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INTEGRATED CONTROL OF THE ALFALFA WEEVIL

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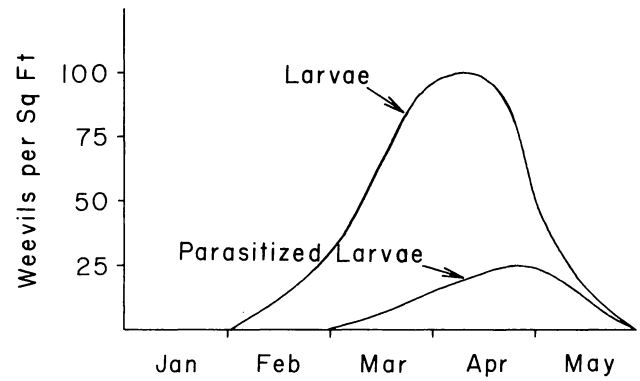
The alfalfa weevil has been a serious pest in Oklahoma since 1972. This species causes moderate to severe damage in most alfalfa production areas every year. Although feeding damage by the weevil occurs early in the growing season before the first harvest of alfalfa forage is taken, residual effects of weevil injury may extend to later harvests throughout the summer. Loss of forage production and stand decline is often considerable when effective control methods are not utilized.

Studies have been directed for the past decade toward development of a pest management program for the alfalfa weevil in Oklahoma. This report describes the principal methods of control now available and the integration of these in a management program.

Seasonal Population Densities

Population levels of the alfalfa weevil have been recorded since 1972 at several locations in Oklahoma. Plant samples taken at 1-2 week intervals are processed throughout the winter months to determine egg numbers. In February and March the procedures are expanded to include counts of weevil larvae. Peak larval populations pose the greatest threat to alfalfa forage production during March and April (Figure 1). Larvae are generally found until May or early June; by late June, all have pupated and newly emerged adults have left alfalfa fields to find shelter in uncultivated sites, such as fence rows, roadsides and other uncultivated areas where they remain until October or November.

Figure 1. - Alfalfa weevil populations in central Oklahoma.



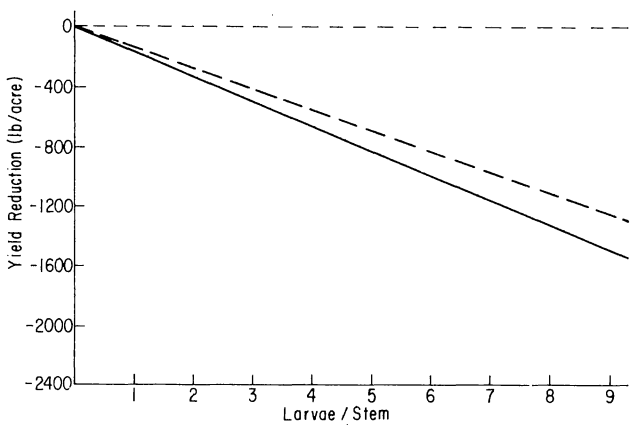
(Values in this figure are averages for 1976-80.)

The highest population densities for the alfalfa weevil in Oklahoma were recorded during the years 1972-74. Since 1975 numbers have gradually declined. Although heavy weevil damage still occurs in localized areas, the general trend is for much less damage and less frequent need for chemical insecticide applications.

Economic Damage Level

Although the start of feeding by weevil larvae varies with weather conditions from year to year, it usually corresponds closely with the start of growth by alfalfa in early spring. Small alfalfa plants (under 12-15 inches in height) can withstand only limited weevil feeding without sustaining serious damage. Experiments conducted at Chickasha, Oklahoma, have shown that yield of forage in the first crop of alfalfa is decreased about 170 lb./acre for each addition of one larva/stem in the weevil population on alfalfa up to 12-15 inches tall (Figure 2). At current prices for alfalfa hay, populations of 1.5-2.0 larvae/stem (about 40/sq. ft.) may cause yield reductions and dollar losses equalling the cost of even the most expensive chemical applications. Larger alfalfa (16-24 inches in height) can withstand feeding by considerably higher numbers of weevil larvae.

Figure 2. - Yield reduction due to alfalfa weevil infestation.



Solid line = 1st crop
dashed line = 2nd crop

Yield reduction is due in large part to extensive defoliation by larvae. Additional factors that contribute to losses include reduced growth and delayed maturity of damaged alfalfa. Heavily damaged alfalfa is often at the prebud stage of growth when uninfested plants have reached the 5-10% bloom stage. Residual effects of weevil infestation on productivity of alfalfa are often apparent after the first harvest even though actual feeding by larvae or adults is usually minimal at this time. Average losses recorded in experiments at Chickasha for the period 1973-78 totaled over 1500 lbs/acre for combined first and second cuttings (Table 1).

