Insect Thresholds as Practiced in the Field

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Introduction

A field of alfalfa supports a wide variety of insects. Over 1000 species of insects, mites and other arthropods are known to inhabit alfalfa in CA. and the number of individuals per acre runs into the millions. These numbers include insects that are both destructive and beneficial not only to alfalfa but to neighboring crops as well. Alfalfa has a unique role in the local farming area ecosystem placing great importance on an insect pest management system.

Only six or seven insects regularly cause economic damage to alfalfa. These include alfalfa weevils, blue alfalfa aphid, pea aphid, alfalfa caterpillar, beet armyworm and western yellow-striped armyworm. Control Action Guidelines have been developed by the Univ. of CA. for all of these pests and are generally numerical thresholds indicating population levels that will cause economical damage. In the interest of time and because of its importance, I will limit this discussion of thresholds to Egyptian alfalfa weevil.

Economic Threshold

A short review of economic thresholds is appropriate. Thresholds are one of the basic decision parameters used by pest management practitioners. The threshold is the pest population level that is profitable to reduce by control. The economic threshold always represents a pest density lower than that of the economic injury level so that control activity can take effect before the pest exceeds the economic injury level. Thresholds are developed by standard economic costs and returns analysis. Although these analysis are complex probability models, there are limitations. The analysis assumes that weather conditions allow for average pest and crop development, the pest will respond to control measures, and the price of the crop will remain constant. In reality, conditions are rarely average or certain. Field observation by trained and experienced practitioners adds the dynamic dimension to the threshold concept.

The economic threshold for alfalfa weevil larvae as stated in the UC IPM manual for Alfalfa Hay (1981) is 20 per sweep. Accurate monitoring is essential for effective use of this threshold. The manual suggests sweeping fields twice a week after larval hatch begins. Divide the field into 4 or more areas and take 5 sweeps in each area. A minimum of 20 counts must be averaged to obtain an estimate of the weevil larvae population. This procedure takes about 30 minutes per field which can be very time consuming if you have 30 to 40 fields and check them all twice a week. However, since monitoring is the backbone of IPM the time spent will likely result in timely treatments, reduced insecticide use, and reduced damage.

Sampling and Adjustments

Sampling alfalfa weevils with a sweep net has some inherent shortcomings. Very small larvae are difficult to dislodge from protective terminals. The condition of the alfalfa such as short growth or lodged hay will affect accuracy. Wet foliage from dew or rain is often encountered in the spring and makes sampling difficult. Personal technique will also lead to variation in population estimates. However, these limitations are acceptable when you consider the speed and ease of sweep net sampling.

Is the 20 per sweep threshold accurate? Koehler and Rosenthal (1975) reported the economic injury level for alfalfa weevils as related to price of hay and cost of treatment (see Table 1). For $90 per ton hay and a cost of treatment at $10 per acre the economic injury level is 24 larvae per sweep. When the price of hay goes up to $100 per ton and the cost of treatment is only $7 per acre the economic injury level drops to 15 larvae per sweep. This example points out the need to be flexible when using thresholds.

Other factors that warrant threshold adjustments include:

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Alfalfa growth and vigor.

Vigorous growth may allow plants to outgrow damage and tolerate higher weevil populations. Slow growth due to diseases, water stress, lack of fertility, highly dormant variety, or stem nematodes can be easily damaged at lower larvae populations. In some areas treatments must be made to allow the field to begin growth.

Weevil population model.

An accurate procedure to predict date and magnitude of the larval peak would allow adjustments to timing of treatments and maximize the use of economic thresholds.

Quality consideration.

Leaves which are full of holes but still intact may not suffer economic yield loss but deteriorate easily and result in quality loss.

Weather.

Above normal temperatures can bring about explosive larval populations. When such weather is predicted it is wise to begin treatments at lower populations. Cooler weather may favor alfalfa growth over larval development and thresholds can be increased.

Weed control.

Weed free fields allow more efficient sweep sampling and result in higher weevil counts but not necessarily increased damage. Thresholds can be increased.

Harvest interval of insecticide.

A decision to treat at lower population levels may be necessary if the choice of insecticide has a long harvest interval.

Application limitations.

Availability and speed of application equipment will influence the timing decision of a treatment. It is very difficult to receive immediate response to a recommendation for treatment and may take 3 to 7 days for the completion of the application after the recommendation is submitted. The reasons for this include weather delays (such as wind or rain, common in the spring), beekeeper notification with 48 hour waiting period, notice of intent and commissioner approval for restricted insecticides, applicator demand exceeds supply because a lot of fields need spraying in a short period of time, and finally delays in delivery of insecticides. Only experience can help the practitioner anticipate these problems and adjust the treatment threshold accordingly.

