Evaluation of Various Insecticides for Late Winter/ Early Spring Insect Control, 2004

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Abstract

Nine insecticides were applied on March 10, 2004, to alfalfa that had been water stressed prior to irrigation on March 6. These actions were thought to have resulted in treatments means with less distinct differences than usually noted for these treatments at 7-14 days post treatment. All pyrethroid treatments as well as Lorsban® and Steward® treatments resulted in significant reductions of alfalfa weevil larvae at four days post treatment. The Trilogy® treatment did not result in acceptable control of this pest. Significant increases in adult alfalfa weevils were noted at 10-14 days post treatment in pyrethroid treated alfalfa, perhaps due to increased production of certain plant volatiles in response to this class of insecticides. Low numbers of blue alfalfa aphids were noted in this study partially due to insecticide control as well as numerous beneficial insects. Fewest damsel bugs were noted from alfalfa treated with MustangMAX™ and Warrior® insecticides.

Introduction

Control of insects in spring alfalfa continues to be of interest to growers, professional crop advisors and the agrichemical industry. New products continue to be available, and pest response to chemical applications can shift over time. This study was conducted to evaluate and compare many alfalfa insecticides for their efficacy against alfalfa pests present in the late winter/early spring. Insecticides such as Trilogy® were also included to help develop information about this chemistry, as it can be used for the organic market and additional information about its effectiveness would be useful.

Methods and Materials

A field of flood/basin irrigated alfalfa in its fourth year production was chosen for this experiment. Alfalfa weevil larval population was at 7.0 per three foot sweep at March 5 (five days prior to application) but was only about 2.3/sweep at application on March 10. Weevil larval numbers were probably greatly reduced via irrigation on March 6 (4 days prior to application), as alfalfa was very short and regrowth was only about four inches on date of application. Alfalfa regrowth had been greatly slowed prior to irrigation, as field had not been irrigated since October of 2003. Many seven-spotted ladybird beetles were also present, cleaning up what remained of a cowpea aphid population as well as feeding on alfalfa weevil larvae as ladybird beetles were often noted searching for prey deep inside new termimal growth that had not yet expanded and unfolded.

Plots were treated the morning of March 10, 2004, with a backpack CO_2 sprayer calibrated to deliver 17.7 gpa at 24.4 psi with four T-Jet 8002VS nozzles on a 6 foot wide boom. Plots were 7 ft wide x 25 ft long, and replicated four times in a randomized complete block design. Treatments included several pyrethroid chemistries (cyfluthrin = active ingredient in Renounce® 20WP and Baythroid® 2; beta-cyfluthrin, active ingredient in Tempo® 1 EC (all Bayer CropScience); zetacypermethrin, active ingredient in MustangMax™0.8EC (FMC Corp).; lambda cylahlothrin = active ingredient in Warrior® 1 CS (Syngenta Crop Protection, Inc.)) as well as chlorpyrifos (Lorsban® 4E, Dow AgroSciences), indoxacarb (Steward®, DuPont Agricultural Products) and Trilogy® (clarified neem oil, Certis USA). All chemistries were registered for usage on alfalfa forage at time of application with the exceptions of MustangMax™0.8EC and Tempo 1 EC.

Plots were sampled at 4, 7, 10, 14 and 17 days post treatment. Sampling consisted of 10 three foot sweeps with a 15 inch diameter net. Net contents were transferred to plastic containers, and containers were then labeled, and frozen to await insect separation and speciation. Upon sample processing, data were recorded and treatment means analyzed using Fisher's least significant difference (StatGraphics Plus for Windows, Manugistics Inc.) for the various insect species encountered.

Results

Egyptian alfalfa weevil larvae

Application of insecticides in this experiment did not result in long term excellent control of Egyptian alfalfa weevil larvae as had been initially expected. This was thought to be partially due to lack of growth associated with drought stress prior to experiment initiation and reduction of suitable oviposition sites. Plants greened up after watering on March 6 and higher numbers of weevil larvae noted at 7-17 days post treatment may be a reflection of eggs that were oviposited immediately prior to and/or at time of insecticide application (Table 1), as weevil larval populations were considered to be of moderate level.

