

WEEVIL DAMAGE INFLUENCED BY ALFALFA VARIETIES AND CUTTING SCHEDULES

Vern L Marble
Extension Agronomist
University of California, Davis

Damage from the Egyptian alfalfa weevil (EAW) represents a significant loss to growers, often when the EAW are controlled. To date, biological control is not exerting a significant affect on weevil populations in California. Plant resistance to the EAW continues to be elusive, with the progress very slow. All three forms of control, i.e. chemical, biological and host plant resistance, were reviewed in the Proceedings, Fifth California Alfalfa Symposium, December 10-11, 1975. Observations made this last spring in an eight variety x six harvest frequency study conducted by the author at U.C. Davis, indicate that we may be able to obtain a significant degree of control of the EAW by choosing the proper variety and manipulating this variety in a longer harvest frequency than is now practiced.

The trial was planted October 22, 1974 on deep Yolo clay loam at the Agronomy Farm at U.C. Davis. Eight varieties were selected to cover the range of winter dormancy from UC Salton, a nonwinter dormant variety, to Dawson, a very winter dormant variety. The varieties included, according to their increasing winter dormancy: UC Salton, Moapa 69, WL 512, N-78 Brand, Lahontan, WL 318, DeKalb Brand 131, and Dawson. For the first harvest year, each set of eight varieties were harvested with six cutting frequencies of 3, 4, 5, and 6 weeks between cuttings, Moapa 69 cut at 1/10 bloom, and DeKalb Brand 131 cut at 1/10 bloom. The first cutting for the three week treatment was made June 2, to initiate the cutting frequencies. A total of 9, 6, 5, 4, 4 and 4 cuttings were taken for the above treatments, respectively. Unfortunately the Moapa 69 cut at 1/10 bloom approximated the same cycle as DeKalb 131 cut at 1/10 bloom. Therefore, the last three treatments were approximately cut at 6 week intervals, with some variation in actual cutting date. The varieties and cutting frequencies are contained in Table 1, which documents the winter dormancy characteristics as evidenced by inches of growth in the spring, with the effect of cutting frequency the previous season illustrated.

Vigor Affected by Cutting Schedule

The recovery in the spring following one year of cutting frequencies indicated in Table 1, indicate that the cutting frequency the previous year has a strong affect on the recovery of alfalfa varieties the next spring. In most seasons at Davis, the alfalfa varieties which we classify as nondormant begin their spring regrowth after final frost about the 15th of February, with the dormant varieties initiating their regrowth up to two weeks later. Every variety, and the average of eight varieties, increased in vigor and growth as the cutting interval widened from 3 to 6 weeks. The dormant varieties accelerate growth, probably due to an abundance of root carbohydrates stored the previous fall. All four nondormant varieties, that is UC Salton, Moapa 69, WL 512, and N-78 Brand, have a good deal of fall regrowth. The very nondormant varieties like UC Salton and Moapa 69, continue to grow throughout the winter and this regrowth is frosted back repeatedly, thus exhausting to some extent the carbohydrates that have been stored in the roots. It should be recognized that all alfalfas must initiate their spring regrowth from root carbohydrate reserves since their photosynthetic ability comes from leaf tissue which develops rather slowly in the spring. It is interesting to note that WL 318 was able to nearly catch the nondormant varieties in growth when the cutting schedule was widened the previous year.

Fall regrowth data following cutting is not available, but will be taken this year, following two years of cutting cycles, since each treatment had a nearly identical last cutting date. The amount of regrowth in November and December, and the attractiveness of plants to EAW adults entering the field, may have an influence on the quantity of eggs laid in each variety and cutting frequency, and thus influence the amount of damage that will be apparent the next spring.

Variety and Cutting Frequency Affect Weevil Damage

EAW counts from sweep net observations indicated that the treatment level of 20 weevil per sweep was reached March 29. Windy weather kept us from making an insecticide treatment until four days later, April 2, 1976. Very few additional weevil were found in the trial, indicating that an excellent control had been obtained. Striking differences in EAW damage were obvious between varieties. It was a little more difficult to observe differences between harvest frequencies, so weevil ratings were made on April 7. These are contained in

Table 2. Differences were slight between some varieties, but Lahontan and Moapa 69 were obviously harder hit than the three dormant varieties, WL 318, DeKalb Brand 131 and Dawson. As the cutting intervals widened, there was progressively less damage as indicated by the average of eight varieties, with some variety-cutting frequency interactions. Lahontan did not improve appreciably through any of the cutting treatments, while WL 318, for example, dramatically improved in its freedom from weevil feeding damage as the cutting intervals widened.

