WEEVILS AND WORMS - NEW PRODUCT UPDATE AND INTEGRATED MANAGEMENT

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ABSTRACT

The Egyptian alfalfa weevil and several species of lepidopterous larvae (beet armyworm, western yellow-striped armyworm, and alfalfa caterpillar) are the most severe insect pests of alfalfa in California. These pests feed on alfalfa leaflets and stems, reducing hay yields. This paper will discuss the management of EAW larvae, including sampling, thresholds, non-chemical controls, insecticidal controls, etc. Results from field trials evaluating the efficacy of registered and experimental insecticides on EAW will be reported herein. A brief summary/discussion of the characteristics of some of the new insecticides with activity on lepidopterous larvae will also be included.

INTRODUCTION

Insect pests inflict significant damage to alfalfa which results in crop loss and increased costs of production when controls measures are used. The Egyptian alfalfa weevil, *Hypera brunnipennis* (alfalfa weevil [*Hypera postica*] in some areas) and several species of lepidopterous larvae (beet armyworm, western yellow-striped armyworm, and alfalfa caterpillar) are the most severe insect pests of alfalfa in California. Several other minor insect pests can also be problematic in certain areas and/or some years (see 'Minor Pests of Alfalfa Hay', by R. Long in this proceedings). Both Egyptian alfalfa weevil (EAW) larvae and lepidopterous larvae damage alfalfa by feeding on the leaflets and stems. This feeding can reduce hay yields and also effect nutrient quality characteristics.

This paper will discuss the management of EAW larvae, including sampling, thresholds, non-chemical controls, insecticidal controls, etc. Results from field trials evaluating the efficacy of registered and experimental insecticides on EAW will be reported herein. Detailed information on integrated management of lepidopterous larvae can be found in Proceedings, 25th California Alfalfa Symposium, 7-8 December 1995, Modesto, CA, UC Cooperative Extension, University of California, Davis, pp. 87-91. A brief summary/discussion of the characteristics of some of the new insecticides with activity on lepidopterous larvae will be included.

Egyptian alfalfa weevil

The alfalfa weevil is thought to have been introduced into the United states from Europe or Asia on 3 separate occasions. The first record of this insect in the U.S. was in 1904 near Salt Lake City; this has been called the western strain of *H. postica*. The second introduction, called the Egyptian alfalfa weevil, *Hypera brunnipennis*, was first found near Yuma, AZ in 1939. The

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third introduction was in 1952 into Maryland and these have been called the eastern strain of *H. postica*. There are important behavioral and ecological differences among these weevils that affect their economic importance and management, but the appearance of all three of these groups is identical. Using advanced molecular techniques, recent research has shown that these weevils are most likely all the same species of insect. Regardless, the habits and characteristics of these weevils differ and this affects management strategies. In this paper, I will continue to consider them two separate species of insects.

In California, the alfalfa weevil occurs in the cooler production areas, i.e, coastal and northern mountain areas, whereas the EAW is found throughout the Central Valley and low deserts. My research has been aimed at the EAW since that is what occurs in the Central Valley. EAW adults spend the summer (~June to October) in a "resting state" in the vicinity of, but outside of the alfalfa fields. In October, the adults move back into the alfalfa fields and lay eggs in the alfalfa stems. Depending on the fall temperatures, a portion of these eggs hatch, but most will not hatch until the following late winter/spring. Egg-laying continues throughout the winter. The majority of the egg hatch and larval population occurs in the spring. Small stage larvae feed in the alfalfa terminals and the larvae move to the leaflets and stems to feed as they mature. The feeding period typically takes about 3 weeks and is completed near the time of the first cutting. EAW eggs and larvae develop at temperatures greater then 45^{0}F. Eggs and larvae require 211 and 373 degree- days, respectively, to complete development. Pupation (transformation into the adult) takes place in a loosely woven whitish "football-shaped" cocoons. Pupae are attached to foliage and also distributed on the soil surface. After the adults emerge, they feed in the alfalfa fields for about 3 weeks and then leave the alfalfa field for the summer resting phase. Therefore, there is one generation per year for this pest.