Insecticide treatments resulted in excellent control of weevil larvae at four days post treatment (Table 1), with the exception of Trilogy®, which had very similar numbers of weevil larvae (24.75/10 sweeps) as that of the untreated control (23.75/10 sweeps). All other treatments had signficantly fewer weevil larvae than these, with fewest noted in the Steward® (1.5), MustangMAX™ (2.0), and Tempo® (2.5) treatments. Highest numbers of weevil larvae per sweep among pyrethroid treatments were noted from Renounce® (8.0) and the low (2 oz./acre) rate of Baythroid® (6.25/10 sweeps) at four days post treatment.

Weevil numbers increased between four and seven days post treatment in all plots with the exception of the untreated check which was very similar (23/ten sweeps) to that noted during the previous sampling. Fewest weevil larvae were noted in Steward® (4.5/ten sweeps) and in both rates of Baythroid® (9.0 and 7.0/ten sweeps). The exact cause of this is unknown but may be an interaction with the sevenspotted lady beetles, a predator of weevil larvae (Evans, unpub.), which were present during the study in low numbers (Table 9). At least one beetle/sweep wat noted at 4 days post treatment in untreated alfalfa and the Steward® treatment, and at 7 days post treatment from the low rate of Baythroid®, Tempo® and the untreated check.

Mean weevil larval numbers continued to increase in all treatments between seven and ten days post treatment (Table 1), with highest numbers noted from alfalfa treated with Trilogy® (43.25/ten sweeps), followed by the untreated check (30.25/ten sweeps). All other treatments had significantly fewer weevil larvae than the check with the exception of the Tempo treatment (20.25/ten sweeps).

Weevil larval numbers peaked in plots at 14 days post treatment, with 47.75/10 sweeps noted in the untreated check (Table 1). Fewest weevil larvae were noted in plots treated with MustangMAX™ (12.75), Lorsban® (15.0) on this sample date, although a number of treatments were very similar. Fewest weevil larvae (9.0/10 sweeps) at 17 days post treatment were noted in the higher rate of Baythroid® (2.4 oz./acre) tested.

Egyptian alfalfa weevil adults

Weevil adults were collected during the experiment with peak numbers noted at 10-14 days post treatment. Many of these adults were noted to be newly emerged. An interesting trend was noted in that fewest adult weevils were almost always collected from the untreated check (Table 2). At four days post treatment significantly more adult weevils were noted in the Tempo® (1.25/10 sweeps) and Renounce® (1.0) treatments than in the untreated check (0.0/10 sweeps). In the next sampling (seven days after application), data indicated that treatments with highest numbers of adult weevils were all synthetic pyrethroids (Table 2), with highest numbers noted from alfalfa treated with Renounce®.

The same phenomena was noted again at both 10 and 14 days post treatment. Numbers of adult weevils declined by 17 days post treatment, but were still highest in alfalfa treated with Renounce® on this sample date (Table 2). As alfalfa had grown rapidly after irrigation and application of treatments, the vast majority of foliage present had not come in contact with insecticide. This does not explain difference noted however.

Why did the pyrethroid treatments result in increased numbers of adult weevils? Perhaps this was due to increased production of certain plant volatiles in response to this class of insecticides. Previous research of *Medicago* species (of which alfalfa, *M. sativae*, is a member) has noted at least three compounds (1-1methyl-4-(1-methylethyl)cyclohexanol, (Z)-geraniol, and hexahydro-farnesol (Core et al., 1994)) which are similar to known insect pheromones. Pyrethroid insecticide application to lettuce has been noted to affect physiological functions for at least 10 days after application (Sances et al., 1981), and may have also similarly affected alfalfa.

Blue alfalfa aphids

Blue alfalfa aphids were fairly low during this study, and numbers were also therefore somewhat altered by aphid predators present such as the convergent lady beetle and sevenspotted lady beetle. At four days post treatment only MustangMAX™ had significantly fewer blue alfalfa aphids than the untreated check (Table 3), and at seven days after application no statistical differences existed between any treatments. Alfalfa treated with either Warrior® or Lorsban® had significantly fewer blue alfalfa aphids at 10 days post treatment than that treated with Renounce® or Steward®. No treatment was statistically different than the untreated check on this sample date.

Warrior® treated alfalfa continued to have the least blue alfalfa aphids (1.5/10 sweeps) at 14 days post treatment (Table 3), and this was the only treatment with significantly less aphids than the untreated check (6.26/10 sweeps) on this sampling date. At 17 days post treatment both Warrior® and Lorsban® had statistically less aphids than the untreated check. Alfalfa treated with other insecticides had similar numbers of aphids as the untreated check on this sample date. The exact reason for these differences is not entirely clear at this time, as the foliage present and inhabited by aphids had developed after insecticide application and would not have insecticide residues present.

