

# Effects of Various Insecticides on Early Fall Alfalfa Insects and Related Crop Yield and Quality

Michael D. Rethwisch and John E. Nelson

## Abstract

*Six insecticides and/or rates were applied for efficacy data collection for *Empoasca* sp. leafhoppers and threecornered alfalfa hoppers. Data were also collected on a number of other insects present. Samples were collected one, four, seven and ten days post treatment. Yield and quality data were obtained after baling. Data indicated that several insecticides effectively controlled threecornered alfalfa hopper, as well as provided control of *Empoasca* leafhoppers. The Baythroid 2 treatment increased yields by 0.3 tons/acre (35%) compared with the check, but yields across the various treatments did not correlate with insect control. Quality from the various treatments was similar. Application of Baythroid 2 at 2 oz/acre increased net return by \$7.63/acre due to increased yields. No positive economic returns were realized from any of the other treatments in this experiment.*

## Introduction

The threecornered alfalfa hopper (*Spissistilus festinus* Say) and potato leafhopper complex (*Empoasca* spp.) are alfalfa pests that often occur and peak in population during the late summer and early fall in desert production. The effects of leafhopper feeding results in a diamond shaped yellowing of leaflets. Severe infestations that are not controlled result in symptoms known as hopperburn and/or hopper yellows. The feeding of leafhoppers can also cause alfalfa plants to be stunted in growth, with reduced vigor of the regrowth in the following cutting.

Less research has been conducted on the threecornered alfalfa hopper (also referred to as 3CAH hereafter), especially under low desert conditions in recent years. A few studies have recently been conducted along the Arizona side of the Colorado River involving the biology of the threecornered alfalfa hopper in the desert southwest (Knowles et al., 1999, Rethwisch and Kruse, 1999). These studies indicated that 3CAH populations are highest from mid-August through early October.

Research conducted in Louisiana found that populations of 3CAH reduced alfalfa plant height, root carbohydrate concentration, forage yield, and forage quality, in addition to the nymphal feeding significantly increasing *Fusarium* crown rot severity (Moellenbeck et al., 1992). Reduction in root carbohydrate concentration can weaken stands, making them more susceptible to severe weather conditions, weed competition, or disease (Kitchen et al., 1990). Similar responses may occur under low desert conditions, especially when potato leafhopper complex (*Empoasca* spp.) populations are present.

3640 SpraCoupe (Mark Hayden Custom Ground Rig Service, Blythe, CA) calibrated to deliver 20 gpa at 45 psi with T-Jet 8006 spray tip nozzles on 20" centers and with a boom height of 20 inches. No buffer was used. Four insecticides were applied at single use rates (Baythroid 2 @ 2.4 oz/acre, Pounce 3.2 @ 4 oz/acre, Dimethoate 2.67 @ 1.5 pts/acre and Lannate LV @ 1.5 pts/acre) and two rates of Warrior T (3.2 and 3.84 oz of product/acre) were applied. Treatments were replicated three times in a randomized complete block design. Plots were 60 feet wide (18 beds) and were 1,083 feet long. Alfalfa regrowth was 19 inches tall at application.

Plots were sampled at 1, 4, 7 and 10 days post treatment (Sept. 24, 27, 30 and Oct. 3). Sampling consisted of ten 90 degree sweeps across a bed of alfalfa with a 15 inch diameter sweep net, with each sweep being about 36-40 inches long. Insects from each plot sample were transferred to a plastic container, frozen, and then later separated, counted, and recorded. Plots were swept mid to late afternoon.

Field was harvested (swathed) on October 6th, and resulting 'rows' were raked together on October 9th. Hay was baled early morning of October 10th (Chairel Hay, Blythe, CA). Bale counts and weights were obtained from each plot with the exception of one control plot (which had been raked differently than instructed), and yields/acre were calculated. Quality samples were also obtained from 3-4 bales/plot of each treatment. Samples consisted of the cores from ends of 3-4 consecutive bales obtained with a Utah sampler. Samples were analyzed for various quality components by near infrared technology (Stanworth Crop Consultants, Blythe, CA).

All data were analyzed utilizing Statgraphics Plus for Windows (Manugistics, Inc.), and separations of treatment means for the various insects was accomplished using a Fishers least significant difference.