Proper timing of treatments is of great importance because existing insecticides have short residual activity of 10 to 20 days. Treatments applied too early may allow damage just before harvest or to regrowth after harvest, those applied too late may have to accept some yield loss that already occurred. A single spray properly timed with the help of intensive monitoring can achieve weevil control in most areas, most years. It should be emphasized that control means reduction of the population, not elimination. The question to ask is how many weevils can I live with? Leaving a pest residue is an important premise of integrated pest management and encourages ecological balance by providing food sources for natural enemies. Although the Bathyplectes parasite is not effective on Egyptian weevil like it is on Alfalfa weevil in coastal areas of CA., insecticides applied to control weevils may destroy natural enemies of aphids and worms and induce pest outbreaks later in the season. Every activity in an alfalfa field should be done so as to have minimum negative impact on natural enemies.

A Case History

This discussion has brought forth some of the important principles of implementing thresholds in the field. It is helpful to examine specific examples so I want to share a few of my own practices and observations which should not be taken as gospel but rather to provide additional information you may find helpful for your own use.

I've worked with 5000 acres of Merced County alfalfa each year for the past 10 years. Since cultural practices are so important to successful weevil control, I meet with growers in January to check soil moisture, review fertility programs and check the progress of weed control. Irrigation water, if needed, should be applied by the middle to end of February to keep alfalfa growing through the month of March. If spring growth of 12" stops due to lack of moisture it is difficult for the field to resume growth and will likely grow from the crown when watered. Weevil damage can be severe even at moderate populations from these water stressed first cuttings.

Sampling for weevils begins in late February. Insecticides, if needed, are applied from March 15 to April 5. I check each individual field for weevils and take height measurements, noting fields with poor vigor. After several sampling dates the fields can be sorted by larval numbers, vigor, and a subjective damage rating. Priority is given to fields with highest larvae counts and potential for damage. As decision time nears, communication activity increases including daily ag weather forecasts, aerial applicator schedules, growers harvest schedules, and availability of insecticides from suppliers. I begin writing recommendations when weevil larvae counts reach 12 to 20 per sweep and schedule applications in cooperation with the grower. Once an application is scheduled, I continue checking the fields and will adjust the schedule with the applicator to accommodate changes in the field.

Since the advent of aerial applications of Roundup at low volumes on fallow beds of other crops, most applicators have booms that can deliver 5 gallons per acre very accurately. Most of my weevil treatments are 5 gal/ac. This volume is just as or more effective than traditional 10 gal/ac. volumes and is quicker and less costly.

My choice of insecticide must be effective, economical, non-disruptive, and have a flexible harvest interval. Furadan 4F at 6 to 8 ounces per acre in a buffered spray solution is my most common recommendation. It provides 2 to 3 weeks suppression at this low rate yet has a harvest interval of only 7 days. The cost is about $3.50 per acre. This rate does not control aphids and blue alfalfa aphid is a concern in my area especially on susceptible varieties. Dimethoate 267 or Phosdrin 4EC at 5 ounces per acre can be tank mixed with Furadan for aphid control. The low rate of Furadan is less damaging to beneficial insects than higher rates, has not caused any problems with waterfowl, and has the same residual toxicity to bees as 8 ounces of Lorsban. The short harvest interval allows harvest at optimum timing with weather. There is some risk of respraying because residual activity is reduced. Overall, using low rates has several benefits but intensive monitoring and accurate timing are essential.

The present threshold of 20 weevil larvae per sweep provides an excellent scientific foundation to protect alfalfa from economic damage. Applied integrated pest management is a combination of science and art working in balance and harmony. Effective implementation of the economic threshold demands the development of the art of pest management.

References

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Koehler, C.S. and Rosenthal, S.S. 1975 Economic injury levels of the Egyptian alfalfa weevil or the alfalfa weevil. Journal of Economic Entomology 68(1):71-75

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Table 1. Peak larval levels on 1st cutting alfalfa justifying control in relation only to immediate control cost input and return, Yolo County, CA., 1970-72.

Cost* of treatment/ acre in $	Number of larvae/net sweep responsible for loss equal to cost of treatment, if hay/ton (10% moisture) return to producer is:						
	40	50	60	70	80	90	100
3.00	16	13	11	9	8	7	7
4.00	22	18	15	13	11	10	9
5.00	27	22	18	16	14	12	11
6.00	33	26	22	19	16	15	13
7.00	38	31	26	22	18	17	15
8.00	44	36	29	26	22	20	18
9.00	49	40	33	28	25	22	20
10.00	55	44	37	31	27	24	22

*Including labor, machinery and insecticide; or custom application
Based on loss of 9.1 lb hay/larvae/sweep.
Koehler, C.S. and Rosenthal, S.S. 1975.