Arizona Department of Agriculture
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Project title:	**Comparative Evaluation of Dinotefuran Formulations for Insect Control in Lettuce**
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Location of Research:	Yuma Valley Agricultural Center

Rationale:

Dinotefuran (Venom, Valent Corp.) has been registered and used on a number of cucurbit and vegetable crops throughout the desert southwest to control sucking insect pests for the past 5 years. Dinotefuran belongs to the neonicotinoid insecticide class and has the highest water solubility and one of the lowest partition coefficients making it highly systemic when soil applied and providing translaminar activity when applied to plant foliage. It is these physio-chemical attributes that make dinotefuran the most versatile neonicotinoid used today. A new proprietary formulation of dinotefuran (Scorpion) has recently been developed by Gowan Co. and is now available for use by growers in 2010. Presumably, the only difference between these two dinotefuran products is in their formulation; Scorpion is a 3.24 lb AI / gal soluble liquid, whereas Venom is formulated as a 20 and 70% soluble granule. Although Venom has become a standard for whitefly control in many cropping systems, very little is known on the insecticidal activity of Scorpion relative to Venom and the other neonicotinoid active ingredients commonly used on vegetable crops. Consequently, an objective recommendation for the use of Scorpion on lettuce cannot be provided to PCAs and growers until an adequate evaluation of the Scorpion formulation of dinotefuran is conducted.

Dinotefuran has a great fit in desert cropping systems because of its versatility in application. It can be applied effectively against a number of insect pests as either a foliar spray, or as a soil treatment through drip irrigation systems, or applied below the seed as sub-surface shank injections. It is particularly effective against whiteflies. To date, Venom has been the most efficacious neonicotinoid used for whitefly control largely because it is inherently more toxic to whiteflies than imidacloprid and, and is especially effective against Q biotype populations in ornamentals. Local trials with Venom have shown that the active ingredient can provide good control of whitefly adults and nymphs in melons and broccoli

Dinotefuran has also shown activity on other important vegetable pests. Foliar sprays have shown good knockdown activity against flea beetles on cole crops and anecdotal reports from PCAs this fall suggest that foliar neonicotinoids have contact and ingestion activity against a new invasive stink bugs species, the Bagrada bug. The effectiveness of soil systemic treatments of dinotefuran to prevent Bagrada bug damage on cole crops seems probable, but we have no data to support this recommendation. Unfortunately, unlike imidacloprid and acetamiprid, control of aphids with dinotefuran on lettuce has been marginal.

As noted above, presumably, the only difference between Venom and Scorpion is that the active ingredient is formulated differently. In all likelihood, when applied at the same rate (lb/AI/ac) the two dinotefuran products should provide comparable efficacy. However, given that the two products are formulated differently (granule vs. liquid), it will be important to demonstrate to PCAs and growers that Scorpion field performance is not significantly affected by application methods (foliar spray/soil injection) or adjuvant usage (NIS). This project addressed these factors, by collecting field efficacy data on Scorpion and Venom for whiteflies, flea beetles, aphids and for the first time will evaluate dinotefuran for thrips control.

I. <u>Whitefly Efficacy (Adults)</u>

Foliar Trial I

The objective of this study was to evaluate the knockdown efficacy of Venom and Scorpion against Sweetpotato whitefly (SWF) adults in fall head lettuce under desert growing conditions. Head Lettuce 'Diamondback' was direct seeded into double row beds on 42 inch centers on 8 Sep, 2011. Plots were two beds wide by 45 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. Formulations and rates for each compound are provided in the table. Two foliar sprays were applied on 9 and 16 Oct as broadcast applications delivered through 2 TXVS-18 ConeJet nozzles per bed at 25 gpa @ 40 psi. An adjuvant, Dyne-Amic (Helena Chemical Co.), was applied at 0.25% to all treatments.

