

Dry Matter Yields and Some Quality Features of Alfalfa (*Medicago sativa* L.) Cultivars under Two Different Locations of Turkey

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ADF

Abstract: This research was conducted to determine the dry matter yields and some quality features of alfalfa cultivars in Ankara and Isparta locations of Turkey. In this study, six alfalfa cultivars, (Daisy, Prosementi, Savas, Bilensoy, Gea) which one of them is candidate were tested in the randomized block design with three replications in 2007-2009 growing seasons. According to the results, significant differences were determined in terms of plant height, main stem diameter, stem number, dry matter yield, crude protein ratio, ADF and NDF contents of alfalfa cultivars. The highest plant heights were determined from Candidate and Prosementi in Ankara, Candidate, Bilensoy and Prosementi in Isparta. The highest stem numbers were determined in Prosementi, Bilensoy and Candidate in Isparta location. Daisy and Candidate had the highest crude protein content and they had the lowest NDF and ADF contents in both locations of the study. While the highest dry matter yield was obtained from Candidate in Ankara, it was obtained from Candidate and Daisy in Isparta. At the end of the study, for the high dry matter yield and quality candidate cultivar is more suitable for Ankara, while candidate and daisy cultivars are more suitable for Isparta location.

Türkiye'nin İki Farklı Lokasyonunda Bazı Yonca (*Medicago sativa* L.) Çeşitlerinin Kuru Madde Verimi ve Kalite Özelliklerinin Belirlenmesi

Anahtar kelimeler

Yonca,
Çeşit,
Kuru madde verimi,
Ham protein oranı,
NDF,
ADF

Özet: Bu çalışma yonca çeşitlerinin kuru madde verimleri ile bazı kalite özelliklerini belirlemek amacıyla Ankara ve Isparta lokasyonlarında yürütülmüştür. Araştırmada, 5 çeşit (Daisy, Prosementi, Savas, Bilensoy, Gea) ve bir aday çeşit olmak üzere 6 adet yonca varyetesi yer almıştır. Deneme tesadüf blokları deneme deseninde 3 tekerrürlü olarak 2007-2009 yıllarında yürütülmüştür. Araştırmadan elde edilen sonuçlara göre yonca çeşitlerinin bitki boyu, ana sap kalınlığı, dal sayısı kuru madde verimi, ham protein oranı, ADF ve NDF oranları arasında önemli farklılıklar belirlenmiştir. En yüksek bitki boyu Ankara lokasyonunda aday çeşit ve Prosementi çeşidinde belirlenirken, Isparta lokasyonunda aday çeşit, Bilensoy ve Prosementi çeşitlerinde belirlenmiştir. Bitki başına en yüksek dal sayısı değerleri sırasıyla Prosementi, Bilensoy ve aday çeşitte Isparta lokasyonundan elde edilmiştir. Çalışmanın her iki lokasyonunda da en yüksek ham protein oranı ve en düşük NDF ve ADF oranları Daisy ile aday çeşitte belirlenmiştir. En yüksek kuru madde verimi Ankara lokasyonunda aday çeşitten elde edilirken Isparta lokasyonunda aday çeşitle birlikte Daisy çeşidinden elde edilmiştir. Çalışmadan elde edilen bulgular doğrultusunda kuru madde verimi ve kalite birlikte değerlendirildiğinde Ankara lokasyonu için aday çeşidin uygun olduğu buna karşın Isparta lokasyonu için aday çeşitle birlikte Daisy çeşidinin daha uygun olduğu sonucuna varılmıştır.

1. Introduction

Alfalfa is one of the most important forage crop in Turkey and world, so alfalfa named “queen of the forages crops” in Turkey. It has high feeding value for animals of all commonly grown hay crops. It is not grazed as it causes bloat in dairy farms. It is cut-air-dried and storages for winter consumption in Turkey. It produces more protein per hectare than the many other forage or grain crops. Alfalfa has a high mineral content and contains at least 10 different vitamins; therefore, it is an important source of vitamins [1].

