SPRAYING UNDER THE WINDROW FOR WEEVIL CONTROL

Carl A. Schoner, Vernon E. Burton and Robert F. Norris
Farm Advisor, Yolo County, Extension Entomologist, U.C. Davis,
and Associate Botanist, U.C. Davis

Destruction of alfalfa regrowth by Egyptian alfalfa weevil (EAW) larvae working under first cutting windrows depressed hay yields and allowed increased weedy grass growth in 1975 field tests. 1/ Elimination of weevil larvae by chemical sprays or by physical removal of the insects reduced damage to alfalfa regrowth and allowed normal yields of weed free hay. The encouraging results of these 1975 experiments prompted further weevil control investigations in the spring and summer of 1976. A swather mounted sprayer was used to control EAW under first cutting windrows in one experiment. Combinations of insecticide applications and physical removal of windrows were used in the second investigation.

Swather-sprayer Investigation

Farm Advisors and Entomologists working in Lassen and Siskiyou Counties demonstrated Alfalfa weevil (Hypera postica) control with swather mounted sprayers prior to 1975. Spraying a band of malathion on alfalfa stubble immediately under the swather crimper reduced damage to alfalfa regrowth caused by larvae of the Alfalfa weevil in their investigations.

To test the value of this control method on Egyptian alfalfa weevil (EAW) (Hypera brunneipennis) Button Enterprises of Winters, Yolo County, constructed a swather mounted sprayer for use in the spring of 1976. The equipment consisted of a 155 gallon steel tank mounted on a John Deere swather. The centrifugal sprayer pump was powered by the swather hydraulic drive system. Four flat fan nozzles were mounted just behind the cutter bar and directed to spray insecticide on alfalfa stubble in a four foot band immediately beneath the alfalfa windrow. The sprayer developed 20 pounds pressure/ sq. in. and delivered spray material at a rate of 20 gallons per sprayed acre. The total cost of the swather mounted sprayer was approximately $600.

The field chosen for the experiment had previously been sprayed with 8 oz./acre carbofuran AI (Active Ingredient) (Furadan ^{R}) for early weevil control. This March 13 aerial spray was effective and at harvest time a low level of 5.1 larvae and 0.2 weevil adults per sweep were present in the alfalfa. On April 23 the swather-sprayer was used to harvest alternate sprayed and unsprayed strips using malathion at a rate of 1.5 lbs. AI/ acre. On May 3, ten days after swathing, samples for insecticide residue analysis were taken by sampling cross sections of sprayed and unsprayed windrows. Two sets of samples were taken from each of six sprayed and six unsprayed plots. No weevil activity was noted in sprayed plots at the time of residue sampling. The field was cubed on the same day. On May 6, three days after cubing, alfalfa regrowth was three to five inches tall in sprayed plots while there was no regrowth in non-treated windrow areas. Paired plot yield samples were taken just prior to each succeeding alfalfa harvest by cutting standing alfalfa from the windrow areas in sprayed and unsprayed plots. Plant material was harvested with a hedge trimmer, each sample representing 1.0 M^2. Plant material consisted of only alfalfa in cuttings 2 and 3. By cutting four, yellow foxtail (pigeongrass or bristlegrass) (Setaria lutescens) began to appear in the harvested material and samples were hand separated before drying.

Table Comparison of dry matter yields of alfalfa lbs/acre) from sprayed and unsprayed windrow areas.

	Alfalfa Yield by Cutting and Treatment						
	Cutting					Total	% of
Treatment	2	3	4	5	Total	in Tons	Control
Sprayed Windrow	4,159	2,880	3,050	2,116	12,205	6.10	118
Unsprayed Windrow	3,358	2,670	2,624	1,656	10,308	5.15	100
LSD.05	263	NS	268	241	622	.31	

A number of factors are involved in alfalfa yield reductions from areas beneath swather windrows, however, the primary factor in this test appeared to be EAW damage to alfalfa regrowth following the first cutting. There was an 18% seasonal increase in alfalfa hay from the sprayed windrow areas as compared to unsprayed plots. (Table I.) Alfalfa yield increases were not as large as in 1975 tests. This may have been due to lower levels of alfalfa weevil larvae in this field at time of the 1976 first cutting.

Estimated Influence of Windrows on Yield and Economics of Alfalfa Hay Production

Total Yield Four Cuttings		
Sprayed Windrows	Unsprayed Windrows	Difference
6.10 tons/acre	5.15 tons/acre	.95 tons/acre

On the basis of a 2.5 ft. windrow laid down by a 14 ft. hay swather:

$\frac{2.5'}{14.0'}$ = 17.9% of the crop area under the windrow.

.179 x .95 tons = .17 tons of dry matter per acre.

.17 tons x $\frac{100}{90}$ = .19 tons of (90% dry matter) hay increase per crop acre when the alfalfa stubble was treated with insecticide at time of 1st cutting.

.19 ton x $70/ton = $13.30 increase (gross) from treatment.

The cost of insecticide was $4.25/acre. The price of the sprayer, extra power to run the equipment and extra down time to fill the swather mounted sprayer must be added to the insecticide cost. Even with these added costs it appears that spraying alfalfa stubble under the windrow at time of 1st alfalfa harvest would be a profitable venture.

