WEED AND WEEVIL CONTROL IN ALFALFA - SOME ECONOMIC CONSIDERATIONS

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Introduction

Making money is the name of the game! Increased production, either as yield or quality, is of little value to the grower, or indirectly to the consumer, if the increased costs of production are higher than the value of the yield increase. Few production techniques can be justified on any other basis than profit when viewed in the long run.

Weed and weevil control is no exception, but accurate data on the cost/benefits of such treatments are hard to find. They also require a great deal of time and effort to produce. This paper presents some recently developed information on such cost/benefits of weed and weevil control treatments. Although the conclusions reached currently seem valid, it is possible that future testing may necessitate their modification.

Materials and Methods

All experiments were conducted in fields of established alfalfa in commercial production. All management practices were those employed by the cooperator, except for the weed or weevil control treatments. The term weevil refers to the Egyptian alfalfa weevil - *Hypera brunneipennis* (Boh).

Herbicides used for weed control were 1.25 lb.a.i./A (1 quart) of dinoseb (Dow General^{R}) plus from 30 to 50 gal/A of weed oil in a total spray volume of 100 gal/A (cost $10.00 to $12.00 per acre); diuron (Karmex^{R}) was used at 2.4 lb.a.i./A (cost $10.50), and GS-14254 (Sumitol^{R}) at 2.0 lb.a.i./A (cost $8.50). Insecticides used were azinphosmethyl (Guthion^{R}) at 0.5 lb.a.i./A, or carbofuran (Furadan^{R}) at 0.5 lb.a.i./A (cost $6.50). Flaming was by propane burner with a 12 ft wide swath from a boom composed of J 12 Manchester burners (cost $7.00 to $10.00). All costs of control treatments include approximate application costs.

Yield data are expressed as tons per acre at zero moisture, except those obtained for cubes when field cured weight was used. Data presented for tons per acre of alfalfa and weeds were obtained by hand separation of small plot samples. No attempt has been made to allow for variations in roadsiding costs, or other variables brought about by altered yields. Sliding scales, based on percent weeds and percent alfalfa, or percent protein, have been used to estimate the value of the hay; the scales used are indicated with the data.

Results and Discussion

First cutting economics.

Weevil control from oil/dinitro in the spring of 1972 was fair (Table 1a) to poor (Table 2a). These low control figures were representative of two other trails. These levels of control were lower than the previous two years, and no good explanation can be offered at present. Flaming provided generally low levels of weevil control in several trails; the data in table 2a are typical. The flaming was done relatively late (Feb. 14, 1972) in all trials; this could have accounted for the low level of control.

Weed control from oil/dinitro treatments was uniformly excellent with only a few of the larger grass weed species not killed (Table 1a and 2a). Flaming suppressed weeds substantially, but the long term control was only fair (Table 2b). The late date of flaming probably contributed to the low levels of weed control.

The combination treatments of herbicides for weed control and insecticides for weevil control were highly effective, regardless of the material used (Table 1a, 2a and 2b). Diuron, however, did not control groundsel (*Senecio vulgaris* L.) in several tests.

The above discussions describe the effects of the weed and weevil control treatments in reference to their effects on the target species. Such discussions, which have been

typical of much past work, do not answer the question as to whether the treatments would have been economically profitable. Yield data have been obtained from several trials, and estimates of the hay value made, so that relative figures for the economics of the treatments could be established.

Table 1a. Effect of herbicides and/or carbofuran treatments on weevil control, and alfalfa or weed yield - U.C.Davis

Treatment	Application date	Weevil larvae per sweep 3/18	3/25	Yield, tons/A-4/1/72 Alfalfa	Weeds
Untreated check	-	98.4	65.6	0.68	0.16
Carbofuran	3/11	5.6	5.1	0.93	0.22
GS-14254	1/11	124.4	77.2	0.83	0.00
GS-14254 + carbofuran	1/11 & 3/11	8.3	6.6	1.14	0.00
Oil/dinitro	1/12	53.5	53.5	1.13	0.00
Oil/dinitro + carbofuran	1/12 & 3/11	3.6	2.6	1.20	0.00

