CONTROL OF THE EGYPTIAN ALFALFA WEEVIL
A PERSPECTIVE FOR THE 1970'S

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The Egyptian alfalfa weevil, Hypera brunneipennis (Boheman), remains the most serious insect pest of forage alfalfa in California. Losses attributable to it, and the closely related alfalfa weevil, H. postica (Gyllenhal), approached $22 million in 1974 (Calif. Dept. Food and Agric. 1975). Recent advancements in the areas of biological control and host plant resistance (Summers and Lehman in press) offer promise of more permanent, less expensive and environmentally more acceptable population suppression than is currently available from unilateral reliance on chemical pesticides. However, until such programs are fully researched and made operational, the use of insecticides remains the most effective means of reducing larval populations to levels which cause a minimum of damage and crop loss. The use of such chemicals however, requires an acceptance of responsibility by all individuals involved in the decision making process. Failure to accept this responsibility will quite likely result in increased costs, additional pest problems, and generally inefficient management programs.

Economic Threshold and Injury Levels

At the base of any insect control program lies the concept of the economic threshold and the economic injury level. The economic injury level was defined by Stern et al. (1959) as "the lowest population that will cause economic damage. Economic damage is the amount of injury which will justify the cost of artificial control measures ..." The economic threshold is "the density at which control measures should be determined to prevent an increasing pest population from reaching the economic injury level." By their very nature, each is tied to the other and both are influenced by such factors as the price of the crop, the cost of treatment, and man's changing concepts of economic values. An economic injury level or economic threshold level is thus difficult to obtain and both should be considered as guidelines for treatment decisions.

Until recently, few data were available on treatment levels for either weevil species. Various suggested treatment levels, in California and nationwide, have recommended treatment when X number of larvae were recovered per sweep or when X percentage of the alfalfa terminals showed feeding injury. Cothran and Summers (1974) discussed the dangers of using visual economic threshold levels in reaching treatment decisions for Hypera spp. and concluded that the use of such visual levels frequently contributes to pesticide abuse in the form of economically unjustifiable treatments. This concept was further strengthened by the findings of Summers and McClellan (1975a,b) that foliar diseases are capable of causing damage and crop loss equal to that caused by H. brunneipennis. These diseases, common leafspot and Stemphylium leafspot caused by Pseudopeziza medicaginis (Lib.) Sacc. and Stemphylium botryosum Wallr. respectively, result in defoliation which may easily be confused with that caused by H. brunneipennis and visual inspection of alfalfa may thus lead to treatment recommendations for the wrong pest.

Koehler and Rosenthal (1975) presented an indepth analysis of economic injury levels for both H. postica and H. brunneipennis. Correlations of larval numbers and 1st cutting hay yields disclosed that every increase of 1 larva per sweep at the larval peak was associated with a yield reduction of 9 pounds of hay. They presented a table of larval numbers per sweep which they considered to be the economic injury level over a wide range of treatment costs and hay prices. These values ranged from 19 to 36 larvae per sweep for $50-70 per ton hay and treatment costs of $6-8 per acre. They also presented a discussion of the limitations of their data and I urge the reader to study their paper in detail.

The data of Koehler and Rosenthal (1975) adds strong support to our current recommended treatment level of 20 larvae per sweep. It likewise clearly indicates that treatments made at low population levels, e.g. 2-3 larvae per sweep, are economically unsound. Treatments at such low levels have been referred to as "preventative sprays" and attempts made to justify such programs on the premise that weevil populations are going to a priori be sufficiently high to justify treatments. Such preventative programs may be acceptable in other crop-pest relationships but not in alfalfa.

Use of Insecticides

When larval populations approach 20 per sweep and all evidence clearly indicates that even greater numbers are likely within the next few days or weeks, a chemical treatment is advised. Responsibility does not end here however, and should be exercised in selecting the proper material and dosage rate. The larvae of H. brunneipennis are susceptible to many insecticides representing several classes of compounds (Summers in press) and H. postica and H. brunneipennis appear equally susceptible to most materials tested (Koehler 1971). Tables 1 and 2 show the potential of several insecticides and dosage rates in controlling the larvae of H. brunneipennis. As is clearly evident from the data, most materials were equally effective and were effective at low as well as high dosage rates. Additional testing on a large plot scale using particularly aircraft application is needed to determine if the exclusive use of such low rates will provide adequate control. The use of such rates offers obvious advantages in terms of economics and reduced adverse effects on non-target species.