Management: With any significant insect pest, it's important to consider all appropriate management strategies. **Biological control** of EAW is an important management tool. In addition to the naturally-occurring generalist predators that feed on EAW larvae, several species of parasitoids have been released into California for this pest. These parasites provide some control of EAW in California, but not to the desired level. Our environmental conditions, agronomic practices, EAW larval behavior, etc. have hindered these parasites from providing the excellent control that they give on alfalfa weevil in the Midwest. In the Midwest, this pest does not reach damaging levels during many years because of the control provided by parasitoids. Research on biological control of this pest in California has been conducted for ~20 years; additional efforts at this time are minimal because of retirements and declining resources. **Alfalfa host plant resistance** to EAW is non-existent. Some vigorously-growing varieties can partially "out grow" the damage, but varieties that kill or repel EAW larvae or adults have not been developed. Some sources of resistance to EAW have been identified and may evenually be worked into commercial varieities. **Cultural control** can play a role in managing EAW. Early-harvest, within the limitations of common agronomic practices, can be used to "control" a damaging EAW population. This practice is often used rather then to apply an insecticide. Even with these strategies and other management tools, **insecticides** are a primary means of controlling EAW in California.

Fields should be checked with a sweep net every 2 to 4 days in the late winter/spring after EAW larvae appear. Take at least 5 sweeps in each of the 4 quadrants of the field; a 180^0 sweep should be used. Management actions should be taken if the field averages 20 or more EAW larvae per sweep. On young growth or regrowth, sweeping is impossible; rely on visual examination of the foliage for EAW larvae.

PROCEDURES

The efficacy of registered and experimental insecticides against EAW larvae has been evaluated since 1992. Treatments were applied with a CO_2 backpack sprayer in late March/early April as the population reached 20 larvae per sweep. Plot design included 12 by 25 feet plots with 4 replicates per treatment. Percentage control was quantified at 1, 3, 7, 14, and 21 days after treatment (DAT). The effect of the treatments on beneficial arthropods was evaluated as well as EAW larval control. The beneficials studied were lady beetles, lacewings, damsel bugs, big-eyed bugs, minute pirate bugs, and spiders. These natural enemies are important for EAW management but probably more importantly for pea aphid management in the second and third cutting.

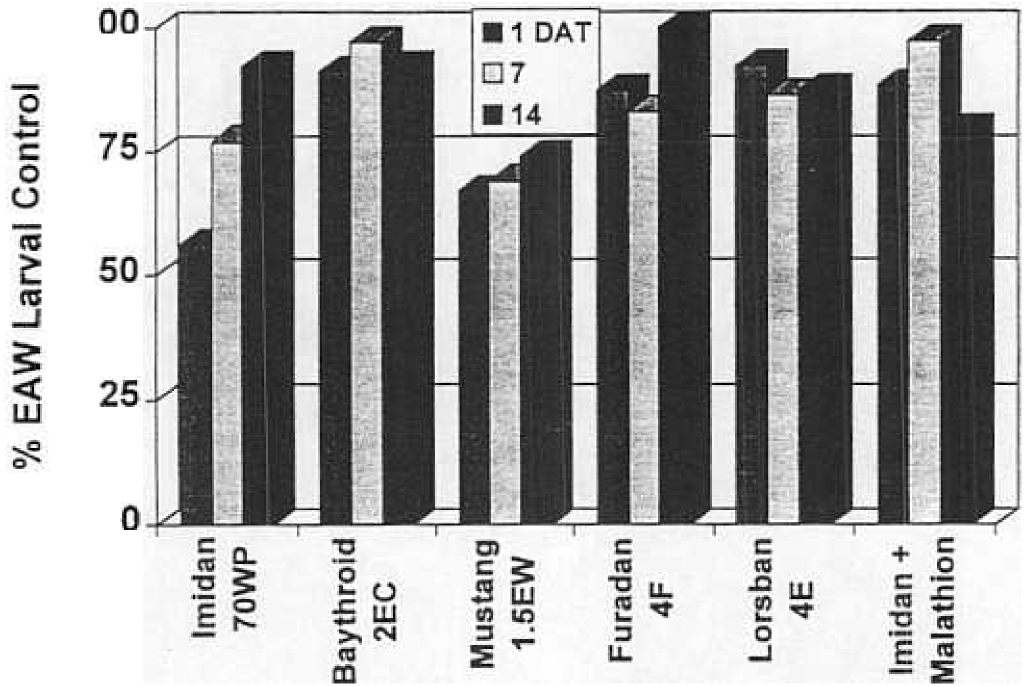
RESULTS

There are ~15 different insecticides registered for EAW control in California. I have found that most of these products work well, i.e., achieve 90+% control, for managing this pest. The important differences among these products are in speed of kill, effects on beneficials, direct effects on aphids, and ease of use. For example, results from 1996 and 1997 are shown in Fig. 1. Rates tested for the products shown in Fig. 1 are standard label rates (Imidan 70WP at 1.0 lbs./A, Baythroid 2EC at 2.8 oz/A, Mustang 1.5EW at 3.2 oz/A (1996) and 4.3 oz/A (1997), Furadan 4F at 1 qt/A, Lorsban 4E at 1.5 pts./A, Imidan + Malathion at 1.0 lb/A + 1.5 pts./A, and Imidan + Lorsban at 1 lb/A + 1 pt./A. In nearly every case, 90%+ control was seen with these materials.

