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Effects of Clipping Height on Some Basic Characteristics of Timothy Grass (*Phleum pratense* L.)

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Abstract: This experiment was conducted to study the reaction of timothy grass to different clipping heights. In the greenhouse of the Agronomy Department of Agricultural Faculty of Ankara University, 20 pots planted with young timothy grass were clipped in 2.5, 5.0, 7.5, and 10.0 cm heights for 86 whenever they reached 15 cm for 86 days in the spring of 1997. No fertiliser was applied but they watered as needed. The forage obtained from every cut was weighted and recorded. The experiment was terminated when the control plants had spikes. After the soil washed away, roots were dried at 70 ^{0}C for 24 h and weighted. Results obtained indicate that plants cut in 2.5 cm gave the lowest usable forage, total forage, tiller number, dry root weight. The number of cuttings depended on the clipping height and ranged from 7 to 12. The higher the clipping height, the higher the number of cuttings. Plants cut to 2.5 cm gave the lowest tiller number. The highest forage yields, tiller numbers and root weights were obtained from the plants cut to 7.5 and 10 cm heights, which is representative of moderate grazing. The strongest effect of deep cutting grazing was on the root development. Plants cut to a height of 2.5 cm produced 6 times less root weight than the control plants. There were no significant differences among the plants cut down to 7.5 and 10 cm. Forage yields, number of cuttings, root weights, tiller numbers were increased with the clipping heights. Clipping to low heights reduced the development of timothy grass; this suggests heavy grazing would also arrest development of timothy grass

Key Words: *Phleum pratense*, clipping height, forage, root, tillering

Biçme Yüksekliğinin Çayır Kelp Kuyruğu (*Phleum pratense* L.)'nun Bazı Temel Özellikleri Üzerine Etkileri

Özet: Bu araştırma çayır kelp kuyruğunun farklı biçme veya otlatma yüksekliklerine karşı tepkisini belirlemek amacıyla yapılmıştır. A.Ü. Ziraat Fakültesi Tarla Bitkileri Bölümü seralarında yapılan çalışmada; genç çayır kelp kuyruğu bitkilerinin dikili olduğu saksılar, 1997 yılının ilkbaharında 86 gün boyunca 15 cm yüksekliğie eriştiklerinde 2.5, 5.0, 7.5 ve 10.0 cm yükseklikten biçilmişlerdir. Saksılara herhangi bir gübre verilmemiş, gerektiğinde sulamaları yapılmıştır. Her biçimden elde edilen yeşil yem tartılarak kaydedilmiştir. Çalışmaya kontrol bitkilerinin başaklanmaya başladığı anda son verilmiştir. Saksılardaki toprak yıkandıktan sonra bitkilerin kökleri 70 ^{0}C'de 24 saat kurutulup tartılarak kaydedilmiştir. Çalışmanın sonuçlarına göre; 2.5 cm yükseklikten biçilen bitkiler en az yararlanılan yem, toplam yem ve kök verimi vermiştir. Deneme boyunca bitkiler 7 ile 12 kez biçilmişlerdir. Biçim yüksekliği arttıkça biçim sayısı da artmıştır. 2.5 cm'den biçilen bitkiler en az sayıda kardeş oluşturmuştur. Hafif otlatmayı temsil eden 7.5 ve 10 cmyükseklikten biçilen bitkiler en yüksek yeşil yem ve kök verimini ve kardeş sayısını sağlamışlardır. Dipten biçmenin en olumsuz etkisi kök gelişmesi üzerine olmuştur. 2.5 cm yükseklikten biçilen bitkiler kontrol bitkilerine göre 6 kez daha az kök gelişmesi yapmışlardır. 7.5 ve 10 cm yükseklikten biçilen bitkilerin verimleri arasında önemli bir fark bulunmamıştır. Biçim yüksekliği arttıkça yem verimi, biçim sayısı, kardeş sayısı, kök verimi artmıştır. Aşırı otlatma veya biçme çayır kelp kuyruğunun gelişmesini yavaşlatmıştır.

Anahtar Kelimeler: *Phleum pratense*, biçme yüksekliği, yeşil yem, kök, kardeşlenme

Introduction

Rangelands are important in the agriculture of the rural areas in Turkey. They produce less forage than is potentially available. Excessive grazing has led to a number of desirable plants disappearing because those plants could not tolerate uncontrolled continuos grazing practised for many years. Wolf plants have invaded places left vacant by these desirable plants. Some desirable plants that have tolerated this heavy and early grazing have lost their vigour. As long as these grazing practises continue, rangelands' tremendous potential will not be realised in practise.