Populations of whitefly adults were evaluated at 1, 3 and 5-6 day intervals following each application (DAT). Adult populations were estimated using a modified vacuum method that employed a 2- gallon portable vacuum (DeWALT, Baltimore, MD) which was fitted with cloth-screened 40 Dram 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 s. Containers with adults were taken into the laboratory, placed in a freezer for 24 h after which the number of adults/ plant was recorded. Because of heterogeneity of mean variances, adult data were summed for each sample date, log transformed (mean+0.5) and subjected to ANOVA; means were separated using an *F*-protected LSD ($P \leq 0.05$). Actual non-transformed means are presented in the tables.

The SWF population was heavy during the trial. Prior to the first application, pre-spray counts estimated SWF adult numbers at 32.6 adults / sample. Following the first application, all of the spray treatments significantly reduced adult numbers relative to the untreated check, except the Movento treatment at 1 DAT. Among the foliar treatments, Scorpion+Brigade, Venom+Brigade, Sivanto and NNI-0101 provided the greatest knockdown. By 3 and 5 DAT, adult numbers in all spray treatments were significantly lower than the untreated check; however adult numbers in most treatments had exceeded pre-spray levels. Following the second application, a similar trend was observed where adult numbers in the Exirel and Movento treatments were comparable to Scoprion+Brigade. Averaged across all sample dates, the Scorpion+Brigade, Venom+Brigade, Sivanto, Exirel and NNI-0101 treatments appeared to provide the most consistent reduction in adult SWF numbers. We observed no significant differences in SWF adult control between the Scorpion and Venom treatments.

		SWF Adults /sample						
Treatment	**Rate**	**1-DAT1 10-Oct**	**3-DAT1 12-Oct**	**5-DAT1 14-Oct**	**1-DAT2 17-Oct**	**3-DAT2 19-Oct**	**6-DAT2 22-Oct**	**Trial Avg.**
Lannate + Danitol	0.8 lb+14 oz	14.1 cd	23.2 b	51.5 ab	49.4 a	99.2 b	48.3 a	47.5 b
Venom + Brigade	4 oz+5 oz	8.6 de	13.9 c	26.8 d	26.5 bc	26.4 cd	19.1 b	20.2 cd
Scorpion + Brigade	7 oz+5 oz	4.8 e	7.2 c	26.6 d	19.6 cd	19.4 de	15.4 b	15.5 d
Movento	5 oz	38.0 a	31.2 b	39.7 bc	25.9 bc	40.0 c	15.4 b	31.7 b
Sivanto	10 oz	8.7 de	12.1 c	28.8 d	21.5 cd	35.4 c	24.0 b	21.7 c
Closer	5.7 oz	23.2 b	22.5 b	43.0 bc	41.7 ab	85.8 b	50.0 a	44.4 b
NNI-0101	3.2 oz	5.1 e	11.4 c	38.0 c	13.4 d	31.4 cd	15.3 b	19.1 cd
Exirel	13.5 oz	17.5 bc	11.0 c	21.8 d	18.7 cd	15.9 e	9.1 c	16.6 cd
Untreated check	-	45.6 a	74.7 a	61.0 a	66.3 a	165.1 a	41.8 a	74.7 a

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

Foliar Trial II

The objective of this study was to evaluate the knockdown efficacy of foliar spray mixtures of dinotefuron (Scorpion) and pyrethroid insecticides against sweetpotato whitefly (SWF) adults in fall lettuce under desert growing conditions. Head Lettuce ' Diamondback' was direct seeded into double row beds on 42 inch centers on 8 Sep 2011. Plots were two beds wide by 45 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. Formulations and rates for each compound are provided in the table. Three foliar sprays was applied on 10, 17 and 23 Oct as broadcast applications delivered through 2 TXVS-18 ConeJet nozzles per bed at 25 gpa and 40 psi. An adjuvant, Dyne-Amic (Helena Chemical Co.), was applied at 0.25% to all treatments.

