New Tools for Insect Pest Management in Alfalfa Hay

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ABSTRACT

Several species of lepidopterous (butterfly and moth) larvae infest alfalfa hay in the Central Valley. The yellowstriped armyworm, beet armyworm, and alfalfa caterpillar are the most damaging of these larval pests. The efficacy of registered and experimental insecticides on lepidopterous larvae and on pea aphids was examined, as well as the impact on beneficial insects. Newer insecticides, either "biorationals" or representing new classes of chemistry, were emphasized in this study. Since these species have multiple generations per year (4-7), beneficial insects are important for controlling subsequent generations as well as for controlling other alfalfa insect pests (aphids, thrips, weevils). At 3 days after treatment, Alert, Ambush, Larvin, Lorsban, and Spinosad (0.045 rate) provided good-excellent beet armyworm control and all treatments resulted in high mortality of alfalfa caterpillars. At 7 days after treatment, all treatments killed at least 75% of beet armyworm and of alfalfa caterpillars. Beet armyworm larvae werer generally more difficult to kill with all materials than alfalfa caterpillar larvae. Ambush and Lorsban each reduced populations of beneficials by 76%; no other treatment significantly reduced populations of beneficials at 3 days after treatment.

Key Words: integrated pest management, beneficial insects, insecticides, lepidopterous larvae

INTRODUCTION

Many species of insects inhabit alfalfa fields in the Central Valley. In the Eastern States, nearly 600 species of arthropods (insects, mites, spiders, etc.) have been shown to reside in alfalfa fields. The arthropod diversity in California alfalfa fields is likely equally as diverse. Many of these insects are beneficial and most of them are of no economic importance (positive or negative). A few insects in alfalfa are pests; these insects defoliate alfalfa stems, remove plant juices, or feed on root tissue.

The Egyptian alfalfa weevil/alfalfa weevil complex is generally the most damaging insect pest group of alfalfa hay in California. Larvae of these insects defoliate alfalfa plants from January to April (depending on location). Aphids (pea and blue alfalfa) comprise the second group of significant alfalfa insect pests. Again, depending on location, aphids can build to damaging levels from February to June and, in some cases, pea aphids can build to damaging levels again in the fall (September to December). Root-feeding insects, including the clover root curculio and ground mealybug, are another important group of important pests. The damage done by these pests is

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cryptic, but is probably more economically important than commonly believed. These pests are difficult to sample, research, and manage. Finally, several lepidopterous larvae are important alfalfa pests. These larvae, the immature stages of butterflies and moths, defoliate plants and can cause considerable damage. Larval populations often exceed thresholds, therefore necessitating an insecticide application to minimize economic damage. Several new selective insecticides have recently been registered or are being developed (not registered yet) that may provide acceptable lepidopterous larval control while having minimal impact on beneficial insects. This study evaluated the use of these selective insecticides for larval control and for disruption of beneficial insect levels. These beneficial insects are important for providing biological control of aphids, weevils, and other insect pests during the growing season.

The beneficial insects common in alfalfa fields in the Central Valley include several species of lady beetles and lacewings. In addition, bigeyed bugs, minute pirate bugs, damsel bugs, and spiders are important generalist predators. Several species of parasitic wasps have been released for Egyptian alfalfa weevil/alfalfa weevil and provide some control. Parasitic wasps are also important for aphid control (*Aphidius*), alfalfa caterpillar control (*Apanteles*), and armyworm control (*Hyposoter*).

Three species of lepidopterous larvae are potential pests of alfalfa in the Central Valley. The alfalfa caterpillar (alfalfa butterfly) is a warm weather pest of alfalfa. The yellow butterflies lay single eggs on alfalfa leaflets, which hatch into larvae eventually becoming 1 to 1 1/4 inches long. The larvae are velvety green with a white stripe on each side. The butterflies are attracted to new alfalfa growth (~4-6 inches tall) to oviposit. A generation (egg to adult) can then be completed during the typical hay cutting cycle. Alfalfa caterpillars consume large portions or even entire alfalfa leaflets. Their damage can be distinguished from feeding of armyworms described below. Sampling for alfalfa caterpillar should be done weekly from about June to October. Make 5 sweep net counts (using a 180° sweep) from each of 4-5 locations per field. Management actions should be considered at an average of 10 nonparasitized or disease-free larvae per sweep. Sampled larvae should be checked for the incidence of parasitism because this natural control is very common in many fields. Sample live larvae may be parasitized and therefore die quickly. If the threshold is reached, recommendations for alfalfa caterpillar management include insecticides or early harvesting.