The impact of excessive and early grazing on the range plants has been investigated in Turkey and around the world. Many researchers have investigated grazing through clipping experiments. Results indicate that heavy grazing causes plants to produce less forage and also reduces root development (Weaver 1950, Crider 1955 in Ertan 1991). Excessive grazing leads plants to develop relatively small root systems. Plants with small root system are not able to produce ample forage. Root and stem are connected so vitally that any effect on either one affects the other (Wagner 1952, Kacar 1983)

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The use of grasses as groung cover to improve eroding land as well as a source of forage has received much attention. The amount of root material produced is an important consideration in the use of grasses for soil conservation purposes.

Timoty grass (*Phleum pratense* L.) is a native grass in all regions of Turkey except South Eastern Anatolia (Doğan 1985). Various climatic and soil conditions affect its growth pattern. It is recommended for inclusion in seed mixture used to establish ranges artificially in all parts of Turkey (Bakır 1985). This plant is a productive and palatable source of forage for livestock (Elçi and Açıkgöz 1993).

In this study the effect of heavy grazing on various characteristics of timothy grass has been examined.

Material and Method

General

The timothy grass line developed at the Agronomy Department of Agricultural Faculty of Ankara University was the source of the plant material used in this study. Plants necessary for the experiment were obtained from the Forages Nursery at the Department. It was a greenhouse experiment. The soil used in the experiment consisted of a mixture of two parts greenhouse compost and one part sand (Bakır 1969, Ertan 1991, Akalın 1992). In the early spring of 1997 plants were taken from the nursery. Then, clones with two to three stems were produced from the plant. To obtain a homogeneous plant population, all clones planted in pots were taken from the same plant in the nursery. All pots were watered after planting. Plants were checked after a week to determine viability. Twenty pots with healthy plants were chosen. The experiment was designed in a randomised complete block with 4 replications (Düzgüneţ et al. 1983). The plants were divided into four groups based on their stage of development with regard to reaching the height of 15 cm. A pot from each development group was chosen for each clipping treatment. One pot from each group was left as control plant.

Measurements

Timothy grass is a medium size plant (Hughes et al. 1953). The optimum clipping or grazing height for this type of plants is 15 cm (Bakır 1987). When plants reach this height, grazing will not impair development. This height is also suitable for livestock grazing (Bakır 1987). When all plants reached 15 cm, one of the five groups cut dbwn to a 2.5 cm height and fresh forage from each pot was bagged. The same process was applied to the other groups at 5.0, 7.5, and 10.0 cm. One group was left as a control. Fresh forage from each pot was immediately weighted and recorded.

Pots were watered whenever soil surface was dry during the experiment. Plants were measured daily and clipped if they reached their clipping height. When the control plants had spikes, indicating grazing readiness, the experiment was terminated. Termination occurred on the 86th day after the experiment was initiated. A procedure used by many researchers (Bakır 1969, Ertan 1991, Akalın 1992) and considered standard was used to determine usable and total forage yields. Total forage yield calculated adding amount of stubble in each pot to the usable forage. Before washing the roots free of soil, each pot was soaked in the water until saturated. The soil was then removed by placing the roots in a stream of tap water from a hose. Above and below ground parts of each plant were separated with a scissors. Fresh roots were dried in an oven at 70 ^{0}C for 24 hours before weighting. Results were subjected to an analysis of variance (Düzgüneţ et al. 1983 using Systat Statistical Software.

Results and Discussion

Number of cutting

The mean of the number of cuttings and the mean of the amount of green forage obtained from each cutting are shown in Table 1. The higher the cutting height the higher the number of cuttings (Figure 1). During the 86 days in which the experiment was conducted, plants cut down to 2.5 cm gave forage 7 times. Plants cut to 5 cm, 7.5 cm and 10 cm gave forage 9, 11 and 12 times respectively. In a similar study on *Agropyron intermedium*, which is also a cool season grass, forage was produced 9 to 14 times depending on the cutting height (Ertan 1991). As a rhizomatous plant, *A. intermedium* persists in unfavour-able conditions and heavy grazing better than timothy grass does (Gençkan 1983, Elçi and Açıkgöz 1993). Producing a higher number of cuttings is a desirable characteristic for range plants. It helps managers regulate the grazing on a particular rangeland by extending the grazing period.

