

Comparisons of Differing Rates of Baythroid® 2 and WarriorT® Insecticides for Insect Control in Fall Alfalfa

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Abstract

Various rates of two insecticides were tested for efficacy on threecornered alfalfa hopper and Empoasca sp. leafhoppers. Data were also collected for efficacy of insecticides on beneficial insects present. Hay quality samples were taken after baling. Both insecticides provided excellent control of threecornered alfalfa hopper, and Baythroid also controlled Empoasca sp. leafhoppers. Quality of hay was increased where threecornered alfalfa hoppers were controlled, although this control was for only eight days prior to cutting. A decrease in digestible hay protein was noted with increasing numbers of Empoasca sp. leafhoppers.

Introduction

A few studies have recently been conducted involving the biology and insecticidal control of the threecornered alfalfa hopper, *Spissistilus festinus* (Say), in the desert southwest (Rethwisch et al., 1997; Knowles, 1999, Rethwisch and Kruse, 1999). These studies have not included investigations on the resulting effects of threecornered alfalfa hopper feeding on alfalfa quality or yield. This study was initiated to obtain further insecticidal efficacy data for threecornered alfalfa hopper control as well as obtain data on effects of this insect's feeding on yield and/or quality.

This study compared four rates of the insecticide Baythroid® 2 (active ingredient = cyfluthrin) and two rates of the insecticide Warrior T (active ingredient = lambda-cyhalothrin) for insect control in early fall alfalfa, and examined the resulting quality of alfalfa after baling from three treatments (high rate of Baythroid, low rate of Warrior T, and untreated check).

High numbers of *Empoasca* spp. leafhoppers and threecornered alfalfa hoppers were present in the field at time of application and continued to increase throughout the duration of the experiment, and the fungal disease summer black stem and leaf spot, *Cercospora medicaginis*, was causing lower leaves to shrivel and fall from the lower portions of the plant. Both of these pest organisms may interact with the threecornered alfalfa hoppers and effect yield and/or quality.

Methods and Materials

A first year field of 'Cibola' alfalfa grown on beds with 40" centers was utilized for this experiment. Treatments were applied with ground application equipment on the morning of 5 October, 1999, with a Melroe 3630 SpraCoupe (H&H Sprayers, Blythe, CA) calibrated to deliver 15 gpa at 40 psi with T-Jet 8004 tips on 20" centers. No buffer was used. Two insecticides (Baythroid 2 and Warrior T) were used. Four rates of Baythroid 2 (1.6, 2.0, 2.4 and 2.8 oz of product/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 18 inches tall at application.

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Plots were sampled at 1, 3 and 7 days post treatment (6, 8 & 12 October). Sampling consisted of ten 90 degree sweeps down one bed of alfalfa with a 15 inch diameter sweep net. Insects from each plot sample were transferred to a plastic container, frozen, and then later separated, counted, and recorded. Samples were obtained at beginning at 5:30 pm at 1 day post treatment, and at mid-afternoon at three and seven days post treatment.

Field was harvested (swathed) on 13 October, and resulting 'rows' were raked together on 16 October. Hay was baled early morning of 18 October (J. John Custom Harvesting, Blythe, CA). Three different balers were used across the field. Bale counts were obtained from each plot, but weights were not able to be obtained, and therefore yields/acre were unable to be calculated due to potential differences in pressures and resulting bale weights from the various balers.

Samples were obtained from bales in each replicate of three treatments (Baythroid 2 - 2.8 oz rate; 3.2 oz rate of WarriorT, and the untreated check) for quality analysis. 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 means separations using a Fishers least significant difference.

Results

In addition to the threecornered alfalfa hopper population existing prior to (9.5/90° sweep) and during the study, populations of other insects were high enough to obtain insecticide efficacy data. *Empoasca* leafhoppers and *Lygus* spp. bugs were present during the entire study. Data on spotted alfalfa aphids, *Therioaphis maculata* (Buckton), numbers were collected at 3 and 7 days post treatment, and big-eyed bugs (*Geocoris* spp.) numbers were obtained from the 7 day post treatment samples.