## Results

### Threecornered alfalfa hopper control

Findings from these experiments indicate that most of the pyrethroid insecticides tested very effectively (>90%) controlled threecornered alfalfa hopper at the rates tested when applied by ground, with the exception of the 4 oz/acre rate of Pounce, which provided approximately 70 percent control (Table 1). Higher rates of Pounce have not yet been tested to determine if increased control will result. Dimethoate used at top of label rate (0.5 lbs active ingredient/acre) also provided about 70% control of 3CAH. Lannate LV also very effectively provided initial control, which lasted for about seven days.

### Empoasca leafhopper control

Leafhopper infestations were much lower than three cornered alfalfa hoppers, with fewer than 1/sweep noted at 1 day post treatment. Best control of leafhoppers was noted from Baythroid 2 treatment which provided >95% control from 4-10 days post treatment, followed by the 3.84 oz/acre rate of WarriorT (Table 2). All other insecticide treatments provided between 64-70% control at 10 days post treatment.

### Effects on Big-Eyed Bugs

All insecticides reduced big-eyed bug populations at 1 day post treatment, with reductions noted from 50% (dimethoate) to 100%. Low numbers of big-eyed bugs were noted at this sampling, however, and numbers of big-eyed bugs were not significantly different. At 4 days post treatment, pyrethroid insecticides (WarriorT, Pounce and Baythroid) had the fewest adult big-eyed bugs (Tables 5), with a reduction of 50-100% compared with the untreated check. In non-pyrethroid treatments (Lannate and Dimethoate) adult numbers were equal to or higher than the untreated check. The dimethoate treatment, which had more adults at 4 days post treatment than the check, also had significantly more big-eyed bug nymphs and total big-eyed bugs than any other treatment at this sample date as well (Tables 6,7).

At seven days post treatment, pyrethroid treatments continued to suppress big-eyed bug nymphs by 67-100%, with the 100% suppression noted in both WarriorT treatments. Low numbers of big-eyed bugs nymphs were noted at this sampling, however, and numbers of big eyed bug nymphs were not significantly different. Adult big-eyed bugs numbers (Table 5) ranged from 0.43/sweep in the 3.84 oz/acre rate of WarriorT (65% reduction) to 2.2/sweep in the Lannate treatment, which had significantly more adults than any other treatment and 78% more than the untreated check. Number of adult big-eyed bugs noted in dimethoate treated plots was just slightly less than the untreated check; pyrethroid treated plots had 50+% fewer adult big-eyed bugs when compared with the untreated check with the exception of Pounce which had only 30% fewer adults. Total big-eyed bugs mirrored the adult

populations.

Numbers of big-eyed bug adults declined in all treatments between 7 days and 10 days post treatment. Lowest numbers at 10 days post treatment were noted from the same pyrethroid treatments (WarriorT and Baythroid) which had the fewest adults at 7 days post treatment. Highest numbers of both big-eyed bug adults and nymphs were noted in the Pounce treatment at 10 days post treatment.

#### Effects on Minute Pirate Bugs

At one day post treatment, the highest numbers of adult minute pirate bugs (*Orius tristicolor*) were noted in the untreated check which had significantly more than the insecticide treatments (Table 8). By seven days post treatment the untreated check had the fewest adult minute pirate bugs, however, and highest numbers of adult minute pirate bugs were noted the pyrethroid insecticide plots (WarriorT, Baythroid, Pounce), with significantly more in the Baythroid treatment than any other treatment on this sample date. The rapid change in minute pirate bug adult numbers is thought due to predation of these insects by big-eyed bugs, as *Orius* totals (Table 10) at seven days were negatively correlated with total numbers of big-eyed bugs as pyrethroid treatments had the fewest big-eyed bugs. *Orius* nymph numbers were highest in the Pounce treatment (Table 9) during the final three sample dates.

#### Lygus bug control

All treatment significantly reduced lygus bug numbers at one day post treatment (Tables 11-15) with greatest reduction of adults noted with both WarriorT treatments (Table 11), followed by Lannate. All insecticide treatments reduced numbers of lygus adults on this sample date. The Lannate LV treatment averaged the fewest adult lygus bugs throughout the rest of the study, thought due to a combination of big-eyed bugs present and feeding on the various stages of lygus bugs present and the initial reduction of total lygus bugs (Table 15) by this treatment.