Usable forage yield

Of the cutting heights studied, a height of 2.5 cm had the greatest effect usable forage (Table 2). Newell and Keim (1947), Bakır (1987) found that cutting height affects the total usable forage yield within a growing season. Plants cut to 7.5 cm and 10.0 cm gave the highest total usable forage. These plants, representing moderate grazing, produced 2 times more forage than the plants in the other treatments. Usable forage is defined as the amount of forage that can be obtained from a grazing area governed by range management rules. In this case, forage for the 7.5 and 10.0 cm heights were lower than the other groups in the earliest cuttings. However, usable forage levels in the groups cut to 7.5 and 10.0 cm were higher comparatively in later cuts. In contrast to these groups, plants cut to 2.5 cm gave higher yields in the first cutting, but lower yields during subsequent cuttings (Figure1).

Plants cut or grazed closely to the soil surface perform a slower growth, hence produce less forage (Conard and Bakır 1958 in Bakır 1987).

Table 1. Number of cutting and amount of usable forage (g/plant) obtained from timothy grass cut to different heights

Cutting height	1. cut	2. cut	3. cut	4. cut	5. cut	6. cut	7. cut	8. cut	9. cut	10. cut	11. cut	12. cut	Total
10,0 cm	16.37	12.00	9.37	6.94	6.06	4.96	4.57	4.08	3.60	3.02	2.18	1.81	74.96
7.5 cm	17.27	10.48	8.57	7.17	5.88	5.12	4.72	4.52	3.21	2.91	2.27	0.00	72.22
5.0 cm	19.77	11.47	5.92	5.41	4.43	4.01	3.75	3.31	2.37	0.00	0.00	0.00	60.44
2.5 cm	22.7	8.30	5.15	2.53	1.63	1.2	0.96	0.00	0.00	0.00	0.00	0.00	42.47

Table 2. Usable forage yield, total forage yield, tiller number, dry root weight and number of days to cutting readiness of timothy grass cut to different heights(*)

Cutting heights	Usable forage yield (g/plant)	Total forage yield (g/plant)	Tiller number	Dry root weight (g/plant)	Day number to cutting readiness
2.5 cm	42.47 C c	46.63 C c	23.74 B b	2.02 C b	12.3
5.0 cm	60.44 B b	68.68 B b	54.00 A a	4.11 BC b	9.50
7.5 cm	72.22 A a b	86.34 A a	57.00 A a	6.12 B ab	7.80
10 cm	74.96 A a	93.71 A a	50.75 A a	9.31 A a	7.2
LSD (0.05)	8.63	8.46	12.65	2.87	
LSD (0.01)	12.00	12.15	18.18	4.12	

(*) Means followed by the same capital letter do not differ significantly at the 95% level and by the same lowercase letter at the 99% level, according to Duncan's multiple range test