Table 1b. Economic evaluations of alfalfa hay following treatments for weed and or weevil control. - U.C.Davis

Treatment	Hay value* $/ton	Gross return	Value increase	Profit
Untreated check	28.00	24.60	-	-
Carbofuran	29.00	34.00	9.40	2.90
GS-14254	35.00	29.00	4.40	-4.10
GS-14254 plus carbofuran	35.00	39.90	15.30	0.30
Oil/dinitro	35.00	39.60	15.00	4.50
Oil/dinitro plus carbofuran	35.00	42.00	17.40	0.40

*Assigned on basis of $35/ton for pure alfalfa, and $28/ton for hay with 20% weeds (predominantly groundsel and shepherds purse).

The easiest approach to the economics of winter weed and weevil control is to take the value of the first spring cutting. The data presented in table 1b show the results of one trial at U.C. Davis in 1972. On the basis of these data the best treatment, judged as net profit from a single cutting, (which has been the traditional way to assess the value of a treatment), was weed oil/dinitro applied in January. The weed population in this field was not high, and a single carbofuran treatment also provided a net profit. Weed control alone lost money; the weevils ate the profit. The combination of GS-14254 and carbofuran provided a high yield of alfalfa, but the higher cost of this treatment reduced the amount of profit. Oil/dinitro plus carbofuran gave the highest yield, but the yield increase over oil/dinitro alone was not sufficient to pay for the insecticide treatment. Oil/dinitro alone would probably have required an insecticide treatment after the first cutting to control the carry-over weevil population; such an extra treatment would have changed the relative economics in favour of one of the other treatments. Long term effects of weevil attacks will be investigated in the future.

Data presented at the 1971 California Alfalfa Production Symposium (1) showed that a difference of two weeks in the time of cutting resulted in substantial changes in the net profit. Data presented in Table 2c show the effect of cutting date on net profit during the spring of 1972. No treatment made money based on a single cutting! The relative size of the net losses varied with time of cutting. The loss from GS-14254 applied without insect control increased with time; the weevils ate more at longer times. Economics of azinphosmethyl improved with time, as expected. Flaming and oil/dinitro losses decreased with time. The economics of treatments in this field must be judged in the light of the soil becoming very dry by mid March. Alfalfa growth was very slow after that time, which resulted in reduction in differences due to weed/weevil control treatments. As discussed above, these figures based on a single cutting may not be reflecting the long-term economics of the treatments.

Table 2a. Effect of weed and weevil control treatments in Egyptian alfalfa weevil populations. - U.C.D.

Treatment	Application date	Weevil larvae/sweep 3/8	3/16	3/23	3/29
Untreated check	-	51	139	220	162
GS-14254	12/28/71	47	129	158	132
Azinphosmethyl	3/10/72	38	5	4	3
GS-14254 + azinphosmethyl		58	5	5	2
Flame plus azinphosmethyl	2/14/72	43	5	5	5
Oil/dinitro plus azinphosmethyl	2/3/72	50	2	3	9

Table 2b. Effect of weed and/or weevil control treatments on alfalfa and weed yield. - U.C.D.

Treatment	Yield-tons per acre Weeds 3/17	alfalfa 3/17	Weeds 3/25	alfalfa 3/25	Weeds 4/3	alfalfa 4/3
Untreated check	0.40	0.67	0.37	0.89	0.51	0.62
GS-14254	0.00	0.89	0.00	1.12	0.00	0.82
Azinphosmethyl	0.29	0.79	0.35	1.04	0.23	0.77
GS-14254 plus azinphosmethyl	0.00	0.90	0.00	1.22	0.00	0.96
Flame plus azinphosmethyl	0.10	0.66	0.15	0.84	0.24	0.88
Oil/dinitro plus azinphosmethyl	0.00	0.77	0.00	1.18	0.00	0.97

Table 2c. Economic evaluations of weed and weevil control treatments - U.C.D.