BENEFICIAL ARTHROPODS

Damsel bugs

Damsel bugs (*Nabid* spp.) were fairly prevalent during this study, with both adults and nymphs present. Peak populations were noted at 10-14 days post treatment (Table 4). At four days post treatment only alfalfa treated with Steward® had more significantly more damsel bugs than the untreated check, although a number of treatments resulted in numerically more damsel bugs than the untreated check. At seven days post treatment the untreated check had the most damselbugs (4.75/10 sweeps) with this mean being significantly more than most treatments (Table 4). Usage of Warrior® resulted in the fewest damsel bugs at almost every sampling date through 14 days after application.

Minute pirate bugs

Minute pirate bugs (*Orius tristicolor*) are predators of western flower thrips (although western flower thrips were very abundant, they were not counted in this study with the exception of seven days post treatment). Both adults and nymphal stages of minute pirate bugs were present in adequate numbers for separate data analyses in this study.

No treatment resulted in significantly different populations of adult minutre pirate bugs than the untreated check at four or seven days post treatment (Table 5) although differences existed due to differing treatments. Highest numbers of adult minute pirate bugs among treated alfalfa were noted in the Renounce® (4.5 adults/10 sweeps) and the 2 oz./acre rate of Baythroid® (4.0) at four days post treatment, similar to that of the untreated check (4.25) for this sample date. These two insecticide treatments had significantly more minute pirate bugs nymphs than untreated alfalfa at four days post treatment however (Table 6), although no treatment resulted in significantly different numbers of total minute pirate bugs than the untreated check on this date (Table 7).

Nymphal and adult populations did not mirror each other after the initial sample however. By seven days post treatment numbers of adult *Orius* had increased in all treatments by about 2-4x from the previous sample while nymphal numbers remained similar to that previously noted. Highest number of total *Orius* were noted from alfalfa treated with Lorsban® from 7-14 days post treatment (Table 7) with fewest from alfalfa treated with Trilogy® at 7 and 10 days post treatment. This was primarily a result of adult populations (Table 5). Fewer adults were noted in the untreated check than in insecticide treated alfalfa at 14 and 17 days post treatment (Table 5).

Significant differences in nymphal minute pirate bug numbers due to insecticide treatments were noted only at 10 days post treatment when all insecticide applications, with the exceptions of Lorsban® and Steward®, resulting in fewer minute pirate bug nymphs than the untreated check (Table 6). Warrior® resulted in the fewest nymphs from 4-10 days post treatment (Table 6).

Aphid parasitoid wasps

Aphid parasitoid wasps tended to be more prevalent than blue alfalfa aphids during this study. This was in part due to other predators potentially devouring blue alfalfa aphids combined with the fact that some aphid wasps were probably parasitoids of cowpea aphids (that had existed prior to study initiation) rather than the blue alfalfa aphids which were just beginning to arrive in alfalfa. No attempt was made in this study to determine the various wasp species.

Trilogy® was the only treatment that resulted in significantly more aphid wasps than the untreated check at four days post treatment (Table 8). Numbers of wasps decreased in all treatments between four and seven days after application, and remained low until 14 days post treatment. At 17 days post treatment the highest levels of wasps were noted in the untreated check (7.75/10 sweeps) with this being significantly more than mean wasp numbers from any other treatments except Tempo®. Significantly fewer wasps were noted in the Trilogy® treated plots than in the Tempo treated and untreated check alfalfa at 17 days post treatment (Table 8).

Lady Beetles

Two species of lady beetles were present during this study, the sevenspotted lady beetle (*Coccinella septempunctata* L.) and the convergent lady beetle (*Hippodamia convergens* Guerin-Meneville). The sevenspotted lady beetle will feed on both aphids as well as alfalfa weevil larvae, while the convergent lady beetle's diet is primarily aphids. More seven spotted lady beetles were present at study initiation as this predator can build to high numbers in low desert alfalfa when feeding upon cowpea aphids, which had been present prior to study initiation.