Most insecticide treatments reduced lygus nymph numbers (Tables 12-14) compared with the untreated check with the exception of the Pounce treatment. The reason for this is not entirely understood, but may be due to a combination of only about a 50% initial reduction in lygus population coupled with a decreased big-eyed bug numbers when compared with the untreated check.

#### Beet Armyworms

Beet armyworms were not prevalent in this study, but enough were present to obtain some data. Little difference were noted in numbers of beet armyworms at one and four days post treatment, although the highest numbers at one day post treatment were noted in the dimethoate treatment, which had more than double those in the check. These differences were not significant however.

At seven days post treatment all treatments had fewer beet armyworms than the check with the exception of both WarriorT treatments. The exact reason for the increased numbers in these treatments is not fully understood, but is thought to be partially caused by reduced numbers of big-eyed bug adults and nymphs in combination with reduced numbers of lygus bugs, both of which may also be feeding on beet armyworm caterpillars.

This combination may also have affected beet armyworm numbers after this time. At 10 days post treatment significantly higher numbers of beet armyworms were noted in the dimethoate than any other treatment. Fewest lygus bugs were noted in the dimethoate and Lannate treatments at 7 days post treatment, but the Lannate treatment had almost twice as many big-eyed bugs on this sample date.

#### Leafminer Flies (Adults)

Leafminer activity was noted at study initiation with active mining by larvae and adults present. No attempt was made to quantify effects of insecticide treatments on larval numbers, but data were collected on the adults. At one day post treatment (Table 16) several treatments including both WarriorT treatments and the Baythroid treatment significantly reduced adult numbers compared with the untreated check. At four days post treatment these treatments along with the Pounce reduced adult leafminer numbers, although this reduction was not statistically significant. Higher numbers of adults were noted in the higher rate of WarriorT than the lower rate for four, seven and 10 days post treatment. This indicates that a greater disruption of beneficial insects by the higher insecticide rate that may have also been involved in adult leafminer population management. More parasitic wasps were noted in the lower rate of WarriorT than in the higher rate on most sample dates (Table 17).

At seven days post treatment increased numbers of adult flies were noted in both the Lannate and dimethoate treatments than in the check, which was similar to pyrethroid treatments. Adult leafminer numbers increased from

seven to 10 days post treatment with the exception of the Lannate and Baythroid treatments.

#### Parasitic wasps

A complex of wasp species is included in this area, which attack various insects. No attempt has been made to yet speciate the wasps from each plot, although they are preserved in alcohol. Three treatments (WarriorT - 3.84 oz rate, Baythroid 2, and Dimethoate 2.67) significantly reduced total number of parasitic wasps compared with the untreated check at one day post treatment (Table 17). No significant differences were then noted until 10 days post treatment. Pyrethroid treatments generally had fewest wasps on this sample date.

#### Flea Beetle control

Palestriped flea beetle (*Systema blanda* Melsheimer) numbers increased during the experiment. Although not initially included in species separation in the laboratory, populations were high enough at seven and ten days post treatment to determine differences between treatments for this insect. Four of the treatments (Baythroid, both WarriorT rates, and dimethoate) provided almost 100% control (Table 18). Pounce provided about 50% control at seven days post treatment, but was similar to the control at 10 days. Numbers of flea beetles in the Lannate treated plots at these sample days were similar to or slightly greater than the untreated check.

#### Effects of insect feeding on alfalfa quality and yield

Control of threecornered alfalfa hopper resulted in a slight decrease in percent crude protein (0.3-0.9 of one percent) when compared with the untreated check, although these were not significantly different. No statistical differences were noted for acid detergent fiber. Almost all treatments increased relative feed values (0.3-10.2 points higher than the untreated check) and lower acid detergent fiber (0.4-1.8%) with the exception of the highest yielding treatment (Baythroid 2) which was 3.5 points lower in relative feed value and had higher acid detergent fiber (0.3%) than the check thought due to increased yields.

The Baythroid 2 had significantly higher yield (0.2 tons/acre) than any other treatment and resulting quality factors are correspond with data noted for increased growth in alfalfa. The reason for this increase in yield is not yet understood nor has additional experimentation yet occurred to verify this finding. The yield increase is not apparently correlated with any single insect monitored in this study, although whiteflies were prevalent. Nymphal populations of 3CAH were not obtained via sweep net sampling (which yielded almost entirely adult 3CAH), as nymphs are generally feeding near the crown of the plant close to the soil surface.