Treatment	Hay value - $ per acre* 3/17 Value	3/17 Net	3/25 Value	3/25 Net	4/3 Value	4/3 Net
Untreated check	25.90		34.00		27.40	
GS-14254	31.20	-2.20	39.30	-3.20	28.70	-7.20
Azinphosmethyl	30.50	-1.10	37.80	-1.70	32.50	-0.40
GS-14284 plus azinphosmethyl	31.50	-8.40	42.00	-6.00	33.60	-7.80
Flame plus azinphosmethyl	24.90	-15.00	31.00	-17.00	32.80	-11.10
Oil/dinitro plus azinphosmethyl	27.00	-12.90	41.70	-6.30	33.80	-7.60

*Assigned on the basis of $35.00/ton for weed free hay, $28.00/ton for hay with 25% weeds, and $22.00/ton for hay with 50% weeds.

Season-long economics.

One and one quarter acre plots were established near Woodland in 1971. The 1971 season yield and economics data were presented earlier (1). The plots were retreated with the same treatments in 1972, and season-long harvest data obtained again (Tables 3a and 3b). Winter weed control resulting from diuron or GS-14254 treatments was almost complete; speedwell (*Veronica buxbaumii* Tenore) was not controlled by diuron, and yellow oxalis (*Oxalis corniculata* L.) was not controlled by GS-14254. Oil/dinitro provided excellent broadleaved weed control and substantially reduced the grass species; flaming gave only partial control of weeds. Weevil populations became sufficiently high in all treatments that the whole field was sprayed with azinphosmethyl.

Table 3a. Effect of winter weed control treatments on seasonal alfalfa yield. - Woodland 1972.

Treatment	Yield - tons/A 4/22	5/23	6/24	7/26	8/28	10/3	Total
Check	0.73	0.93	1.05	1.01	1.20	0.76	5.68
Diuron	0.54	1.02	1.33	1.28	1.27	0.65	6.09
GS-14254	0.69	1.02	1.28	1.21	1.28	0.64	6.12
Oil/dinitro	0.76	1.01	1.21	1.22	1.30	0.59	6.09
Flame	0.74	1.02	1.12	1.20	1.29	0.63	5.00

Table 3b. Estimated season-long economics of winter weed control treatments in alfalfa hay. - Woodland, 1972.

Treatment	Hay value - $/acre 4/22	5/23	6/24	7/26	8/28	10/3	Total	Net
Check	21.20	27.90	35.50	32.30	36.00	19.00	171.90	-
Diuron	18.90	32.60	42.50	41.00	37.10	19.50	192.60	10.20
GS-14254	23.50	32.60	41.00	38.70	37.40	19.20	192.40	12.00
Oil/dinitro	24.30	31.30	37.50	37.80	39.00	17.10	187.00	4.10
Flame	22.90	31.60	34.70	37.30	38.70	18.20	183.40	2.00

All treatments, including check, treated with azinphosmethyl.
Clean hay valued at $35.00/ton at 4/22, $32.00/ton for 5/23, 6/24 and 7/26, and at $30.00/ton for 8/28 and 10/3.

No treatment made a profit at the first cutting (Table 3b). The increased quality only partially offset the decrease in total yield resulting from removal of weeds. Judging solely on the basis of first cutting none of these treatments would have been considered worth using. At the second cutting, however, all treated plots outyielded the untreated check plots, and third cutting differences were even larger. At the 6/24 harvest the cost of the GS-14254 and diuron treatments had been recovered. At this harvest date, also, all traces of winter weeds were dead and the increased yield at the 7/26 and 8/28 harvest reflected only the better stand and vigor resulting from the earlier weed control. The untreated plots produced the highest yield on 10/3, but this increase reflected yield of yellow foxtail (*Setaria glauca* (L.) Beauv.) which was considerably suppressed by the more vigorous alfalfa growth in the treated plots. The data for economics (Table 3b) showed that by the end of the season all treatments had made a profit. The two soil acting herbicides gave the best overall economics.

When the overall economics for the 1971 and 1972 seasons are combined flaming still provided the highest profit of $8.50 per acre per year; GS-14254 provided $6.50 per year; oil/dinitro $3.30 per year, and diuron lost an average of $1.25 per year due to almost complete lack of effect in 1971. The economics for GS-14254 are probably low due to the loss incurred in 1971 due to uncontrolled weevil attack (1).

