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Insect Management For Desert Lettuce Production

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Introduction

Desert lettuce production remains highly dependent on the availability of effective and economical insecticides. The implementation of FQPA has already reduced the availability of many important compounds (i.e., Diazinon uses are now restricted, and Dimethoate can no longer be used in head lettuce, the number of endosulfan applications will be reduced). Consequently, development of new insecticide alternatives to effectively control insects in the desert has become especially important. Fortunately, there are several new chemistries that are now reaching the market or will be available for insect management in the next few years. Research to evaluate and develop new insecticide uses specifically for desert head lettuce IPM programs is well justified and has been supported through funding provided by the AILRC and the Agrochemical industry for over 17 years.

The continual occurrence of several key insect pests further justifies the need to explore new chemistries and develop use patterns for local growers and PCAs. Aphids, (Foxglove aphid and Lettuce *"Red"* aphid) have become well established in desert lettuce and present new challenges. Research over the past 2 years suggests that neonicotinoids are less effective against both of these aphid species, and may be showing signs of reduced residual efficacy against whiteflies. In many cases, additional foliar sprays are needed to prevent late season buildups of both of these pests. Furthermore, Western Flower Thrips remain a very difficult pest to control and has become increasingly difficult and expensive to control in spring lettuce. Many of the compounds currently used for controlling thrips (Lannate, Orthene, Endosulfan) are directly threatened by FQPA. Finally, lepidopterous pests such as Beet armyworm and Cabbage looper remain the most economically important pest in fall lettuce and typically require numerous foliar sprays throughout the season to prevent losses. Surveys indicate that PCA's are primarily using Success and Pyrethroids for control.

Several new insecticide compounds have been developed by the Agrichemical Industry which offer alternatives for cost-effective control of these pests (Table 1). Coragen™ *(rynaxypyr)* is a new product that has excellent activity on worms, leafminers and potentially whiteflies. It has an extremely safe toxicological profile and will be available for use by desert growers next fall. Because it has systemic activity via root uptake when applied to the soil, preliminary research has shown that it can be applied to lettuce similar to how Admire is used, but provides residual worm control. This use pattern could potentially reduce the number of foliar sprays by half in fall lettuce and offers many benefits to growers including reduced spray costs, avoidance of worker exposure and urban encroachment issues.

Another exciting compound that has a potential fit in desert lettuce is Movento® *(spirotetramat)*. Similarly, it is a very safe product and will be available to growers in the fall of 2008. As a foliar spray it has systemic activity in the plant (phloem and xylem mobile) and is active against aphids and whiteflies. Both of these products represent unique modes of action and are different than any other product currently labeled in head lettuce.

There are other new foliar compounds as well that offer activity against thrips (Radiant, Tesoro), aphids (Beleaf, Assail) and worms (Synapse, Alverde, Radiant, Tesoro) when sprayed on lettuce. Although we have conducted preliminary research with these compounds on a variety of leafy vegetable and melon crops, this project proposes to specifically examine their efficacy and fit in head lettuce grown in the desert.

Objective 1. **To continue monitoring for a 16th consecutive year the commercial field performance of imidacloprid soil treatments for control of whiteflies in Yuma.**

EVALUATION OF IMIDACLOPRID FOR CONTROL OF WHITEFLIES IN COMMERCIAL LETTUCE AND BROCCOLI

Several commercial lettuce fields planted in the Dome Valley, Gila Valley and Yuma Valley were used for these studies from 1993-2008. A total of 6-9 monitoring sites were established for each season (8 in 2008). Lettuce fields were planted within a week in early September (Sep 9-17) in each year. Imidacloprid was evaluated on varying lettuce varieties each year. Two treatments were evaluated in each growers field: (1) growers standard application of Admire throughout the field, and (2) an untreated check plot where Admire was not applied in a randomly selected area in the field measuring 4 beds * 100 ft. The commercial standard field received 16 oz of Admire or Alias at planting in a total volume of 20 gallons/acre. The insecticide was injected at a depth of ~ 2" below the seed line just prior to seeding.

Lettuce plants were sampled for immature whitefly densities three times each season, based on crop phenology. Twenty basal leaves from the center rows of each plot were collected randomly from ten lettuce plants at: thinning stage (4-leaf stage; 21 days after planting), heading or “rosette” stage (leaves begin to cup inward to form heads; 50 days after planting), and harvest (mature heads; 69-77 days after planting). Samples were taken to the laboratory where two 1-cm^2 areas were selected randomly on each leaf, and the numbers of all immature stages of whiteflies were counted using a stereo microscope and recorded. Since 1998, studies similar to above were initiated in commercial broccoli and melon fields in the Yuma and Gila valleys. Broccoli plots were established in early September similar to the lettuce trials described above. Admire was applied similar to the lettuce trials. Leaf samples were collected from basal leaves at 20 , 40 and 60 days after planting and immature densities were assessed as above.

Evaluations of Admire field efficacy in lettuce for the 2008 growing season are found in Figure 1. Over the past 16years, silverleaf whitefly densities in lettuce fields have declined dramatically, but have begun to show reduced residual efficacy in the past few years. We observed a small outbreak in 2005, but numbers declined to low levels the following season although untreated lettuce plots had significantly greater whitefly densities throughout the season than the Admire treated field plots. However, over the past several years a decline in residual efficacy has been observed Figure 1B, and this was particularly evident from the 2007 and 2008 seasons where whitefly numbers did not differ from the Admire field standard and the untreated check.

In general, our data suggests that Admire is beginning to lose residual efficacy. Thus, as of the fall 2008 our initial conclusion is that although Admire remains efficacious, residual efficacy appears to eroding. This can be further observed in our broccoli data (Figure 2). Because lettuce is a marginal host for whitefly development and colonization, untreated test sites were established in commercial broccoli fields beginning in the fall 1998 to measure differences in whitefly colonization in these highly preferred host crops. Figure 2 shows whitefly population responses (3^{rd} and 4^{th} instars) on imidacloprid treated and untreated plants sampled from sentinel plots in commercial broccoli fields in the Yuma Valley at 20, 40 and 60 days after planting from the fall of 1998 through 2008. Figure 2A shows the actual densities of large nymphs over the 10 year period and although numbers have not been extremely high, the admire field standard did not perform up to standards at 40 and 60 DATas it had prior to 2005. Figure 2B shows the % reduction in nymphs in the field compared to the untreated plots averaged over the 60 day. This figure clearly shows a negative trend in whitefly population reduction with exposure to imidacloprid through time and strongly suggests imidacloprid has steadily lost residual efficacy of whitefly large nymphs in the desert .

