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Yield, Nutritional and Chemical Properties of Some Sorghum x Sudan Grass Hybrids (*Sorghum bicolour* (L.) *Moench* x *Sorghum sudanense* Stapf.)

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Abstract: The aim of study was to compare the yield, nutritional and chemical properties of eight sorghum x sudan grass hybrid cultivars in Samsun, Turkey ecological conditions in 2007. While, late-maturing cultivars (Jumbo, Sweet Jumbo, Pacific-8386) were harvested once, early-maturing cultivars (Sugar Graze, Pacific Bmr, Chopper, Grazer N2 and Hayday) twice in the research. In terms of the highest and the lowest values, the total fresh herbage and hay yields of Jumbo (97408 kg ha^{-1}) and Pacific-8386 (23608 kg ha^{-1}) cultivars, respectively were higher than those of Chopper (50041 and 12871 kg ha^{-1}, respectively). Grazer N2 (2062 kg ha^{-1}) and Pacific 8386 (1753 kg ha^{-1}) cultivars had higher total crude protein and ash yields compared to Chopper (1007 and 936 kg ha^{-1}, respectively). However, the relative feed value of Chopper (81.53) was higher than those of Jumbo (63.78) at the first harvest due to Acid Detergent Fiber (ADF) and Neutral Detergent Fiber (NDF) ratios. The ADF and NDF ratios were 48.32 vs. 40.24% and 66.04 vs. 74.89% at first harvest. The Ca/P and K/(Ca+Mg) ratios of studied cultivars changed from 1.43-3.19 and from 1.77-2.64, respectively. The cultivars of Grazer N2, Sweet Jumbo, Pacific-8386 and Pacific Bmr had higher yield and quality values than others based on data of 1 year.

Key words: Sorghum x sudan grass, cultivar, yield, crude protein, crude ash, relative feed value, livestock, milk fever, tetany

INTRODUCTION

Sorghum, which mainland is East Africa, is one of the first crops, which was taken into cultivation (House, 1985). All of the sorghum cultivars taken into cultivation are belong to *Sorghum bicolor* (L.) *Moench* sp. At present, sorghum x sudan grass hybrids are preferred as fodder due to the higher yields and sibling ratios and also their thin stems and higher leaf ratios. Sorghum x sudan grass hybrids are more yielding than corn in the areas at which higher temperatures and lower and uneven precipitations are prevailed. In such areas, corn production is limited. These climate factors are prevailed in all countries in mediterranean climate zone.

These plants are commonly cultivated in the countries in which animal husbandry is developed. Sorghum x sudan grass cultivars have some other advantages compared to corn. These plants are more tolerance to drought and hot temperatures, diseases, pests various soil types and have higher water use efficiency, higher production capacity from unit area (Undersander and Lane, 2003; Uzun and Cigdem, 2005). In addition to nutritive value was improved with recent breeding studies. Furthermore, Sorghum x sudan grass cultivars are recently preferred to corn as summer crop in most regions of World due to global warming (Chaudhuri *et al*., 1986).

In all regions of Turkey and also, in most of the regions of the world, the main reason of avoidance from summer crop is inadequacy of precipitation and irrigation possibilities. The rainfalls are too scarce between end of June and end of September in the research area. This period is corresponded to the main growth period of summer plants. For this reason, growing of sorghum x sudan grass cultivars due to mentioned characteristic is gaining a vital importance in experimental area and similar areas during recent years. The new cultivars are coming on to the market continuously with parallel to increase in interest and demand to these plants. It is essential to determine the performances of these novel cultivars in various ecologies and then recommend these cultivars to the farmers. In a previous study, Jumbo and Grazer cultivars were recommended to the farmers for this region and similar regions (Cigdem, 2004). But, from that time

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various cultivars entered the market. In this study, it was aimed to compare the performances of these recommended cultivars with those of novel sorghum xsudan grass cultivars in this region.