The varieties were not ready for first harvest when the above weevil damage readings were taken, so harvest was delayed until April 20. All cutting treatments were harvested the same day for this initial first cutting of the season. Another weevil damage rating, which indicated recovery from weevil feeding damage, was made April 20, 18 days after treatment. Differences among varieties were strikingly large, with smaller differences attributable to cutting intervals. These ratings are found in Table 3. Moapa 69 and Lahontan had very little recovery from terminals damaged by EAW feeding. WL 318, DeKalb Brand 131, and Dawson, all winter dormant varieties, had virtually complete recovery with new leaves formed and stem elongation proceeding at a normal rate. Among the nondormant varieties, WL 512 appeared to be superior, being somewhat intermediary between the dormant and the nondormant varieties. WL 512 has a capacity for side branching at leaf nodes that Moapa 69 does not exhibit. While not documented in this paper, WL 318, DeKalb 131 and Dawson appear to have the same characteristics, even to a greater extent than WL 512. The degree of damage and stunting of Moapa 69 and Lahontan compared to WL 318 is shown in Figures 1, 2 and 3. Figure 1 is a close-up of Figure 2, showing the extent of terminal damage.

Making visual recovery ratings did not really distinguish between the growth effects due to cutting frequencies. Another technique must be developed in order to document the benefit that was really there due to the wider cutting frequencies. This is more obvious if you look at the heights taken the day before cutting and tabulated in Table 4, and the yields of the first cutting taken on April 20 (Table 5). Although the statistical analysis for height measurements and the two weevil readings have not been made at this date, the height data show an increasing recovery from EAW damage with the wider cutting intervals. The growth suppression in Lahontan and Moapa 69 at the short cutting intervals of 3 and 4 weeks was truly dramatic. Lahontan did not recover to any striking degree at any cutting interval, while Moapa 69 recovered at the wider cutting frequencies. The height difference at harvest for WL 318 and DeKalb Brand 131 was obvious at the shorter intervals but was essentially equal to or exceeded the height differences of the nondormant varieties UC Salton and Moapa 69 at the wider frequencies. Height differences at harvest for the 6 week cutting frequency are illustrated in Figure 3 for all eight varieties. The most obvious height reduction is in Lahontan. All of the four nondormant varieties had considerable terminal growth in the 17 days between measurements and insecticide application, but it was striking how much of the growth in UC Salton, Moapa 69, WL 512 and N-78 Brand occurred as a result of the development of crown buds. This development had a great influence on recovery ratings and height measurements. Without this crown bud development and the extension of those stems to mask visual ratings and height measurements, the damage from these two measurements would have been more obvious.

The yield of the first cutting, contained in Table 5, makes the difference between harvest intervals and among dormant and nondormant varieties much more obvious. WL 318 was significantly superior to all other varieties, and DeKalb Brand 131 was significantly superior to all others except WL 318, and Lahontan and Moapa 69 are significantly inferior to all other varieties when averaged over the six cutting frequency treatments. When you compare the harvest interval treatments, yields increased linearly as the interval between cuttings increases. Although all varieties responded to wider cutting intervals, the low yield in Lahontan at a near normal 4 week interval indicates its low vigor and inability to cope with heavy weevil attack (compare Lahontan, Figure 4, with WL 318, Figure 5). Conversely, WL 318 yielded exceptionally well at all cutting intervals, though higher at the wider intervals, and other varieties such as Moapa 69, WL 512 and Dawson had greater response to the 5 and 6 week intervals than to shorter intervals. Comparing varieties at the more typical 4 and 5 week harvest intervals, and using Moapa 69 as a check variety, only WL 318 is statistically superior when harvested at the 4 week interval, and DeKalb Brand 131 and WL 318 at the 5 week interval.