Higher numbers of sevenspotted lady beetles (2.25/10 sweeps) were noted in Steward® treated alfalfa than in any other treatment at four days after application (Table 9). No differences were noted for convergent lady beetles (Table 10) on this sampling date, nor did any treatment result in total numbers of lady beetles (both species combined) being statistically different than the untreated check (Table 11). Total numbers of lady beetles was greatest as result of the Steward® treatment (2.5/10 sweeps) and this was significantly more than any treatment containing the active ingredients cyfluthrin (Baythroid®, Renounce®) or beta-cyfluthrin (Tempo®).

At seven day post treatment numbers of convergent lady beetles had increased, although no differerences among treatments were noted (Table 10). Differences were noted for seven spotted lady beetles on this sample date however (Table 9), with Lorsban® treated alfalfa having significantly fewer than Tempo®, the 2 oz./acre rate of Baythroid®, and the untreated check (all with >1/10 sweeps). Fewest total lady beetles at seven days post treatment were noted in alfalfa treated with Renounce®, while the most was in the 2 oz./acre rate of Baythroid®. This is unusual as both treatments contain the same active ingredient but indicates that activity effects may differ. Populations of lady bird beetles were fairly low the remainder of the study.

Differences noted may or may not be reliable due to the small plots and mobility of the beetles. Larger plot sizes may have resulted in a clearer demarcation of the effects of the treatments on ladybird beetle numbers.

Bathyplectes spp. wasps

Bathyplectes spp. wasps are parasitoids of alfalfa weevil larvae. No treatment resulted in statistically different numbers of adult *Bathyplectes* wasps than the untreated check throughout the duration of this experiment (Table 12), although differences did occasionally exist for numbers of this insect between treatments. At four days post treatment more wasps were noted in alfalfa receiving the 2 oz./acre rate Baythroid® treatment than the Steward® or Tempo® treatments. Usage of Warrior® insecticide resulted in fewest *Bathyplectes* wasps during the latter half of the the experiment (Table 12).

Spiders

Spiders were not prevalent at the beginning of sampling, but increased throughout the experiment. No differences were noted at four days post treatment (Table 13), although some differences were noted at all later sampling dates. Untreated alfalfa had the highest numbers of spiders at seven days post treatment, but had the lowest numbers at 10 days post treatment (Table 13). The reason for this fluctuation is unknown, but perhaps may be related to other predators present. Numbers of spiders increased between 10 and 14 days post treatment, with highest numbers of spider noted in the Trilogy® (9.75/10 sweeps) and untreated alfalfa (9.25) plots. All pyrethroid treatments resulted in a signfiicantly fewer spiders (<5 spiders/10 sweeps) with Steward® and Lorsban® treated alfalfa noted to have numerically less than the untreated or Trilogy® plots but more than the pyrethroid treated alfalfa (Table 13) at 14 days post treatment. Similar data were also noted at 17 days post treatment.

Literature Cited

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Acknowledgements

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Table 1. Mean numbers of Egyptian alfalfa weevil larvae/10 three foot sweeps, Blythe, CA, 2004

Treatment	Rate/acre	Days after treatments applied				
		4	7	10	14	17
Baythroid® 2EC	2.0 oz	6.25ab	9.0ab	16.25a	16.75ab	13.5ab
Baythroid® 2EC	2.4 oz	3.5a	7.0a	12.0a	15.75ab	9.0a
Lorsban® 4E	32 oz	4.5ab	11.75ab	10.15a	15.0a	11.25ab
MustangMAX™ 0.8EW	4.0 oz	2.0a	12.0ab	11.5a	12.75a	11.75ab
Renounce® 20WP	3.0 oz	8.0 b	11.5ab	15.75a	16.25ab	14.75ab
Steward® 1.25SC	6.7 oz	1.5a	4.5a	17.25a	16.0ab	14.75ab
Tempo® 1EC	2.0 oz	2.5a	11.25ab	20.25ab	17.25ab	13.75ab
Trilogy®	32 oz	24.75c	26.0 d	43.25 c	38.0 c	23.75 bc
Warrior® 1CS	3.0 oz	4.0ab	16.0 bc	18.75a	24.0 b	18.5 ab
Untreated Check	----	23.75c	23.0 cd	30.25 b	47.75 d	31.25 c

Means in columns followed by the same letter are not statistically different at the $p \leq 0.05$ level (Fisher's LSD test).