Two species of armyworms are also important alfalfa pests in California. The beet armyworm and the western yellowstriped armyworm are similar in life cycle, damage, and management. The relative proportions of these two species vary among areas and years. Both species lay their eggs in masses on the upper side of alfalfa leaflets. The larvae reach full size in about 2-3 weeks after hatching. The appearance of the larvae is an easy way to separate these two species. The larvae of both species are "smooth-skinned"; however, the beet armyworm has a dark stripe down the back with a yellow stripe on each side (overall color of the larvae varies from green to almost black). The western yellowstriped armyworm is usually black with a wide orange stripe and many small stripes down each side. Most importantly, the beet armyworm has a black dot on each side above the second pair of legs and the western yellowstriped armyworm has a large black dot on each side above the first legless segment. The beet armyworm and the western yellowstriped

armyworm skeletonize foliage as they feed. The veins of the leaflets are left intact. The threshold for the armyworms is 15 nonparasitized or disease-free larvae per sweep. Sampling and management for the armyworms is identical to the alfalfa caterpillar.

Table 1. Summary of key lepidopterous larvae infesting alfalfa in Central Valley

Species	Eggs	Larvae	Damage	Sampling Method	Threshold	Management
alfalfa caterpillar	singly on leaflets	velvety green; white stripe on each side	consume large portions or entire alfalfa leaflets	sweep net - 180° sweep	10 non-parasitized or disease-free larvae per sweep	biological, early harvest, insecticides
beet armyworm	masses on leaflets	green to almost black; dark stripe on back; yellow stripe on each side	skeletonize leaflets	sweep net - 180° sweep	15 non-parasitized or disease-free larvae per sweep	biological, early harvest, insecticides
western yellowstriped armyworm	masses on leaflets	black; wide orange stripe and many small stripes on each side	skeletonize leaflets	sweep net - 180° sweep	15 non-parasitized or disease-free larvae per sweep	biological, early harvest, insecticides

PROCEDURES

The objective of this test was to evaluate the efficacy of several insecticidal treatments on lepidopterous larvae in alfalfa. We wanted to emphasize several newly registered products or newer experimental products with many of these being "biorational" type products. In addition, materials from new classes of chemistry were tested. Testing was done in a commercial alfalfa field in Yolo County. Applications were made on 21 August 1995 at 20 GPA with a backpack sprayer. The 13 treatments were arranged in a randomized complete block design. Following the application, larval densities were evaluated at 1, 3, 7, and 10 days after treatment (DAT). Pretreatment densities were also determined. Ten 180° sweeps per plot were used to estimate densities. Pea aphid densities and number of beneficials were also determined, although the sweep net is not the most efficient method to sample for pea aphids. In addition, the small plot size (10 feet by 20 feet) and the high mobility of many of the beneficials may have limited the utility of the data on beneficials. In addition, if the food supply (larvae or aphids) is decimated, then the beneficials may move out of the plot.

The following materials were tested.

Table 2. Treatment list for lepidopterous larvae on alfalfa.

Treatment	Rate	Registered on Alfalfa	Type of Product/Chemistry
Alert 2SC	0.2 lbs. AI/A	No	Pyrrole
Ambush 2E	0.15 lbs. AI/A	Yes	Pyrethroid
Condor XLT	1.0 pt./A	Yes	*Bacillus thuringiensis* subsp. *kurstaki*
Condor XLT	1.5 pt./A	Yes	*Bacillus thuringiensis* subsp. *kurstaki*
Confirm 70%	0.125 lbs. AI/A	No	Insect Growth Regulator
Fipronil 80 WDG	0.05 lbs. AI/A	No	Fipronil
Javelin WG	1.5 lbs./A	Yes	*Bacillus thuringiensis* subsp. *kurstaki*
Larvin 3.2F	0.6 lbs. AI/A	No	Carbamate - ovicide
Lorsban 4E	1.0 lbs. AI/A	Yes	Organophosphate
Spinosad 80%	0.045 lbs. AI/A	No	Spinosyn - fermentation product
Spinosad 80%	0.09 lbs. AI/A	No	Spinosyn - fermentation product
XenTari WG	2.0 lbs./A	Yes	*Bacillus thuringiensis* subsp. *aizawai*