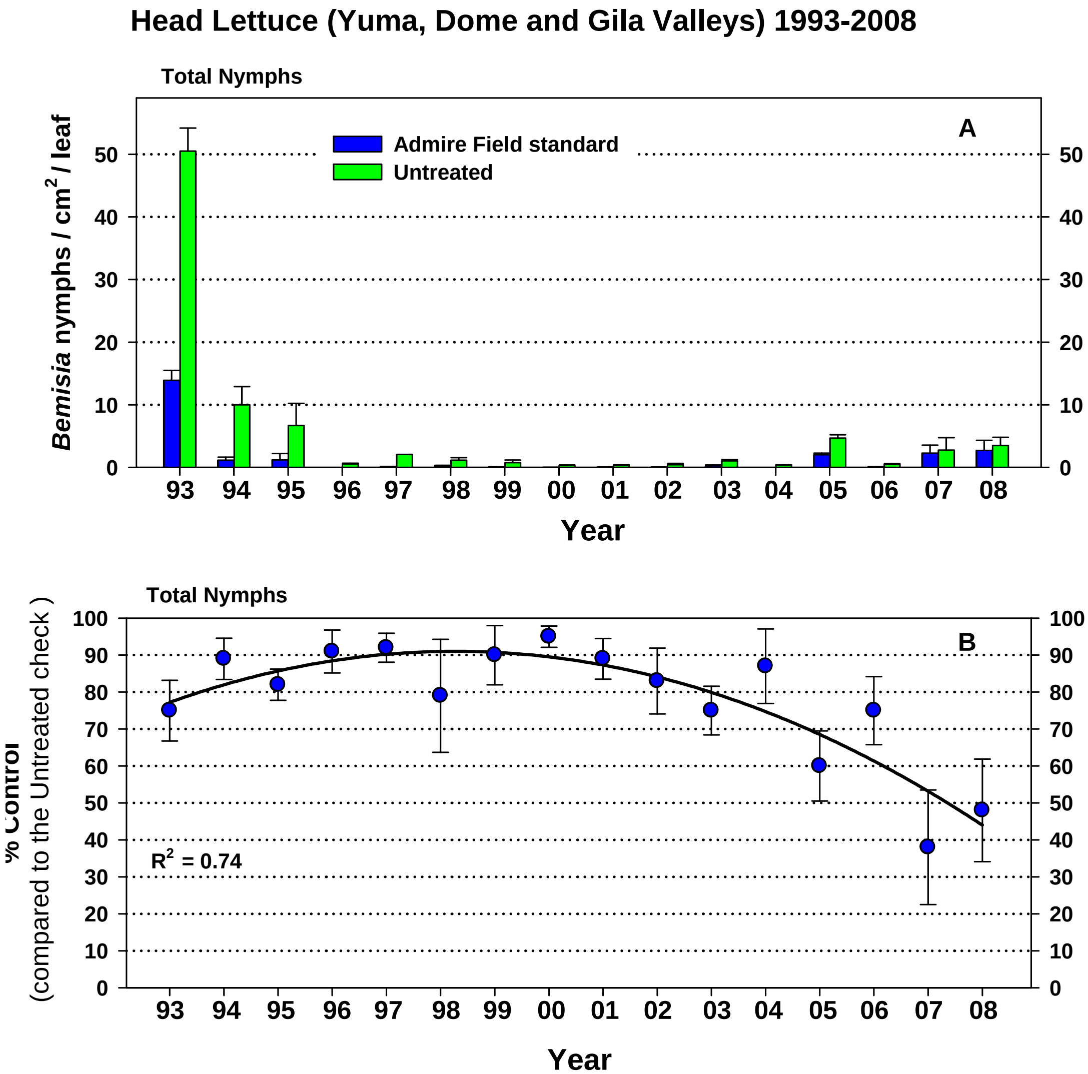

Figure 1. Whitefly population responses of large nymphs (3rd and 4th instars) on imidacloprid treated and untreated plants sampled from sentinel plots in commercial lettuce fields in the Yuma Valley at thinning and heading stages from the fall of 1993 through 2008. Graph A shows the actual densities of large nymphs over the 16 year period; and Graph B shows a negative trend in whitefly population reduction with exposure to imidacloprid through time.

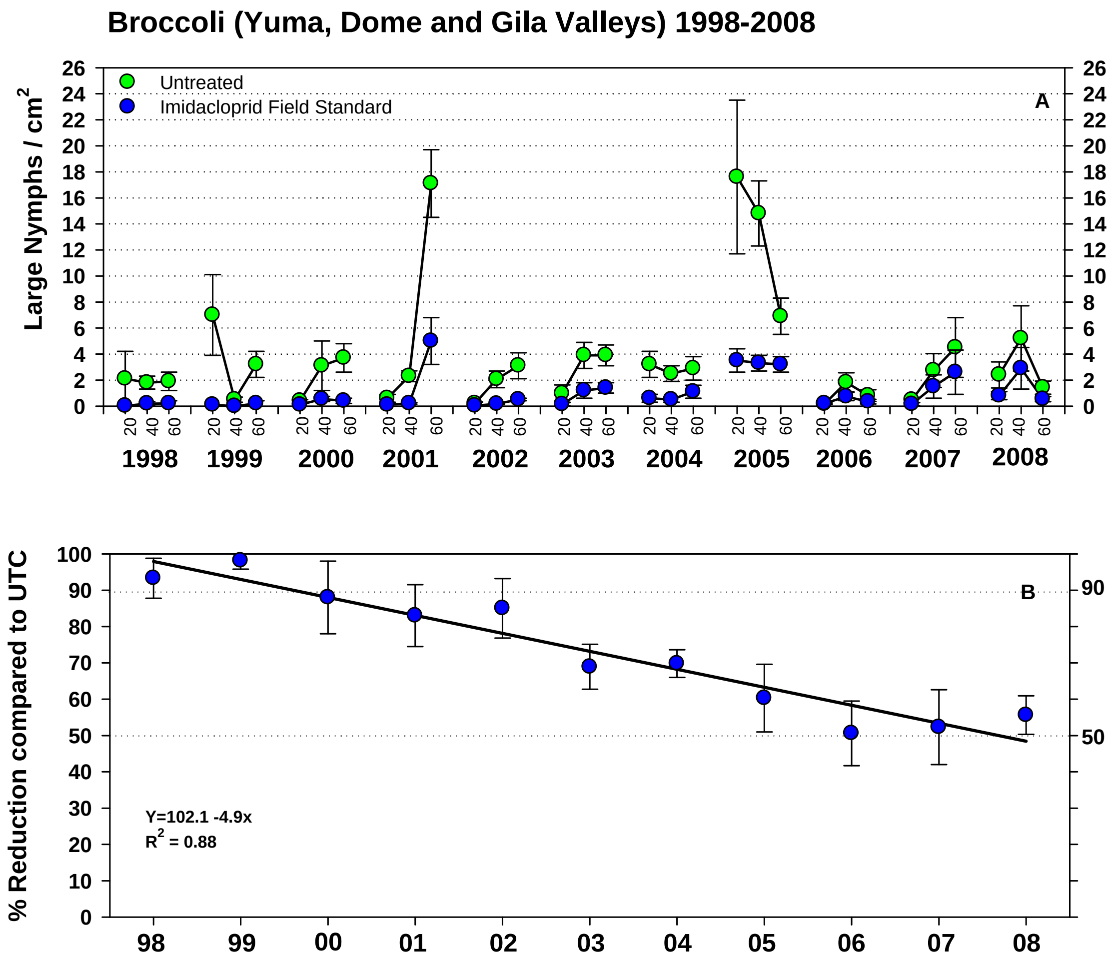

Figure 2. Whitefly population responses of large nymphs (3rd and 4th instars) on imidacloprid treated and untreated plants sampled from sentinel plots in commercial broccoli fields in the Yuma Valley at 20, 40 and 60 days after planting from the fall of 1998 through 2008. Graph A shows the actual densities of large nymphs over the 10 year period; and Graph C shows a negative trend in whitefly population reduction with exposure to imidacloprid through time.

<u>Objective 2.</u> **To evaluate new insecticides applied as foliar treatments, and as at-planting soil treatments for control of lepidopterous larvae in fall head lettuce.**

EVALUATION OF NOVEL SOIL APPLIED INSECTICIDES FOR CONTROL OF LEPIDOPTEROUS LARVAE ON FALL LETTUCE

The objective of the study was to evaluate the efficacy of several new soil applied insecticides against lepidopterous larvae on head lettuce under desert growing conditions. Lettuce was direct seeded on 6 Sep 2008 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 compound are provided in the tables. Coragen and Durivo treatments were applied to the soil at planting as either a sub-surface soil injection (SSI) or a surface band (SB). The SSI treatments were injected 2" below each seedline at planting in a total water volume of 20.5 GPA. The SB treatments were applied as a 1.5 inch wide surface band applied directly over the seedline immediately following seed placement at 23.4 GPA and 40 psi with flat fan nozzle. Platinum was applied as a SSI similar to the above treatments, and also received three foliar sprays on 8, 17, 25 Oct and 8 Nov. Foliar sprays were applied with a CO_2 operated boom sprayer that delivered a broadcast application at 50 psi and 24 gpa with 3 TXVS-18 ConeJet nozzles per bed. An adjuvant, Dyne-Amic (Helena Chemical Co.), was applied to all treatments at a rate of 0.25% v/v. Evaluation of efficacy was based on the number of live larvae per plant. Ten plants per replicate were destructively sampled on each sample date. The sample unit consisted of examination of whole plants for presence of Beet armyworm (BAW) and Cabbage looper (CL) and Corn earworm (CEW) where their numbers were recorded by instars. Treatment means were analyzed using a 1-way ANOVA and means separated by a protected LSD $_{(P<0.05)}$.

