MANAGEMENT TECHNIQUES FOR WEED CONTROL IN ALFALFA

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Poor irrigation management and improper harvest schedules probably account for most of the weed problems in alfalfa, Marble (1974). In addition to these two chief causes of weediness in alfalfa, we may add other factors which involve management decisions or action such as choice of land, seedbed preparation, use of high quality seed, planting, and a wise timing of most cultural practices.

Choice of Land

Alfalfa is best adapted to medium textured soils with good internal drainage and low or no salinity problems. Medium or slightly basic pH favors the development and growth of alfalfa and the bacteria which fix nitrogen on the roots. Factors which favor good alfalfa growth will tend to minimize weed problems simply because they make alfalfa more capable of suppressing weeds by sheer crop competition.

Land should also be chosen which is irrigable with a minimum tendency for water accumulation when the crop is irrigated. If possible, the land should be leveled so there are no depressions to collect and retain water, Lehman and Erwin (1974). Alfalfa stands decline rapidly if water collects around the crowns of plants and remains there over prolonged periods, Erwin and Lehman (1974). Furthermore, when alfalfa stands decline, weeds move in and become so competitive that alfalfa production becomes unprofitable.

A third consideration for choice of land is to avoid those fields which have a bad weed history, especially if the weeds are the kinds which have a competitive advantage over alfalfa either in stand establishment or in the established crop. Seeding alfalfa into fields heavily infested with such perennial weeds as bermudagrass, Johnsongrass, or field bindweed is sure to detract from productivity of the alfalfa especially if planted in the late spring of the year. Land infested with seeds of fast-growing weeds is also to be avoided since alfalfa plants are small and slow-growing in the seedling stage.

Seedbed Preparation

Any land preparation measure which favors good alfalfa growth will minimize weed problems throughout the life of the stand. If the land has a severe weed history, this should be taken into account and steps be taken to reduce weed pressures on the new seeding. Perennial broadleaf and grassy weeds should be pre-treated and eliminated with effective translocated herbicides that present no residue problems for the alfalfa. Annual weeds can be reduced by intermittent pre-irrigations and cultivations before the final seedbed preparation. Land should be leveled to take out low spots where water will accumulate and cause alfalfa stand losses. The final seedbed preparation should provide a fine, firm, and moist seedbed into which alfalfa can be seeded at a uniformly shallow depth to insure rapid germination and emergence. A uniformly dense alfalfa stand is a good competitor with weeds if growing conditions are right for the alfalfa.

Fertilizers for new seedings of alfalfa should generally be applied during the seedbed preparation period. Usually, phosphorus is applied prior to disking. Sometimes complete fertilizers are applied and do enhance early alfalfa growth but nitrogen applications above minimal rates of 25 to 30 pounds of N per acre are not considered advisable for they tend to promote excessive weedy growth, especially grasses.

Seeding and Seeding Rates

There are approximately 210,000 seeds in a pound of alfalfa seeds. Mature alfalfa seeds are about 2.5 X 1.5 X 1.1 mm in length, width, and thickness, Gunn (1972). As an assurance for good emergence and good stand establishment, the small seeds of alfalfa should not be planted deeper then 1/2 to 1 1/2 inches, depending on soil type and conditions. The greater depths are for sandy soils or soils which do not crust or which have a tendency to dry out during the germination period. In no case should seed be planted deeper than is necessary to insure a good stand. The good stand is essential to hedge against weed establishment.

Seeding rates affect stand establishment but not necessarily yields or stand persistence. McClellan (1975) found that at the end of the first season, there were no differences in plant populations or yields of alfalfa seeded at 14.4, 24.6, or 33.0 lbs. of seed per acre. The higher seeding rates may provide somewhat better crop competition with weeds in the course of stand establishment, but generally 15 lbs. of seed per acre is adequate if the seedbed is properly prepared and good planting techniques are employed. Fifteen pounds of seed per acre would provide in excess of 72 alfalfa seeds per square foot or 1 plant in each 2 square inches if they all germinated.