Table 2. Mean numbers of Egyptian alfalfa weevil adults/10 three foot sweeps, Blythe, CA, 2004

		Days after treatments applied				
Treatment	Rate/acre	4	7	10	14	17
Baythroid® 2EC	2.0 oz	0.00a	2.25abc	10.5 b	7.5 d	2.25 bc
Baythroid® 2EC	2.4 oz	0.25ab	3.25 bc	8.5 b	10.25 d	1.25ab
Lorsban® 4E	32 oz	0.00a	1.0 ab	4.25a	1.75 b	0.75ab
MustangMAX™ 0.8EW	4.0 oz	0.75abc	2.5 abc	10.0 b	9.75 d	1.00ab
Renounce® 20WP	3.0 oz	1.00 bc	4.0 c	8.75 b	9.75 d	3.75 c
Steward® 1.25SC	6.7 oz	0.25ab	0.25a	1.75a	0.25a	0.25a
Tempo® 1EC	2.0 oz	1.25 c	2.75abc	10.5 b	8.0 d	1.5ab
Trilogy®	32 oz	0.00a	0.25a	4.0a	3.0abc	0.25a
Warrior® 1CS	3.0 oz	0.00a	2.0abc	9.75 b	6.25 bcd	0.25a
Untreated Check	----	0.00a	0.0 a	2.75a	0. a	0.00a

Means in columns followed by the same letter are not statistically different at the $p \leq 0.05$ level (Fisher's LSD test).

Table 3. Mean numbers of blue alfalfa aphids/10 three foot sweeps, Blythe, CA, 2004

		Days after treatments applied				
Treatment	Rate/acre	4	7	10	14	17
Baythroid® 2EC	2.0 oz	1.75ab	1.75a	2.25abc	5.5 b	14.25 b
Baythroid® 2EC	2.4 oz	1.75ab	2.25a	1.75abc	4.25ab	10.25ab
Lorsban® 4E	32 oz	0.75ab	1.75a	0.75ab	3.25ab	5.0 a
MustangMAX™ 0.8EW	4.0 oz	0.5a	1.5a	2.75abc	3.25ab	9.0ab
Renounce® 20WP	3.0 oz	2.5 b	3.5a	3.5 c	4.5ab	14.0 b
Steward® 1.25SC	6.7 oz	1.75ab	3.0a	3.5 c	6.25 b	10.25ab
Tempo® 1EC	2.0 oz	1.25ab	2.25a	3.25 bc	6.0 b	11.5 b
Trilogy®	32 oz	1.5ab	3.0a	3.0 bc	4.5ab	10.25ab
Warrior® 1CS	3.0 oz	1.0ab	1.5a	0.25a	1.5a	4.5a
Untreated Check	----	2.5 b	2.25a	2.25abc	6.25 b	11.5 b

Means in columns followed by the same letter are not statistically different at the $p \leq 0.05$ level (Fisher's LSD test).

Table 4. Mean numbers of damsel bugs (adults + nymphs)/10 three foot sweeps, Blythe, CA, 2004

		Days after treatments applied				
Treatment	Rate/acre	4	7	10	14	17
Baythroid® 2EC	2.0 oz	2.25abc	2.75abc	3.5abc	4.5abc	3.5 ab
Baythroid® 2EC	2.4 oz	1.5 abc	1.75 bc	5.25bcd	3.0ab	1.5 b
Lorsban® 4E	32 oz	1.25abc	1.5 bc	2.5 abc	3.5abc	2.0 b
MustangMAX™ 0.8EW	4.0 oz	1.0 ab	0.5 c	1.75ab	4.0abc	1.75 b
Renounce® 20WP	3.0 oz	2.75abcd	1.75 bc	5.0 bcd	4.75abc	2.0 b
Steward® 1.25SC	6.7 oz	5.25 d	3.5ab	7.75 d	6.0 bc	4.0 ab
Tempo® 1EC	2.0 oz	3.5 bcd	2.25abc	6.0 cd	5.0abc	3.0 ab
Trilogy®	32 oz	4.0 cd	3.0 abc	7.25 d	7.25 c	5.25a
Warrior® 1CS	3.0 oz	0.25a	0.75 bc	0.5a	1.25a	3.0 ab
Untreated Check	----	1.75abc	4.75a	4.75 bcd	5.75 bc	3.75ab

Means in columns followed by the same letter are not statistically different at the p≤0.05 level (Fisher's LSD test).