These data show clearly that the effects of treatments applied during the winter persist a great deal longer than the first cutting. They also show that the effects in the second year of treatment were larger than in the first year.

The weed spectrum at the Woodland trail, as noted previously (1), included heavy stands of an atypical weed. A trial was established near Davis in January 1972 to investigate season-long effects from control of a more typical winter weed population, including annual bluegrass (*Poa annua* L.), foxtail barley (*Hordeum murinum* L.), canary grass (*Phalaris minor* Retz), groundsel, chickweed (*Stellaria media* L.) and other species. GS-14254 controlled all species completely, resulting in a 'clean' stand of alfalfa. The only weed to escape was scattered plants of milk thistle (*Silybum marianum* Gaertn). Diuron controlled most species adequately, except for complete lack of effect on groundsel. Oil/dinitro controlled the broadleaved species but only retarded the grasses; flaming was only partially successful, with at least some of all species remaining. Weevils were

supressed somewhat by oil/dinitro and flaming, but not enough to eliminate treatment with azinphosmethyl, which was applied to all plots.

Table 4a. Yield and quality of alfalfa following winter weed control treatments. - Davis 1972.

Treatment	Yield - tons per acre			% protein		
	4/14	5/18	6/21	4/14	5/18	6/21
Check	0.77	0.91	1.07	20.8	24.7	21.2
Diuron	0.69	0.93	1.05	20.8	25.0	21.2
GS-14254	0.66	1.01	1.20	24.7	25.5	20.8
Oil/dinitro	0.68	0.92	1.09	23.0	25.4	21.0
Flame	0.64	0.90	1.02	24.2	23.5	21.0

Table 4b. Estimated economics of alfalfa production following winter weed control treatments. - Davis 1972.

Treatment	Hay value - $ per acre				
	4/14	5/18	6/21	Total**	Net
Check*	19.20	27.80	34.30	81.20	-
Diuron*	21.40	29.80	33.60	84.80	-6.90
GS-14254*	23.10	32.20	38.00	93.30	3.60
Oil/dinitro*	22.80	29.40	34.80	87.00	-5.20
Flame*	21.80	27.00	32.60	81.40	-6.80

* All plots treated with azinphosmethyl.
** Total for first three cuttings.
Hay value judged on weeds present and % protein; $35.00/ton allowed for first cutting pure alfalfa, $32.00/ton for later cuttings.

First cutting yields were reduced by successful weed control treatments (Table 4a), but quality was much improved. Similar to the Woodland trial the net result at the first cutting was all treatments made a loss (Table 4b). At the second (5/18) and third cutting (6/21) the GS-14254 treated plots outyielded all other plots. This could only be attributed to the excellent winter weed control. These increases in yield were sufficient to realize a substantial profit for GS-14254 by the end of the third cutting (Table 4b). Continued yield increases were anticipated, but irrigation problems due to loss of Clear Lake water in July precluded obtaining further data.

The information presented here shows that effective winter treatments can influence yield and quality for several cuttings. The statement therefore seems justified to the effect that economic considerations for weed, and probably weevil control treatments should be based on several cuttings, probably the whole season, and possibly even on the life of the stand.

Summary

Weed and weevil control treatments must increase alfalfa yield and/or quality sufficiently to provide a net profit. The timing of the first cutting can alter the cost to profit relationship. The situation in individual fields will probably have to be judged on local variables such as weather, soil type, severity of weed population and weevil attack, stand, etc. Delayed cutting in some situations can result in substantially increased profit, but in other situations a relatively early cutting can minimize losses due to weed competition or weevil attack. Maximum yield does not necessarily mean maximum profit!

The economics of winter and early spring treatments must be evaluated over the whole growing season. Evidence is presented that shows that the largest yield effects of winter weed control are recorded at the second through the fourth cutting. Weevil control treat-

ments must also be judged in terms of second, and possibly third, cutting yields, as early weevil attacks can reduce alfalfa vigor.

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Reference

1. Norris, Robert F. Integrating weed and weevil control programs. Calif. Alfalfa Prod Symp. Dec. 1971. pp. 44-51.