Table 1. Yield reduction by the alfalfa weevil

		Yield (lb./acre)	
	Larvae/ stem	1st Harvest	2nd Harvest
Treated	0.4	3239	2826
Untreated	3.9	2293	2194
	Reduction	946	632

(Values in this table are averages of 2 studies conducted from 1973-78, variety = 'Kanza'.

It is very important that producers check fields carefully during March and April to determine the need and/or proper timing of chemical insecticide applications. Many growers use a threshold level of 1.0-2.0 larvae per stem (depending on plant height and degree day accumulation) as a starting point for chemical application. This replaces the earlier less accurate 40% of the alfalfa terminals showing feeding damage. More complete information is given in Fact Sheet 7150, Alfalfa Forage Insect Control and the degree-day concept and charts for timing spray applications are found in Current Report #7177, Sampling for the Alfalfa Weevil in Oklahoma.

COMPONENTS OF CONTROL PROGRAM

Winter Grazing

Weevil larvae which hatch from eggs laid during the winter months contribute greatly to early season damage. A means of reducing egg numbers and therefore subsequent larval production which has been investigated in Oklahoma is winter grazing of alfalfa stands by cattle. This practice destroys overwintering eggs as well as plant material where additional eggs could be placed. To minimize damage to alfalfa stands, grazing should not be initiated until foliage has been browned by freezing weather in the fall and should not be continued after alfalfa has begun to grow in spring.

As shown in Table 2, grazing has resulted in significant reductions in egg and larval populations before chemical application. In addition, an increase of larval populations after insecticide applications was less rapid in grazed plots. Winter grazing has excellent potential for reducing rates and perhaps numbers of insecticide applications needed for weevil control. However, our recent studies indicate that some reduction in alfalfa yields may result over a period of years when winter grazing is utilized. We do not believe that such reductions will outweigh the value of this practice for weevil control particularly when the value of forage consumed by grazing livestock is considered.

Tolerant Alfalfa Varieties

There are 4 released varieties adapted for production in Oklahoma which exhibit some tolerance to alfalfa weevil feeding. The first of these to be

Table 2. Effects of winter grazing on alfalfa weevil populations.

	Weevils/sq. ft.		%
Time Period	Ungrazed	Grazed	Reduction
Grazing Initiated (December	321 eggs	321 eggs	--
Peak Population (January)	500 eggs	180 eggs	64
Onset of Alfalfa Growth (February - March)	300 eggs	83 eggs	72
Insecticide Application[a] (March)	211 larvae	100 larvae	53
2 Weeks after application (March - April)	40 larvae	15 larvae	61

(Values in this table are averages computed from 4 grazing studies conducted from 1973-75).

[a]Furadan® - 1.0 lb. AI/acre.

released was 'Team', which has generally been replaced in recent years by 'Arc', 'Liberty' and 'Cimarron'. These varieties possess a higher level of weevil tolerance than Team. All of these varieties possess the same general characteristics which enable plants to withstand effects of weevil feeding. These characteristics include rapid, vigorous growth in early spring and extensive lateral branching which helps to compensate for weevil damage in growing terminals.

In experiments conducted in Oklahoma, these varieties are usually 2-4 inches taller than susceptible varieties at the time that weevil feeding becomes extensive.

We feel that production can be maintained with fewer insecticide applications in tolerant varieties. However, we do not anticipate that the level of weevil tolerance now available will eliminate the necessity for chemical insecticide applications.

In an integrated control program it is advantageous to utilize varieties with resistance to more than one pest species. All weevil tolerant varieties possess high levels of resistance to the pea aphid, another early season pest which frequently infests alfalfa in Oklahoma. However, with exception of Cimarron, these varieties do not have resistance to the spotted alfalfa aphid. Although incidence of damaging infestations of this aphid is somewhat sporadic, it is capable of causing damage and sometimes loss of stands throughout the season. Release of Cimarron is an important assist for alfalfa producers in Oklahoma because for the first time resistance to both weevil and spotted aphid is incorporated in the same variety.

The blue alfalfa aphid first appeared in Oklahoma in 1977, but it was not until 1980 that significant damage by this pest occurred. The blue aphid is very similar in appearance to the pea aphid and it also infests alfalfa in the spring. However, the blue aphid is a much more damaging pest and is capable of reducing yields at lower population levels. None of the weevil tolerant cultivars are resistant to this pest.

Chemical Control

Chemical insecticides play a very important role in an integrated control program for the alfalfa weevil. Throughout the period from March to May weevils may cause serious damage even when measures such as winter grazing and tolerant varieties are utilized. Insecticides provide an essential means for reducing high populations and thereby preventing serious losses. The following recommendations should be followed to achieve the best possible results with insecticides.

