

Effects of Autumn Cutting Management on Alfalfa Hay Yield and Some Characteristics

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Abstract: The experiment was carried out under irrigated conditions in Faculty of Agriculture of Ataturk University, during 1999-2001. Different harvest management treatments were imposed on alfalfa in autumn of 1999 and 2000. Three cutting times (15 September, 1 October and 15 October) and 4 stubble heights (0, 5, 10 and 15 cm) were imposed for determination of suitable autumn harvest management. Alfalfa hay yield, plant height and stem number of meter square were measured in 2000 and 2001. According to the mean of two years data, alfalfa should be cut at 1 October with 10 cm stubble height in Erzurum conditions.

Key words: Alfalfa, cutting date, stubble height, hay yield, plant height, stem number

Introduction

A true management must be imposed on perennial forages for use in severe years. Especially, clippings should be organized as true for minimum risk in the critical periods. Inappropriate management may reduce plant vigor and increase stand loss in winter period. Therefore, autumn harvest regime is very important on productivity and longevity of alfalfa stand.

It is concept to as the "fall critical period" that from 4 to 6 weeks before the first killing frost. This interval is very important for build up carbohydrate reserves to carry them through winter and provide energy for regrowth in spring of perennial forages (Smith, 1972). Therefore, plants may be stored adequate assimilate after the last autumn cutting, or they don't regrowth that they use root reserves and they may be came in the winter season. Schoner (1981) and Sheaffer *et al.* (1986) reported that stand density and hay yield of alfalfa were decreased by delaying the last autumn harvest. On the other hand, After early autumn cutting, the plants regrowth that they use root reserves, but don't build up because air temperature reduced (Marble *et al.*, 1989). If a severe winter is following the critical period, important damage occurs on alfalfa stand (Sheaffer *et al.*, 1988). But Tesar and Yager (1985) found that autumn cutting is not harmful on alfalfa. For these reasons, autumn cutting time of alfalfa may be determined in Eastern Anatolia.

Stubble heights is important another factor on winter hardy and spring growth of alfalfa. Kust and Smith (1961) suggested that an adequate stubble height (6-7 cm) for alfalfa don't fill from frequent cutting systems. Increasing stubble heights are useful for fall cuttings (Serin and Tan, 2001). Stubble (at least 15 cm) catches snow and provides a longer duration of snow cover (Sheaffer *et al.*, 1988). Nelson and Smith (1968) reported that to have 15 to 25 cm plant material to protect the soil during winter and reduce soil temperature fluctuation.

This study was planned to determination of last cutting time and stubble height of alfalfa in autumn.

Materials and Methods

The experiment was carried out in Erzurum irrigated conditions in 1999-2001 in the factorial arrangement of randomized complete block design (RCBD) with four replications. In the study three different cutting times (15 September, 1 October and 15 October) and four stubble heights (0, 5, 10 and 15 cm) were imposed on alfalfa (*Medicago sativa* L. var. Bilensoy).

Alfalfa was sown at rate of 25 kg/ha with 20 cm row spacing in spring of 1999. The cutting treatments imposed each autumn in 1999 and 2000. Plots were fertilized with 50 kg ha⁻¹ N as ammonium sulphate and 300 kg ha⁻¹ P₂O₅ as triple super phosphate only seeding year (Öden, 1987; Serin and Tan, 2001). All plots were harvested three times at 10% bloom in 2000 and 2001, and plant height, stem number of meter square and total hay yield were measured. Data were analyzed using standard analysis of variance procedure and means compared using LSD test.

The loamy soil of experiment field was in neuter acidity, it was poor in organic matter and phosphorus, but rich potassium content.

Table 1 gives the details of weather data recorded in 2000 and 2001 and long term averages in Erzurum. Mean monthly temperatures were above at both years than long-term average. The total rainfall of 2001 was higher than others. First killing frost occurred at 23 September and 4 October in autumn of 1999 and 2000, respectively. Vegetation period limits the alfalfa reach both hay and seed harvest maturing in the same season in Erzurum (Tan *et al.*, 1997). The growing season in most of Erzurum extends 150 frost-free days making two to three harvest possible in alfalfa.

Results and Discussion

Hay Yields

Total hay yields from the three harvests in 2000 and 2001 averaged 7191 and 8371 kg ha⁻¹, respectively (Table 2). Forage yields during the first and second year were influenced in the fall cutting date and height to the extent that differential recovery periods affected forage availability.

