.9ab	18.4ab	26.3ab	141.0a	71.6	78.4	72.0ab	52.8a
Lannate~Radiant~Lannate	0.8 lb / 7 oz	12.0	14.6	6.4b	23.3ab	21.8ab	63.8b	64.5	85.5	94.1a	42.9b
Azera~Entrust~Azera	3 pt / 10 oz	24.8	21.0	14.6ab	26.3ab	14.6b	138.4a	73.9	105.4	76.5ab	55.0a
Untreated	-	24.0	22.1	25.1a	29.3a	23.3a	113.3a	70.1	90.4	76.5ab	52.7a

		Larvae - WFT / Plant									
		4-DAA1	*7-DAA1*	*2-DAA2*	*5-DAA2*	*8-DAA2*	*4-DAA3*	*7-DAA3*	*11-DA3*	*14-DA3*	
Treatment	**Rate/ac**	**23-Mar**	**26-Mar**	**29-Mar**	**1-Apr**	**4-Apr**	**8-Apr**	**11-Apr**	**15-Apr**	**18-Apr**	**Avg**
Venerate~Radiant~Venerate	2 pt / 7 oz	124.9a	288.5a	55.1b	33.0b	18.4	13.9ab	36.8b	228.0a	258.0	117.4b
Venerate~Entrust~Venerate	2 pt / 10 oz	129.4a	259.1a	54.8b	30.4b	21.0	19.1ab	50.6b	282.8a	274.1	124.6b
Lannate~Radiant~Lannate	0.8 lb / 7 oz	42.8b	120.4b	29.3b	8.3c	8.3	4.5c	16.5c	75.8b	204.8	56.7c
Azera~Entrust~Azera	3 pt / 10 oz	142.1a	286.9a	56.9b	18.4bc	11.5	9.4bc	56.3b	193.1a	222.8	110.8b
Untreated	-	132.4a	273.4a	175.5a	112.1a	74.3	63.0a	127.5a	258.0a	221.3	159.7a

Treatment	Rate/ac	Total- WFT / Plant									
		4-DAA1	*7-DAA1*	*2-DAA2*	*5-DAA2*	*8-DAA2*	*4-DAA3*	*7-DAA3*	*11-DA3*	*14-DA3*	
		23-Mar	**26-Mar**	**29-Mar**	**1-Apr**	**4-Apr**	**8-Apr**	**11-Apr**	**15-Apr**	**18-Apr**	**Avg**
Venerate~Radiant~Venerate	2 pt / 7 oz	147.4a	307.3a	67.12b	50.6b	33.7ab	166.9a	117.2b	310.5a	318.4	168.8b
Venerate~Entrust~Venerate	2 pt / 10 oz	155.3a	283.5a	71.6b	48.8b	47.3ab	160.1a	122.3b	361.1a	346.1	177.3b
Lannate~Radiant~Lannate	0.8 lb / 7 oz	54.8b	135.0b	35.6c	31.5b	30.0ab	68.3b	81.0c	161.3b	298.9	99.6c
Azera~Entrust~Azera	3 pt / 10 oz	166.9a	307.9a	71.5b	44.6b	26.1b	147.8a	130.1b	298.5a	299.3	165.6b
Untreated	-	156.4a	295.5a	200.6a	141.4a	97.5a	176.3a	197.6a	348.5a	297.8	212.4a

Treatment	Rate/ac	Seasonal Average WFT/Plant		Leaf-scarring Damage Rating		
		Adults	**Larvae**	**Lower 1/3**	**Mid 1/3**	**Upper 1/3**
Venerate~Radiant~Venerate	2 pt / 7 oz	51.4ab	117.4b	2.33b	1.83a	1.33a
Venerate~Entrust~Venerate	2 pt / 10 oz	52.8a	124.6b	2.50b	1.83a	1.25a
Lannate~Radiant~Lannate	0.8 lb / 7 oz	42.9b	56.7c	1.42c	1.16b	0.33b
Azera~Entrust~Azera	3 pt / 10 oz	55.0a	110.8b	2.33b	1.92a	1.42a
Untreated	-	52.7a	159.7a	3.00a	2.25a	1.58a