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Seasonal changes of quantitative and qualitative performances of some alfalfa cultivars in the Mediterranean coastal part of Aegean Region

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SUMMARY – This study was conducted in order to determine the effect of different cutting times on the quantitative and qualitative performances of some alfalfa cultivars under Bornova-Izmir/Turkey ecological conditions during different growing seasons of 1997 and 1998. Five different alfalfa cultivars (ABP-987, NS-2011, NS-2022, NS-2020, Pioneer 5715) and three cutting times (late April, mid July and late October) were the factors tested in the study. The two-year average indicated that spring cuttings gave higher green and dry matter yield and higher quality than summer and autumn harvests. There were significant differences among alfalfa cultivars with regard to yield characteristics however no significant qualitative differences, except crude cellulose content were observed.

Key words: Alfalfa, green herbage, dry matter content, protein, ash, cellulose, Ca, P.

RESUME – *"Variation saisonnière de la qualité et de la production de variétés de luzerne dans la zone côtière de la région égéenne". Cette recherche a été menée en vue de déterminer l'effet de différentes fenaisons sur les performances qualitatives et quantitatives des certaines espèces de luzerne dans les circonstances écologiques de Bornova/Izmir en 1997-1998. Les facteurs examinés durant ce travail étaient cinq espèces différentes de luzerne (ABP-987, INS-2011, NS-2022, NS-2020, Pioneer 5715) et trois fenaisons (avril tard, milieu de juillet, octobre tard). La moyenne des deux années a montré que les fenaisons printanières assuraient plus de matériels verts, plus de matières sèches et plus de qualité que celles d'été et d'automne. Il existait d'importantes différences parmi les espèces de luzerne du point de vue des caractéristiques de rendement, pourtant on n'a pas pu constater de différence qualitative, excepté le contenu en cellulose brute.*

Mots-clés : *Luzerne, herbe verte, rendement en matière sèche, protéine, cendre, cellulose, Ca, P.*

Introduction

The yields of farm animals are very low in Turkey because of the shortage of forage sources and the low yields of oriental breeds. The acreage of forage crops is quite limited, 3% of the whole-cultivated area, although it is the most significant feed source following natural pastures and meadows in the country. In addition to some other factors (social, cultural and economic obstacles), the shortage of forages and their low quality are among the reasons (Avcioglu *et al.,* 1995; Avcioglu and Budak, 1999). Considering the limited forage production and the unproductive structure of the animal husbandry sector, it seems reasonable to stress that alfalfa cultivation could be one measure to solve the problem in the country.

Materials and methods

The field studies were conducted during the 1997 and 1998 growing season on a silty-clay loam soil with 7.8 pH in the Bornova experimental area in Ege University (27ºE, 38ºN) located at about 2 m a.s.l. with typical Mediterranean climate characteristics. Meteorological data in 1997 and 1998 were monthly mean temperature 16.8-17.7ºC, monthly total precipitation 616-839.4 mm, monthly mean relative humidity 59-61%, monthly mean duration of sunshine 8.0-7.5 h/day, respectively. 5 alfalfa cultivars (C) (ABP-987, NS-2011, NS-2022, NS-2020, Pioneer 5715) and 3 cutting times (CT) (late April, mid July, late October) based on seasonal changes were applied. The experimental design was a split plot arrangement of a randomized complete block with 4 replications. The cutting times were main plots, and cultivars were sub-plots. Each sub-plot consisted of 10 rows 20 cm apart and 5 m in length. All cultivars were sown on 15th

February 1997 in the field whose previous crop was perennial rye grass. 25 kg/ha N fertilizer was applied as starting rate and also 80 kg/ha P_2O_5 and 70 kg/ha K_2O according to the soil test. All plots were irrigated through the growing season using 80 mm water for each application. The plots were harvested at 10-25% blooming stage during the season, and only 3 of them were chosen as cutting times as mentioned before. Samples were measured in terms of different characteristics such as plant height, green herbage yields, dry matter, crude protein, crude ash, crude cellulose, calcium and phosphorous contents. In variation analysis, the least significant difference test was performed using the data related to alfalfa cultivars and cutting practices for each year and 2 year average.

Results and discussion

The results of the effect of seasonal cutting practices and cultivars on the qualitative and quantitative performances of alfalfa cultivars are presented in Table 1.