The Utility of Modeling in Weevil Control

An important approach to the effective integration of control practices is the employment of the computer as an aid in understanding complex agroecosystems. The following (from Glass 1975) explains the utility of such models. "Computer models serve two useful functions in pest management. First, through systems analysis, they provide avenues enabling researchers to identify the most important of key factors in a system. The identification of key factors points out the need for additional information to fill voids in the data base. A net result is the optimization of research manpower and an increase in the real value of money spent on the development of integrated pest management programs. Second, models are of value in the implementation of integrated pest management. A crop-pest model, for example, may be used to predict when, or if, pest populations will reach economic injury levels. In addition, the model should aid in the decision-making process, or actually make the proper control decision for the grower."

"To achieve a model useful in integrated pest management systems, at least three basic submodels must be developed. These include a plant growth model, a pest complex model and a biometeorological accounting model. The plant growth model describes the relationships between plants, environment and yield. The pest complex model describes relationships involving the pest and its environment including pest migration, influence of heat accumulation of day length, overwintering survival, natural enemies and other factors influencing the pest populations. The biometeorological accounting system is essential to maintain an organized input of data into the plant growth model and the pest complex model."

Such a model for alfalfa and the Egyptian alfalfa weevil has recently been developed (Gutierrez et al. in press). The model is weather driven and simulates the year-long development of both alfalfa and H. brunneipennis based on early season population estimates for each and for weather. An economic model (Gutierrez et al. in press) has also been developed which includes an analysis of the phenologies of the pest and plant, insect population and the effect of quantity and timing of pesticide applications on weevil control and on secondary pest outbreaks. At the present time, these models, and the sampling required to generate predictions, are too complex to be readily used in the field. However, we are in the precess of developing a system which will provide a series of graphs and charts from which answers based on the data input may be read directly and translated into an accurate prediction of what the larval population is likely to do during the next few days or weeks. A similar approach used during 1975 in Illinois (Armbrust et al. 1975) indicates that this will be an extremely useful tool in any management decision regarding weevil control.

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Table 1. Efficacy of insecticides and dosage rates[a/] for control of the Egyptian alfalfa weevil, Woodville, Tulare County, Calif.

Insecticide	Oz AI/acre	Mean no. larvae/sweep on[b/] 30 Mar.	6 Apr.
Phosmet	16	1.3 a	1.8 a
Phosmet	8	2.2 a	2.9 a
Methidathion	8	3.4 a	0.9 a
Methidathion	4	3.0 a	1.1 a
Carbofuran	8	2.2 a	0.2 a
Carbofuran	4	2.3 a	0.5 a
Chlorpyrifos	8	2.4 a	1.0 a
Chlorpyrifos	4	2.0 a	1.9 a
Chlorpyrifos	2	2.2 a	4.3 b
Phosalone	20	1.0 a	0.9 a
Phosalone	16	1.1 a	0.5 a
Untreated	-	23.4 b	35.1 c

a/ Materials applied Mar. 23, 1973.

b/ Means followed by the same letter(s) are not significantly different at P = 0.05 according to Duncan's multiple range test.

Table 2. Efficacy of insecticides and dosage rates[a/] for control of the Egyptian alfalfa weevil, Visalia, Tulare County, Calif.

Insecticide	Oz AI/acre	Mean no. weevil larvae/sweep[b/] on Mar. 29
Phosmet	16	3.5 a
Phosmet	8	4.3 a
Methidathion	8	6.2 a
Methidathion	4	6.2 a
Carbofuran	8	5.0 a
Carbofuran	4	4.7 a
Chlorpyrifos	8	3.0 a
Chlorpyrifos	4	3.5 a
Chlorpyrifos	1.6	10.5 b
FMC 33297	3.2	3.3 a
FMC 33297	1.6	7.7 a
FMC 33297	0.16	40.4 c
Parathion	8	1.0 a
Parathion	6	1.2 a
Carbaryl	32	5.6 a
Carbaryl	16	8.0 a
Methomyl	8	8.6 a
Methomyl	4	17.5 b
Acephate	32	1.4 a
Acephate	16	1.3 a
Acephate	8	3.1 a
TH 6040	8	45.0 cd
TH 6040	4	52.6 d
Pirimphos-methyl	16	2.9 a
Pirimphos-methyl	8	3.9 a
Untreated	-	74.5 e

a/ Materials applied Mar. 21, 1974.

b/ Means followed by the same letter(s) are not significantly different at P = 0.05 according to Duncan's multiple range test.