Populations of whitefly adults were evaluated at various intervals following each application (DAT). Adult populations were estimated using a modified vacuum method that employed a 2- gallon portable vacuum (DeWALT, Baltimore, MD) which was fitted with cloth-screened 40 Dram 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 s. Containers with adults were taken into the laboratory, placed in a freezer for 24 h after which the number of adults/ plant was recorded. Because of heterogeneity of mean variances, adult data were summed for each sample date, log transformed (mean+0.5) and subjected to ANOVA; means were separated using an *F*-protected LSD ($P \leq 0.05$). Actual non-transformed means are presented in the tables.

The SWF population was heavy during the trial. Prior to the first application, pre-spray counts estimated SWF adult numbers at 51.2 adults / sample. At each sample interval following the three applications, all of the spray treatments except the Brigade applied alone significantly reduced adult numbers relative to the untreated check. With the exception of the 1-DAT1 sample, differences in adult knockdown were not observed between the two neonicotinoid treatments applied alone (Scorpion and Assail). However, the Scorpion+Brigade mixture provided significantly better SWF adult control that the Assail+ Brigade mixture on several post-treatment evaluations. When averaged across all sample evaluations, the Scorpion+Brigade mixture provided significantly better control than the Scorpion applied alone. In contrast, addition of the pyrethroid with Assail did not significantly enhance adult SWF control.

		SWF Adults / sample								
Treatment	**Rate/ac**	**1-DAT1**	**3-DAT1**	**5-DAT1**	**2-DAT2**	**4-DAT2**	**6-DAT2**	**1-DAT3**	**5-DAT3**	**Avg.**
Brigade	5 oz	49.5 a	58.0 a	72.0 a	45.9 b	69.5 ab	65.9 a	64.0 a	55.7 a	59.6 a
Scorpion	7 oz	11.4 c	13.2 b	43.2 b	20.4cd	40.4 bc	40.5 bc	26.8 b	10.2 b	25.8 b
Scorpion+Brigade	7 oz + 5 oz	8.5 c	9.1 c	34.1 b	12.5 d	20.5 c	25.5 c	21.3 b	14.5 b	18.4 c
Assail	4 oz	20.1 b	22.5 b	42.6 b	31.5 c	29.7 c	51.7 b	29.0 b	12.5 b	29.7 b
Assail+Brigade	4 oz + 5 oz	22.5 b	29.1 b	36.8 b	32.6 c	30.8 c	41.8 bc	32.5 b	15.9 b	30.0 b
Check	-	63.5 a	55.5 a	72.5 a	68.9 a	75.0 a	69.5 a	75.5 a	59.5 a	67.7 a

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

II. <u>Whitefly Efficacy (Immatures)</u>

Soil Trial I

The objective of this study was to evaluate the efficacy of several soil systemic insecticides applied as soil insecticides against sweetpotato whitefly (SWF). Head Lettuce 'Diamondback' was direct seeded into double row beds on 42 inch centers on 2 Sep, 2011. Plots were two beds wide by 45 ft long and bordered by one untreated bed. 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 spray program are provided in the tables. The soil insecticides were applied as a surface-band treatment using a single-bed boom equipped with a flat fan nozzle (8004VS) oriented parallel over each seed line and calibrated to deliver 25 gallons of spray per acre at 40 psi. A 2-3 inch spray band was placed directly over each seed line immediately following planting. The insecticides were incorporated into the bed using sprinkler irrigation that was used for seed germination and irrigation during the trial.

Evaluations of SWF control was estimated by counting the number of total nymphs on two, 2-cm^2 disk sections taken from 2 consecutive basal leaves collected from each of 5 plants per replicate at various days after wet date (DAW). SWF nymph densities on each leaf disk were estimated under magnification in the laboratory. Because of heterogeneity of mean variances, data were log transform (mean+0.5) and subjected to ANOVA; means were separated using an *F*-protected LSD ($P \leq 0.05$). Actual non-transformed means are presented in the tables.