Table 5. Mean numbers of *Orius* adults/10 three foot sweeps, Blythe, CA, 2004

		Days after treatments applied				
Treatment	Rate/acre	4	7	10	14	17
Baythroid® 2EC	2.0 oz	4.0ab	10.5ab	17.0a	13.75 bc	9.5ab
Baythroid® 2EC	2.4 oz	3.25ab	7.5ab	16.5a	11.0ab	9.75ab
Lorsban® 4E	32 oz	3.0ab	12.0 b	23.75 b	17.25 c	12.0ab
MustangMAX™ 0.8EW	4.0 oz	1.75 b	9.5ab	18.75ab	15.75 c	12.5 b
Renounce® 20WP	3.0 oz	4.5ab	10.0ab	16.25a	14.5 bc	10.25ab
Steward® 1.25SC	6.7 oz	3.75ab	9.0ab	13.75a	11.5ab	11.25ab
Tempo® 1EC	2.0 oz	2.5 b	9.75ab	18.0ab	15.75 c	8.5ab
Trilogy®	32 oz	2.5 b	5.5a	14.25a	9.25a	10.25ab
Warrior® 1CS	3.0 oz	5.5a	9.25ab	17.75a	14.0 bc	9.25ab
Untreated Check	----	4.25ab	8.25ab	15.5a	7.5a	7.75a

Means in columns followed by the same letter are not statistically different at the p≤0.05 level (Fisher's LSD test).

Table 6. Mean numbers of *Orius* nymphs/10 three foot sweeps, Blythe, CA, 2004

Treatment	Rate/acre	Days after treatments applied				
		4	7	10	14	17
Baythroid® 2EC	2.0 oz	4.0a	3.75a	2.75ab	0.75ab	0.25a
Baythroid® 2EC	2.4 oz	2.25ab	2.75a	2.75ab	1.5 b	0.5a
Lorsban® 4E	32 oz	4.0a	3.5a	5.0abc	0.0a	0.25a
MustangMAX™ 0.8EW	4.0 oz	1.75ab	2.5a	2.25ab	0.25ab	0.25a
Renounce® 20WP	3.0 oz	3.25ab	2.5a	2.5 ab	0.25ab	0.5a
Steward® 1.25SC	6.7 oz	1.5 b	1.5a	5.75 bc	0.5ab	0.0a
Tempo® 1EC	2.0 oz	1.75ab	1.5a	2.0ab	1.25ab	0.0a
Trilogy®	32 oz	1.75ab	3.5a	2.25ab	1.0ab	0.0a
Warrior® 1CS	3.0 oz	1.25 b	1.0a	1.5a	0.5ab	0.0a
Untreated Check	----	1.25 b	2.0a	6.75 c	1.25ab	0.0a

Means in columns followed by the same letter are not statistically different at the p≤0.05 level (Fisher's LSD test).

Table 7. Mean numbers of total minute pirate bugs (*Orius tristicolor)*/10 three foot sweeps, Blythe, CA, 2004

Treatment	Rate/acre	Days after treatments applied				
		4	7	10	14	17
Baythroid® 2EC	2.0 oz	8.0a	14.25ab	19.75a	12.5abcd	9.75ab
Baythroid® 2EC	2.4 oz	5.5ab	10.25ab	19.25a	14.5 bcd	10.25ab
Lorsban® 4E	32 oz	7.0ab	15.5 a	28.75 b	17.25 d	12.25 b
MustangMAX™ 0.8EW	4.0 oz	3.5 b	12.0ab	21.0a	16.0 cd	12.75 b
Renounce® 20WP	3.0 oz	7.75a	12.5ab	18.75a	14.75 bcd	10.75ab
Steward® 1.25SC	6.7 oz	5.25ab	10.5ab	19.5a	12.0abc	11.25ab
Tempo® 1EC	2.0 oz	4.25ab	11.25ab	20.0a	17.0 bcd	8.5ab
Trilogy®	32 oz	4.25ab	9.0 b	16.5a	10.25ab	10.25ab
Warrior® 1CS	3.0 oz	6.75ab	10.25ab	19.25a	14.5 abc	9.25ab
Untreated Check	----	5.5ab	10.25ab	22.25ab	8.75a	7.75a

Means in columns followed by the same letter are not statistically different at the p≤0.05 level (Fisher's LSD test).