We have observed in our variety trials conducted at Davis and other places in the State, that Lahontan and Moapa 69 appear to be more susceptible to EAW attack than other varieties. This is especially true of Lahontan, with Moapa 69 having normally less damage. This fact was illustrated in the first cutting of a third year trial here at Davis conducted by Carl

Schoner, Art Swenerton and Ted Tornngren. An infestation of the EAW, that was not controlled prior to harvest, produced damage ratings and first cutting yields for some selected varieties in a 12 entry trial, shown in Table 6.

Figure 6 shows the heavy damage done to Lahontan compared with light damage for WL 309, a dormant variety. Again, Lahontan appears to lack the ability to recover from heavy weevil damage while WL 309 was able to continue growth under heavy attack and produce a near-normal yield, even without any insecticides being applied.

Summary

When taken together, these data indicate

1. The harvest interval practiced the previous season will influence rate of spring growth, EAW damage, and yield obtained in the first cutting of the next season.
2. Certain dormant varieties have the ability to continue terminal growth and leaf production under heavy EAW attack, thus reducing total damage.
3. There is an interaction in growth rate, weevil damage, and yield of first cut, between varieties and cutting frequencies, indicating that all varieties do not react the same to cutting frequencies.
4. Generally speaking, winter dormant and semidormant varieties, with the exception of Lahontan, are able to produce at a higher yield level than nondormant varieties at the wider harvest intervals of 5 and 6 weeks in the first cutting.
5. The vigor, and continued growth characteristics under heavy EAW attack, of dormant and semidormant varieties (except Lahontan) may be related to the lack of fall growth and longer period of storage of root carbohydrates, compared to the nonwinter dormant varieties. The greater root storage of carbohydrates that occurs in the wider cutting intervals during the season may be influencing this same development, since there was a more rapid growth in the spring from varieties that had wider cutting intervals the previous year.
6. Dormant varieties, when cut at wide intervals, offer another means to obtain high yields under EAW attack.

Some questions we must still answer with further research this fall and spring include:

1. Is there a preferential selection of varieties with different quantities of fall foliage by the adult EAW when it returns to the fields in November and December?
2. Are there different quantities of eggs laid in the different varieties and cutting intervals?
3. Are there differences in the quantity of carbohydrates stored in the roots of different varieties and cutting frequencies?
4. Is the apparent "resistance" to EAW a reflection of spring vigor and ability to produce leaves thus diluting the damage?

A good deal more information must be gathered before we have the answers to the above questions. However, at the moment, the ability of the winter dormant varieties to more effectively cope with attacks from the EAW adds another plus to the list of reasons why I am recommending winter dormant varieties to replace nonwinter dormant varieties in the upper San Joaquin and Sacramento Valleys on all but sandy soils. As reported in 1974, my continuing research program has already established that, at Davis, winter dormant varieties will yield equal or more than nonwinter dormant varieties if they are cut fewer times using wider intervals. The quality will be equal or superior to nondormant varieties cut at shorter intervals, and in addition they will have longer stand life and fewer weeds.

TABLE 1
 INCHES OF SPRING REGROWTH
 March 6, 1976
 University of California, Davis

Variety	3 weeks	4 weeks	5 weeks	6 weeks	1/10 bloom		Mean	Duncan's	
					Moapa 69	DK Br. 131		Range	Test
								.05	.01
UC Salton	8.6	11.0	11.8	14.0	14.0	13.8	12.2		
N-78 Brand	9.0	10.2	12.2	12.8	13.2	13.8	11.9		
Moapa 69	7.6	11.2	11.2	13.2	12.6	14.0	11.6		
WL 512	7.8	10.4	11.2	11.0	13.2	13.6	11.2		
WL 318	4.0	5.8	7.0	8.8	11.4	10.8	8.0		
DK Br. 131	3.4	3.4	5.6	7.6	7.6	8.8	6.1		
Lahontan	3.2	5.0	5.4	6.2	8.8	7.0	5.9		
Dawson	2.4	2.6	4.2	5.8	7.4	6.2	4.8		
MEAN	5.7	7.5	8.6	9.9	11.0	11.0	8.9		

LSD's:

	<u>.05</u>	<u>.01</u>
between harvest interval means	0.8	1.2
between variety means	0.5	0.7
between different varieties for same interval	1.3	1.7
between different varieties for different intervals	1.5	2.0