Alfalfa cut on 1 October yielded more the next year than when cut earlier or later. The first killing frost of 1999 and 2000 occurred on 23 September and 4 October, respectively. Therefore, September is considered the critical fall period in Erzurum. If the last harvest made on 15 September, alfalfa can regrowth until the first killing frost. The young plants were not long enough to contribute markedly to hay yields but probably depleted root carbohydrate reserves. October weather in Erzurum is usually cool and freezing, therefore it is not suitable for photosynthetic activities. Smith (1972) and Sheaffer *et al.* (1988) suggested that alfalfa should not be cut from 4 to 6 weeks before the first killing frost in autumn. The final cut during the critical period consistently reduced subsequent yields. The last harvest taken after the killing frost tended to have a slightly lower plant vigor and root reserves because of low temperature. There was little regrowth (5-10 cm) of alfalfa after cutting 15 October. Therefore, late harvest (15 October) also decreased subsequent yields. Sheaffer and Marten (1990) determined that delayed cuttings in the third autumn on 15 September or 15 October reduced yields by 68% in the spring following compared with a final cut on 1 September in Minnesota.

Cutting (stubble) height in autumn also influenced subsequent yields. Hay yields were less when plants were cut to a 5 cm and no stubble rather than 10 and 15 cm stubble height. As an average two years, the highest hay yield (8315 kg/da) was obtained from 10 cm stubble height.

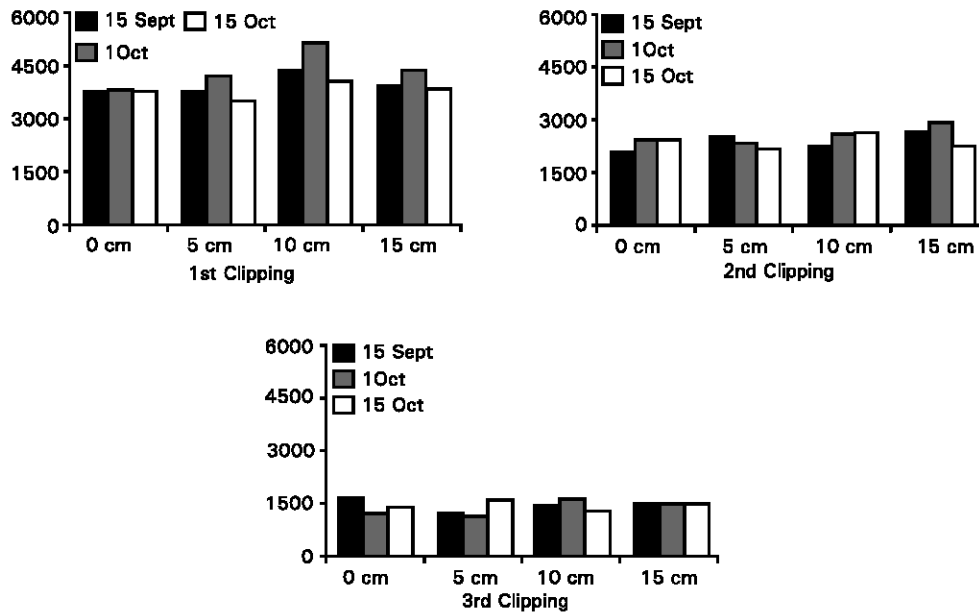


Fig. 1: Effect of harvest management of alfalfa hay yield throughout the growing season

Table 1: Some climatic data recorded in Erzurum for vegetation period (April-September) in 1999-2001

Climatic Parameters	2000	2001	1929-2000
Mean monthly temperature	13.7	13.3	11.5
Total rainfall	178.0	281.7	269.6
Mean monthly humidity	51.0	55.6	56.4
First killing frost date	23 Sep (1999)	4 Oct (2000)	9 Oct (long-term)

Table 2: Effects of autumn cutting management on alfalfa hay yield in 2000, 2001 and average of two years (kg ha^{-1})

Cutting date	Stubble heights (cm)				Mean *
	0	5	10	15	
2000					
15 September	7231	6580	6346	7043	6800b
1 October	7037	8061	8554	8090	7936a
15 October	6816	6082	7142	7303	6836b
Mean	7028	6908	7347	7479	7191B
2001					
15 September	7432	7506	9361	8670	8242b
1 October	7682	7243	10064	9537	8632a
15 October	8194	8555	8423	7779	8238b
Mean	7769C	7768C	9283A	8662B	8371A
Average					
15 September	7332	7043	7854	7857	7522B
1 October	7360	7652	9309	8814	8284A
15 October	7505	7319	7783	7541	7537B
Mean	7399B	7338B	8315A	8071AB	7781

LSD (A × B), 2001: 992

* Same letters in uppercase were not different at 0.01 level, those in lowercase at 0.05 level

Tosun (1967) found that the closest clipping reduced the weight of tops and roots in alfalfa, on the contrary, the clippings to a height of 15 cm were not harmful to both top and root growth of plants. Leaving height stubbles catches snow and provides probably a longer duration of snow cover. It also reduces fluctuations in soil temperature in fall and early spring (Sheaffer *et al.*, 1988).