Plant High Quality Seed

Discolored or off-colored seed is usually of poor germinability or if it germinates, it produces seedlings poor in vigor. Weeds are permitted to establish because of failure of alfalfa plants to grow and dominate. Cleanliness of seeds is of even greater importance because poor vigor and germination can be somewhat corrected for by seeding at higher rates whereas contaminated seed lots only add to the weed problem. Alfalfa seeds infested with dodder seeds have been the major source of spread of this insidious weed. Some grassy weeds are virtually impossible to separate from alfalfa seeds, consequently the best insurance against creating a weed problem is to plant weed-free seeds of known quality.

Time of Planting

Alfalfa seeds will germinate at lower temperatures than most summer annual weeds. We have observed that alfalfa seeds will germinate and seedlings will become established when soil surface temperatures approach freezing in the early mornings but daytime temperatures rise to 60°F or 70°F. Furthermore, alfalfa seedlings tend to survive frosts rather well after the first trifoliolate leaf is established. Using this as a base of operation, it is best to plant alfalfa in the fall of the year or very early spring to avoid excessive weed competition. If winter weeds do appear to be a threat, they can be controlled adequately by postemergence herbicides. Fall and early spring plantings also provide the advantages of more effective management of irrigations for germination and stand establishment and the slower growth of weed competition while alfalfa is becoming established.

Tillage and Cropping Practices

Avoidance or escape from weed problems in alfalfa can be achieved through the use of good tillage and cropping practices. These practices must begin before the alfalfa is planted and continue throughout the rotation cycle. Sometimes "smother" crops are used to minimize perennial weed infestations before planting alfalfa. Herbicides can substitute for mechanical fallow in the control of troublesome weeds. The use of proper crop rotations or cropping sequences assists in freeing the land of weeds which could be a problem in alfalfa. Different crops are usually associated with specific weed problems and have their own array of safe herbicides. These herbicides each control certain weed species, thus crop rotation affords a means of getting at different weedy problems and provides a way to minimize certain weed problems in alfalfa. Peters and Peters (1972).

Irrigation Management

Irrigation management is extremely critical both as to times of application, amounts, and duration. As a direct result of poor irrigation management, alfalfa stand losses occur and weeds invade. Erwin and Lehman (1974) showed that alfalfa plants died after remaining in saturated soils longer than 24 hours. They also found that mowing alfalfa plants just before an irrigation resulted in more plants dying from over irrigation than if they irrigated first and harvested later. These findings imply that irrigations should be of short duration permitting the soil to drain to field capacity or below in less than a 24-hour period. Furthermore, in order to maintain a good alfalfa stand, irrigations should be made on growing alfalfa just before harvests instead of just after harvests.

Another factor to consider in this relationship of harvesting and irrigations is that irrigating freshly harvested fields provides a perfect situation for weeds to develop. The soil surface is wetted and sustained at sufficiently high moisture for weed seeds to germinate. At the same time, sunlight reaches the exposed surfaces between plants and weed seeds that require light and moisture to grow are favored. Alfalfa plants are slower to start regrowth and some may have died as a result of the irrigation after cutting, consequently, weeds move in where the alfalfa stand becomes weaker.

Field Compaction

Many alfalfa stands decline and weeds replace alfalfa plants because the alfalfa is abused through excessive field traffic at harvest time or during the dormant season. Harvest equipment wheels run over as much as 75 percent of the surface area of hay fields during each harvest, Sheesley et al.(1974). Repeated harvests or repeated compaction in the same areas has a substantial adverse effect on alfalfa growth and stand survival. Sheesley et al. (1974) also found that much of the initial alfalfa stand loss occurred as a result of wheel traffic in the first and second harvests of new alfalfa fields. They concluded that where unimpeded soils permit good alfalfa root development, alfalfa roots on newly established stands should be well developed into the 1 1/2 to 2-foot depths of the soil before the first harvest is made. This would reduce stand losses thus minimizing prospects for weed invasion into newly established stands.