TABLE 2
 ALFALFA: 8 VARIETY X 6 HARVEST INTERVAL, UCD
 Weevil Damage* April 7, 1976

Variety	3 weeks	4 weeks	5 weeks	6 weeks	1/10 bloom		Ave.
					Moapa 69	DK Br. 131	
UC Salton	3.5	3.0	3.1	2.5	2.3	3.0	2.9
Moapa 69	4.1	3.8	3.2	2.8	3.5	3.6	3.5
WL 512	3.6	3.2	3.1	2.5	2.7	2.6	2.9
N-78 Brand	3.4	3.3	3.0	2.7	3.2	3.1	3.1
WL 318	2.6	3.1	2.9	2.7	1.4	1.4	2.4
Lahontan	3.6	3.9	3.9	4.0	3.5	3.4	3.7
DK Br. 131	3.0	3.0	3.2	3.2	2.8	2.4	2.9
Dawson	3.0	2.7	3.0	3.0	3.0	2.8	2.9
AVE.	3.3	3.3	3.2	2.9	2.8	2.8	3.0

* 1 = slight damage.
 9 = heavy damage.

TABLE 3
 RECOVERY FROM WEEVIL DAMAGE*- April 20, 1976
 CONTROLLED - April 2, 1976

Varieties	3 weeks	4 weeks	5 weeks	6 weeks	1/10 bloom	1/10 bloom	Ave.
					Moapa 69	DK Br. 131	
UC Salton	3.5	4.5	4.0	3.0	3.0	3.5	3.58
Moapa 69	4.5	6.0	4.0	5.0	5.0	4.5	4.83
WL 512	3.5	3.0	2.5	3.0	3.0	3.0	3.00
N-78 Brand	4.0	4.5	3.0	3.0	3.0	3.0	3.42
WL 318	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Lahontan	3.0	4.0	4.0	4.0	4.0	3.0	3.67
DK Br. 131	1.5	2.0	1.5	2.0	1.0	1.5	1.58
Dawson	2.0	1.5	1.5	2.0	2.0	1.0	1.67
AVE.	2.88	3.56	2.69	2.88	2.75	2.56	

* 1 = complete recovery and slight damage
 9 = no recovery and heavy damage

TABLE 4
 HEIGHT MEASUREMENTS-INCHES
 April 19, 1976

Varieties	Harvest Interval				1/10 bloom Moapa 69	1/10 bloom DK Br. 131	Ave.
	3 weeks	4 weeks	5 weeks	6 weeks			
UC Salton	17.4	20.4	21.4	23.4	22.2	23.0	21.3
Moapa 69	15.2	13.2	21.6	22.4	20.8	22.2	19.2
WL 512	17.6	20.0	19.8	19.0	21.6	21.8	20.0
N-78 Br.	17.8	19.0	23.2	22.6	22.8	23.2	21.4
WL 318	15.8	19.2	19.6	21.8	25.8	24.6	21.3
Lahontan	12.4	14.4	16.0	15.8	18.8	18.6	16.0
DK Br. 131	13.8	15.6	18.4	20.0	23.8	22.4	19.0
Dawson	10.8	14.0	16.0	16.8	20.4	19.6	16.2
AVE.	15.1	17.0	19.5	20.2	22.0	21.9	18.9

TABLE 5
ALFALFA
8 VARIETY X 6 CUTTING INTERVAL TRIAL
 University of California, Davis

1976 1st Cutting Yields, Tons/Acre
 April 20, 1976

Varieties	Harvest Interval				1/10 bloom Moapa 69	1/10 bloom DK Br. 131	Ave.	Duncan's Multiple Range, 5%
	3 weeks	4 weeks	5 weeks	6 weeks				
WL 318	2.08	1.75	2.11	2.24	2.66	2.46	2.22	a
DK Br. 131	1.73	1.62	1.97	1.95	2.38	2.42	2.01	b
Dawson	1.58	1.41	1.93	1.91	2.18	2.19	1.86	c
WL 512	1.62	1.60	1.88	1.83	2.01	2.11	1.84	cd
N-78 Br.	1.74	1.60	1.88	1.82	1.73	1.81	1.76	d
UC Salton	1.56	1.83	1.69	1.90	1.79	1.77	1.76	d
Moapa 69	1.33	1.44	1.74	1.78	1.69	1.62	1.60	e
Lahontan	1.12	1.10	1.48	1.38	1.54	1.46	1.35	f
AVE.	1.59	1.54	1.83	1.85	2.00	1.98	1.80	