RESULTS

Pretreatment counts showed an average of 6.8 larvae per sweep with the population being comprised of 41% yellowstriped armyworms, 6% beet armyworms, and 53% alfalfa caterpillars. Therefore, the population was less than the accepted threshold value, but still offered a chance to evaluate these products. The alfalfa caterpillar larvae were mostly 4th and 5th instars, whereas larvae from the other two species were smaller. On the later sample dates, population density of alfalfa caterpillars and yellowstriped armyworms declined; however, beet armyworm levels increased. The larval density was 2.7 larvae per sweep at 7 DAT. At 3 DAT, Alert, Ambush, Larvin, Lorsban, and Spinosad (0.045 rate) provided good-excellent beet armyworm control and all treatments resulted in high mortality of alfalfa caterpillars (Table 3). At 7 DAT, all treatments killed at least 75% of beet armyworm and of alfalfa caterpillars. As has been previously shown, beet armyworm larvae are generally more difficult to kill than alfalfa caterpillar larvae. This was generally true with the biorational and conventional insecticides. In addition, the somewhat slow speed of kill of the *Bacillus thuringiensis* products and of Confirm was expected. The *Bacillus thuringiensis* products must be consumed by the larvae and exert a toxic effect (paralysis) on the larvae. Confirm is an insect growth regulator that disrupts the growth and development process of the larvae. However, these newer biorational materials provide quicker kill than the initial products of this type. In addition, larval feeding may be reduced or even stopped for several days before death. Yellowstriped armyworm control was similar to the beet armyworm control. Only Lorsban and Ambush effectively controlled pea aphids.

Table 3. Percentage control of beet armyworm and alfalfa caterpillar at 3 and 7 days after treatment.

		% Control - 3 DAT		% Control - 7 DAT	
Product	Rate	BAW	AC	BAW	AC
Alert 2SC	0.2 lbs. AI/A	100	95	96	100
Ambush 2E	0.15 lbs. AI/A	76	99	93	100
Condor XLT	1.0 pt./A	0	91	88	100
Condor XLT	1.5 pt./A	0	88	77	96
Confirm 70%	0.125 lbs. AI/A	11	67	89	97
Fipronil 80 WDG	0.05 lbs. AI/A	0	90	75	100
Javelin WG	1.5 lbs./A	0	86	80	100
Larvin 3.2F	0.6 lbs. AI/A	82	99	98	94
Lorsban 4E	1.0 lbs. AI/A	91	100	93	91
Spinosad 80%	0.045 lbs. AI/A	69	95	82	89
Spinosad 80%	0.09 lbs. AI/A	13	96	100	100
XenTari WG	2.0 lbs./A	29	82	81	96

BAW = beet armyworm
AC = alfalfa caterpillar

The effect of the treatments on beneficial insects at 3 DAT was evaluated. This short time interval should help to minimize the confounding effects of movement of beneficials among plots. Ambush and Lorsban each reduced populations of beneficials by 76%. No other treatment significantly reduced populations of beneficials at 3 DAT.

SUMMARY

Several newly registered insecticides or materials still under development were found to provide excellent alfalfa caterpillar and armyworm control, while still having minimal impact on beneficials in this study. However, additional work needs to be done to fully evaluate the effect on beneficials. The percentage control of alfalfa caterpillar and beet armyworm was similar at 7 DAT. Many of these biorational products work somewhat more slowly than the conventional insecticides. This should be taken into account when evaluating field performance. In addition, many of these products must be consumed by the larvae to exert an effect. Therefore, thorough coverage of the foliage is critical. The registration dates for the materials under development are uncertain.