Threecornered alfalfa hoppers Numbers of this insect were fairly constant throughout the study, although numbers from the 1 day post treatment sampling recorded were lower than prior study (9.5/90° sweep). This may be due to time of day when samples were obtained. Sampling at one day post treatment began at 5:30 pm, concluding at or just after dusk. Conditions were somewhat cooler, darker, and windier than when other samples were taken in mid-afternoon when light and temperatures were more conducive to this insect's activity.

All rates of insecticides tested provided 94.9+% control of threecornered alfalfa hoppers throughout the study (Table 1). Little if any difference was noted between insecticides or between insecticide rates for control of this insect although the lowest control percentage (94.9%) was noted for the lowest rate of Baythroid 2 (1.6 oz) at 7 days post application and complete (100%) control was noted for several treatments at 1 and 3 days post application.

Empoasca spp. leafhoppers Insect numbers continued to increase during the study (Table 1), with 12.6/sweep noted at 7 days post treatment in the untreated check. All rates of Baythroid treatments provided excellent control (approximately 97%) throughout the study. WarriorT also significantly reduced *Empoasca* leafhopper numbers but control ranged from 83.5-92% at one day post treatment to 76.1-79% at 7 days post treatment.

Lygus bugs Significant differences existed between treatment extremes of adult lygus bug control throughout the study, with both rates of WarriorT and the high (2.8oz/acre) rate of Baythroid 2 providing 100% control at one day post treatment. A rate response was noted for the Baythroid treatments at one day after application for adult lygus bug control, but not as evident in samples at three and seven days post application (Table 2). It should be noted that adult lygus bug numbers were fairly low throughout the study however.

Little difference was noted for lygus control by insecticide rate except for a trend of less lygus with higher rates at seven days post treatment. Differences were noted between insecticidal chemistries in level of control. WarriorT provided better control of nymphs and total lygus (about 42% reduction compared with the untreated

check) at 7 days after application than did Baythoid 2 (about 26% control at higher rates, 10% at lower rates).

Spotted alfalfa aphids A difference in spotted alfalfa aphid numbers was noted between the two chemistries was noted at both 3 and 7 days post treatment (Table 3). Baythroid 2 treatments had more spotted alfalfa aphids (44-175% more) than the untreated check at three days after application; similar numbers to the check were noted at 7 days post application. WarriorT treatments had significantly fewer spotted alfalfa aphids at 7 days post application, and very similar numbers at 3 days post application. The reason for this is unclear, but may involve a combination of spotted alfalfa aphid control as well as interactions with beneficial insects (predators and parasitoids) that were present. Most aphids in samples were alate (winged) forms however, indicating that aphids were either under stress and/or were migrating into the plots from other areas. Low numbers indicate the latter.

Bigeyed bugs Most of the bigeyed bugs present in this study were the western bigeyed bug (*Geocoris pallens* Stål), although an occasional *G. atricolor* Montandon was also noted. Both insecticidal chemistries significantly lowered populations of the beneficial bigeyed bugs (Table 3), with WarriorT reducing overall population by at least 94.8%. Baythroid 2 also reduced bigeyed bug populations but only by about 60%.

Other insects noted Western flower thrips were numerous during the study but were not counted. Beet armyworms populations were not adequate to allow data to be collected, nor were those of minute pirate bugs (*Orius tristicolor*).

Quality Alfalfa quality from the two insecticide treatments (2.8 oz/acre rate of Baythoid and the 3.2 oz/acre rate of WarriorT) were extremely similar for almost every factor measured (Table 4). The slight differences noted (although not statistically different) between the two treatments were for percent crude protein and percent digestible protein. These differences are thought to exist due to differences in *Empoasca* spp. leafhoppers between the two treatments; *Empoasca* spp. leafhopper feeding has been shown to reduce protein in desert alfalfa (Rethwisch and Tickes, 1987).