<u>LSD's:</u>	<u>.05</u>	<u>.01</u>
Harvest interval	0.17	0.23
Between varieties	0.09	0.12
Between varieties for same interval	0.23	0.30
Between varieties for different harvest interval	0.27	0.37

TABLE 6
REGIONAL VARIETY AND BRAND TRIAL
 University of California, Davis
 First Cutting 1976

Varieties	EAW damage rating*	Yield T/A
Moapa 69	4.4	0.87
Lahontan	4.8	0.96
AS-49R	3.2	1.13
WL 309	2.6	1.34

* 1 = no damage
 10 = complete defoliation



Figure 1. Terminal EAW damage differences between Moapa 69 (left), WL 318 (center), and Lahontan (right). 1975 harvest frequency was six weeks.

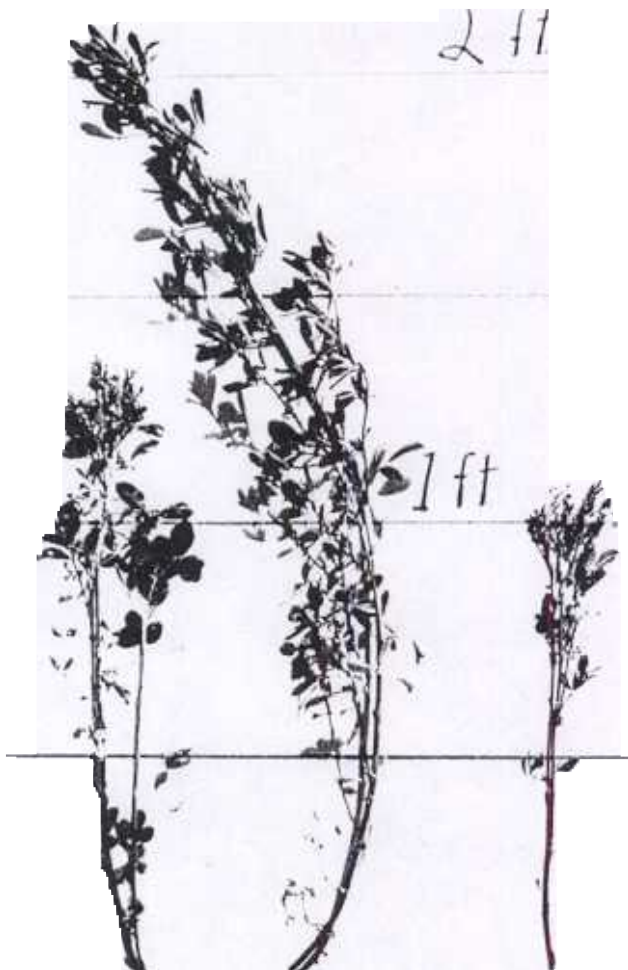


Figure 2.

Growth differences on April 19, 1976 due to EAW feeding for six week cutting schedule in 1975. Top - Moapa 69; Center - WL 318; Bottom - Lahontan. Note stunting, leafiness and side branching.