1. Follow recommended sampling procedures and guidelines for determining when insecticide applications are needed.

2. Apply all insecticides when temperature is 50°F or above.

3. Do not apply insecticides when wind velocity exceeds 8-10 mph. Avoid spray drift into nontarget areas.

4. Keep sprayer properly calibrated for correct dosage.

5. Use adequate spray gallonage for thorough coverage of foliage.

   Ground Application -

   10-15 gallons/acre for plants 8-12 inches in height.

   15-20 gallons/acre for larger plants.

   Aerial Application -

   2-3 gallons per acre minimum

Increase gallonage for dense, rank alfalfa growth.

Research in Oklahoma and other states has shown that effective weevil control can be obtained with either ground or aerial application. Studies have demonstrated in addition that use of higher spray volumes in aerial application has resulted in more effective control. Averages for 2 studies conducted in Oklahoma during 1973-75 are shown in Table 3. Note that for all sampling dates, populations in plots sprayed with 0.5 gallons/acre were nearly double those in plots where 4.0 gallons/acre were used. In all treatments, the dosage of Methyl parathion used was 0.5 lb. AI/acre.

See Fact Sheet 7150 for insecticides recommended for alfalfa weevil control.

Biological Control

Bathyplectes curculionis is the most important beneficial insect species which attacks the alfalfa weevil. This parasite of weevil larvae is well established in all alfalfa growing areas of Oklahoma. Rates of parasitism by this species have ranged from 20-40% in peak weevil populations over the past 5 years. Much higher rates of parasitism (85-90%) are common near the first cutting in late April and May. Consequently, this beneficial species may be responsible for destruction of most weevil larvae present in the first crop of alfalfa within 2-3 weeks of cutting (Figure 3). Careful timing and avoidance of unneeded insecticide applications, particularly near first cutting, are quite important for integration of chemical and biological components of the integrated control program.

Several natural threats to the effectiveness of B. curculionis have been identified. Among these are two species of hyperparasites (secondary parasites) which destroy B. curculionis larvae in their cocoons. Encapsulation and destruction of parasite eggs by blood cells of weevil larvae constitutes a second threat. However, research indicates that many parasites survive and that biological control

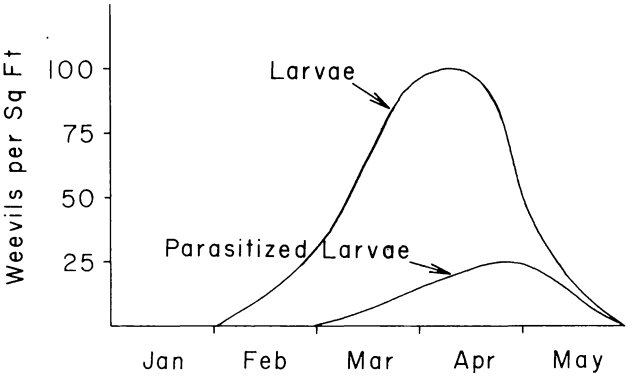
Table 3. Effects of increased spray volume for weevil control with aerial application.

	Weevil Larvae/sq. ft.		
Gallons/Acre	3 Days[a]	1 Week	2 Weeks
4.0	24	25	56
2.0	28	32	71
1.0	31	43	65
0.5	46	47	91
Untreated	90	114	296

(Dosage on all plots = 0.5 lb. AI/acre - Methyl parathion.

[a]Time interval after application.

Figure 3. - Parasitism of alfalfa weevil larvae in central Oklahoma by Bathyplectes curculionis.



(Values in this figure are averages for 1976-80.)

with B. curculionis will continue to be important in limiting weevil populations.

Summary

Four types of controls are being combined to implement an integrated program for limiting alfalfa weevil populations in Oklahoma. Overwintering weevil egg populations and subsequent damaging larval populations can be lowered considerably with winter grazing. Grazing dormant stands does not appear to have a serious impact in reducing parasitism by B. curculionis. Despite the fact that some overwintering parasites are killed due to trampling by livestock, average parasitism in grazed plots has been 41% vs. 34% in those areas not grazed.

Indications are that grazing may cause some yield reductions over the life of an alfalfa stand. However, lower weevil numbers and reduced costs for chemical controls may compensate for such yield reductions. In recent studies, cost of insecticide applications in grazed plots averaged about one-half those in ungrazed plots.

Tolerant alfalfa varieties play an important role in that they can withstand considerable weevil feeding and in combination with winter grazing should allow further decreases in control costs.

These alternate measures may play an important part in reducing the need for insecticides; however, chemical control is essential for prevention of serious losses when larval populations exceed 1.5-2.0 larvae/stem (40-50 larvae/sq. ft.).

The biological agent, B. curculionis, destroys most larvae which survive insecticide applications and regularly parasitized 80-90% of those larvae present during late April and May. The result of parasitism by B. curculionis is that fewer weevils survive to the adult stage and contribute to populations during the following year.