SWF pressure was heavy during the trial. Differences in nymph densities among the soil applied insecticides and the untreated check were observed on each sample date following emergence. The new compound Verimark provided significant control of SWF nymphs comparable to the industry standard (Admire Pro), whereas Durivo provided less consistent control. Reduction of SWF nymphs in the Belay and Venom/Scorpion treatments was inconsistent and overall did not differ from the untreated check.

		Whitefly Nymphs Densities (avg/cm^2)				
Treatment	**Rate/ac**	**21 DAW**	**28 DAW**	**35 DAW**	**42 DAW**	**Avg.**
Admire Pro 4.6F	10.4 oz	0.6 b	1.0 c	5.0 bcd	5.2 bc	3.0 c
Venom 70 WG	6 oz	2.5 ab	4.1 ab	8.1 ab	9.1 ab	5.9 ab
Scorpion 35SL	10.5 oz	2.4 ab	4.3 ab	7.8 ab	9.0 ab	5.8 ab
Durivo SC	13 oz	0.4 b	1.1 c	6.1 bc	7.1 bc	3.6 bc
Belay 2.13SC	12 oz	4.0 a	3.0 bc	5.9 bc	12.1 a	6.3 a
Verimark 20SC	10 oz	0.4 b	0.3 d	2.0 cd	4.7 bc	1.9 c
Untreated	-	2.6 a	5.3 a	10.4 a	12.3 a	7.7 a

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

Soil Trial II

The objective of this study was to evaluate the efficacy of several soil systemic insecticides applied as soil insecticides against sweetpotato whitefly (SWF). Head Lettuce 'Diamondback' was direct seeded into double row beds on 42 inch centers on 14 Sep, 2011. Plots were two beds wide by 40 ft long and bordered by one untreated bed. 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 spray program are provided in the tables. Sub-surface, soil injection treatments were applied by placing the insecticides 1.5 inches directly below each seed line with a modified fertilizer shank just prior to planting in a total water volume of 20.5 gpa. No other insecticides were applied to the soil treated plants during the trial. The insecticides were incorporated into the bed using sprinkler irrigation that was used for seed germination and irrigation during the trial.

Evaluations of SWF control was estimated by counting the number of total nymphs on two, 2-cm^2 disk sections taken from 2 consecutive basal leaves collected from each of 5 plants per replicate at various days after wet date (DAW). SWF nymph densities on each leaf disk were estimated under magnification in the laboratory. Because of heterogeneity of mean variances, data were log transform (mean+0.5) and subjected to ANOVA; means were separated using an *F*-protected LSD ($P \leq 0.05$). Actual non-transformed means are presented in the tables.

SWF pressure was moderate during the trial. Differences in nymph densities among the soil applied insecticides and the untreated check were not observed until 26 DAP. The new compound Verimark provided significant control of SWF nymphs comparable to the industry standard (Admire Pro), whereas Durivo provided less consistent control. Reduction of SWF nymphs in the Belay and Venom/Scorpion treatments was not consistent and did not differ from the untreated check on any of the sampling dates.

		Whitefly Nymphs Densities (avg/cm^2)				
Treatment	**Rate/ac**	**20 DAP**	**26 DAP**	**32 DAP**	**40 DAP**	**Avg.**
Verimark	10 oz	0.3 a	0.4 c	0.1 d	1.1 c	0.5 d
Durivo	13 oz	0.3 a	2.3 bc	1.8 abc	2.7 ab	1.8 bc
Admire Pro	10 oz	0.2 a	2.7 b	2.1 ab	2.0 bc	1.8 bc
Coragen	7.5 oz	0.3 a	1.8 bc	0.9 cd	2.6 ab	1.4 c
Venom	6 oz	0.4 a	5.2 a	2.3 a	2.7 bc	2.7 ab
Scorpion	10.5 oz	0.4 a	4.3 a	2.5 a	2.4 ab	2.4 ab
Untreated	-	0.2 a	6.2 a	2.6 a	3.2 a	3.1 a