Table III. Comparison of dry matter yields of weedy summer grass (lbs/acre) from sprayed and unsprayed windrow areas.

	Weed Yield by Cutting and Treatment			
	Cutting			
Treatment	4	5	Total	% of Control
Sprayed Windrow	178	169	347	34
Unsprayed Windrow	429	603	1,032	100
LSD.05	190	238	402	

In this test the unsprayed windrow area contributed three times more weed growth than similar windrow areas treated with insecticide at time of 1st cutting. (Table I.) The weed growth consisted mainly of yellow foxtail (Setaria lutescens) and barnyardgrass (watergrass) (Echinochloa crusgalli). These summer grasses are very undesirable in alfalfa hay and can contribute to a lower price per ton received by the hay grower.

Table III. Analyses of malathion residues from alfalfa hay windrows following stubble treatment by a swather-sprayer.

Treatment	Malathion residues in parts per million of dry alfalfa	
No spray (control) Cross section of windrow	.12	a
1.5# malathion (AI) Cross section of windrow	4.19	b
1.5# malathion (AI) Cross section of bottom half windrow	4.08	b

LSD.01 = 2.48 PPM

Residue samples taken from alfalfa windrows ten days following harvest and stubble treatment with swather-sprayer.

Established EPA tolerance for malathion residues in alfalfa hay ≤ 135 PPM

Malathion was applied to alfalfa stubble under the swather cutter bar and immediately ahead of alfalfa windrow placement on the stubble. The alfalfa itself was not sprayed with insecticide therefore residues presumably occur from harvested alfalfa coming into contact with the sprayed stubble. Malathion residues found were far below the official tolerance established by the Environmental Protection Agency (EPA). (Table III.)

Windrow Modification Studies

This trial is similar to a test reported at the 1975 California Alfalfa Symposium. Its objective was to determine how modification of 1st and 2nd cutting swather windrows might affect alfalfa yields, and subsequent summer grass infestations beneath the windrow area. A four year old stand of Lahontan on the Wirth Ranch near Woodland was selected for the test. Early insecticide treatments for weevil control were only partially effective, and an average of 28 EAW larvae per sweep were still present at time of 1st harvest. Treatments were hand applied to sections of alfalfa windrows as follows:

1. Insecticide sprayed on stubble beneath the alfalfa windrow at 1st cutting. 1.5 lbs./acre malathion AI.
2. Insecticide sprayed on stubble beneath the alfalfa windrow at 1st cutting. 3.75 lbs./acre malathion AI.
3. Windrow removed immediately after swathing (1st cutting only).
4. Windrow removed 30 hours after swathing (1st cutting only).
5. Windrow removed immediately after swathing (1st and 2nd cuttings).
6. Check - Regular grower schedule. Alfalfa windrows left in place until baling.

(Windrows removed were taken entirely out of the check to an adjacent area.)

Just prior to the second and subsequent cuttings, yield samples were harvested from standing alfalfa in the 30 inch band representing the 1st cutting windrow area. Samples were dried and weighed to obtain yield estimations. Samples from the second and third cuttings consisted of alfalfa, by the fourth cutting yellow foxtail and barnyardgrass appeared in yield samples. Fourth and fifth cutting samples were hand separated into alfalfa and grass and each sample dried and weighed separately.

Table IV. Dry matter yields of alfalfa (lbs/acre) from beneath swather windrows as affected by windrow treatment at first and second cutting.

	Alfalfa Yield by Cutting and Treatment						
	Cutting						
Treatment	2	3	4	5	Total	% of Check	
Malathion (3.75 lb./acre	2,722	3,340	3,530	,581	,173	10	a
Immediate removal (1st & 2nd cutting)	2,745	3,066	3,387	,652	10,850	107	b
Malathion (1.5 lb./acre)	2,983	3,197	3,233	,379	10,792	106	b
Immediate removal (1st cutting only	2,650	3,007	3,114	,414	10,185	100	b
No treatment (check)	2,555	2,912	3,304	,391	10,162	100	b
30 hour removal (1st cutting)	2,520	2,745	3,138	391	9,794	96	b
LSD.05	333	345	NS	NS	975		

Alfalfa yields were similar to the 1975 experiments, however, in 1976 the only treatment giving a significant seasonal yield increase was 3.75 lbs./acre of malathion sprayed under the windrow at 1st cutting (Table IV.) Malathion at 1.5 lbs./acre gave statistically significant yield increases at the second cutting but this did not persist over the entire season. Immediate removal of the windrow at time of first cutting did not cause increased yields of the magnitude accorded in the previous year.

A number of factors were probably involved in alfalfa yield reductions from the area beneath the swather windrow. These include insect damage, disease damage and stunting of alfalfa regrowth due to shade effect of the windrow. However, weevil damage to regrowth following the first cutting appeared to be the primary factor affecting yields in this test.

Table V. Dry matter yields of weedy summer grass (lbs./acre) from beneath swather windrows as affected by windrow treatment at first and second cuttings.