Differences, many highly significant, existed between control plots and insecticide treated plots for every quality factor measured (Table 4). These differences are attributed to control of threecornered alfalfa hopper. These quality differences will also influence the value of the hay crop (Table 5). Although California hay quality classes are based on acid detergent fiber (ADF) with the lower ADF score the better, other entities base value on relative feed value, with a higher hay value for higher relative feed value.

Results from this experiment indicate that untreated population levels (10-12 threecornered alfalfa hoppers/90° sweep for eight days) in the presence of summer black stem and leaf spot significantly reduced alfalfa hay quality. The active presence of summer black stem and leaf spot prior to insecticide application may also have affected quality class designation of alfalfa hay (lowered due to leaf loss on lower parts of stems); without this leaf loss alfalfa hay from treated plots may have been designated as being good rather than at the high end of fair and would have a higher economic value. Controlling threecornered alfalfa hopper may also have reduced this disease due to less stress on alfalfa plants from insect feeding and/or less insects to potentially vector spores and create entry sites via feeding.

Yields Overall yield average was 0.924 tons/acre for this cutting but because yields for each plot were not able to be calculated, differences may (or may not) have existed between treated and untreated alfalfa. Yield data needs to be collected and combined with quality data to determine if the treatments were economical and/or otherwise justified.

More testing is necessary to further determine the feeding effects of threecornered alfalfa hopper on alfalfa, which appears to be greater than previously known. Questions which need answering for desert alfalfa production are: (1) What effect(s) does threecornered alfalfa hopper feeding incur on plant growth and resulting yields and quality? (2) What are the effects of interactions between threecornered alfalfa hoppers and summer black stem and leaf spot? (3) What much will a longer period (>8 days) of control effect quality/yield? (4) Is control economical?

Literature Cited

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Table 1. Mean number of *Empoasca* spp. leafhoppers and threecornered alfalfa hoppers at 1, 3 & 7 days post treatment

Treatment	Rate/acre		Number of insects per ten 90° sweeps						
	Product	lbs.ai	<u>Empoasca leafhoppers</u>			<u>Three cornered alfalfa hoppers</u>			
			<u>1</u>	<u>3</u>	<u>7</u>	<u>1</u>	<u>3</u>	<u>7</u>	
Baythroid 2	1.6 oz	0.025	2.00a	1.67a	2.67a	0.33a	0.67a	5.33a	
Baythroid 2	2.0 oz	0.03125	2.33a	1.33a	3.33a	0.0a	0.00a	3.67a	
Baythroid 2	2.4 oz	0.0375	1.00a	1.67a	1.67a	0.0a	0.33a	2.00a	
Baythroid 2	2.8 oz	0.04375	1.33a	1.67a	3.33a	0.67a	0.00a	3.67a	
Warrior T	3.2 oz	0.025	5.33a	21.00ab	29.00a	1.67a	0.00a	3.67a	
Warrior T	3.84 oz	0.030	11.00a	15.33a	26.33a	1.33a	0.33a	3.00a	
Untreated check			66.67 b		88.00 b	126.00 b	50.33b	120.67 b	104.00 b

p≤0.01 p≤0.001 p≤0.001 p≤0.001 p≤0.001 p≤0.001

Means in columns followed by the same letter are not significantly different, level of statistical significance for each column indicated at bottom

Table 2. Mean number of *Lygus* spp. (adults, nymphs, total) at 1, 3 & 7 days post treatment