Cutting Management

The vigor of alfalfa plants is minimal soon after the forage is harvested. Plants begin to mobilize and transport root reserves to produce new top growth and it is not until plants reach about 1/10 bloom that root reserves have been restored to the original level. As a consequence, cutting interval has a decided impact on stand persistence of alfalfa as shown in Tables 1 and 3. Stand persistence, in turn, affects the rate of weed invasion of alfalfa fields as shown in Table 2. Alfalfa varieties, because of their different growth characteristics must be harvested differently in order to maintain adequate stands.

Differences between varietal responses for the different cutting intervals between the two locations as shown in Tables 1 and 3 may be, in part, explained by different management practices at Davis and Riverside. At Davis, plots were flood irrigated and no herbicides were used for weed control. At Riverside, plots were sprinkler irrigated and soil persistent herbicides were used to control most weeds. Those varieties most adversely affected by frequent harvests were probably also more adversely affected by weed competition at Davis than at Riverside. In the 4th year of production at Riverside, however, weeds tolerant of Diuron and Trifluralin did invade thinned alfalfa stands in the 3 and 4-week cutting-interval-plots but not in plots where harvest interval was greater than 4 weeks.

Most varieties of alfalfa require at least 4 weeks or more after a harvest to reach 1/10 bloom; dormant varieties may take a week or two longer even during hot weather. When weather is cool in the spring and fall, six weeks or more may be required from harvest to

1/10 bloom for non-dormant varieties and longer for dormant varieties. Harvesting alfalfa before 1/10 bloom depletes root reserves on most varieties and repeated harvests accentuate the problem. Therefore, cutting interval should be adjusted to fit the variety and temperatures to avoid loss of stand from poor plant root reserves. If stands are maintained strong and healthy, weeds have difficulty competing with well managed alfalfa.

Literature Cited

Erwin, D. C. and W. F. Lehman. 1974. Summer Stand Depletion of Alfalfa In the Low Desert Valleys of Southern California. Proc. California and Arizona Low Desert Alfalfa Symposium. pp. 58-64.

Gunn, C. R. 1972. Seed Characteristics. In: Alfalfa Science and Technology. Amer Soc. Agron. Monograph Series No. 15. pp. 677-687.

Lehman, W. F. and D. C. Erwin. 1974. The Use of Land Leveling, Irrigation, and Varieties In the Reduction of Summer Stand Decline of Alfalfa In Desert Areas. Proc. California and Arizona Low Desert Alfalfa Symposium. pp. 49-57.

Marble, V. L. 1974. Optimizing Alfalfa Production In Desert Areas of The Southwestern United States. Proc. California and Arizona Low Desert Alfalfa Symposium. pp. 75-91.

McClellan, W. D. 1975. Alfalfa: Effects of Seeding Rates and Rhizobium Inoculations. Calif. Agr. 29:13.

Peters, E. J. and R. A. Peters. 1972. Weeds and Weed Control. In: Alfalfa Science and Technology. Amer. Soc. Agron. Monograph Series No. 15. pp. 555-573.

Sheesley, R., D. W. Grimes, W. D. McClellan, C. G. Summers, and V. Marble. 1974. Influence of Wheel Traffic on Yield and Stand Longevity of Alfalfa. Calif. Agr. 28:6-7.

TABLE 1

EFFECT OF CUTTING INTERVAL ON STAND PERSISTENCE
OF ALFALFA VARIETIES AT U.C. DAVIS

Alfalfa Variety	Persistence Ratings for Different Cutting Intervals 1/						Variety Means	Mean Separations* 5% & 1% Levels
	3	4	5	6	MO 69	DK 131		
UC Salton	6.6	6.2	3.6	3.2	3.6	3.2	4.4	D
Moapa 69	4.6	5.0	2.8	2.6	2.8	2.6	3.4	C
WL 512	4.4	4.4	2.4	2.2	1.6	2.2	2.87	B
N-78	5.6	6.4	3.2	2.8	3.6	2.8	4.07	D
WL 318	3.6	3.2	2.2	2.2	2.8	2.4	2.80	B
Lahontan	3.4	3.0	1.2	1.6	1.8	1.4	2.07	A
DeKalb 131	5.8	5.2	3.8	3.8	4.6	3.0	4.37	D
Dawson	5.2	6.0	3.4	3.4	4.0	3.2	4.20	D
Cutting Interval Means	4.90	4.93	2.83	2.78	3.10	2.60		
Mean Separations* Both 5% & 1% Levels	B	B	A	A	A	A		