Table 3: Effects of autumn cutting management on alfalfa plant height in 2000, 2001 and average of two years (cm)

Cutting date	Stubble height (cm)				Mean*
	0	5	10	15	
2000					
15 September	66.0	58.7	79.3	56.0	65.0b
1 October	70.7	82.0	88.7	86.7	82.0a
15 October	62.0	64.7	61.3	68.7	64.2b
Mean	66.2	68.4	76.4	70.4	70.4B
2001					
15 September	78.0	74.7	96.0	86.0	83.7
1 October	86.0	74.7	99.3	90.0	87.5
15 October	77.7	80.9	94.7	82.7	83.9
Mean	80.6B	76.7B	96.7A	86.2AB	85.0A
Average					
15 September	72.0	66.7	87.7	71.0	74.3b
1 October	78.3	78.3	94.0	88.3	84.8a
15 October	69.8	72.7	78.0	75.7	74.0b
Mean	73.4b	72.6b	86.6a	78.3ab	77.7

* Same letters in uppercase were not different at 0.01 level, those in lowercase at 0.05 level

There were in our study significant ($P < 0.05$) interaction in 2001 among cutting date and stubble height. But 2000 and average yields of two years were not affected by harvest date and stubble height interaction.

The details of seasonal distribution of forage yields are shown at Fig.1. First clipping has higher hay yield than 2nd and 3rd, due to cool and wet spring conditions. Harvest management did not affect on yield distribution. In general, cutting time and stubble height were effect similarly hay yield in all clippings.

Plant height

Fall harvest management (cutting date and stubble height) had a great effect on plant heights in the subsequent spring (Table 3). Fall cutting date significantly affected the plant height in the first year, stubble height also did in second year. Plants vigorously grown in 2001 and they had tall stems (85.0 cm).

Table 4: Effects of autumn cutting management on alfalfa stem number in 2000, 2001 and average of two years (number m⁻²)

Cutting date	Stubble height (cm)				Mean*
	0	5	10	15	
2000					
15 September	376	320	314	284	323A
1 October	274	300	320	292	296AB
15 October	228	258	238	246	242B
Mean	292	292	291	274	287A
2001					
15 September	264	264	248	188	241a
1 October	196	184	184	176	185b
15 October	246	270	222	200	235a
Mean	235	239	218	188	220B
Average					
15 September	320	292	282	236	283A
1 October	234	242	252	234	241B
15 October	236	264	230	204	233B
Mean	263	266	255	225	252

* Same letters in uppercase were not different at 0.01 level, those in lowercase at 0.05 level

According to the means of two year results, when alfalfa was cut on 15 September, 1 October and 15 October, the plant heights were determined as 74.3, 84.8 and 74.3 cm, respectively. Harvest on 1 October, plants were taller than other dates of harvest because they probably have sufficient root reserves for normal growth the next spring.

Plant heights during the 2nd year were influenced in the fall stubble height but they were not in the 1st year. Cutting to the level of soil and a-5 cm stubble height produced 73.4 and 72.6 cm of plant height in next year as shown by the 2 year average values. Leaving tall stubbles (10 and 15 cm) increased plant height (86.6 and 78.3 cm) compared to the short stubbles.

Stem Numbers

Date of last cut and cutting height affected subsequent stem number of alfalfa. Alfalfa stem counts were determined 287, 220 and 252 number m⁻² in 2000, 2001 and average of two years. Stand densities in 2000 and 2001 are shown Table 4. Fall cutting dates affected the stand density in both years, but stubble height did not.

Harvesting on 15 September produced in next spring high stem counts in both years (323 and 241 number m^{-2}). Stem numbers were reduced by delaying of cutting date to 1 and 15 October. Because alfalfa regrew after last cutting, when it was cut on 15 September. Therefore, early cutting caused more stem number compared late cuttings.

As an average stem numbers of 0, 5, 10 and 15 cm stubble heights were counted 263, 266, 255 and 225 plants m^{-2} . The treatment had relatively small effect on the number of stem which varied only from 255 per sq m to 266. Stem numbers of the longest stubble height was the lowest (255 number m^{-2}). But the decreasing was not important significantly.

Fall cutting management affected subsequent yield of alfalfa in Erzurum. Results indicate that the best harvest date in autumn is to cut on 1 October in Erzurum so that stand vigor and longevity is maintained. The final harvest of alfalfa should be near to the date of first killing frost that is about in the end of September and early October. If the alfalfa final harvest made on before first killing frost, plants regrowth and consume available carbohydrate reserves in the roots. Plants don't fill them again after first killing frost, because of decreasing temperature and day length. Additionally, alfalfa should be cut with 10 cm stubble height in the final harvest. The tall stubble height may catch and hold snow during winter and early spring.

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