The highest plant height was observed in spring cuttings and control alfalfa, Pioneer 5715 in both years. Summer cuttings gave the lowest plant height. The cutting time cultivar interaction was not significant, indicating that the alfalfa cultivars did not respond differentially to the cutting practices. It might happen that higher temperatures during the summer period reduced the development of vegetative growth causing lower plant height. Avcioglu *et al*. (1999) also indicated that many legumes are significantly affected by stress factors in Mediterranean ecologies.

There were no significant interactions in different years and two-year's average in terms of green herbage yield. NS-2022 alfalfa and spring cuttings had the higher green herbage yields than other practices and cultivars. Francis (1988) also suggested that spring cuttings are usually higher than summer and autumn cuttings in which temperature and humidity factors are closer to plants' needs.

Cutting practices significantly affected the dry matter contents whereas cultivars had no significant variation. These could be due to the genotypic characteristics of the cultivars used in the study. Autumn cuttings had the highest dry matter contents in both years whereas the spring cuttings had the lowest in both years and in two year average. These results were in agreement with Pfitzenmeyer (1963) who claimed the significance of effect of climatic changes of seasonal variations on alfalfa growth.

All cultivars and cutting times had significantly different dry matter yields, spring and autumn harvests having the highest yields in 1997 and spring and autumn having the highest yields in 1998 and in two years average. This might be due to the effect of seasonal changes in climatic parameters and partly because of the green matter yield variation among the cultivars. It is well known that dry matter yield is the composition of dry matter contents times the green matter yields of crops, NS-2022 had obviously more green matter yield than others. The same situation was also true for the cutting practices.

Cultivars and cutting practices had no significant variation in terms of crude protein content, which is a significant quality parameter for forage crops. The results indicating protein content figures were in agreement with those of Bergmann (1986) but the absence of any significant variation among cultivars and cutting practices suggested that crude protein contents of alfalfa crops changed between very short limits. These results did not confirm the studies of Avcioglu (1975) indicating that crude protein contents of alfalfa differed with regard to cultivars and cutting times.

Cultivars and cutting practices affected significantly the crude cellulose content although the interaction component was not significant in 1997. However, there were no significant differences between the cultivars and cutting practices in 1998 and in two year average except in cultivars. NS-2020 had the highest cellulose rate whereas NS-2011 had the lowest cellulose content, which is favorable for the nutritive value of material.

There were no significant differences between the cultivars and cutting practices in terms of crude ash content while cutting practices had significant variation only in two year average. The reason for having no significant variation in terms of ash content could be that all alfalfa crops were cut at similar growing stages in cutting practices. Manga (1974) indicated the effects of growth stages on the ash content of alfalfa crops.

Table 1. Effects of seasonal cutting times (CT) and alfalfa cultivars (C) in qualitative and quantitative parameters