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

III. Aphids

Foliar and Soil Trial

The objective of this study was to evaluate the efficacy of several soil and foliar neonicotinoid insecticides against aphids in head lettuce in desert growing areas of southwestern U.S. Head lettuce was direct seeded on 14 Nov at the Yuma Valley Agricultural Center, Yuma, AZ into double row beds on 42 inch centers. Stand establishment was achieved using overhead sprinkler irrigation, furrow irrigated thereafter. Plots were four beds wide by 50 ft long and bordered by two untreated beds. Each treatment was replicated four times and arranged in a randomized complete block design. The at-planting soil applications of Venom were applied as a pre-plant injection at a depth of 1.5" below the seed line at bed shaping in a 15 GPA final dilution. Foliar applications were made with a CO_2 operated boom sprayer operated at 60 psi and 27 GPA. A directed spray (nozzles directed toward the plants) was delivered through 3 nozzles (TX-12) per bed. A total of 3 spray applications were applied on 21 Jan, 4 Feb and 16 Feb. An adjuvant was applied to all foliar treatments; DyneAmic on the 1st application and Exit on the 2nd and 3rd applications at 0.125%v/v.

Aphid populations were assessed by estimating the number of aphids /plant in whole plant, destructive samples. At harvest (Mar 6th) infestation levels of apterous aphids were estimated by randomly selecting 10 plants within each replicate, visually counting all aphids on frame/wrapper leaves and heads separately. Data were analyzed as a 1-way ANOVA using a protected LSD *F* test to distinguish treatment mean differences

Foxglove aphids were the dominant aphid species during this trial, but *A. lactucae* was unusually abundant this season. The soil-applied neonicotinoid treatments provided marginal control of foxglove aphids at harvest, and head contamination was lowest in the Admire (16 oz) plots. None of the soil treatments were comparable to the foliar sprays in controlling foxglove aphids, but all of the soil treatments except Venom suppressed populations of the green peach aphids, *A. lactucae*, and lettuce aphids to very low levels. In most cases, all of the foliar sprays reduced aphid numbers to acceptable levels at harvest. Venom and Scorpion did not provide significant control relative to the other foliar compounds, and Assail applied alone, provided marginal control of foxglove aphid. Beleaf and Movento provided excellent control of all aphids. No phytotoxicity was observed with any of the treatments.

		Mean Apterous Aphids / Plant at Harvest			
		Foxglove aphid		***A. lactucae***	
Treatment (Rate/ac)	**Application**	**Frame leaves**	**Heads**	**Frame leaves**	**Heads**
Admire 2F (16 oz)	Soil-at plant	43.6 bc	8.0 cd	0.3 bc	0.6 c
Platinum 2SC (8 oz)	Soil-at plant	39.4 bc	22.6 bc	1.0 bc	0 c
Venom (6 oz)	Soil-at plant	82.3 b	28.5 ab	117.7 a	22.0 a
Scorpion (10 oz)	Foliar	60.2 b	32.1 ab	41.1 a	9.5 b
Venom (4 oz)	Foliar	52.8 b	28.4 ab	44.1 a	8.6 b
Assail 70W (1.7 oz)	Foliar	18.0 cd	14.8 bc	3.2 bc	1.3 c
Movento 5 oz	Foliar	0.5 f	0.4 f	0 c	0 c
Beleaf (2.8 oz)	Foliar	2.7e	2.0 e	0 c	0.2 c
Untreated	-	233.9 a	70.4 a	194.8 a	39.1 a