Table 8. Mean numbers of aphid wasps/10 three foot sweeps, Blythe, CA, 2004

Treatment	Rate/acre	Days after treatments applied				
		4	7	10	14	17
Baythroid® 2EC	2.0 oz	5.75 b	3.0ab	1.75a	5.75a	3.25 bc
Baythroid® 2EC	2.4 oz	8.25ab	3.5a	2.0a	7.75a	3.0 bc
Lorsban® 4E	32 oz	5.75 b	1.25 bc	2.25a	5.25a	4.5 bc
MustangMAX™ 0.8EW	4.0 oz	5.75b	2.25abc	1.0a	4.5a	4.25 bc
Renounce® 20WP	3.0 oz	6.5ab	2.25abc	3.0a	4.75a	4.5 bc
Steward® 1.25SC	6.7 oz	5.5 b	1.0 c	3.0a	6.5a	3.0 bc
Tempo® 1EC	2.0 oz	5.75 b	2.25abc	2.0a	7.25a	6.0ab
Trilogy®	32 oz	10.5a	1.25 bc	1.5a	6.75a	2.0 c
Warrior® 1CS	3.0 oz	6.0ab	1.75abc	2.75a	6.0 a	4.25bc
Untreated Check	----	5.5 b	1.5 bc	1.0a	5.75a	7.75a

Means in columns followed by the same letter are not statistically different at the $p \leq 0.05$ level (Fisher's LSD test).

Table 9. Mean numbers of sevenspotted lady beetles/10 three foot sweeps, Blythe, CA, 2004.

Treatment	Rate/acre	Days after treatments applied				
		4	7	10	14	17
Baythroid® 2EC	2.0 oz	0.75 b	1.75a	0.0a	0.25ab	0.75a
Baythroid® 2EC	2.4 oz	0.25 b	0.75 bc	0.0a	0.0 b	0.0 b
Lorsban® 4E	32 oz	0.25 b	0.0 c	0.50a	0.25ab	0.0 b
MustangMAX™ 0.8EW	4.0 oz	0.50 b	0.75 bc	0.30a	0.0 b	0.0 b
Renounce® 20WP	3.0 oz	0.25 b	0.25 bc	0.50a	0.50ab	0.25ab
Steward® 1.25SC	6.7 oz	2.25a	0.50 bc	0.0a	0.75a	0.25ab
Tempo® 1EC	2.0 oz	0.25 b	1.0ab	0.75a	0.0 b	0.25ab
Trilogy®	32 oz	0.0 b	0.25 bc	0.25a	0.50ab	0.25ab
Warrior® 1CS	3.0 oz	0.75 b	0.75 bc	0.0a	0.00 b	0.50ab
Untreated Check	----	1.00 b	1.00ab	0.25a	0.25ab	0.25ab

Means in columns followed by the same letter are not statistically different at the $p \leq 0.05$ level (Fisher's LSD test).

Table 10. Mean numbers of convergent lady beetles/10 three foot sweeps, Blythe, CA, 2004

		Days after treatments applied				
Treatment	Rate/acre	4	7	10	14	17
Baythroid® 2EC	2.0 oz	0.0a	1.25a	0.0 c	0.25a	0.0 b
Baythroid® 2EC	2.4 oz	0.5a	1.25a	0.0 c	0.25a	0.75ab
Lorsban® 4E	32 oz	0.75a	1.25a	0.75ab	0.0a	0.75ab
MustangMAX™ 0.8EW	4.0 oz	0.75a	1.5a	1.0a	0.25a	1.0 ab
Renounce® 20WP	3.0 oz	0.25a	0.5a	0.25 bc	0.25a	0.75ab
Steward® 1.25SC	6.7 oz	0.25a	0.50a	0.50abc	0.25a	0.50ab
Tempo® 1EC	2.0 oz	0.50a	0.50a	0.50abc	0.0a	0.25ab
Trilogy®	32 oz	1.0a	0.75a	0.25 bc	0.0a	0.0 b
Warrior® 1CS	3.0 oz	0.25a	0.25a	0.25 bc	0.0a	1.25a
Untreated Check	----	0.50a	1.5a	0.25 bc	0.25a	0.5 ab

Means in columns followed by the same letter are not statistically different at the $p \leq 0.05$ level (Fisher's LSD test).