Alfalfa species have a very wide adaptation capability in different ecological conditions. For example, some cultivars are extremely resistant to low temperature, contrarily; some are adapted to hot climatic conditions. Therefore, it is important to find the alfalfa varieties suitable for different ecological regions, while the enlargement of alfalfa planting areas with high yield and quality is necessary. The aim of this study is to determine on forage yield and quality of some alfalfa cultivars in Ankara and Isparta locations of Turkey

2. Material and Method

Experimental site: The experiments were established in Ankara location (39° 57' N, 32° 53' E, 848 m elevation) and Isparta (37° 45' N, 30° 33' E, elevation 1,035 m), during the years 2007, 2008 and 2009. The major soil characteristics of the study areas, based on the method described by Rowell [2] were found to be as follows. The soil texture was clay loam at Isparta and silty clay loam at Ankara, organic matter were 1.2% and 1.78% Isparta and Ankara respectively by the Walkley-Black method. Total salt was 0.35% and 0.12%, lime was 7.1% and 6.35%, by Schiebler calcimeter, extractable P was 3.4 and 5.68 mg kg⁻¹ by 0.5N NaHCO₃ extraction, exchangeable K was 113 and 158 mg kg⁻¹ and pH in a soil saturation extract was 7.8 and 8.1 in Isparta and Ankara respectively.

The total amount of precipitation during the years 2007, 2008, and 2009 were 306 mm, 324 mm, and 460 mm in Ankara and 429 mm, 294 mm, and 667 mm in Isparta respectively [3]. The means of the temperature and relative humidity during the experimental period were close to the mean of long years.

Experimental design and plant material: In the study, six alfalfa cultivars, one of them is candidate, were used as research materials. Candidate, Daisy, Prosementi, Savas, Bilensoy and Gea (*Medicago sativa* L.) alfalfa cultivars obtained from Ankara University, Faculty of Agriculture Department of Field Crops Seed Bank.

The experimental design was a randomized complete block with three replications. Each plot consisted of 8 rows of 5 m length. Row spacing was 20 cm. Seeding rate was 2 kg da⁻¹ for all cultivars. Sowing was made

by hand in April 2007 both locations in Ankara and Isparta. 4 kg da⁻¹ nitrogen and 8 kg da⁻¹ phosphorus fertilizers applied during the sowing.

Besides, in the 2nd and 3rd years of experiment 8 kg da⁻¹ phosphorus was applied. Study was conducted in irrigated conditions so plants were irrigated regularly by sprinkles. Plant heights, main stem diameters and stem numbers were measured before the harvests. Harvests were made by hand at the 10% flowering stage. Cuttings were done at 8-10 cm stubble height. In 2008, there were six cuttings in Ankara and five cuttings in Isparta and there were five cuttings in the year 2009 in both locations. The experiment was not harvested during the establishment season in 2007.

Chemical and data analysis: After all plots had been harvested, a 500-550 g sample was taken from each plot. Than the samples were dried at 70°C for 48 h and weighed, later dry matter ratio was found by using dried samples. Dry matter yields were calculated by using green herbage yield and dry matter ratio. The dried samples were reassembled and grounded to pass through an 1 mm sieve. Crude protein content was calculated by multiplying the Kjeldahl nitrogen concentration by 6.25 [4]. ADF (Acid detergent fiber) and NDF (Neutral detergent fiber) concentrations were determined by using standard laboratory procedures of forage quality analysis outlined by Ankom Technology [5].

Data, obtained from the research were analysed by using the standard analysis of variance technique and means were separated by using the comparisons based upon the least significant difference (LSD 0.05) by using GLM producers of SAS (1998).

3. Results and Discussion

Some morphological properties of alfalfa cultivars in Ankara and Isparta locations are shown in Table 1. Both years and locations of the study regarding of plant height, statistically significant differences were found at P≤0.05 level among the cultivars. The plant heights of cultivars ranged from 48.00 to 73.38 cm in Ankara and 60.88 to 75.75 cm in Isparta locations at average of two years. The highest plant heights were determined on Candidate (73.38 cm) and Prosementi, (68.25 cm) cultivars in Ankara, while the highest plant heights were observed Candidate (75.75 cm), Bilensoy (72.88 cm) and Prosementi, (71.38 cm) cultivars in Isparta location as average of two years. The lowest plant height was determined on Daisy cultivar in both locations and years of the study (Table 1). Our results are same with the Tucak *et al.* [6] founding. Acikgoz [7] stated that plant height of alfalfa cultivars could vary depending on their genetic, ecological conditions and cutting stages.