The influence of insecticides used for EAW control on beneficials is an important aspect of alfalfa pest management strategies. Alfalfa is a host for a tremendous number and variety of beneficial arthropods. These natural enemies help in controlling pea aphids, thrips, worm pests, and leafhoppers among other potential pests. Fig. 2 depicts the effects of these insecticides on populations of beneficial arthropods in alfalfa. Considering the small plot size used in these studies, only short-term effects are shown, i.e., 1 to 7 days after treatment. This was done to minimize the influence of predator movement among plots. In addition, if the density of prey (food) is decreased by the insecticide then the density of beneficials will also likely decline as they search for food. Therefore, the data in Fig. 2 must be interpreted with caution. On some sample dates, the density of beneficials was very low. For example, in 1996 at 1 DAT, the untreated averaged only 1 beneficial per sweep; therefore, the insecticides showed an apparent "all-or-nothing" effect. Several obvious differences can be seen in the effects of these insecticides on beneficials.

Several new insecticides are being developed in the U. S. for lepidopterous larval control. These are targeted primarily for "armyworms" (*Spodoptera* spp.) and the bollworm/fruitworm complex (*Heliothis* sp.). Some of these compounds may eventually be registered in alfalfa for worm and weevil control; however, it will probably take several years for this to occur. The key characteristics of these products are that they are very effective at low rates, very selective for the pest, low toxicity to beneficials, and low mammalian toxicity. These products possess several modes of action and fall into several categories 1.) products of fermentation of microorganisms, 2.) insect growth regulators, 3.) microorganisms, 4.) natural products, 5.) traditional insecticides but within new classes of insecticides. The various modes of action will help to reduce the incidence of resistance development in key pests.