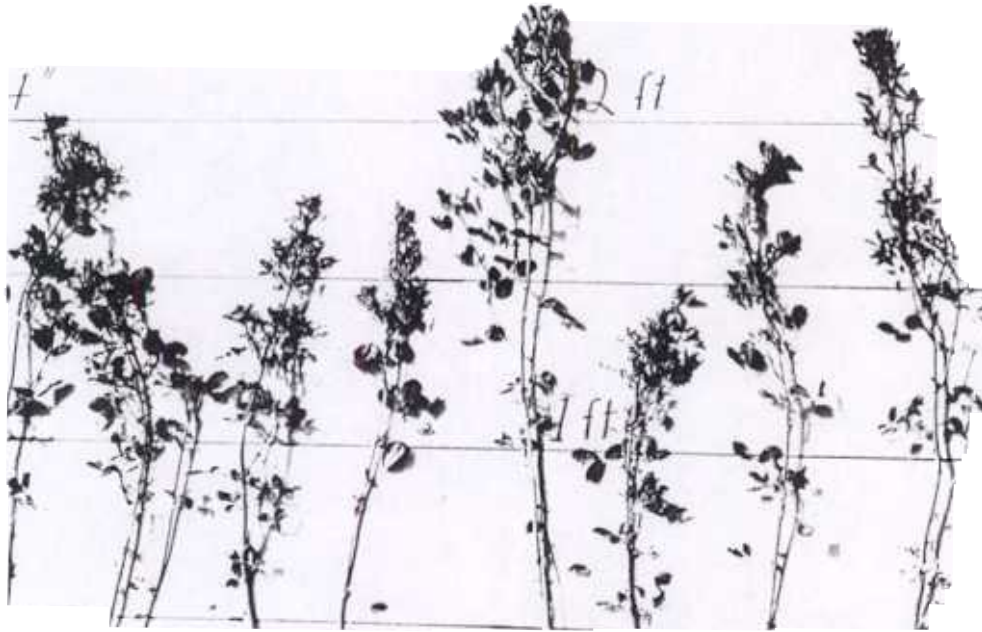


Figure 3. Height and damage differences for first cutting April 19, 1976 for six week schedule previous year. Left to right - UC Salton, Moapa 69, WL 512 N-78 Brand, WL 318, Lahontan, DeKalb Brand 131, and Dawson. Note recovery from insecticide application April 2, 1976.

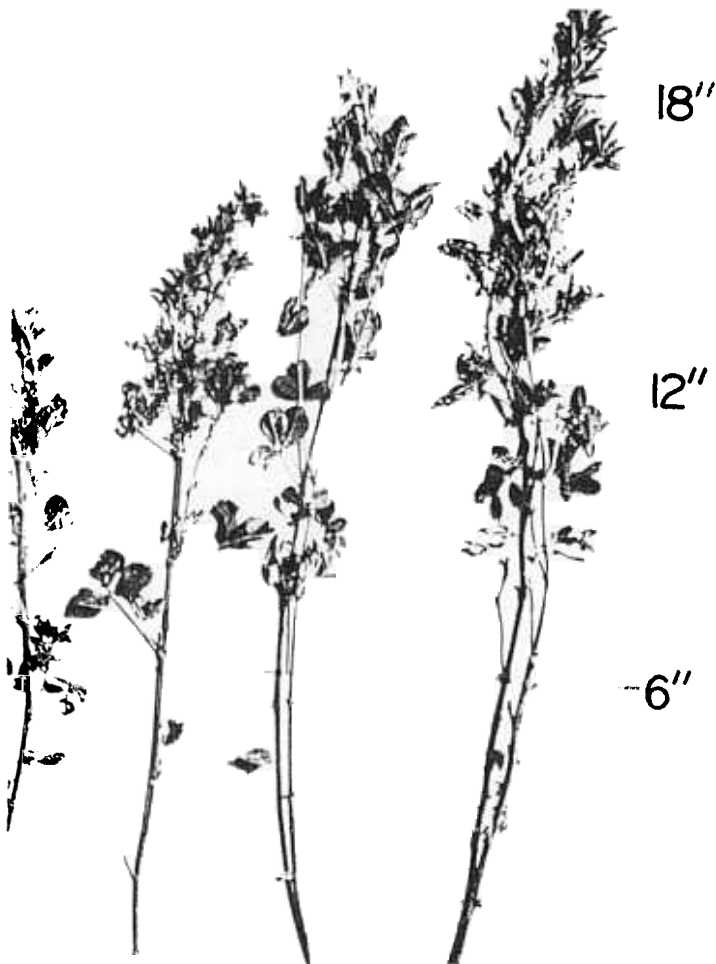


Figure 4. Height and growth difference April 19, 1976 for Lahontan at 3, 4, 5 and 6 weeks (left to right) cutting schedule in 1975. Maximum height is 20 inches (6 inches between lines).