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

Foliar Trial I

Lettuce 'Synergen 352 ' was direct seeded on 29 Nov, 2011 at the Yuma Valley Agricultural Center, Yuma, AZ into double row beds on 42 inch centers. Stand establishment was achieved using overhead sprinkler irrigation, furrow irrigated thereafter. Plots for each trial consisted of 2 beds, 35' long with a two bed buffer between the plots. Plots were arranged in a randomized complete block design with 4 replications. Foliar applications were made with a CO2 operated boom sprayer operated at 60 psi and 27 GPA. A broadcast spray was delivered through 2 TX-18 ConeJet nozzles per bed. An adjuvant, DyneAmic (Helena Chemical Co.), was applied at 0.125%v/v with all spray applications. Sprays were applied on Jan 4 and Feb 15 . No other pesticides were applied.

Green peach aphid (GPA) and Foxglove (FGA) populations were assessed by estimating the number of aphids /plant in whole plant, destructive samples. On each sample date, 5-8 plants were randomly selected from each plot and placed individually into large 3-gal tubs. Each plant was sampled by visually examining all plant foliage and counting the number of apterous aphids present. At harvest infestation levels of apterous aphids were estimated by randomly selecting 10 plants within each replicate, visually counting all aphids on frame/wrapper leaves and heads separately. Data were analyzed as a 1-way ANOVA using a protected LSD F test to distinguish treatment mean differences

Aphid populations were moderate during this trial, and Foxglove aphids were the dominant aphid species. The foliar-applied neonicotinoid treatments provided marginal control of foxglove aphids at harvest, and head contamination was significantly lower in all treatments compared to than the untreated check. Overall, the Beleaf treatment had to the lowest number of aphids per plant, followed by Venom and Scorpion which provided the same level of aphid control. No differences between the two formulations were observed.

		Mean Aphids / Plant				
		Foxglove aphids		Green Peach Aphids		
Treatment	Rate/ac	Head	Frame leaves	Head	Frame leaves	Total aphids
Provado Pro	3.75 oz	0.9 b	8.5 bc	0.6 b	1.7 b	11.6 b
Assail	4 oz	2.9 b	28.1 a	1.0 b	1.3 b	32.9 c
Venom	4 oz	3.0 b	6.1 bc	0.8 b	5.8 a	15.5 b
Scorpion	7.5 oz	3.5 b	5.5 bc	1.1 b	6.9 a	17.0 b
Beleaf	2.3 oz	0.5 b	0.3 c	0.5 b	0.9 b	1.8 d
Untreated	-	17.7 a	19.1 b	4.0 a	7.5 a	48.2 a

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

Foliar Trial II

The objective of this study was to evaluate the efficacy of several new insecticide compounds against green peach aphids (GPA) in cabbage under desert growing conditions. Cabbage 'Gazzelle' was direct seeded into double row beds on 42 inch centers on 2 Nov, 2011. Plots were two beds wide by 45 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. Formulations and rates for each compound are provided in the tables. Two foliar sprays were applied on 6 and 23 Mar as a broadcast application delivered through 2 TXVS-18 ConeJet nozzles per bed at 21.5 gpa @ 40 psi.

Evaluations of GPA populations were assessed by estimating the number of apterous and alate aphids / plant in whole plant, destructive samples. On each sample date, five 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. Data were log transform (mean+1) and subjected to ANOVA; means were separated using an *F*-protected LSD ($P \leq 0.05$). Actual non-transformed means are presented in the tables.

GPA population pressure was heavy during the trial. Pre-spray aphid samples indicated that plants were infested with an average of 15.5 GPA / plant when the trial was initiated. Following the 1st spray application, GPA populations increased quickly in the untreated check. All spray treatments significantly reduced apterous GPA numbers relative to the untreated check for 14 days, with the exception of the Exirel which did not differ from the untreated check at 14 DAT. Following the 2nd application a similar trend was observed, and all spray treatments, except Exirel, significantly reduced GPA numbers relative to the untreated check for 28 DAT. Overall, Movento and Closer provided the most consistent control of GPA, but only Movento provided commercially acceptable control of GPA on cabbage plants at the end of the trial (20 Apr). Neither Scorpion nor Venom provided economically acceptable control of GPA during this trial.