L.S.D. for Variety X Cutting Interval 5% = 0.77
1% = 1.06

1/ Cutting intervals are equal to 3, 4, 5, and 6-week intervals, plus MO 69 = 1/10 bloom for Moapa 69 and DK 131 = 1/10 bloom for WL 318 and DeKalb 131. Tabular values are visual estimates of alfalfa stands based on a 1 to 9 scale where 1 is a perfect stand and 9 is no stand. Ratings were made October 1977 at the end of the 3rd production year.

* Any two means not accompanied by the same letter are significantly different at both the 5% and 1% levels of confidence.

TABLE 2

EFFECT OF CUTTING INTERVAL ON CONTROL OF WEEDS
IN ALFALFA VARIETIES GROWN AT U.C. DAVIS

Alfalfa Variety	Cutting Interval 1/						Variety Means	Mean Separations* 5% & 1% Levels
	3	4	5	6	MO 69	DK 131		
UC Salton	5.6	1.8	1.0	1.0	1.4	1.0	1.97	AB
Moapa 69	4.6	1.6	1.0	1.0	1.2	1.0	1.73	A
WL 512	4.2	1.8	1.0	1.0	1.0	1.0	1.67	A
N-78	6.2	4.4	1.0	1.0	1.8	1.0	2.57	C
WL 318	4.6	3.8	1.2	1.0	2.2	1.0	2.30	BC
Lahontan	5.2	3.6	1.0	1.0	1.8	1.0	2.27	BC
DeKalb 131	6.8	6.4	1.4	1.0	4.4	1.0	3.50	D
Dawson	6.2	7.4	2.2	1.0	5.0	1.0	3.80	D
Cutting Interval Means	5.43	3.85	1.22	1.0	2.35	1.0		
Mean Separations* 5%	D	C	A	A	B	A		
1%	c	b	a	a	a	a		

L.S.D. for Variety X Cutting Interval 5% = 1.09
1% = 1.48

1/ Cutting intervals are equal to 3, 4, 5, and 6-week intervals, plus MO 69 = 1/10 bloom for Moapa 69 and DK 131 = 1/10 bloom for WL 318 and DeKalb 131.

* Tabular values are for degree of weed infestation where 1 = no weeds and 9 = heavy weed infestation.

TABLE 3

EFFECT OF CUTTING INTERVAL ON STAND PERSISTENCE OF ALFALFA VARIETIES AT U.C. RIVERSIDE

Alfalfa Variety	Percent Stand for Different Cutting Intervals[1/]						Variety Means	Mean Separations*	
	3	4	5	6	MO 69	DK 131		5%	1%
Mexican Sonora	18.8	32.5	46.2	63.8	48.8	53.8	44.0	E	d
UC Salton	32.5	58.8	53.8	75.0	58.8	67.5	57.7	D	c
Moapa 69	42.5	75.0	75.0	76.2	72.5	77.0	69.7	C	b
AS 13	21.2	78.8	86.2	87.5	80.0	83.2	72.8	BC	b
WL 508	60.0	77.5	87.5	84.2	77.5	80.0	77.8	B	b
N-78	57.5	70.0	83.8	83.8	76.2	76.2	74.6	BC	b
Lahontan	72.5	81.2	92.5	90.0	87.5	93.8	86.2	A	a
DeKalb 131	18.8	70.0	90.8	91.2	81.2	85.0	72.8	BC	b
Cutting Interval Means	40.5	68.0	77.0	81.5	72.8	77.1			
Mean Separations* 5%	A	B	CD	D	BC	CD			
1%	a	b	bc	c	cd	cd			

L.S.D. for Variety X Cutting Interval 5% = 15.5%
1% = 20.5%

1/ Percent stand is an estimate of desirable stand believed necessary for maximum production with 100% being perfect.

* Any two means not accompanied by the same letter are significantly different at the confidence level shown.