The yield response noted may be partially due to the hydrocarbon xylene which was contained in both of the highest yielding treatments (Baythroid 2, Dimethoate 2.67). This compound may have supplemented root carbohydrate reserves and resulted in an increase in alfalfa growth, but this has not yet been proven. If true, differences noted between these two insecticides that contained xylene would be due to insecticide control.

The effect of threecornered alfalfa hopper control on root carbohydrate reserves and results on plant populations and yields has not yet been determined under low desert conditions. Further work is necessary to do so.

#### Economics

The yield increase for the rate of Baythroid 2 in this experiment was provided a net economic return of \$7.63/acre more than the untreated check on alfalfa hay selling for \$75/ton. No other insecticide treatment provided positive economic return as yields were very similar to the untreated check.

## **Conclusions**

Treatments for threecornered alfalfa hoppers resulted in increased forage quality parameters in 1999 when the disease summer black stem and leaf spot was present (Rethwisch, 2000). However, in the absence of this disease in 2000, control of 3CAH did not result in significant increase in alfalfa forage quality. Baythroid 2 increased alfalfa hay yield by 0.3 tons compared to the untreated check, and out-yielded all other treatments by at least 0.2 tons. The exact reason for this yield increase is unclear and is not correlated with control of insects monitored in this experiment. WarriorT and Lannate LV also provided excellent control of 3CAH and all treatments tested in 2000 provided at least 80% control of leafhoppers at 4 days post treatment. However, yields from these treatments was only slightly higher than the untreated check. Root carbohydrate levels have not been evaluated under desert production conditions to ascertain if insect control affect such.

## Literature Cited

- Kitchen, N. R., D. D. Buchholz, & C. J. Nelson. 1990. Potassium fertilizer and potato leafhopper effects on alfalfa growth. *Agron. J.* 82: 1069-1074.
- Knowles, T.C., V. Wakimoto, and B. Dare. 1999. Treehopper and leafhopper population dynamics following spring Furadan alfalfa stubble treatment. In 1999 University of Arizona College of Agriculture Forage and Grain Report. M. Ottman, ed. Pp. 40-48.
- Mollenbeck, D. J., S. S. Quisenberry, and P. D. Colyer. 1992. Fusarium crown-rot development in alfalfa stressed by threecornered alfalfa hopper (Homoptera: membracidae) Feeding. *J. Econ. Entomol.* 85: 1442-1449.
- Rethwisch, M. D., and M. D. Kruse. 1999. Effect of late winter 1998 Furadan4F alfalfa stubble treatment on alfalfa growth and alfalfa weevil, aphid and threecornered alfalfa hopper populations. In 1999 University of Arizona College of Agriculture Forage and Grain Report. M. Ottman, ed. Pp. 35-39.
- Rethwisch, M. D. 2000. Comparisons of differing rates of Baythoid 2 and WarriorT insecticides for insect control in fall alfalfa. In 2000 University of Arizona College of Agriculture Forage and Grain Report, series P-124. M. Ottman, ed. Pp. 21-28.

## ***ACKNOWLEDGEMENTS***

This study was financially supported by Bayer Agricultural Division and Zeneca Ag Products. We also thank David Elms for usage of his alfalfa field for this study.

**Table 1. Mean number of threecornered alfalfa hoppers per 10 three foot sweeps at 1, 4, 7, and 10 days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>1 DAT</u>	<u>4 DAT</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	0.33a	8.67a	25.33a	22.33a
Baythroid 2	2.4 oz (0.0375)	1.33a	4.33a	2.00a	2.67a
WarriorT	3.2 oz (0.025)	3.67a	3.33a	7.00a	8.33a
WarriorT	3.84 oz (0.030)	4.0a	1.00a	4.67a	5.67a
Pounce 3.2EC	4 oz (0.10)	10.3a	29.67a	51.33a	44.67a
Dimethoate 2.67	1.5 pts (0.5)	16.0a	37.33a	42.33a	24.33a
Untreated check	-----	50.0 b	124.33 b	144.33 b	117.3b