Larval pressure was moderate. BAW populations were heaviest at prior to thinning (1-24 days after planting [DAP] and CL population were heaviest following thinning. CEW numbers were very light. All soil treatments, regardless of product, rate or placement provided significant control of lepidopterous larvae when sampled at 20 DAP. Thereafter, numbers of 1st and 2nd instar larvae varied among the treatments and the UTC. However, all of the soil treatments siginifcantly prevented larvae from developing beyond the 2nd instar for 27 days. As the trial progressed, larger numbers of large larvae (3rd instar or >) were observed. The lack of difference in 1st instar larve among treatments and the UTC throughout the did not reflect a lack of control, but in many cases reflected the presence of neonates that had not yet consumed treated leaf tissue. Consequently, evaluation of residual efficacy of these soil treatments should be based on the presence of 2nd and 3rd instar larvae actively feeding on plants. Thus based on this and other similar studies, it appears that Coragen and Durivo soil treatments can provide 25-30 d of protection before additional treatments, based on current action thresholds, are required for treating BAW,CL and CEW populations with foliar sprays on head lettuce.

Table 1.

Treatment	Rate/acre	Placement[2]	Avg. BAW, CL and CEW Larvae /10 Plants							
			20 DAP (Sep 26)				27 DAP (Oct 3)			
			1st instar	2nd instar	3rd instar or >	All instars	1st instar	2nd instar	3rd instar or >	All instars
Durivo 2.5EC	10.3 oz	SSI	0.0a	0.0c	0.0b	0.0c	3.4b	3.1 bc	0.0b	6.5ab
Durivo 2.5EC	13.1 oz	SSI	0.2a	0.0c	0.0b	0.2c	3.1b	1.9bc	0.0b	5.0b
Durivo 2.5EC	10.3 oz	SB	0.0a	0.0c	0.0b	0.0c	15.3ab	0.9c	0.0b	16.3b
Durivo 2.5EC	13.0 oz	SB	0.7a	0.0c	0.0b	0.7bc	7.8ab	3.1bc	0.0b	10.9ab
Platinum 2SC [1]	11.0 oz	SSI	0.0a	2.7b	1.2a	3.8 b	14.4ab	10.0ab	0.0b	24.4a
Coragen 1.67SC	5.0 zo	SSI	0.0a	0.0c	0.0.b	0.0c	7.5ab	5.6abc	0.0b	13.1ab
Coragen 1.67SC	6.7 oz	SSI	1.2a	0.0c	0.0b	1.2bc	1.6b	0.6c	0.0b	2.2b
Coragen 1.67SC	7.7 oz	SSI	0.8a	0.0c	0.0b	0.8bc	18.4a	0.6c	0.0b	19.1ab
Coragen 1.67SC	7.7 oz	SB	0.0a	0.0c	0.0b	0.0c	1.6b	1.9bc	0.0b	3.4b
UTC	-	.	3.0a	5.7a	1.2a	9.8 a	2.5b	13.4a	5.0a	20.9ab

Table 1. continued

Treatment	Rate/acre	Placement[2]	Avg. BAW, CL and CEW Larvae /10 Plants: 34 DAP (Oct 10) 1st instar	2nd instar	3rd instar or >	All instars	41 DAP (Oct 17) 1st instar	2nd instar	3rd instar or >	All instars
Durivo 2.5EC	10.3 oz	SSI	0.8a	4.2a	0.4b	5.4 b	0.0a	3.8a	0.3b	4.1 bc
Durivo 2.5EC	13.1 oz	SSI	2.9a	1.7a	0.4b	5.0b	1.6a	2.5a	2.5b	6.6bc
Durivo 2.5EC	10.3 oz	SB	2.1a	7.1a	0.8b	10.0b	1.9a	3.4a	3.1b	8.4b
Durivo 2.5EC	13.0 oz	SB	0.4a	3.3a	0.4b	4.2b	0.0a	3.4a	3.8b	7.2b
Platinum 2SC [1]	11.0 oz	SSI	0.0a	2.5a	0.0b	2.5b	0.6a	3.4a	0.0b	0.9c
Coragen 1.67SC	5.0 zo	SSI	0.4a	3.3a	0.0b	3.8b	0.9 a	0.9a	0.6b	2.5bc
Coragen 1.67SC	6.7 oz	SSI	2.5a	6.7a	0.0b	9.2b	0.0 a	4.4a	1.3b	5.6bc
Coragen 1.67SC	7.7 oz	SSI	0.4a	2.9a	0.0b	3.3b	0.6 a	1.3a	1.6b	3.4bc
Coragen 1.67SC	7.7 oz	SB	0.4a	1.7a	0.0b	2.0b	0.3 a	0.3a	0.9b	1.6bc
UTC	-	.	0.0a	9.6a	16.7a	26.3a	0.6 a	4.7a	10.3a	15.6a

Table 1. continued

Treatment	Rate/acre	Placement[2]	Avg. BAW, CL and CEW Larvae /10 Plants: 49 DAP (Oct 25)				Trial Average			
			1st instar	2nd instar	3rd instar or >	All instars	1st instar	2nd instar	3rd instar or >	All instars
Durivo 2.5EC	10.3 oz	SSI	0.0a	4.0a	4.5 bc	8.5bc	0.8a	3.0b	1.0b	4.9bc
Durivo 2.5EC	13.1 oz	SSI	0.0a	4.0a	3.5bc	7.5bc	1.6a	2.0b	1.3b	4.8bc
Durivo 2.5EC	10.3 oz	SB	0.0a	6.5a	7.0b	13.5ab	3.8a	3.6b	2.2b	9.6b
Durivo 2.5EC	13.0 oz	SB	0.0a	1.0a	6.0b	7.0bc	1.8a	2.2b	2.0b	6.0bc
Platinum 2SC [1]	11.0 oz	SSI	0.0a	1.5a	0.0c	1.5c	3.0a	3.4b	0.2b	6.6bc
Coragen 1.67SC	5.0 zo	SSI	0.0a	4.0a	4.5bc	8.5bc	1.8a	2.8b	1.0b	5.6bc
Coragen 1.67SC	6.7 oz	SSI	0.0a	1.5a	2.5bc	4.0c	1.0a	2.6b	0.8b	4.4bc
Coragen 1.67SC	7.7 oz	SSI	0.0a	4.5a	4.5bc	9.0bc	4.1a	1.8b	1.2b	7.1bc
Coragen 1.67SC	7.7 oz	SB	0.0a	1.0a	4.0bc	5.0bc	0.5a	1.0b	1.0b	2.4c
UTC	-	.	0.0a	4.0a	15.0a	19.0a	1.2a	7.5a	9.6a	18.3a

Means followed by the same letter are not significantly different, ANOVA; protected LSD *(p>0.05)*

[1] Platinum applied at planting followed by 3 foliar sprays; Proclaim (3.2 oz)+Warrior (3.5 oz) applied on 26 Sep and 16 Oct, and Voliam Xpress (9.0 oz) applied on 3 Oct.

[2] placement of compounds at planting either SSI=sub-surface soil injection 2" below each seeedline at planting; SB = a 1.5 inch wide surface band applied over the seedline immediately following planting

EVALUATION OF NEW REDUCED-RISK INSECTICIDES FOR CONTROL OF LEPIDOPTEROUS LARVAE ON FALL LETTUCE

The objective of the study was to evaluate the efficacy of several new reduced-risk compounds against lepidopterous larvae on head lettuce under desert growing conditions. Lettuce was direct seeded on Sep 14, 2007 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 randomized complete block design. Formulations and rates for each compound are provided in the tables. Sprays were applied on 8, 17, 25 Oct and 8 Nov. Foliar sprays were applied with a CO_2 operated boom sprayer that delivered a broadcast application at 50 psi and 24 gpa with 3 TXVS-18 ConeJet nozzles per bed. An adjuvant, DyneAmic (Helena Chemical Co.), was applied to all treatments at a rate of 0.25% v/v. An adjuvant, DyneAmic (Helena Chemical Co.), was applied at 0.125% v/v with all treatments. Evaluation of efficacy was based on the number of live larvae per plant. Ten plants per replicate were destructively sampled on each sample date. The sample unit consisted of examination of whole plants for presence of small (neonate and 2^{nd} instar larve) and large (3^{rd} or > instar) Beet armyworm (BAW) and Cabbage looper (CL). At harvest (20 Nov), 10 mature plants per plot were randomly selected and assessed for presence of live larvae, feeding damage and frass on the heads and wrapper leaves. Treatment means were analyzed using a 1-way ANOVA and means separated by a protected LSD $_{(P<0.05)}$.