Egyptian Alfalfa Weevil Larval Contro   996



Egyptian Alfalfa Weevil Larval Contro   997

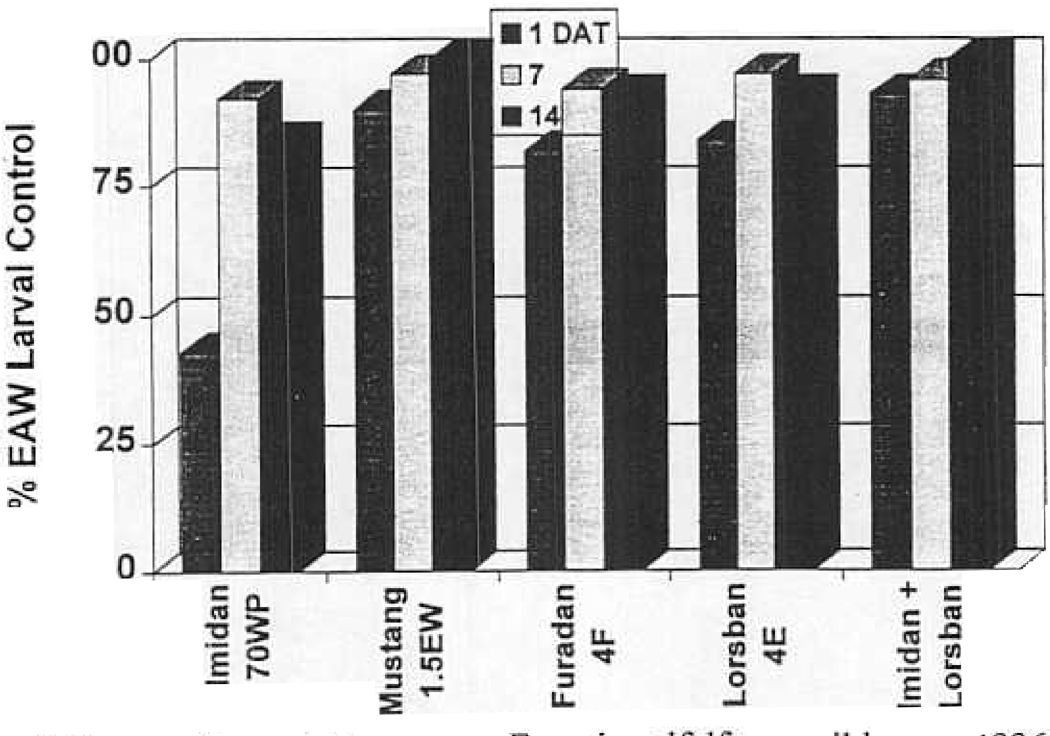


Fig.   Efficacy of insecticides against Egyptian alfalfa weevil larvae, 1996-97

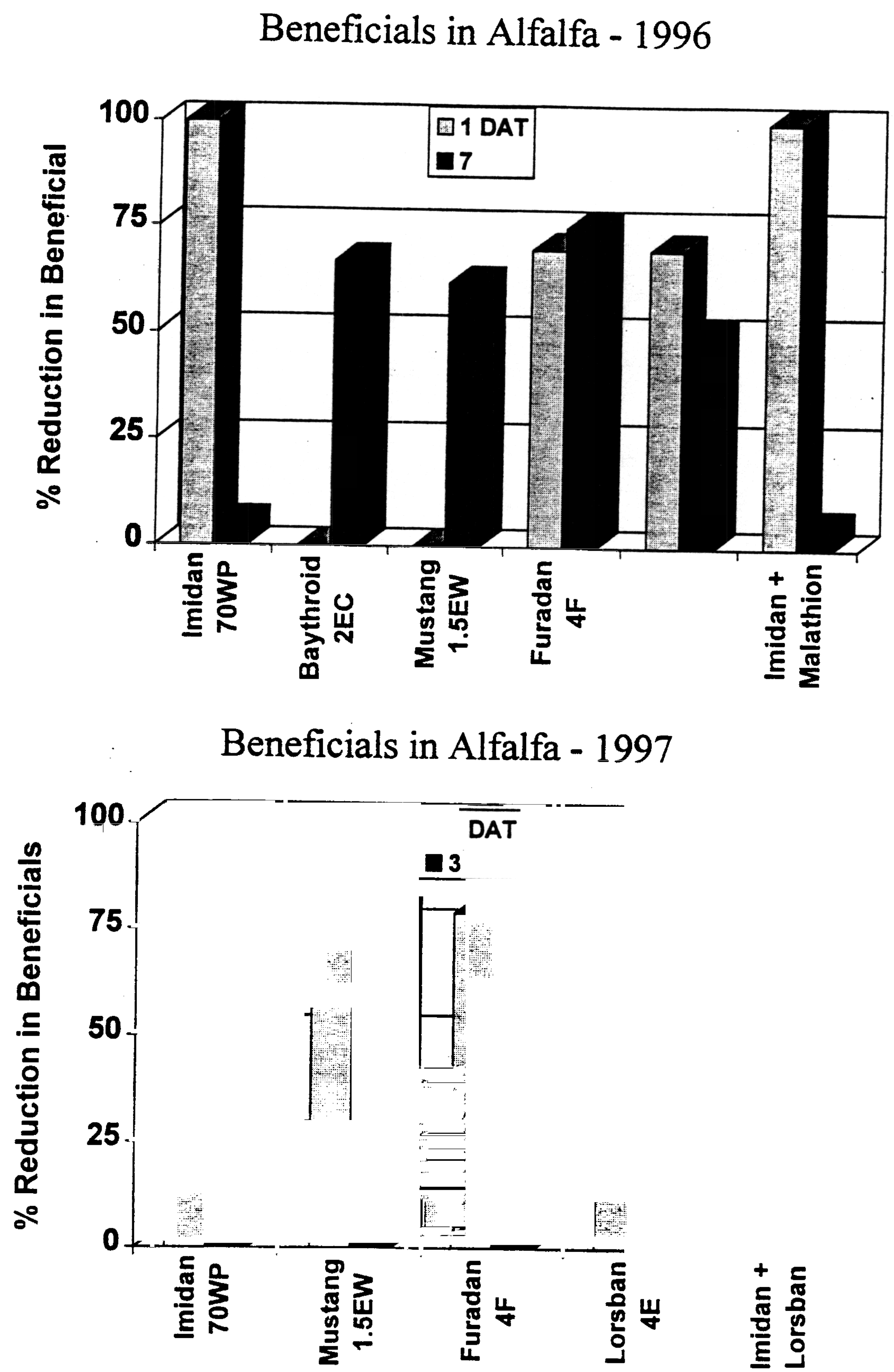


Fig. 2. Influence of insecticides, applied against Egyptian alfalfa weevil larvae, on beneficial arthropods in alfalfa, 1996-97.