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 2. Mean number of *Empoasca* spp. leafhoppers per 10 three foot sweeps at 1, 4, 7, and 10 days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>1 DAT</u>	<u>4 DAT</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	0.33a	1.00a	3.67a	6.33a
Baythroid 2	2.4 oz (0.0375)	1.0 a	0.33a	0.67a	0.33a
WarriorT	3.2 oz (0.025)	2.0 ab	1.33a	1.67a	5.33a
WarriorT	3.84 oz (0.03)	1.0 a	0.33a	1.00a	4.00a
Pounce 3.2EC	4 oz (0.10)	0.67a	4.0a	6.33a	6.33a
Dimethoate 2.67	1.5 pts (0.5)	1.33a	3.0a	4.67a	5.67a
Untreated check	-----	5.67 b	27.0 b	21.33b	17.67 b

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 3. Mean number of beet armyworms per 10 three foot sweeps at 1, 4, 7, and 10 days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>1 DAT</u>	<u>4 DAT</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	1.33a	1.33a	4.0ab	1.00a
Baythroid 2	2.4 oz (0.0375)	4.33a	0.33a	2.00a	0.67a
WarriorT	3.2 oz (0.025)	2.33a	3.67a	10.67 b	2.00a
WarriorT	3.84 oz (0.03)	4.00a	1.00a	5.33ab	3.67a
Pounce 3.2EC	4 oz (0.1)	2.67a	2.00a	1.00a	1.67a
Dimethoate 2.67	1.5 pts (0.5)	6.00a	2.33a	2.67ab	8.67 b
Untreated check	-----	2.67a	1.67a	4.33ab	3.67a

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 4. Mean number of spotted alfalfa aphids per 10 three foot sweeps at 1, 4, 7, and 10 days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>1 DAT</u>	<u>4 DAT</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	0.33a	8.67a	6.67 bc	10.0ab
Baythroid 2	2.4 oz (0.0375)	4.67a	7.33a	5.0abc	10.3ab
WarriorT	3.2 oz (0.025)	1.67a	3.33a	4.33abc	11.0ab
WarriorT	3.84 oz (0.03)	2.67a	4.33a	1.33a	11.67b
Pounce 3.2EC	4 oz (0.1)	3.67a	11.33a	7.67 c	7.7ab
Dimethoate 2.67	1.5 pts (0.5)	2.33a	2.00a	1.67ab	7.0ab
Untreated check	-----	2.00a	8.33a	4.00abc	3.0 a

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 5. Mean number of bigeyed bug adults per 10 three foot sweeps at 1, 4, 7, and 10 days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>1 DAT</u>	<u>4 DAT</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	0.00a	3.33ab	22.0a	5.67abc
Baythroid 2	2.4 oz (0.0375)	0.33a	0.33 bc	5.33 b	2.00abc
WarriorT	3.2 oz (0.025)	0.33a	1.00 bc	5.67 b	1.00 bc
WarriorT	3.84 oz (0.03)	0.00a	0.00 c	4.33 b	0.00 c
Pounce 3.2EC	4 oz (0.1)	0.33a	1.67 bc	8.67 b	7.67a
Dimethoate 2.67	1.5 pts (0.5)	0.67a	5.61a	10.33 b	4.67abc
Untreated check	-----	1.33a	3.33ab	12.33 b	6.67ab

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 6. Mean number of bigeyed bug nymphs per 10 three foot sweeps at 1, 4, 7, and 10 days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>1 DAT</u>	<u>4 DAT</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	0.33a	0.67 b	1.67a	0.67a
Baythroid 2	2.4 oz (0.0375)	0.00a	0.33 b	0.33a	0.33a
WarriorT	3.2 oz (0.025)	0.00a	0.00 b	0.00a	0.33a
WarriorT	3.84 oz (0.03)	0.00a	0.00 b	0.00a	0.33a
Pounce 3.2EC	4 oz (0.1)	0.33a	0.33 b	0.33a	2.67a
Dimethoate 2.67	1.5 pts (0.5)	0.00a	2.19a	1.33a	2.00a
Untreated check	-----	0.00a	0.33 b	1.00a	0.67a