	Weed Yield by Cutting and Treatment			
	Cutting			
Treatment	4	5	Total	% of Check
30 hour removal (1st cutting)	181	440	62	65
Malathion (1.5 lb/acre)	173	499	672	
Immediate removal (1st & 2nd cutting)	220	582	802	84
Malathion (3.75 lb/acre)	219	589	808	85
No treatment (check)	260	689	949	100
Immediate removal (1st cutting only)	217	796	1,013	107
LSD.05	NS	NS	NS	

Weed yields were variable and did not show statistically significant differences in the 1976 test (Table V). In 1975, controlling Egyptian alfalfa weevil larvae at 1st cutting did reduce weeds in subsequent cuttings; the trend in the 1976 yields are, however, similar.

Discussion:

From the standpoint of climate and insect populations, 1976 was an unusual year. Yolo County received only 40% of average winter rainfall and summer irrigation water supplies were inadequate to meet normal water requirements of alfalfa raised for hay. Delayed and/or inadequate summer irrigations resulted in alfalfa hay yields somewhat lower than average and weedy summer grass infestations were less serious than in previous years. Egyptian alfalfa weevil infestations were generally below those of previous years and most infestations were adequately controlled with early aerial applications of insecticide. As a result of these climatic factors, test result differences were not as dramatic as in 1976. However, spraying of alfalfa stubble for weevil control at time of 1st cutting in 1976 did increase alfalfa yields and decrease weeds in windrow areas of the tests. The swather-sprayer method of controlling EAW larvae under 1st cutting windrows shows promise in reducing the damage to alfalfa regrowth by this insect. And since the best and most efficient weed control program is a dense and vigorously growing stand of alfalfa the elimination of insect damage can help decrease amounts of weedy summer grasses in alfalfa hay.

Researchers in other states have studied alfalfa weevil (Hypera postica) damage to alfalfa following first cutting and have measured second cutting yield reductions similar to ours. Gary W. Fick of Cornell 2/ studied the effect of high alfalfa weevil populations on alfalfa stubble and found up to 34% reductions in alfalfa dry matter 40 days following the first cutting. He discovered that most damage to regrowth occurred in the first two or three days after cutting. High populations of larvae feeding on alfalfa stubble after cutting consumed all remaining leaves and then destroyed new buds that should have formed the second cutting. Fick suggests that if larval populations are high at time of first cutting it is important to spray as soon after harvest as possible.

We do not have information relating larval levels in the field to second cutting hay yield reductions, however in 1975 and 1976 larval levels from 5 to 13 per sweep decreased second cutting alfalfa yields.

Using a swather-sprayer to reduce larval populations of the EAW beneath first cutting windrows may have several advantages:

1. Increased yield of second cutting alfalfa by reducing damage to regrowth under the windrow area.
2. More vigorous growth of alfalfa in the windrow area may lead to fewer grassy weeds in late cuttings of hay.
3. Cutting and applying insecticide under the windrow can be done in one operation, thus minimizing application costs and wheel traffic in the field.
4. Since only 30% of the field is sprayed, less insecticide is used, cost is minimized and there should be less damage to beneficial insects.

CAUTIONS -- This is not a recommendation for the use of insecticide applied to alfalfa stubble during first cutting because:

While malathion is registered for use on alfalfa hay and residue analyses indicate that swather-sprayer applied malathion residues are well below the established tolerances on alfalfa, this method is still not registered for use in California. Thus, swather-sprayer applications of malathion are illegal at this time.

2. Spraying alfalfa stubble beneath first cutting windrows is not a substitute for early Egyptian alfalfa weevil control in the central valleys of California Rather it represents a potentially practical method of reducing infestations of EAW occurring in alfalfa at time of first cutting.

3. Control of weevils under first cutting windrows may not always be necessary. If early insecticide applications gave excellent control of weevil larvae there might not be enough insects in the field to justify spraying at cutting time.

Acknowledgements

Cooperation of the following persons is gratefully acknowledged, without thei contributions much of this work would not have been possible.

Tony Turkovich and Robert Button, Jr. of Button Enterprises, Inc., Winters, Ca. (Swather-sprayer studies)
Phillip and W. K. Wirth of Woodland, Ca. (Windrow Modification Studies)
Lorry Dunning, Extension Staff Research Associate; Carl Rimbey, Farm Advisor, Lassen County and Roger Benton, Farm Advisor, Siskiyou County. The unpublished materials on controlling alfalfa weevil with swather mounted sprayers.
Charles Langston and Renzo Lardelli - for technical assistance throughout this work.
J. E. Swift - for arranging residue analyses.
T. E. Archer - for conducting residue analyses.

References Cited

1/ Schoner, C. A., R. F. Norris. 1975. Windrow Effects on Weevils and Weeds. Proc. Fifth California Alfalfa Symposium pp. 41-48.

2/ Fick, G. W. 1976. Alfalfa Weevil Effects on Regrowth of Alfalfa. Agronomy Journal Vol. 68.809-812.

To simplify information, when trade names of products have been used, no endorsement of products named is intended, nor criticism implied of products which are not mentioned.