BAW and CL pressure was light-moderate compared to past years. Treatment differences among the spray treatments for BAW and CL control were consistent following each application. CL efficacy was comparable among the treatments where significant post-treatment reduction of large CL was similar for all treatments applied compared to the untreated check (Table 1). The newer compounds Radiant, Synapse and Coragen reduced large CL larvae numbers comparable to the industry standards of Avaunt, Intrepid and Proclaim. Trends were similar for BAW where Radiant, Synapse and Coragen significantly reduced large BAW larvae comparable to the industry standards following each spray application (Table 2). The lack of significant differences in small CL and BAW among the spray treatments and the untreated control following some sprays did not reflect a lack of control because many of the small larvae had hatched 2-3 days following each application. At harvest, all treatments significantly prevented economic head damage and contamination which was commercially unacceptable in the UTC (Table 3). The results of this trial suggest that Radiant, Synapse and Coragen can control BAW and CL comparable to products presently used in desert head lettuce production. No phytotoxicity was observed.

Table 1.

Treatment	Rate	CL Larvae / 10 Plants									
		12-Oct		15-Oct		20-Oct		24-Oct		31-Oct	
		Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
Avaunt 30WG	4.5 oz	0.0 a	0.0 b	0.0 a	0.0 b	0.0 b	0.0 b	0.0 a	0.0 b	0.0 b	0.0 a
Intrepid 2F	8 oz	0.0 a	0.0 b	0.0 a	0.0 b	0.0 b	0.0 b	0.0 a	0.0 b	0.0 b	0.0 a
Proclaim 5SG	3.5 oz	0.0 a	0.0 b	0.0 a	0.0 b	0.0 b	0.0 b	0.9 a	0.0 b	0.0 b	0.9 a
Synapse 24WG	2 oz	0.3 a	0.0 b	0.0 a	0.0 b	0.0. b	0.0 b	0.0 a	0.0 b	1.3 a	0.0 a
Synaspe 24 WG	3 oz	0.0 a	0.0 b	0.0 a	0.0 b	0.3 b	0.0 b	0.0 a	0.0 b	0.4 ab	0.0 a
Radiant 1SC	5 oz	0.0 a	0.0 b	0.0 a	0.0 b	0.7 ab	0.0 b	0.0 a	0.0 b	0.0 b	0.0 a
Coragen 1.6 SC	5 oz	0.3 a	0.0 b	0.0 a	0.0 b	0.0 a	0.0 b	0.0 a	0.0 b	0.0 b	0.0 a
UTC	-	1.3 a	0.7 a	0.7 a	1.6 a	1.8 a	1.4 a	0.6 a	2.2 a	1.3 a	0.4 a

Means followed by the same letter are not significantly different, ANOVA; protected LSD $_{(p>0.05)}$

Table 1 continued.

		CL Larvae / 10 Plants							
		8-Nov		15-Nov		20-Nov		Season Avg	
Treatment	Rate	Small	Large	Small	Large	Small	Large	Small	Large
Avaunt 30WG	4.5 oz	0.0 a	0.5 b	0.5 b	0.0 b	0.0 a	0.0 b	0.1 b	0.1 b
Intrepid 2F	8 oz	0.5 a	0.0 b	0.0 b	0.0 b	0.0 a	0.0 b	0.1 b	0.0 b
Proclaim 5SG	3.5 oz	1.0 a	1.5 ab	1.0 b	0.5 b	0.0 a	0.0 b	0.4 b	0.3 b
Synapse 24WG	2 oz	0.0 a	0.5 b	1.0 b	0.0 b	0.0 a	0.4 b	0.4 b	0.1 b
Synaspe 24 WG	3 oz	1.0 a	1.0 b	1.0 b	0.0 b	0.0 a	0.0 b	0.4 b	0.1 b
Radiant 1SC	5 oz	0.5 a	0.0 b	0.0 b	0.0 b	0.0 a	0.0 b	0.2 b	0.0 b
Coragen 1.6 SC	5 oz	0.0 a	0.0 b	1.5 ab	0.0 b	0.0 a	0.4 b	0.3 b	0.0 b
UTC	-	2.0 a	3.0 a	4.0 a	1.5 a	0.2 a	2.3 a	1.6 a	1.6 a

Means followed by the same letter are not significantly different, ANOVA; protected LSD *$(p>0.05)$*

Table 2.

Treatment	Rate	BAW Larvae / 10 Plants									
		12-Oct		15-Oct		20-Oct		24-Oct		31-Oct	
		Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
Avaunt 30WG	4.5 oz	0.9 a	0.3 b	0.9 b	0.3 b	0.4 a	0.0 b	1.9 ab	0.6 b	0.0 b	0.0 b
Intrepid 2F	8 oz	6.6 a	0.0 b	0.3 b	0.3 b	0.0 a	0.7 b	0.3 b	0.0 b	0.0 b	0.0 b
Proclaim 5SG	3.5 oz	0.6 a	0.3 b	0.6 b	0.0 b	0.4 a	0.0 b	0.3 b	0.3 b	0.4 b	0.0 b
Synapse 24WG	2 oz	0.3 a	0.0 b	0.0 b	0.0 b	0.4 a	0.4 b	0.3 b	0.3 b	0.0 b	0.0 b
Synaspe 24 WG	3 oz	3.1 a	0.0 b	0.0 b	0.0 b	0.4 a	0.0 b	0.0 b	0.0 b	0.0 b	0.4 b
Radiant 1SC	5 oz	0.0 a	0.0 b	0.0 b	0.3 b	0.0 a	0.0 b	0.3 b	0.3 b	0.0 b	0.0 b
Coragen 1.6 SC	5 oz	1.6 a	0.0 b	0.0 b	0.0 b	0.4 a	0.0 b	1.3 ab	0.3 b	0.0 b	0.0 b
UTC	-	6.3 a	2.2 a	3.2 a	4.4 a	0.7 a	5.0 a	3.2 a	5.3 a	2.5 a	3.3 a

Means followed by the same letter are not significantly different, ANOVA; protected LSD $_{(p>0.05)}$

Table 2 continued.

		BAW Larvae / 10 Plants							
		8-Nov		15-Nov		20-Nov		Season Avg	
Treatment	Rate	Small	Large	Small	Large	Small	Large	Small	Large
Avaunt 30WG	4.5 oz	0.0 a	0.5 a	0.0 a	0.0 a	0.0 a	0.0 b	0.6 b	0.3 b
Intrepid 2F	8 oz	0.5 a	0.5 a	0.5 a	0.0 a	0.0 a	0.0 b	1.2 ab	0.2 b
Proclaim 5SG	3.5 oz	2.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 b	0.6 b	0.1 b
Synapse 24WG	2 oz	3.5 a	0.5 a	0.0 a	0.5 a	0.0 a	0.0 b	0.6 b	0.2 b
Synaspe 24 WG	3 oz	0.0 a	0.0 a	0.0 a	0.0 a	0.2 a	0.0 b	0.5 b	0.1 b
Radiant 1SC	5 oz	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 b	0.1 b	0.1 b
Coragen 1.6 SC	5 oz	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 b	0.5 b	0.1 b
UTC	-	0.0 a	0.5 a	0.5 a	0.5 a	0.0 a	0.6 a	2.3 a	3.0 a

Means followed by the same letter are not significantly different, ANOVA; protected LSD $_{(p>0.05)}$

Table 3.

		Plants infested at harvest (%)					
		Heads			Wrapper leaves		
Treatment	Rate	Feeding Damage	Frass	Larvae	Feeding Damage	Frass	Larvae
Avaunt 30WG	4.5 oz	0.0 b	0.0 b	0.0 b	8.0 b	8.0 b	0.0 a
Intrepid 2F	8 oz	4.2 b	4.2 b	0.0 b	0.0 b	0.0 b	0.0 a
Proclaim 5SG	3.5 oz	4.2 b	4.2 b	4.2 b	0.0 b	0.0 b	0.0 a
Synapse 24WG	2 oz	4.2 b	4.2 b	0.0 b	4.2 b	4.2 b	4.2 a
Synaspe 24 WG	3 oz	0.0 b	0.0 b	4.2 b	8.3 b	4.2 b	0.0 a
Radiant 1SC	5 oz	4.2 b	0.0 b	0.0 b	4.2 b	0.0 b	0.0 a
Coragen 1.6 SC	5 oz	4.2 b	4.2 b	4.2 b	4.2 b	4.2 b	0.0 a
UTC	-	41.8 a	29.0 a	33.2 a	58.0 a	62.5 a	16.5 a

Means followed by the same letter are not significantly different, ANOVA; protected LSD $_{(p>0.05)}$

Objective 3. To initiate a monitoring program for the commercial field performance of Coragen and soil treatments for control of armyworms, loopers, leafminers in the Yuma area (if approved for use before September).