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 7. Mean number of bigeyed bugs (adult plus nymphs) per 10 three foot sweeps at 1, 4, 7, and 10 days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>1 DAT</u>	<u>4 DAT</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	0.33a	4.00ab	23.67a	6.33abc
Baythroid 2	2.4 oz (0.0375)	0.33a	0.67 bc	5.67bc	2.33 bc
WarriorT	3.2 oz (0.025)	0.33a	1.00 bc	5.67bc	1.33 bc
WarriorT	3.84 oz (0.03)	0.00a	0.00 c	4.33 c	0.33 c
Pounce 3.2EC	4 oz (0.1)	0.67a	2.00 bc	9.0 bc	10.33a
Dimethoate 2.67	1.5 pts (0.5)	1.00a	7.81a	11.67bc	6.67ab
Untreated check	-----	1.33a	3.67abc	13.33 b	7.33ab

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 8. Mean number of *Orius tristicolor* adults per 10 three foot sweeps at 1, 4, 7, and 10 days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>1 DAT</u>	<u>4 DAT</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	1.00 b	3.00a	7.33 bc	12.00ab
Baythroid 2	2.4 oz (0.0375)	0.67 b	6.00a	21.0a	14.33ab
WarriorT	3.2 oz (0.025)	1.33ab	5.33a	10.33 bc	17.67a
WarriorT	3.84 oz (0.03)	0.67 b	2.67a	12.67 b	11.67ab
Pounce 3.2EC	4 oz (0.1)	1.67ab	6.67a	9.67 bc	8.33 b
Dimethoate 2.67	1.5 pts (0.5)	1.67ab	6.33a	8.00 bc	10.00 b
Untreated check	-----	3.00a	5.33a	3.67 c	9.67 b

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 9. Mean number of *Orius tristicolor* nymphs per 10 three foot sweeps at 1, 4, 7, and 10 days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>1 DAT</u>	<u>4 DAT</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	0.67a	1.00a	1.00ab	1.67ab
Baythroid 2	2.4 oz (0.0375)	0.00a	0.67a	1.33ab	0.33 b
WarriorT	3.2 oz (0.025)	0.67a	1.00a	0.33 b	0.33 b
WarriorT	3.84 oz (0.03)	0.00a	0.33a	0.00 b	0.67 b
Pounce 3.2EC	4 oz (0.1)	0.33a	3.00a	3.33a	4.67a
Dimethoate 2.67	1.5 pts (0.5)	0.33a	1.67a	0.67 b	0.33 b
Untreated check	-----	0.33a	0.33a	1.33ab	2.67ab

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 10. Mean number of total *Orius tristicolor* (adult plus nymphs) per 10 three foot sweeps at 1, 4, 7, and 10 days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>1 DAT</u>	<u>4 DAT</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	1.67ab	4.00 bc	8.33bc	13.67a
Baythroid 2	2.4 oz (0.0375)	0.67 b	6.67abc	22.3a	14.67a
WarriorT	3.2 oz (0.025)	2.00ab	6.33abc	10.67bc	18.00a
WarriorT	3.84 oz (0.03)	0.67 b	3.00 c	12.67b	12.33a
Pounce 3.2EC	4 oz (0.1)	2.00ab	9.67a	13.0 b	13.00a
Dimethoate 2.67	1.5 pts (0.5)	2.00ab	8.00ab	8.67bc	10.33a
Untreated check	-----	3.33a	5.67abc	5.00 c	12.33a

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 11. Mean number of *Lygus* bug adults per 10 three foot sweeps at 1, 4, 7, and 10 days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>1 DAT</u>	<u>4 DAT</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	1.00a	1.33a	1.33a	3.67a
Baythroid 2	2.4 oz (0.0375)	1.67ab	2.00ab	2.33ab	7.33a
WarriorT	3.2 oz (0.025)	0.67a	2.33ab	4.67ab	7.00a
WarriorT	3.84 oz (0.030)	0.67a	2.33ab	3.33ab	4.00a
Pounce 3.2EC	4 oz (0.1)	2.67 b	5.33 b	6.33 bc	6.67a
Dimethoate 2.67	1.5 pts (0.5)	2.00ab	2.33ab	2.33ab	3.33a
Untreated check	-----	4.67 c	4.67ab	9.33 c	9.33a