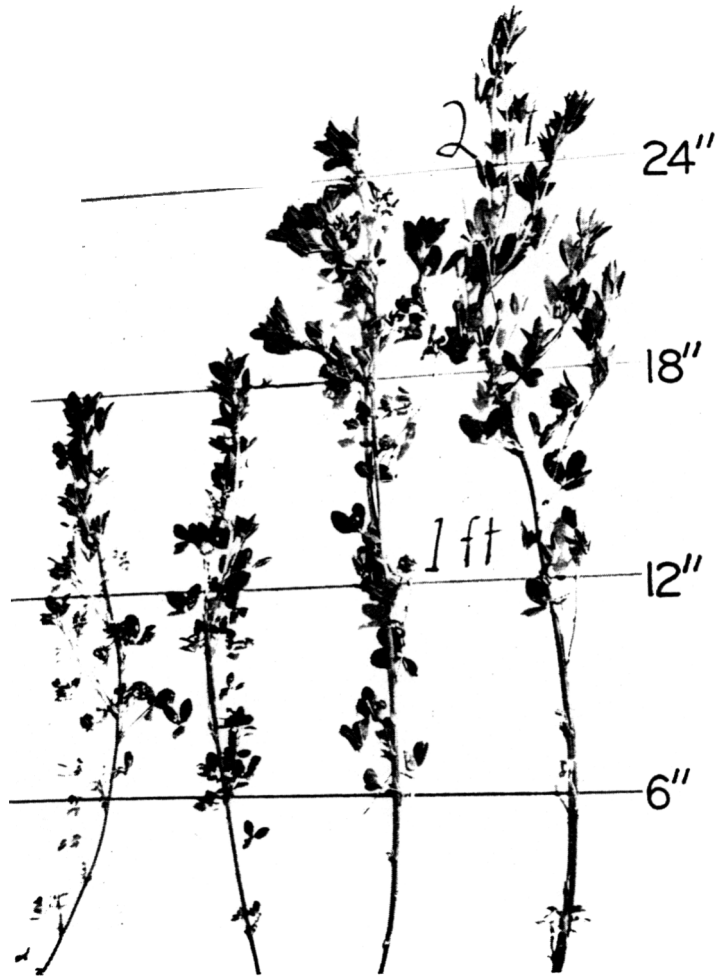


Figure 5. Height and growth differences on April 19, 1976 for WL 318 cut on a 3, 4, 5 and 6 week (left to right) schedule in 1975. Maximum height is 28 inches. Note side branching.

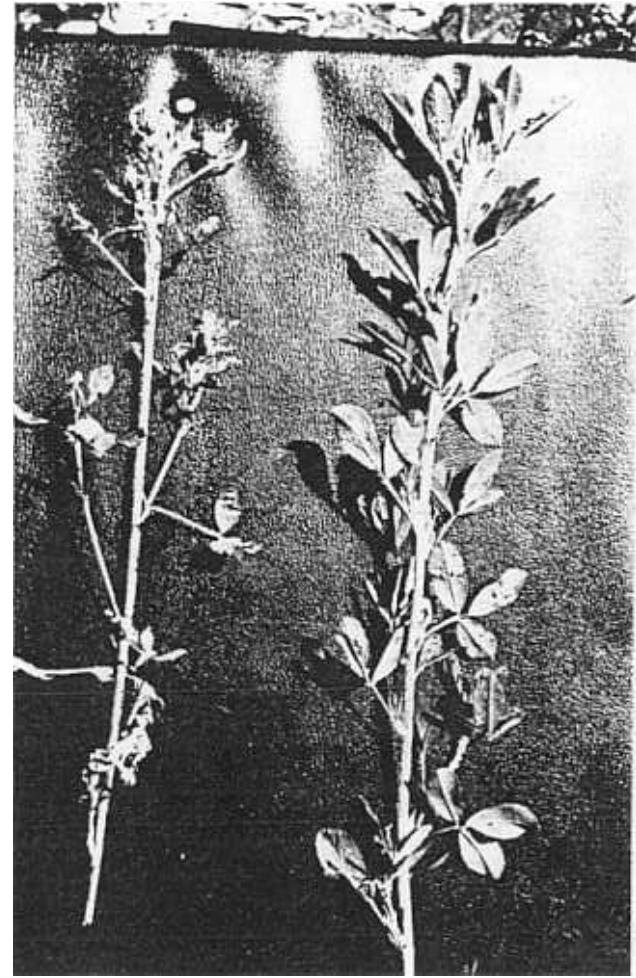


Figure 6. EAW damage, leafiness, and growth differences April 15, 1976. Lahontan (left) and WL 309 (right). EAW population not controlled.