Coragen was not approved for soil use during the fall 2008 growing season. We have initiated a preliminary program that will be conducted during the fall of 2009 to measure commercial field performance.

Objective 4. To evaluate several new insecticides for control of thrips (Radiant, Tesoro) and aphids (Movento, Beleaf) in spring lettuce.

INFLUENCE OF ADJUVANTS AND MOVENTO SPRAY TIMING ON APHID CONTAMINATION IN HEAD LETTUCE

The objective of this study was to evaluate the addition of a penetrating adjuvant with Movento (spirotetramat) applied at threshold and as a pre-harvest spray on lettuce aphid (LA) efficacy in lettuce. Small-plot, field studies were conducted at the University of Arizona, Yuma Agricultural Center in the spring 2008 growing season. Lettuce 'Desert Springt' was direct seeded into double row beds on 42 inch centers on 14 Dec 2007. 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. Foliar sprays were applied on 7 and 25 Mar as a broadcast application delivered through 2, TX-18 ConeJet nozzles per bed at 22.5 GPA @ 50 psi. Movento treatments (both with and without DyneAmic at 0.75% v/v) were either applied once (Mar 25; 24-d before harvest) or twice (7 and 25 Mar; 24- and 6-d before harvest, respectively). The Beleaf+Assail combination (with DyneAmic ay 0.75%) was applied twice on 7 and 25 Mar. Post-treatment evaluations of LA populations were assessed by estimating the number of aphids / plant in whole plant, destructive samples. On Mar 15 and Mar 24, 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 apterous aphids present. At harvest (Mar 31), head contamination was estimated by randomly selecting 8 plants within each replicate and recording for each individual head the number LA from 2 wrapper leaves , the cap leaf and all leaves within each mature head. Mean LA per head and the % of heads contaminated with greater than 5 live LA were calculated at harvest. Data were log transform (mean+1) prior to the ANOVA and a protected LSD F test to distinguish treatment mean differences. Actual non-transformed means are presented in the tables.

LA pressure was heavy when the first spray was applied and had exceeded the action threshold of 10% infested plants. At 8 DAT-1, the Movento+DyneAmic and Beleaf+Assail treatments had fewer LA than the Movento treatment applied without an adjuvant (Table 1). At 17 DAT-1, LA numbers in the Movento treatments did not differ, and were significantly lower than the both the UTC and Beleaf+Assail treatment. Similarly, at harvest these Movento treatments (regardless whether an adjuvant was added) prevented significant economic contamination of lettuce heads. Although LA numbers per head were significantly reduced in the Beleaf +Assail treatment relative the UTC, contamination levels showed that a significant percentage of heads contained LA numbers well above acceptable grading standards (Table

2). LA numbers at harvest in the two Movento treatments (with and without adjuvant) that were applied only once 6 days before harvest (25 Mar) were not different from the UTC and heads would not have been commercially marketable. Overall, results from this study suggested that timing and frequency of Movento applications had a more significant influence on LA control in head lettuce than use of an adjuvant.

TABLE 1.

			Mean Aphids / Plant	
Treatment	Rate/acre	Spray Dates	15-Mar	24-Mar
Movento 2SC	5 oz	25-Mar	31.6 ab	92.5 a
Movento + Dyne-Amic	5 oz	25-Mar	43.8 a	110.9 a
Movento 2SC	5 oz	7 , 25-Mar	7.1 bc	2.5 b
Movento + Dyne-Amic	5 oz	7 , 25-Mar	1.3 d	1.4 b
Beleaf 50SG+Assail 30SG	2.8+4.0 oz	7 , 25-Mar	4.7 cd	6.0 b
UTC	-	-	64.7 a	108.8 a

TABLE 2.

			Head Contamination at Harvest (31- Mar)	
Treatment	Rate/acre	Spray Dates	Mean LA / Head	% heads with > 5 LA
Movento 2SC	5 oz	25-Mar	78.7 a	91.5 a
Movento + Dyne-Amic	5 oz	25-Mar	39.4 ab	87.5 a
Movento 2SC	5 oz	7 , 25-Mar	0.8 c	0.0 b
Movento + Dyne-Amic	5 oz	7 , 25-Mar	1.1 c	4.5 b
Beleaf 50SG+Assail 30SG	2.8+4.0 oz	7 , 25-Mar	19.8 b	66.8 a
UTC	-	-	86.3 a	91.5 a

INFLUENCE OF ADJUVANTS ON MOVENTO EFFICAY AGAINST APHIDS IN SPRING HEAD LETTUCE

The objective of this study was to evaluate the influence of spray adjuvants on the efficacy of Movento (spirotetramat) for control of aphids on lettuce. Small-plot, field studies were conducted at the University of Arizona, Yuma Agricultural Center in the spring 2008 growing season. Head lettuce was direct seeded into double row beds on 42 inch centers on 29 Nov, 2007. Plots for each trial were 2 beds wide by 40' long with two untreated beds between plots. Plots were arranged in a RCB design with 4 replications. Rates and formulations for each treatment are shown in the tables. Foliar sprays were applied on 15 Jan, 16 Feb and 26 Feb with a CO_2 operated boom sprayer at 50 psi and 23 gpa. A broadcast application was delivered through 2 TX-12 ConeJet nozzles per bed. The Movento+Dyne-Amic (5 oz/ac) treatment was only treated twice and did not receive the third spray on 26 Feb. Aphid populations were assessed by estimating the number of aphids /plant in whole plant, destructive samples. On each sampling 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 apterous (non-winged) aphids present. At harvest, individual hearts were sampled for aphid contamination by selecting 10 plants per plot, removing the outer frame and wrapper leaves and counting the number of aphids on and within individual romaine hearts. Data were analyzed as a 1-way ANOVA using a protected LSD F test to distinguish treatment mean differences.

Aphid pressure was moderate during the trial. All Movento+Adjuvant spray treatments significantly reduced green peach aphid (GPA) numbers compared to the UTC following each application (Table1). Among the Movento+Adjuvant treatments, significant differences in GPA numbers varied throughout the trial. However, differences in GPA infesting romaine hearts at harvest did not differ among the Adjuvant treatments. Lettuce aphid (LA) populations did not reach significant levels until harvest (Table 2). All Movento+Adjuvant treatments significantly reduced LA numbers per head compared to the UTC and the Beleaf+Dyne-Amic treatment. Overall, based on economic aphid contamination observed at harvest no single adjuvant type appeared to provide better control of GPA or LA. Furthermore, comparable aphid control was obtained for both the Movento+Dyne-Amic treatments, regardless of rate, timing or spray frequency.

Table 1.

Treatment	Rate/acre	Adjuvant (% v/v)	Mean Green Peach Aphids / Plant						Harvest *(Mar 5)* Avg / Heart
			15-Jan	22-Jan	30-Jan	5-Feb	12-Feb	23-Feb	
Movento+Induce	3 oz	0.25%	5.0 a	6.6 a	1.1 b	1.4 bc	0.9 c	4.4 bc	0.3 bc
Movento+Exit	3 oz	0.25%	5.8 a	6.0 a	0.9 b	2.2 b	2.2 b	5.4 b	0.5 bc
Movento+Torpedo	3 oz	0.25%	4.5 a	2.5 a	0.3 bc	0.8 bc	1.8 bc	6.5 b	0.9 bc
Movento+Destiny	3 oz	0.50%	5.0 a	2.1 a	0.3 bc	0.4 c	1.7 bc	4.1 bc	0.2 bc
Movento+DyneAmic	3 oz	0.50%	5.8 a	2.4 a	1.0 b	0.5 c	1.4 bc	1.9 c	0.2 bc
Movento+DyneAmic	5 oz	0.50%	5.2 a	2.1 a	0.5 bc	0.6 c	1.2 bc	4.7 b	0.1 c
Beleaf+DyneAmic	2.8 oz	0.50%	5.2 a	1.7 a	0.2 c	0.5 c	1.8 b	4.7 b	1.0 b
UTC	-	-	5.0 a	4.3 a	5.9 a	5.0 a	17.7 a	60.5 a	40.9 a

Means followed by the same letter for each date are not significantly different, ANOVA; protected LSD $_{(p>0.05)}$

Table 2.