Main stem diameters of cultivars were not statistically different in Ankara location but Isparta location was different at P≤0.05 level. The values ranged from 2.55 to 2.71 mm in Ankara and 2.61 to

2.85 mm in Isparta location. All cultivars except for Candidate and Savas have statically been in similar group in Isparta location. The thinnest main stem diameter was determined in Prosementi, (2.55 mm) in Ankara and Daisy (2.61 mm) cultivar in Isparta (Table 1). Cultivars were shown different performance in terms of main stem diameter in these two different ecological conditions. Also Demiroglu *et al.* [8] reported that main stem diameters of the alfalfa cultivars could vary in different locations. Stem numbers of cultivars changed from 17.25 to 20.00 per

plant and all varieties were not statistically different at average of two years in Ankara location. However; there were statically significant differences at $P \leq 0.05$ level in Isparta location. The highest stem number observed from Prosementi (18.50) cultivar in Isparta, also Bilensoy and Candidate was in the same statistical group with Prosementi. The Gea variety had the lowest stem number (14.00) and it was in the same statistical group with Savas and Daisy cultivars (Table 1).

Table 1. Some morphological properties of alfalfa cultivars in Ankara and Isparta locations.

	Ankara			Isparta		
	2008	2009	Mean	2008	2009	Mean
Plant height (cm)						
Candidate	64.25 a	82.50 a	73.38 a	69.75 a	81.75 a	75.75 a
Daisy	41.00 c	55.00 d	48.00 c	53.75 d	68.00 bc	60.88 b
Prosementi	62.25 a	74.25 ab	68.25 ab	66.50 ac	76.25 ac	71.38 a
Savas	45.00 bc	61.50 cd	53.25 c	60.25 cd	69.00 bc	64.63 b
Bilensoy	54.50 ab	73.75 ab	64.13 b	68.25 ab	77.50 ab	72.88 a
Gea	56.25 a	70.75 bc	63.50 b	61.25 bc	67.25 c	64.25 b
CV (%)	13.38	9.18	11.04	7.61	9.11	8.52
Main stem diameter (mm)						
Candidate	2.29 a	2.90	2.59	2.69	2.99	2.85 ab
Daisy	2.17 b	3.03	2.60	2.44	2.78	2.61 b
Prosementi	2.23 ab	2.87	2.55	2.55	2.78	2.67 b
Savas	2.20 b	3.17	2.68	2.95	3.43	3.19 a
Bilensoy	2.23 ab	2.89	2.56	2.52	3.01	2.77 b
Gea	2.22 ab	3.19	2.71	2.38	2.86	2.62 b
CV (%)	2.11	17.45	14.25	11.04	13.07	12.26
Stem number (per plant)						
Candidate	19.25	20.75	20.00	16.75 ab	17.75 ab	17.25 a
Daisy	16.25	18.25	17.25	14.50 bc	14.75 bc	14.63 b
Prosementi	18.75	19.50	19.13	17.75 a	19.25 a	18.50 a
Savas	18.75	18.50	18.62	13.25 c	14.25 c	13.75 b
Bilensoy	17.00	20.00	18.50	17.75 a	18.00 ab	17.88 a
Gea	17.25	17.25	17.25	13.25 c	14.75 bc	14.00 b
CV (%)	18.61	11.54	15.27	12.01	13.49	12.82

Means followed by the same letters are not statistically significant $P \leq 0.05$

According to the our results, there were statistically significant ($P \leq 0.05$) differences among the cultivars about crude protein content in both locations. Crude protein contents of cultivars varied from 15.14 to 18.56% in Ankara and 16.28 to 19.13% in Isparta location. Candidate and Daisy had the highest value both in Ankara and Isparta location at average of crude protein content of cultivars. On the contrary, Savas cultivar had the lowest crude protein content in both locations. Some researchers reported that the crude protein contents of alfalfa had been varying from 12.60 to 20.26 [9; 10; 11; 12; 13; 14; 15]. Our findings were in same with these results but they were lower than the data which were found by Tucak *et al.* [16], Grewal and Williams [17] and Tongel and Ayan [18]. The differences between our results may be caused from cutting stage, drying methods, climatic and environmental conditions [7].