Cultivars	1997				1998				2-year average			
	Late April	Mid July	Late Oct.	Mean	Late April	Mid July	Late Oct.	Mean	Late April	Mid July	Late Oct.	Mean
Plant height (cm)												
ABP-987	63.9	47.0	43.4	51.4	65.3	61.9	63.3	63.5	64.6	54.4	53.4	57.5
NS-2011	66.9	45.4	44.3	52.2	66.7	60.7	63.5	63.6	66.8	53.0	53.9	57.9
NS-2022	73.7	46.0	44.8	54.8	71.5	63.6	71.8	69.0	72.6	54.8	58.3	61.9
NS-2020	66.8	49.4	45.3	53.8	68.4	64.0	64.5	65.6	67.6	56.7	54.9	59.7
Pioneer 5715	72.3	49.9	47.5	56.6	72.2	65.5	67.7	68.5	72.2	57.7	57.6	62.5
Mean	68.7	47.5	45.0	53.8	68.8	63.1	66.2	66.0	68.8	55.3	55.6	59.9
LSD(%5)	CT:1.8 C:2.3 CTxC:3.9				CT:4.2 C:2.8 CTxC:ns				CT:2.4 C:2.2 CTxC:ns			
Green herbage yield (kg/1000 m^2)												
ABP-987	1172	848	1008	1009	1742	1575	1110	1476	1457	1212	1059	1243
NS-2011	1197	842	975	1004	1817	1450	943	1403	1507	1146	959	1204
NS-2022	1450	1067	1062	1193	2083	1883	1182	1716	1767	1475	1122	1454
NS-2020	1300	938	1058	1099	1925	1767	1077	1589	1613	1353	1068	1344
Pioneer 5715	1233	905	1000	1046	1813	1592	1032	1479	1523	1248	1016	1263
Mean	1270	920	1021	1070	1876	1653	1069	1533	1573	1287	1045	1302
LSD(%5)	CT:65 C:88 CTxC:ns				CT:290 C:104 CTxC:ns				CT:140 C:82 CTxC:ns			
Dry matter content (%)												
ABP-987	21.1	26.2	27.8	25.0	21.1	24.2	26.0	23.8	21.1	25.2	26.9	24.4
NS-2011	21.9	25.8	28.7	25.5	21.8	24.0	24.9	23.6	21.9	24.9	26.8	24.5
NS-2022	21.4	26.5	28.4	25.4	21.4	25.2	26.2	24.3	21.4	25.9	27.3	24.8
NS-2020	21.4	25.7	27.3	24.8	21.0	25.4	25.6	24.0	21.2	25.5	26.5	24.4
Pioneer 5715	21.8	25.5	27.4	24.9	21.4	25.1	25.3	23.9	21.6	25.3	26.4	24.4
Mean	21.5	26.0	27.9	25.1	21.3	24.8	25.6	23.9	21.4	25.4	26.7	24.5
LSD(%5)	CT:1.4 C:ns CTxC:ns				CT:0.4 C:ns CTxC:ns				CT:0.8 C:ns CTxC:ns			
Dry matter yield (kg/1000 m^2)												
ABP-987	247	223	280	250	367	382	288	346	307	303	284	298
NS-2011	263	217	280	253	396	348	235	326	329	282	257	290
NS-2022	310	283	301	298	446	475	309	410	378	379	305	354
NS-2020	278	241	289	269	405	448	276	376	341	345	282	323
Pioneer 5715	269	231	274	258	389	400	261	350	329	315	267	304
Mean	273	239	285	266	401	411	274	362	337	325	279	314
LSD(%5)	CT:27 C:23 CTxC:ns				CT:73 C:26 CTxC:ns				CT:34 C:21 CTxC:ns			
Crude protein content (%)												
ABP-987	17.87	17.17	16.97	17.34	19.22	18.51	17.81	18.51	18.55	17.84	17.39	17.93
NS-2011	17.39	17.83	18.00	17.74	19.08	17.38	17.91	18.12	18.24	17.60	17.96	17.93
NS-2022	17.64	17.83	17.43	17.64	18.60	17.99	17.54	18.05	18.12	17.91	17.49	17.84
NS-2020	17.64	18.02	18.20	17.95	18.52	19.44	18.19	18.72	18.08	18.73	18.20	18.34
Pioneer 5715	18.00	17.93	18.20	18.04	18.82	18.59	17.80	18.40	18.41	18.26	18.00	18.22
Mean	17.71	17.76	17.76	17.74	18.85	18.38	17.85	18.36	18.28	18.07	17.80	18.05
LSD(%5)	CT:ns C:ns CTxC:ns				CT:ns C:ns CTxC:ns				CT:ns C:ns CTxC:ns			
Crude cellulose content (%)												
ABP-987	21.47	19.69	22.60	21.25	26.14	25.26	25.28	25.56	23.81	22.47	23.94	23.41
NS-2011	21.51	19.87	22.50	21.29	25.14	26.05	23.83	25.00	23.32	22.96	23.16	23.15
NS-2022	22.29	20.52	22.86	21.89	25.51	25.38	24.57	25.15	23.90	22.95	23.72	23.52
NS-2020	23.12	22.42	24.81	23.45	25.78	25.81	26.16	25.92	24.45	24.12	25.48	24.68
Pioneer 5715	23.83	21.85	23.60	23.09	25.82	26.29	24.10	25.40	24.83	24.07	23.85	24.25
Mean	22.44	20.87	23.27	22.20	25.68	25.76	24.79	25.41	24.06	23.31	24.03	23.80
LSD(%5)	CT:0.52 C:1.43 CTxC:ns				CT:ns C:ns CTxC:ns				CT:ns C:0.70 CTxC:ns			

The variation of the Ca content of the cultivars and cutting practices were statistically significant in both years and in a two year average. Spring harvests contained more Ca than others and Pioneer 5715 and NS-2011 were the richest cultivars (Table 2). Kling and Wöhlbier (1983) stressed the significance of growth stage in Ca content in legumes and suggested that the Ca rate was higher when the crops matured. Our results confirms the Kling and Wöhlbier's (1983) indications.