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 12. Mean number of *Lygus* bug large nymphs per 10 three foot sweeps at 1, 4, 7, and 10 days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>1 DAT</u>	<u>4 DAT</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	1.33a	0.00a	1.00a	1.00a
Baythroid 2	2.4 oz (0.0375)	0.67a	0.67a	3.67ab	4.00ab
WarriorT	3.2 oz (0.025)	0.33a	0.33a	1.00a	5.33ab
WarriorT	3.84 oz (0.030)	2.00a	1.67a	1.00a	7.33ab
Pounce 3.2EC	4 oz (0.1)	1.00a	6.00 b	2.67ab	7.33ab
Dimethoate 2.67	1.5 pts (0.5)	0.67a	1.00a	1.00a	2.00a
Untreated check	-----	2.00a	3.33ab	5.33 b	10.00 b

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 13. Mean number of *Lygus* bug small nymphs per 10 three foot sweeps at 1, 4, 7, and 10 days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>1 DAT</u>	<u>4 DAT</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	0.33a	2.33ab	1.67a	13.00ab
Baythroid 2	2.4 oz (0.0375)	1.67ab	5.00ab	11.33ab	14.00bc
WarriorT	3.2 oz (0.025)	0.00a	3.00ab	6.67ab	13.0ab
WarriorT	3.84 oz (0.030)	1.67ab	5.33ab	8.33ab	16.33abc
Pounce 3.2EC	4 oz (0.1)	1.67ab	9.00 b	19.33 b	22.33 bc
Dimethoate 2.67	1.5 pts (0.5)	1.67ab	1.00a	2.33a	8.67a
Untreated check	-----	3.67 b	4.33ab	17.33 b	25.33 c

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 14. Mean number of total *Lygus* bug nymphs per 10 three foot sweeps at 1, 4, 7, and 10 days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>1 DAT</u>	<u>4 DAT</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	1.67ab	2.33a	2.67a	14.00ab
Baythroid 2	2.4 oz (0.0375)	2.33ab	5.67ab	15.0ab	18.00ab
WarriorT	3.2 oz (0.025)	0.33a	3.33a	7.67ab	18.33ab
WarriorT	3.84 oz (0.03)	3.67ab	7.00ab	9.33ab	23.67abc
Pounce 3.2EC	4 oz (0.1)	2.67ab	15.00 b	22.00 b	29.67 bc
Dimethoate 2.67	1.5 pts (0.5)	2.33ab	2.00a	3.33a	10.67a
Untreated check	-----	5.67 b	7.67ab	22.67 b	35.33 c

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 15. Mean number of total *Lygus* bugs (adult plus nymphs) per 10 three foot sweeps at 1, 4, 7, and 10 days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>1 DAT</u>	<u>4 DAT</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	2.67ab	3.67a	4.00a	17.7ab
Baythroid 2	2.4 oz (0.0375)	4.00ab	7.67a	17.3abc	25.3abc
WarriorT	3.2 oz (0.025)	1.00a	5.67a	12.3ab	25.3abc
WarriorT	3.84 oz (0.030)	4.33ab	9.33ab	12.7ab	27.7abc
Pounce 3.2EC	4 oz (0.1)	5.33 b	20.33 b	23.3 bc	36.3 bc
Dimethoate 2.67	1.5 pts (0.5)	4.33ab	4.33a	5.67a	14.0a
Untreated check	-----	10.33 c	12.33ab	32.0 c	44.7 c

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 16. Mean number of adult leafminer flies per 10 three foot sweeps at 1, 4, 7, and 10 days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>1 DAT</u>	<u>4 DAT</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	4.33 bcd	16.00a	29.33 c	18.67ab
Baythroid 2	2.4 oz (0.0375)	2.00ab	8.33a	16.00ab	12.00a
WarriorT	3.2 oz (0.025)	1.67ab	4.67a	10.00a	20.00ab
WarriorT	3.84 oz (0.030)	0.67a	10.00a	13.67ab	23.33ab
Pounce 3.2EC	4 oz (0.1)	5.33 cd	8.33a	10.33a	22.33ab
Dimethoate 2.67	1.5 pts (0.5)	3.67abc	15.00a	23.67 bc	29.33 b
Untreated check	-----	7.00 d	14.67a	15.33ab	30.33 b