NDF contents of alfalfa cultivars in two locations and years have shown in Table 2. Our results showed that

there were significant differences at $P \leq 0.05$ level among the cultivars. NDF contents were between 43.46 and 48.47% in Ankara and 42.08 and 46.81% in Isparta at average of two years. Savas had the highest NDF content in both locations. However, candidate had the lowest NDF content cultivar in both Ankara and Isparta locations (43.46% and 42.08% respectively). Our results were similar with the data which were revealed by Canbolat and Karaman [19] as 42.51% and 49.46% revealed by Cerci *et al.* [20], but the were higher than 31.4-38.0 % stated by Tremblay *et al.* [21] and 34.58-41.02% belonging to Tucak *et al.* [16]. Also our results were lower than Sehu *et al.* [22] and Sayan *et al.* [23]. Differences in the NDF contents might be resulted from the cutting stage of the plants. It is known many quality parameters of alfalfa such as NDF, ADF and crude protein contents are affected the cutting stages. There were statistically significant differences regarding ADF contents of cultivars at $P \leq 0.05$ level

(Table 2). ADF contents of cultivars changed from 33.16 to 35.21% in Ankara and 31.33 to 34.92% in Isparta location at average of two years. Savas cultivar had the highest ADF content (35.21%) and statistically indifferent from Bilensoy, Gea and Prosementi cultivars in Ankara location. Candidate cultivar had the lowest (33.16%) ADF content and it was in the same statistical group with Daisy. On the other hand, Savas cultivar had the highest ADF content (34.92%) in Isparta location and was not statistically different from Gea (34.70%). The lowest ADF content value was determined on Candidate variety in Isparta location at average of two years.

Tucak *et al.* [16], reported that ADF content of alfalfa cultivars varied between 30.16 and 35.91% and also Cerci *et al.* [20] and Tessema and Baars [24], determined the ADF content of alfalfa as 36.34% and 36.2% respectively. These results are insimilar with our findings. However, Canbolat and Karaman [19] and Tremblay *et al.* [21] determined the ADF contents of alfalfa as 28.87% and between 26.4-32.5% respectively. These results are lower than our findings, but the results of Sehu *et al.* [22] are higher than ours (40.09%). Also, this differences may be related with the harvesting stage of the plants like in the NDF contents. It was reported that with the increasing maturation, NDF and ADF contents increase and digestibility decreases [25].

Table 2. Some quality parameters of alfalfa cultivars in Ankara and Isparta locations.

	Ankara			Isparta		
	2008	2009	Mean	2008	2009	Mean
Crude Protein (%)						
Candidate	18.74 a	18.38 a	18.56 a	19.70	18.34 a	19.02 ab
Daisy	19.47 a	17.56 ab	18.51 a	20.63	17.64 ab	19.13 a
Prosementi	18.53 a	16.34 bc	17.58 b	18.69	16.63 bc	17.66 c
Savas	15.19 c	15.09 d	15.14 d	17.66	14.90 d	16.28 d
Bilensoy	18.48 ab	16.09 cd	17.28 bc	18.41	16.10 cd	17.26 cd
Gea	17.21 b	15.84 cd	16.52 c	18.68	17.15 ac	17.91 bc
CV (%)	4.86	5.62	5.22	6.64	5.44	6.15
NDF (%)						
Candidate	42.51 c	44.42 c	43.46 e	41.34 c	42.81 c	42.08 e
Daisy	42.97 c	46.79 b	44.88 d	42.67 bc	42.83 c	42.75 de
Prosementi	43.84 bc	47.59 ab	45.71 cd	43.75 b	48.79 a	46.27 ab
Savas	47.72 a	49.21 a	48.47 a	46.20 a	47.42 ab	46.81 a
Bilensoy	44.82 b	48.31 ab	46.56 bc	43.85 b	44.76 bc	44.30 cd
Gea	45.51 b	49.08 ab	47.39 ab	42.46 bc	47.04 ab	44.75 bc
CV (%)	2.57	3.21	2.93	2.58	5.03	4.06
ADF (%)						
Candidate	32.18 c	34.13	33.16 c	30.50 c	32.16 d	31.33 c
Daisy	32.89 bc	35.19	34.04 bc	32.03 bc	32.99 cd	32.51 b
Prosementi	33.64 ab	34.99	34.32 ab	32.53 ab	34.27 b	33.40 b
Savas	34.83 a	35.59	35.21 a	33.97 a	35.87 a	34.92 a
Bilensoy	33.99 ab	35.04	34.52 ab	33.09 ab	33.63 bc	33.36 b
Gea	34.12 ab	35.53	34.82 ab	32.50 ab	36.91 a	34.70 a
CV (%)	2.86	3.59	3.26	3.64	2.18	2.96