Figure 1. Additional usable forage yields of plants cut to different heights

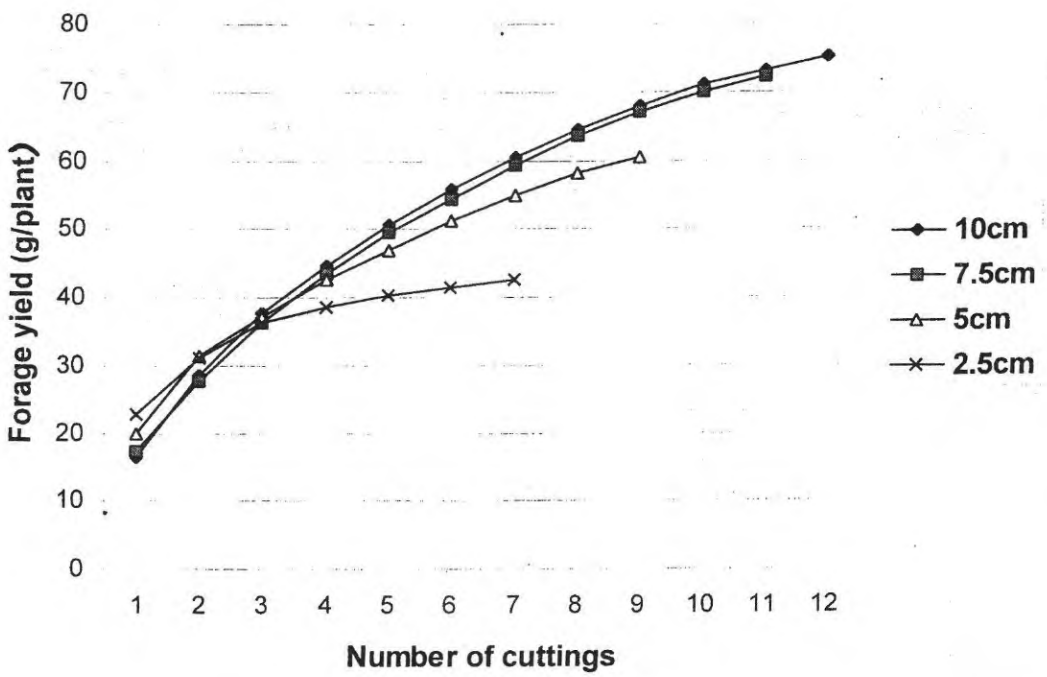

Table 4. Means and indices of various characteristics of plants cut to different heights

Characteristics	Cutting heights				
	2.5 cm	5.0 cm	7.5 cm	10 cm	Control
Usable forage (g)	42.47	60.44	72.22	74.96	148.41
Index (%)	100	142	142	176	349
Total forage (g)	46.63	68.68	86.34	93.71	163.93
Index (%)	100	147	185	200	351
Tiller number	23.74	54.00	57.00	50.57	82.35
Index(%)	100	227	240	213	345
Root weight (g)	2.02	4.11	6.12	9.31	12.35
Index (%)	100	203	303	461	611

Total forage yield: The total forage yield result and usable forage result are highly related. In general, the shorter the plant was cut, the less top growth it produced. Plants cut to 2.5 cm produced the least total forage in this experiment. This related to studies showing that excessive grazing in the early spring, year after year weakens cool-season perennial grasses (Young and Allen 1997). Plants cut to 7.5 cm and 10 cm gave the highest forage yield in this experiment. They produced 2 times more fresh forage than other plants. Leaving sufficient plant at every cutting or grazing helps plant produce more forage. The total leaf area per unit is the most critical factor limiting photosynthesis in range plants (Bakır 1987). Plants bearing sufficient leaves can regenerate easily and produce abundant biomass after cutting or grazing in proper environmental conditions. In this experiment, the more plant material that allowed to remain on the plant after cutting, more forage was produced.

Tiller number

There were significant differences among the plants with regard to tiller number. Plants cut to 2.5 cm had the lowest tiller number. Wagner (1952) and Tükel et al. (1996) also found that lower clipping heights decreases the number of tiller. The other 3 cutting treatments fell within the same range for tiller number. Higher tiller numbers in range plants increases forage yield of a unit area. Tillering is not a reproduction type. It does not produce new plants, but it increases the number of stems and size of the plant so that it covers a larger soil area.

Tillering helps the soil keep in place tightening the vegetation. Under the heavy grazing conditions, plants with lower tiller number produce less forage.

Root development

There were significant differences among the dry root weights of plants, among the different heights. Plants produced more root weight when they cut to 7.5 and 10.0 cm. Both groups cut to 2.5 and 5.0 cm produced less root weight in this experiment. Lower cutting heights caused less dry root weight. Tosun (1967), Bakır (1969), Bakır (1987), Ertan (1991) also found that cutting heights affect plant development and production. The above and below ground parts of plants are directly dependent upon each other for their growth and presence. As Wagner (1952) found, any change in one system has a direct bearing on its counterpart. Kacar (1983) also found that there is a strong correlation between the root and shoot development. Plants cut relatively high generated more growth and produced larger root systems.

Comparison with control plants

In every case the greatest yield of both top growth and below growth parts was obtained from those plants that were not clipped until the completion of the trail. When compared with control plants the clearest effect of deep cutting was observed on root development (Table 3). Plants cut to 2.5 cm produced 6 times less root than the control plants did during the experimental period. Heavy cutting also showed a substantial reducing effect on other plant characteristics, showing almost 3 times less development when compared with the control plants. Heavy grazing affects both plant development and root growth though the later is the most heavy affected. Frequently and heavy clipping has a greater reducing effect on root development than above ground production (Carter and Law 1948, Tosun 1971). These results also agree with Wagner (1952) who found that although root systems have been studied less intensively than tops, there is some evidence that the roots of forage species may be more seriously affected than the tops by certain grazing and clipping practises.

The results obtained in this study show that clipping affected top and root growth as well as tiller development of timothy grass. Heavy clipping usually reduced root growth more than top growth.

Acknowledments

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