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 17. Mean number of parasitic wasps per 10 three foot sweeps at 1, 4, 7, and 10 days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>1 DAT</u>	<u>4 DAT</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	4.67ab	11.00a	24.67a	26.33ab
Baythroid 2	2.4 oz (0.0375)	1.33a	16.33a	16.33a	20.67a
WarriorT	3.2 oz (0.025)	3.33ab	21.33a	16.67a	41.67 c
WarriorT	3.84 oz (0.030)	1.00a	13.67a	19.33a	27.00ab
Pounce 3.2EC	4 oz (0.1)	4.33ab	10.67a	23.67a	25.00ab
Dimethoate 2.67	1.5 pts (0.5)	1.67a	12.67a	19.33a	42.00 c
Untreated check	-----	6.67 b	20.67a	22.33a	36.67 bc

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 18. Mean number of adult flea beetles per 10 three foot sweeps at seven and ten days following insecticide application on September 23, 2000.**

<u>Insecticide</u>	<u>Rate/Acre(ai/acre)</u>	<u>7 DAT</u>	<u>10 DAT</u>
Lannate LV	1.5 pts (0.45)	5.00 c	5.00 c
Baythroid 2	2.4 oz (0.0375)	0.00a	0.00a
WarriorT	3.2 oz (0.025)	0.00a	0.00a
WarriorT	3.84 oz (0.030)	0.00a	0.00a
Pounce 3.2EC	4 oz (0.1)	2.67 b	4.00abc
Dimethoate 2.67	1.5 pts (0.5)	0.00a	0.33ab
Untreated check	-----	5.00 c	4.33 bc

*Means in columns followed by the same letter are not significantly different at the  $p \leq 0.05$  level (Fishers LSD test).*

**Table 19. Yield and alfalfa quality characteristic means obtained after hay baling from an insecticide application on September 23, 2000, thirteen days prior to alfalfa cutting on October 6.**

<b>Treatment</b>	<b>Product (Rate/acre)</b>	<b>Hay Yield (Tons/acre)</b>	<b>Acid Detergent Fiber<sup>1</sup></b>	<b>Percent Crude Protein<sup>1</sup></b>	<b>Percent Digestible Protein<sup>1</sup></b>	<b>Total Digestible Nutrients<sup>2</sup></b>	<b>Neutral Detergent Fiber<sup>1</sup></b>	<b>Modified Crude Fiber<sup>1</sup></b>	<b>Relative Feed Value</b>
<b>Baythroid 2</b>	<b>2.4 oz</b>	<b>1.10a</b>	<b>31.1a</b>	<b>23.4a</b>	<b>16.0a</b>	<b>53.1a</b>	<b>39.4a</b>	<b>25.6a</b>	<b>152.9a</b>
<b>Dimethoate 2.67 EC</b>	<b>1.5 pts</b>	<b>0.90 b</b>	<b>29.7a</b>	<b>24.1a</b>	<b>16.4a</b>	<b>54.1a</b>	<b>38.4a</b>	<b>25.5a</b>	<b>159.6a</b>
<b>WarriorT</b>	<b>3.2 oz</b>	<b>0.86 b</b>	<b>29.8a</b>	<b>23.7a</b>	<b>16.2a</b>	<b>54.0a</b>	<b>38.6a</b>	<b>25.3a</b>	<b>158.6a</b>
<b>WarriorT</b>	<b>3.84 oz</b>	<b>0.85 b</b>	<b>30.4a</b>	<b>23.6a</b>	<b>16.1a</b>	<b>53.5a</b>	<b>38.8a</b>	<b>25.9a</b>	<b>156.8a</b>
<b>Pounce 3.2</b>	<b>4.0 oz</b>	<b>0.85 b</b>	<b>29.8a</b>	<b>23.8a</b>	<b>16.2a</b>	<b>54.0a</b>	<b>38.3a</b>	<b>25.7a</b>	<b>159.4a</b>
<b>Lannate LV</b>	<b>1.5 pts</b>	<b>0.82 b</b>	<b>29.0a</b>	<b>23.8a</b>	<b>16.3a</b>	<b>54.4a</b>	<b>37.0a</b>	<b>24.4a</b>	<b>166.7a</b>
<b>Untreated check</b>	<b>-----</b>	<b>0.80 b</b>	<b>30.8a</b>	<b>24.3a</b>	<b>16.4a</b>	<b>53.3a</b>	<b>38.4a</b>	<b>27.1a</b>	<b>156.5a</b>

*Means in columns are not significantly different the  $p \leq 0.05$  level (Fishers LSD test).*

<sup>1</sup> Means reported at 100% dry matter level.

<sup>2</sup> Means reported at 90% dry matter level.