Means followed by the same letters are not statistically significant $P \leq 0.05$

Dry matter yields of alfalfa cultivars are shown in Table 3. According to the our results, statistically significant differences were determined among the cultivars in point of dry matter yields. Dry matter yields of cultivars varied between 2845 and 3339 kg da⁻¹ in Ankara and 2032 and 2617 kg da⁻¹ in Isparta location at average of two years.

The highest dry matter yield was obtained from Candidate cultivar as 3339 and 2617 kg da⁻¹ in both locations respectively. Candidate and Daisy were statistically indifferent in Isparta, but Candidate and Daisy were different in Ankara. This is because the cultivars show different performance due to the climatic conditions of locations. Savas had the lowest dry matter yield (2845 and 2032 kg da⁻¹ respectively)

in both locations. Results of Altinok and Karakaya [12] and Tongel and Ayan [18] are similar to our results 3214 kg da⁻¹ and 1869-2858 kg da⁻¹ respectively. Researchers have conducted many studies with alfalfa cultivars in different ecological conditions. They revealed the dry matter yields as follows: Metochis and Orphanos [26] 1770 - 2150, Sevimay [27] 1530 - 2200, Colombari *et al.* [28] 1320 - 1680, Sengül and Tahtacioglu [29] 980 - 1800, Cevheri [30] 1063 - 1232, Aka and Avcioglu [31] 1153 - 1473, Annicchiaro, [32] 1384 - 1490 and Tucak *et al.* [16] 1502 - 2046 kg da⁻¹. These results are lower than our findings. It is understood that the variation of dry matter yields caused from different cultivars and ecological conditions.

Table 3. Dry matter yields of alfalfa cultivars in Ankara and Isparta locations (kg da⁻¹).

	Ankara			Isparta		
	2008	2009	Mean	2008	2009	Mean
Candidate	3883 a	2794 a	3339 a	2551 a	2684 a	2617 a
Daisy	3410 b	2465 c	2937 cd	2424 a	2604 a	2514 ab
Prosementi	3512 b	2665 b	3089 b	2571 a	2341 b	2456 bc
Savas	3263 b	2427 c	2845 d	2108 b	1956 c	2032 d
Bilensoy	3427 b	2706 ab	3067 bc	2061 b	2615 a	2338 c
Gea	3413 b	2676 b	3044 bc	1955 b	2176 b	2066 d
CV (%)	5.06	2.75	4.41	6.12	5.14	5.63

Means followed by the same letters are not statistically significant $P \leq 0.05$

4. Conclusion

According to our results; Candidate genotype had the highest dry matter yields 3339 and 2617 kg da⁻¹ in Ankara and Isparta respectively and also Daisy was statistically in the same group in Isparta location. The lowest dry matter yield was obtained from Savas cultivar in both locations and Gea was not statistically different from Savas in Isparta location. Candidate (18.56-19.02%) and Daisy (18.51-19.13%) cultivars had the highest CP contents in Ankara and Isparta locations respectively. In both locations, the lowest CP content was determined on Savas. Candidate gave the lowest NDF and ADF contents; however, Savas gave the highest NDF and ADF contents in both locations. It is obvious that Candidate and Daisy cultivars are continuously superior about many morphological and quality parameters among the cultivars. The results of two years, the candidate cultivar can be preferable for Ankara while candidate and daisy cultivars can be preferable for Isparta location for high dry matter yields and quality.

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