Table 11. Mean numbers of total lady beetles/10 three foot sweeps, Blythe, CA, 2004

		Days after treatments applied				
Treatment	Rate/acre	4	7	10	14	17
Baythroid® 2EC	2.0 oz	0.75 b	3.00a	0.00b	0.50ab	0.75ab
Baythroid® 2EC	2.4 oz	0.75 b	2.00abc	0.00 b	0.25ab	0.75ab
Lorsban® 4E	32 oz	1.0ab	1.25 bc	1.25ab	0.25ab	0.75ab
MustangMAX™ 0.8EW	4.0 oz	1.25ab	2.25abc	1.5a	0.25ab	1.0 ab
Renounce® 20WP	3.0 oz	0.50 b	0.75 c	0.75ab	0.75ab	1.0 ab
Steward® 1.25SC	6.7 oz	2.5a	1.0 bc	0.25ab	1.00a	0.75ab
Tempo® 1EC	2.0 oz	0.75 b	1.5abc	1.25ab	0.00a	0.50ab
Trilogy®	32 oz	1.00ab	1.00 bc	0.50ab	0.50ab	0.25 b
Warrior® 1CS	3.0 oz	1.00ab	1.00 bc	0.25ab	0.0a	1.75a
Untreated Check	----	1.50ab	2.5 ab	0.5 ab	0.50ab	0.75ab

Means in columns followed by the same letter are not statistically different at the $p \leq 0.05$ level (Fisher's LSD test).

Table 12. Mean numbers of *Bathyplectes* spp. wasps/10 three foot sweeps, Blythe, CA, 2004

		Days after treatments applied				
Treatment	Rate/acre	4	7	10	14	17
Baythroid® 2EC	2.0 oz	6.5a	2.25a	1.75a	1.25ab	0.75 b
Baythroid® 2EC	2.4 oz	4.0ab	3.25a	4.0a	1.25ab	2.25a
Lorsban® 4E	32 oz	4.5ab	2.5a	3.0a	1.00ab	0.75 b
MustangMAX™ 0.8EW	4.0 oz	4.5ab	2.75a	1.5a	2.50a	0.5 b
Renounce® 20WP	3.0 oz	5.0ab	1.75a	1.75a	1.00ab	0.75b
Steward® 1.25SC	6.7 oz	2.75 b	2.25a	3.75a	2.00ab	1.50ab
Tempo® 1EC	2.0 oz	3.0 b	3.5a	2.25a	1.00ab	0.75 b
Trilogy®	32 oz	5.5ab	3.5a	3.5a	2.00ab	0.75 b
Warrior® 1CS	3.0 oz	3.25ab	1.5a	1.0a	0.75 b	0.25 b
Untreated Check	----	4.25ab	3.5a	4.0a	2.25ab	1.25ab

Means in columns followed by the same letter are not statistically different at the $p \leq 0.05$ level (Fisher's LSD test).

Table 13. Mean numbers of spiders/10 three foot sweeps, Blythe, CA, 2004

		Days after treatments applied				
Treatment	Rate/acre	4	7	10	14	17
Baythroid® 2EC	2.0 oz	0.5a	1.25ab	1.5 bc	3.75 bcd	1.0 cd
Baythroid® 2EC	2.4 oz	0.5a	1.25ab	1.5 bc	4.75 bcd	1.25 cd
Lorsban® 4E	32 oz	0.5a	1.75ab	3.0 ab	7.5 ab	3.75a
MustangMAX™ 0.8EW	4.0 oz	1.0a	0.5 b	1.5 bc	2.0 d	0.75 d
Renounce® 20WP	3.0 oz	1.75a	1.25ab	1.5 bc	4.75 bcd	0.5 d
Steward® 1.25SC	6.7 oz	1.5a	0.75 b	4.0a	6.5 abc	2.75abc
Tempo® 1EC	2.0 oz	0.5a	0.75 b	1.75 bc	3.0 cd	1.75 bcd
Trilogy®	32 oz	1.5a	1.25ab	1.25 bc	9.75a	2.75abc
Warrior® 1CS	3.0 oz	1.5a	0.5 b	1.5 bc	4.0 bcd	0.25 d
Untreated Check	----	1.0a	2.5 a	0.75 c	9.25a	3.25ab

Means in columns followed by the same letter are not statistically different at the $p \leq 0.05$ level (Fisher's LSD test).