Treatment	Rate/acre	Adjuvant (% v/v)	Mean Lettuce Aphids / Plant 15-Jan	22-Jan	30-Jan	5-Feb	12-Feb	23-Feb	Harvest *(Mar 5)* Avg / Heart
Movento+Induce	3 oz	0.25%	0	0	0	0 a	0 a	0.4 a	0.4 c
Movento+Exit	3 oz	0.25%	0	0	0	0 a	0.1 a	0.7 a	0 d
Movento+Torpedo	3 oz	0.25%	0	0	0	0 a	0 a	0.1 a	0.2 cd
Movento+Destiny	3 oz	0.50%	0	0	0	0 a	0 a	0.5 a	0 d
Movento+DyneAmic	3 oz	0.50%	0	0	0	0 a	0 a	0 a	0 d
Movento+DyneAmic	5 oz	0.50%	0	0	0	0 a	0 a	0 a	0.1 cd
Beleaf+DyneAmic	2.8 oz	0.50%	0	0	0	0 a	0 a	0.6 a	1.5 b
UTC	-	-	0	0	0	0.1 a	0.1 a	29.2 a	9.5 a

Means followed by the same letter for each date are not significantly different, ANOVA; protected LSD $_{(p>0.05)}$

APHID CONTROL WITH FOLIAR AND SOIL APPLIED NEONICOTINOIDS IN SPRING HEAD LETTUCE

The objective of this study was to compare the residual efficacy of soil and foliar applied neonicotinoids against aphids on spring head lettuce under desert growing conditions. Small-plot, field studies were conducted at the University of Arizona, Yuma Agricultural Center in the spring 2007 growing seasons. Head Lettuce 'Westland' was direct seeded into double row beds on 42 inch centers on 16 Nov, 2007. Plots for each trial consisted of 2 beds , 45' long. Plots were arranged in a randomized complete block design with 4 replications. Formulations and rates for each compound are provided in the tables. The Admire Pro and Platinum treatments were applied at a depth of 2" below the seed line during planting in a total water volume of 21 GPA . Foliar sprays were applied on 10 Jan, 27 Jan and 17 Feb with a CO_2 operated boom sprayer at 50 psi and 28 gpa. A broadcast application was delivered through 3 TXVS-12 ConeJet nozzles per bed. An adjuvant, DyneAmic (Helena Chemical Co.), was applied at 0.25% to all treatments. The Movento treatment was applied only once on Feb 17 on lettuce plots treated with Admire Pro at planting. Extremely cold weather was recorded from Jan 15-17 (below freezing temperatures recorded for several hours). At harvest (Mar 7), 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 and documenting the percentage of heads with aphid infestations of >5 and > 10 aphids/head. Data were analyzed as a 1-way ANOVA using a protected LSD F test to distinguish treatment mean differences.

Aphid pressure was moderate-heavy during the study. Foxglove aphids(FGA) aphid infestation levels at harvest varied significantly among the soil and foliar spray treatments (Table 1). The Platinum (8 oz) and Admire Pro soil treatments, and the low-rate Actara (3 oz) foliar treatment did not significantly reduce the number of FGA/head compared with the UTC. Furthermore, because the USDA marketing standard for U.S. No.1 lettuce does not accept lettuce shipments that exceed 12% of the heads with 5 or or more aphids, these same treatments would not have been commercially acceptable. Lettuce aphid (LA) infestation levels were much higher at harvest than for FGA (Table 2). All the foliar spray treatments and the Platinum (8oz) treatment had significantly fewer LA than the UTC. However, only the Movento spray treatment applied 18 d before harvest to Admire Pro soil-treated plots provided lettuce heads that were commercially acceptable based on USDA marketing standards.

Table 1.

Treatment	Rate	Avg. FGA / head	% Heads infested with > 5 FGA	% Heads infested with > 10 FGA
Platinum 2SC	8 oz	4.2 ab	18.0 b	10.8 a
Platinum 2SC	11 oz	1.6 b	10.8 b	0.0 a
Alias 2F	20 oz	4.4 ab	25.3 ab	17.8 a
Alias+ Movento	8 oz +8 oz	0.5 b	0.0 b	0.0 a
Actara 25WG	3 oz	3.9 ab	14.3 b	14.3 a
Actara 25WG	4 oz	0.4 b	0.0 b	0.0 a
Belaf 50SG	2.8 oz	0.04 b	0.0 b	0.0 a
Assail 30SG	4 oz	1.5 b	10.8 b	3.5 a
UTC	-	6.8 a	49.8 a	25.0 a

Table 2.

Treatment	Rate	Avg. LA/ head	% Heads infested with > 5 LA	% Heads infested with LA/ head
Platinum 2SC	8 oz	35.6 bc	78.8 abc	35.6 bc
Platinum 2SC	11 oz	77.1 ab	82.0 abc	77.1 ab
Alias 2F	20 oz	52.1 abc	89.3 ab	52.1 abc
Alias+ Movento	8 oz +8 oz	1.0 c	0.0 d	1.0 c
Actara 25WG	3 oz	20.5 c	85.8 ab	20.5 c
Actara 25WG	4 oz	16.9 c	67.8 bc	16.9 c
Belaf 50SG	2.8 oz	19.9 c	71.3 bc	19.9 c
Assail 30SG	4 oz	21.6 c	60.5 c	21.6 c
UTC	-	100.1 a	100 a	100.1 a

INFLUENCE OF ADJUVANTS ON MOVENTO AS A PRE-HARVEST TREATMENT FOR APHID CONTROL IN ROMAINE LETTUCE

The objective of this study was to evaluate the efficacy of Movento (with or without various adjuvants) against LA when applied as a pre-harvest spray to romaine lettuce. Small-plot, field studies were conducted at the University of Arizona, Yuma Agricultural Center in the spring 2008 growing season. Romaine 'Fresh Heart' was direct seeded into double row beds on 42 inch centers on 14 Dec 2007. Plots for each trial consisted of 2 beds by 45 ft long, with a 2 bed untreated buffer. Plots were arranged in a RCB design with 4 replications. Formulations and rates for each treatment are provided above and in the table. A single foliar spray was applied 7 days prior to harvest on 27 Mar with a CO_2 operated boom sprayer at 50 psi and 23 gpa. A broadcast application was delivered through 2 TX-12 ConeJet nozzles per bed. LA populations were assessed by estimating the number of live and dead apterous LA per romaine plant in whole plant, destructive samples. Prior to the application, LA population abundance within the experimental area was estimated from 50 randomly selected plants. At harvest (7 days following application), 10 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 recording the number of live and dead apterous LA present on plants. Data was collected and recorded from whole plants and hearts seperately. Data were log transform (mean+1) prior to the ANOVA and a protected LSD F test to distinguish treatment mean differences. Actual non-transformed means are presented in the tables.

Lettuce aphid (LA) infestation levels prior to the spray application were heavy and were estimated at an average of 482.6 LA per plant. Following the application, all spray treatments significantly reduced the number of live LA numbers per whole plant and heart compared to the UTC. However, the addition of an adjuvant had a significant effect on Movento activity, but varied among products. The addition of Nufilm-P and Hook with Movento did not significantly improve LA control relative to the Movento applied without adjuvant, whereas Movento applied with Dyne-Amic, Exit and Induce provided significantly greater reductions in live LA numbers. Conversely, plants treated with the Moveno+Adjuvant combinations all had significantly greater numbers of dead LA per plant and heart compared to the UTC. The total number of all aphids (dead+alive) found on whole plant or hearts at harvest did not differ among any of the treatments and the UTC. The results of this study suggest that although Movento can be applied to romaine plants just prior to harvest to kill LA infesting the hearts, the number of dead aphids remaining within romaine plants under these conditions would render the hearts unmarketable.