<u>Treatment</u>	<u>Rate/acre</u>	<u>Means of insects per ten 90° sweeps</u>								
		<u>Lygus Adults</u>			<u>Lygus nymphs</u>			<u>Total Lygus bugs</u>		
		<u>1</u>	<u>3</u>	<u>7</u>	<u>1</u>	<u>3</u>	<u>7</u>	<u>1</u>	<u>3</u>	<u>7</u>
Baythroid 2	1.6 oz	2.00 c	1.00ab	3.00 bc	3.67 b	13.67a	28.33a	5.67 c	14.67a	31.33a
Baythroid 2	2.0 oz	1.67ab	0.33a	3.33 c	1.67ab	8.33a	28.67a	2.33abc	8.67a	32.0a
Baythroid 2	2.4 oz	0.33ab	2.00ab	1.67abc	2.00ab	12.00a	22.67a	2.33abc	14.00a	24.33a
Baythroid 2	2.8 oz	0.00a	0.33a	1.00ab	2.00ab	8.33a	26.33a	2.00ab	8.67a	27.33a
Warrior T	3.2 oz	0.00a	2.33 b	1.33abc	0.33a	11.00a	19.33a	0.33a	13.33a	20.67a
Warrior T	3.84 oz	0.00a	1.00ab	0.67a	2.00ab	6.00a	18.33a	2.00ab	7.00a	19.0a
Untreated check	-----	1.67 bc	1.33ab	2.67abc	2.67ab	10.33a	32.67a	4.33 bc	11.67a	35.3a

Means in columns followed by the same letter are not significantly different at the $P \leq 0.05$ level of probability with the exception of *Lygus* adults at 1 day post treatment which is shown at the $P \leq 0.01$ level.

Table 3. Mean number of spotted alfalfa aphids at 3 & 7 days post treatment, and *Geocoris* spp. (bigeyed bugs) adults and nymphs at 7 days post treatment

		Number of insects per ten 90° sweeps				
Treatment	Rate/acre	Spotted alfalfa aphids		Bigeyed bugs		
		3	7	Adults		
Nymphs	Total					
Baythroid 2	1.6 oz	11.00ab	19.00abcd	1.67ab	5.33 b	7.00 c
Baythroid 2	2.0 oz	14.67 b	31.67 d	2.33 b	5.33 b	7.67 c
Baythroid 2	2.4 oz	7.67ab	18.33abc	1.50ab	4.50ab	6.0abc
Baythroid 2	2.8 oz	12.00ab	19.67 bcd	1.33ab	5.00ab	6.33bc
Warrior T	3.2 oz	5.00a	7.33ab	0.33ab	0.67ab	
	1.00ab					
Warrior T	3.84 oz	5.00a	6.33a	0.00a	0.33a	0.33a
Untreated check	-----	5.33a	23.00 cd	8.67 c	11.00 c	19.67 d
		p≤0.01	p≤0.01	p≤0.05	p≤0.05	

Means in columns followed by the same letter are not significantly different, level of statistical significance for each column indicated at bottom.

Table 4. Means of various alfalfa quality characteristics from bales after insecticide application eight days prior to cutting.

<u>Treatment</u>	<u>Rate/acre</u>	<u>ADF¹</u>	<u>Modified Crude Fiber</u>	<u>Neutral Det. Fiber</u>	<u>% Crude Protein</u>	<u>% Digestible Protein</u>	<u>Total Digestible Nutrients</u>	<u>Relative Feed Value</u>
Baythroid 2	2.8 oz	32.2a	24.6 a	39.43a	21.97a	15.17a	52.37a	150.6a
WarriorT	3.2 oz	32.23a	24.67a	39.33a	21.7 ab	14.93ab	52.3 a	151.0a
Untreated check		34.8b	26.5 b	40.57 b	19.97 b	13.77 b	50.63 b	141.7 b

_____ p≤0.05 p≤ 0.01 p≤0.05 p≤0.01 p≤0.01 p≤0.05 p≤0.01

¹Means in columns followed by the same letter are not significantly different, level of statistical significance for each column indicated at column bottom.

Table 5. Alfalfa quality class designations

<u>Quality Designation</u>	<u>ADF (100% DM)</u>	<u>TDN (90% DM)</u>	<u>Value/ton¹</u>
Extra Premium	<27%	>55.9%	
Premium	27-29%	54.9-55.9%	
Good	29-32%	52.5-54.5%	\$ 70-85
Fair	32-35%	50.5-52.5%	\$ 62-70
Low	>35%	<50.5%	

_____ ADF = Acid detergent fiber, data obtained at 100% dry matter (DM) level.

_____ TDN = Total digestible nutrients

¹ Values noted for Blythe, CA production in October 8, 1999, edition of California Weekly Hay Report