There were significant differences between harvest times in both years and in two-year average. The cultivar cutting practices interaction was found not to be significant indicating that the alfalfa cultivars responded similarly to the cutting practices. This might be due to the genetic behavior of the alfalfa crop and the limited occurrence of phosphorous in legume tissues. These results were in agreement with those of Bergmann (1986).

Table 2. Effects of seasonal cutting times (CT) and alfalfa cultivars (C) in ash and mineral contents

Cultivars	1997				1998				2-year average			
	Late April	Mid July	Late Oct.	Mean	Late April	Mid July	Late Oct.	Mean	Late April	Mid July	Late Oct.	Mean
Crude ash content (%)												
ABP-987	10.06	9.59	9.83	9.82	9.47	8.99	9.25	9.24	9.76	9.29	9.54	9.53
NS-2011	9.62	9.23	9.58	9.48	9.11	8.74	9.28	9.04	9.36	8.99	9.43	9.26
NS-2022	9.61	9.42	9.43	9.49	8.70	8.82	9.50	9.01	9.15	9.12	9.47	9.25
NS-2020	9.52	9.65	9.83	9.67	9.92	8.82	9.08	9.27	9.72	9.24	9.45	9.47
Pioneer 5715	9.83	9.54	9.74	9.70	8.78	8.89	9.14	8.94	9.31	9.22	9.44	9.32
Mean	9.73	9.49	9.68	9.63	9.20	8.85	9.25	9.10	9.46	9.17	9.47	9.37
LSD(%5)	CT:ns C:ns CTxC:ns				CT:ns C:ns CTxC:ns				CT:0.16 C:ns CTxC:ns			
Calcium content (g/kg)												
ABP-987	16.12	14.58	15.60	15.43	16.85	16.13	14.10	15.69	16.49	15.35	14.85	15.56
NS-2011	16.40	14.61	15.33	15.45	15.17	14.15	13.33	14.22	15.79	14.38	14.33	14.83
NS-2022	16.59	13.82	14.86	15.09	14.07	13.74	14.29	14.03	15.33	13.78	14.58	14.56
NS-2020	17.23	12.98	15.98	15.39	17.88	13.91	15.49	15.76	17.55	13.44	15.74	15.58
Pioneer 5715	16.93	14.98	15.52	15.81	14.16	13.58	14.15	13.96	15.55	14.28	14.84	14.89
Mean	16.65	14.19	15.46	15.44	15.63	14.30	14.27	14.73	16.14	14.25	14.87	15.08
LSD(%5)	CT:0.81 C:ns CTxC:ns				CT:0.51 C:1.15 CTxC:ns				CT:0.56 C:ns CTxC:ns			
Phosphorous content (g/kg)												
ABP-987	1.27	1.64	1.31	1.40	1.86	1.96	1.63	1.82	1.56	1.80	1.47	1.61
NS-2011	1.39	1.57	1.47	1.48	2.19	1.77	1.75	1.90	1.79	1.67	1.61	1.69
NS-2022	1.27	1.80	1.52	1.53	1.97	1.71	1.78	1.82	1.62	1.75	1.65	1.67
NS-2020	1.20	1.49	1.35	1.35	2.16	1.73	1.71	1.87	1.68	1.61	1.53	1.61
Pioneer 5715	1.26	1.74	1.59	1.53	1.82	1.75	1.68	1.75	1.54	1.75	1.64	1.64
Mean	1.28	1.65	1.45	1.46	2.00	1.78	1.71	1.83	1.64	1.71	1.58	1.64
LSD(%5)	CT:0.07 C:0.12 CTxC:ns				CT:0.08 C:ns CTxC:ns				CT:0.06 C:ns CTxC:ns			

Conclusions

Spring cuttings had the highest yield performances, and NS-2022 cv. had highest green and dry matter yields. NS-2020 also gives better quality factors such as crude protein and crude ash. These cultivars should be screened for breeding programmes in the area and more attention should be given to the spring cutting practices of alfalfa under farm conditions.

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