Table 1.

Treatment	Rate /acre	Adjuvant rate (% v/v)	Live LA		Dead LA		All Aphids (Dead+Alive)	
			Heart	**Whole Plant**	**Heart**	**Whole Plant**	**Heart**	**Whole Plant**
Movento	5 oz	-	45.5 b	106.5 b	69.4 b	133.3 b	114.9 a	239.8 a
Movento + DyneAmic	5 oz	0.75%	5.0 e	25.8 d	117.4 ab	205.2 b	122.4 a	231.1 a
Movento + Exit	5 oz	0.50%	6.2 de	52.6 bcd	123.2 a	212.7 b	129.5 a	265.3 a
Movento+NuFilm-P	5 oz	0.20%	48.2 b	125.2 b	67.5 b	126.8 b	115.7 a	252.5 a
Movento+Hook	5 oz	0.25%	35.7 bc	88.5 bc	75.6 ab	138.0 b	111.3 a	226.6 a
Movento+Induce	5 oz	0.25%	12.2 cd	35.9 cd	137.3 ab	234.1 b	149.6 a	270.1 a
UTC	-	-	203.4 a	356.8 a	10.7 c	25.1 a	214.2 a	381.9 a

Means followed by the same letter are not significantly different, ANOVA; protected LSD (p>0.05)

WESTERN FLOWER THRIPS CONTROL WITH RADIANT ON SPRING HEAD LETTUCE

The objective of the study was to compare the efficacy of the new insecticide Radiant (spinetoram) with industry standards for control of western flower thrips on romaine lettuce under desert growing conditions. Head Lettuce was direct seeded on 16 Nov, 2006 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 45 ft long and bordered by two untreated beds. Four replications of each treatment were arranged in a randomized complete block design. Formulations and rates for each compound are provided in the tables. Foliar sprays were applied on 24 Jan, 4 Feb and 14 Feb with a CO_2 operated boom sprayer that delivered a broadcast application at 50 psi and 28 gpa through 3 TXVS-18 ConeJet nozzles per bed. An adjuvant, DyneAmic (Helena Chemical Co.), was applied at 0.15% to all treatments. 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 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. Data were analyzed as a 1-way ANOVA with means compared where appropriate using a protected LSD *F* test $_{(p<0.05)}$.

WFT population levels were moderate during this trial. Following each spray application, all of the Radiant treatments significantly reduced numbers of WFT adults compared to the untreated control (Table1). When averaged across all sample dates, the Radiant treatments provided efficacy comparable to the Lannate +Mustang Max standard tank-mixture. The Lannate+Tesoro combination provide less consistent WFT adult efficacy compared to the other treatments. Against larvae, all treatments significantly reduced larvae numbers following each spray (Table 2) . The addition of Lannate, Tesoro or Mustang Max with Radiant did not significantly improve larval efficacy. Furthermore, larval efficacy did not different between the Radiant treatments applied at the 5 and 7 oz rates. When averaged across all sample dates, all Radiant Treatments provide significantly better efficacy that both Lannate+Mustang Max and Lannate +Tesoro. No phytotoxicity was observed.

Table 1.

		WFT Adults / Plant							
		6 DAT-1	*9 DAT-1*	*3 DAT-2*	*8 DAT-2*	*5 DAT-3*	*10 DAT-3*	*14 DAT-3*	
Treatment	Rate/ac	30-Jan	2-Feb	7-Feb	12-Feb	19-Feb	24-Feb	28-Feb	Avg.
Radiant 1SC	7 oz	1.3 ab	0.8 b	0.8 b	1.4 b	2.1 b	3.2 bc	3.8 b	1.9 bc
Radiant 1SC	5 oz	0.9 b	0.9 b	0.8 b	1.3 b	2.7 b	2.3 c	4.6 b	1.9 bc
Radiant 1SC	3 oz	1.1 b	0.6 b	1.0 b	0.9 b	2.5 b	2.9 bc	5.6 b	2.1 bc
Success 2SC	6 oz	1.1 b	1.1 b	1.1 b	1.8 b	2.7 b	3.8 b	6.3 b	2.5 b
Lannate SP+Mustang Max	0.5 lb+4 oz	0.9 b	0.4 b	0.5 b	1.4 b	1.5 b	2.1 c	3.7 b	1.5 c
UTC	-	2.1 a	2.3 a	2.9 a	4.2 a	6.9 a	10.4 a	10.4 a	5.6 a

Means followed by the same letter are not significantly different, ANOVA; protected LSD $_{(p>0.05)}$

Table 2

Treatment	Rate/ac	WFT Larvae / Plant							
		6 DAT-1	*9 DAT-1*	*3 DAT-2*	*8 DAT-2*	*5 DAT-3*	*10 DAT-3*	*14 DAT-3*	
		30-Jan	2-Feb	7-Feb	12-Feb	19-Feb	24-Feb	28-Feb	Avg.
Radiant 1SC	7 oz	7.4 b	3.7 a	6.3 c	2.9 c	1.3 b	1.1 b	1.1 b	3.4 b
Radiant 1SC	5 oz	6.2 b	6.4 a	4.6 c	3.3 c	1.9 b	0.7 b	0.7 b	3.4 b
Radiant 1SC	3 oz	4.8 b	5.8 a	11.1 b	3.9 c	2.4 b	1.9 b	1.8 b	4.5 b
Success 2SC	6 oz	6.6 b	6.3 a	10.8 b	9.1 b	2.9 b	2.2 b	2.3 b	5.8 b
Lannate SP+Mustang Max	0.5 lb+4 oz	8.5 ab	5.4 a	6.4 c	7.0 bc	2.5 b	1.4 b	1.3 b	4.6 b
UTC	-	11.9 a	6.8 a	17.9 a	34.1 a	31.3 a	27.9 a	22.9 a	21.8 a

Means followed by the same letter are not significantly different, ANOVA; protected LSD $_{(p>0.05)}$

WESTERN FLOWER THRIPS CONTROL WITH INSECTICIDE COMBINATIONS ON ROMAINE LETTUCE

The objective of the study was to compare the efficacy of several insecticide combinations for control of western flower thrips on romaine lettuce under desert growing conditions. Romaine lettuce 'Fresh heart' was direct seeded on 16 Dec, 2006 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 45 ft long and bordered by two untreated beds. Four replications of each treatment were arranged in a randomized complete block design. Formulations and rates for each compound are provided in the tables. The rate of Lannate were increased to 0.75 lb / acre for the combination treatments on the 3rd spray. Foliar sprays were applied on 16 Feb, 2 Mar, and 14 Mar with a CO_2 operated boom sprayer that delivered a broadcast application at 50 psi and 28 gpa through 3 TXVS-18 ConeJet nozzles per bed. An adjuvant, DyneAmic (Helena Chemical Co.), was applied at 0.25% to all treatments. 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 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 Data were analyzed as a 1-way ANOVA with means compared where appropriate using a protected LSD *F* test $_{(p<0.05)}$.

WFT population levels were moderate during this trial. All treatments provided significant control of adult WFT following the 1^{st} application and at 5 d following the 2^{nd} spray (Table 1). Thereafter WFT adult numbers did not differ among the spray combination treatments and the UTC. This is likely due to daily adult movement within the experimental area and immigration from outside sources in mid-March that masked treatment effects. All spray combination treatments significantly reduced WFT larvae numbers following each spray application with the exception of Tesoro and Tesoro +Mustang Max treatments following the first application. Overall, the Lannate+Capture, Lannate+Mustang Max and Tesoro+Lannate combinations provided the most consistent efficacy against WFT larvae. No phytotoxicity was observed.

Table 1.