		Avg. Green Peach Aphids / Plant						
Treatment	**Rate/ac**	**7 DAT1**	**14 DAT1**	**7 DAT2**	**14 DAT2**	**21 DAT2**	**28 DAT2**	**Avg**
Movento	5 oz	9.3 de	15.2 c	5.6 c	9.4 c	9.3 d	34.9 e	18.7 f
Assail	4 oz	29.5 cde	18.5 c	19.0 bc	76.8 bc	151.1 bcd	599.0 bcd	116.3 d
Scorpion	7.5 oz	98.3 b	33.0 bc	48.3 b	132.5 b	204.8 b	878.7 b	200.1 c
Venom	4 oz	90.2 b	39.2 bc	40.1 b	129.3 b	197.8 b	892.2 b	219.5 c
Beleaf	2.8 oz	27.1 cde	24.7 c	10.3 c	54.8 bc	173.9 bc	361.6 de	85.8 de
Closer	2.85 oz	6.2 e	19.0 c	5.3 c	11.9 c	40.3 cd	188.7 e	36.0 ef
Exirel	17 oz	41.4 cd	52.3 ab	29.8 bc	245.2 a	226.0 b	1359.9 a	263.8 b
Untreated	-	292.3 a	60.8 a	190.9 a	312.2 a	485.2 a	1309.3 a	404.0 a

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

IV. Western Flower Thrips

The objective of this trial was to determine whether Venom or Scorpion had any economic activity against western flower thrips (WFT) on fall lettuce. Romaine lettuce 'PIC 715' was direct seeded on Sep 20, 2005 at the Yuma Valley Agricultural Center, Yuma, AZ into double row beds on 42 inch centers. Stand establishment was achieved using overhead sprinkler irrigation, furrow irrigated thereafter. Plots were two beds wide by 35 ft long and bordered by two untreated beds. Each treatment was replicated four times and arranged in a randomized complete block design. Two foliar sprays were applied on 6 and 23 Mar as a broadcast application delivered through 2 TXVS-18 ConeJet nozzles per bed at 21.5 gpa @ 40 psi.

Numbers of WFT from 5 plants per replicate were recorded on each sample date. Relative WFT numbers were measured by removing plants and beating them vigorously against a screened pan (12 in. x 7 in. x 2 in) for a predetermined time (15 sec). A 6 in. by 6 in. sticky trap was placed inside of the pan to catch the dislodged WFT. Sticky traps were then taken to the laboratory where adult and larvae were counted. Data were analyzed as a 1-way ANOVA with means compared where appropriate using a protected LSD F test ($p<0.05$).

WFT populations were moderate for fall lettuce. The table below that neither Venom or Scorpion provided economic efficacy against WFT as compared to both the industry standard (Radiant) and the untreated control.

		Mean Adults / Plant			
Treatment	**Rate ai/ac**	**13-Oct**	**20-Oct**	**27-Oct**	**4-Nov**
Venom	4 oz	5.0 a	12.7 a	9.9 a	10.3 a
Scorpion	7.5 oz	5.1 a	13.1 a	10.1 a	9.9 a
Radiant	7 oz	1.9 b	2.5 b	1.1 b	1.2 b
Untreated	-	5.1 a	13. a	7.0 a	7.2 a

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

		Mean Larvae / Plant			
Treatment	**Rate ai/ac**	**13-Oct**	**20-Oct**	**27-Oct**	**4-Nov**
Venom	4 oz	2.7 a	7.4 a	71.7 a	62.6 a
Scorpion	7.5 oz	3.0 a	5.0 a	79.5 a	73.6 a
Radiant	7 oz	0.5 a	0.9 b	11.2 b	8.9 b
Untreated	-	2.5 a	6.0 a	88.0 a	91.9 a

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