		Adult WFT / Plant							
		4 DAT-1	*7 DAT-1*	*11 DAT-1*	*5 DAT-2*	*10 DAT-2*	*5 DAT-3*	*4 DAT-9*	
Treatment	Rate/ac	20-Feb	23-Feb	27-Feb	7-Mar	12-Mar	19-Mar	23-Mar	Avg.
Lannate SP+Mustang Max	0.5 lb+4 oz	2.1 bc	3.8 b	5.4 b	5.8 b	12.5 a	19.5 a	13.5 a	8.9 b
Lannate SP+Capture 2EC	0.5 lb +5 oz	1.3 c	4.8 b	5.2 b	6.7 b	15.0 a	27.5 a	17.5 a	11.1 b
Lannate SP +Hero 1.24EC	0.5 lb + 10 oz	2.3 bc	4.7 b	4.0 b	5.7 b	16.0 a	21.5 a	22.5 a	10.9 b
Lannate SP+Ambush 25WP	0.5 lb+12 oz	2.7 b	3.4 b	5.4 b	6.3 b	19.5 a	29.5 a	21.0 a	12.5 b
Tesoro 4EC+ Lannate SP	6 oz + 0.5 lb	1.4 bc	4.8 b	4.8 b	6.5 b	13.0 a	21.5 a	16.5 a	9.8 b
Tesoro 4EC+ Mustang Max	6 oz + 4 oz	2.6 bc	4.1 b	4.3 b	6.8 b	14.5 a	28.0 a	14.5 a	10.7 b
Tesoro 4EC	6 oz	2.5 bc	3.3 b	5.5 b	5.1 b	13.0 a	21.5 a	15.5 a	9.5 b
UTC	-	5.6 a	11.4 a	11.1 a	15.4 a	22.5 a	39.5 a	18.0 a	17.6 a

Means followed by the same letter are not significantly different, ANOVA; protected LSD $_{(p>0.05)}$

		Larvae WFT / Plant							
		4 DAT-1	*7 DAT-1*	*11 DAT-1*	*5 DAT-2*	*10 DAT-2*	*5 DAT-3*	*4 DAT-9*	
Treatment	Rate/ac	20-Feb	23-Feb	27-Feb	7-Mar	12-Mar	19-Mar	23-Mar	Avg.
Lannate SP+Mustang Max	0.5 lb+4 oz	1.9 b	5.7 c	7.8 b	5.8 bc	30.5 bcd	60.0 bc	43.5 b	22.2 c
Lannate SP+Capture 2EC	0.5 lb +5 oz	3.1 b	5.3 c	6.7 b	5.0 c	21.0 d	41.0 c	56.0 b	19.8 c
Lannate SP +Hero 1.24EC	0.5 lb + 10 oz	2.8 b	9.2 bc	6.4 b	5.6 c	27.0 cd	67.5 bc	57.0 b	25.1 bc
Lannate SP+Ambush 25WP	0.5 lb+12 oz	2.4 b	4.7 c	6.3 b	7.0 bc	34.0 bcd	59.0 bc	65.5 b	25.6 bc
Tesoro 4EC+ Lannate SP	6 oz + 0.5 lb	1.3 b	6.1 bc	6.5 b	8.0 bc	30.0 bcd	64.5 bc	40.5 b	22.4 c
Tesoro 4EC+ Mustang Max	6 oz + 4 oz	3.3 b	9.8 abc	12.2 b	11.8 bc	60.0 b	115.0 b	71.5 b	40.0 b
Tesoro 4EC	6 oz	3.3 b	11.4 ab	9.9 b	14.8 b	54.5 bc	85.0 bc	66.0 b	35.0 bc
UTC	-	7.1 a	15.5 a	19.8 a	51.5 a	113.5 a	216.0 a	141.5 a	80.7 a

Means followed by the same letter are not significantly different, ANOVA; protected LSD $_{(p>0.05)}$

WESTERN FLOWER THRIPS CONTROL WITH RADIANT TANK MIXES ON SPRING LETTUCE

The objective of the study was to evaluate the efficacy of the new insecticide Radiant (spinetoram) when combined with industry standards for control of western flower thrips on romaine lettuce under desert growing conditions. Romaine lettuce (Green Forrest) was direct seeded on 29 Dec 2007 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 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 compound are provided in the tables. Foliar sprays were applied on 1 Feb, 10 Feb and 20 Feb with a CO_2 operated boom sprayer that delivered a broadcast application at 50 psi and 28 gpa through 3 TXVS-18 ConeJet nozzles per bed. An adjuvant, DyneAmic (Helena Chemical Co.), was applied at 0.25% to all treatments. 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 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. Data were analyzed as a 1-way ANOVA with means compared where appropriate using a protected LSD F test $_{(p<0.05)}$.

WFT population levels were moderate during this trial. Following each spray application, all of the Radiant treatments significantly reduced numbers of WFT adults compared to the untreated control (Table1). When averaged across all sample dates, the Radiant treatments provided efficacy comparable to the Lannate +Mustang Max standard tank-mixture. The Lannate+Tesoro combination provided less consistent WFT adult efficacy compared to the other treatments. All treatments significantly reduced numbers of WFT larvae following each spray (Table 2). In most cases, the addition of Lannate, Tesoro or Mustang Max with Radiant did not significantly improve larval efficacy over Radiant applied alone. Furthermore, following the 2nd application, larval efficacy was not different between the Radiant treatments applied at the 5 and 7 oz rates. When averaged across all sample dates, all Radiant treatments provide significantly better efficacy than both the Lannate+Mustang Max and Lannate +Tesoro treatments.

Table 1.

Treatment	Rate/acre	Mean Adult WFT / Plant						
		3 DAT-1	7 DAT-1	4 DAT-2	8 DAT-2	4 DAT-3	8 DAT-3	
		4-Mar	8-Mar	14-Mar	18-Mar	24-Mar	28-Mar	Trial Average
Radiant 1SC	7 oz	6.6 b	11.3 b	24.0 b	19.9 bc	55.9 b	55.5 a	28.9 bc
Radiant 1SC	5 oz	9.3 b	13.9 b	21.0 bc	20.3 bc	58.9 b	57.5 a	30.1 bc
Radiant+Lannate SP	5 oz+0.4 lb	6.6 b	17.3 b	16.5 bc	13.9 bc	49.9 b	60.5 a	27.4 cd
Radiant+Tesoro 4EC	5 oz+6 oz	9.3 b	12.8 b	16.9 bc	15.8 bc	52.5 b	53.5 a	26.8 cd
Radiant+Mustang Max	5 oz+4 oz	7.8 b	10.9 b	12.8 c	10.9 c	43.5 b	46.5 a	22.1 d
Lannate+Tesoro 4EC	0.5 lb+6 oz	7.2 b	14.3 b	21.8 bc	23.6 b	69.0 ab	74.0 a	34.9 b
Lannate+Mustang	0.5 lb+4 oz	5.4 b	12.4 b	16.5 bc	17.6 bc	50.3 b	56.0 a	26.4 cd
UTC	-	22.2 a	31.9 a	44.3 a	40.1 c	89.6 a	53.0 a	46.8 a

Means followed by the same letter are not significantly different, ANOVA; protected LSD *($p>0.05$)*

Table 1.

Treatment	Rate/acre	Mean WFT Larvae / Plant						
		3 DAT-1	7 DAT-1	4 DAT-2	8 DAT-2	4 DAT-3	8 DAT-3	
		4-Mar	8-Mar	14-Mar	18-Mar	24-Mar	28-Mar	Trial Average
Radiant 1SC	7 oz	13.5 c	13.5 c	7.5 d	5.3 b	8.3 bc	12.5 d	39.4 d
Radiant 1SC	5 oz	25.2 b	25.2 b	9.0 cd	6.8 b	5.6 c	18.0 d	44.2 d
Radiant+Lannate SP	5 oz+0.4 lb	14.7 c	14.7 c	6.4 d	6.4 b	4.9 c	18.0 d	37.9 d
Radiant+Tesoro 4EC	5 oz+6 oz	23.7 bc	23.7 bc	12.4 bcd	5.3 b	7.9 bc	27.0 cd	44.4 d
Radiant+Mustang Max	5 oz+4 oz	20.7 bc	20.7 bc	9.8 cd	6.8 b	9.0 bc	18.5 d	36.7 d
Lannate+Tesoro 4EC	0.5 lb+6 oz	27.0 b	27.0 b	22.9 bc	13.5 b	30.8 b	101.7 b	73.7 b
Lannate+Mustang Max	0.5 lb+4 oz	25.8 b	25.8 b	27.0 b	7.5 b	27.4 bc	72.5 bc	58.7 c
UTC	-	58.5 a	58.5 a	82.1 a	87.4 b	186.4 a	277.0 a	172.7 a

Means followed by the same letter are not significantly different, ANOVA; protected LSD *(p>0.05)*