MATERIALS AND METHODS

This study was conducted at the University of Ondokuz Mayis Research Station, Samsun, located on the Black Sea coast of Turkey (41°21'N, 36°15'E, elevation 140 m) in 2006. Some climatic values of the study area are presented in Table 1. Soil characteristics were determined by the method described by Rowell (1996) were found to be as follows; the soil texture was clay, organic matter was around 2.30 (medium), extractable P by 0.5 N $NaHCO_3$ extraction was 1.22 mg kg^{-1} (low), exchangeable K by 1 N ammonium acetate extraction was 109.2 mg kg^{-1} (medium), pH is 6.25 in soil saturation extract and EC is 2.25 dS cm^{-1} (low) in the same saturation extract.

The experimental design was a randomized complete block with three replications and eight sorghum x sudan grass hybrid cultivars (Jumbo, Sweet Jumbo, Pacific-8386, Sugar Graze, Pacific Bmr, Chopper, Grazer N2 and Hayday) were used in the experiment. Experimental field was grown and then seed bed was prepared by raking. Seeds of each cultivar were sown on the 17.5 m^2 plots at a seed rate of 20 kg ha^{-1}. Each experiment unit had 5 rows with 5 m length and row spacing was 70 cm. Furrows were made in the soil with a hoe and cultivars were planted at a 4-5 cm depth by hand on 27th May 2007.

N and P were applied at doses of 180 and 100 kg ha^{-1}, respectively, according to the recommendations of soil analysis laboratory. Calcium ammonium nitrate and diammoniumphosphate were used as N and P sources, respectively. All of the P and half of the N were applied during sowing by hand and the other half part of N was applied when the plants reached to height of 40-50 cm.

Experimental area was hoed 2 times; during 4-5 leaf growth period and when the plants reached to 40-50 cm in height. Water requirements were determined according to the external appearance of plants and watering was applied up to the field capacity. Measurements and observations were made in parcels of 8.4 m^2 (2.1×4 m). While, Grazer, Hayday, Sugar Graze, Chopper cultivars were harvested on September 13, Pacific Bmr was harvested on October 2. All these cultivars were harvested at milk stage. Pacific-8386, Jumbo and Sweet Jumbo were harvested on October 10 prior to clustering period for not delaying the winter sowings. Sugar Graze, Pacific Bmr, Grazer, Hayday and Chopper re-growed after first harvest and were harvested 2nd time on October 10 without taking into consideration the stage periods.

Fresh herbage yield was measured by reaping and weighing the parcels. Afterwards, the dry forage yields were determined by drying (at 70°C for 48 h) and then weighing the samples obtained from each parcel. Dried plant samples were sieved in to <0.5 mm for analysis. Samples were scanned using a near-infrared scanning monochromotor (NIR Systems, Perstorp Analytical Co, Silver Spring, MD). Using Near Infrared Reflectance Spectroscopy (NIRS), prediction equations were developed for crude protein, acid detergent fiber and neutral detergent fiber ratios of all samples. Software options Center and Select (Win ISI II version 1.5, Foss NIRSystems, Silver Springs, MD), were used for calibration equation development (Windham *et al*., 1989). Crude ash contents were determined described by AOAC (1995). Crude protein and crude ash yields were determined by multiplying their concentrations with hay yield. Relative feed value was calculated according to Moore and Undersander (2002).

Samples were also digested with 3:1 (v v^{-1}) HNO_3: $HClO_4$ wet digestion method for determining mineral content and P content of plant material were determined by vanadomolibdophosphoric yellow color method according to Ryan *et al*. (2001). Ca, Mg and K concentrations were determined by atomic absorption spectrophotometers (Perkin Elmer, model 1300) using (flame) mode according to Johnston and Ulrich (1959).

The model used to analyze the data was the randomized complete block design (Little and Hills, 1978). Means were separated by Least Significant Differences (LSD) tests.

Table 1: Some climatic values of Samsun*

		Months					
Climatic values	Years	May	Jun	July	Aug.	Sept.	Oct.
Mean temperature (°C)	2007	17.2	23.0	24.7	25.4	21.5	18.2
	1974-2007	15.3	20.0	23.2	23.2	19.8	15.9
Total precipitation (L/m^2)	2007	67.0	38.0	31.4	111.8	28.7	72.4
	1974-2007	50.6	47.9	31.3	31.5	50.9	87.4
Moisture (%)	2007	82.6	70.2	71.5	75.7	77.5	78.1
	1974-2007	80.7	76.5	73.5	73.9	74.8	75.8

*Meteorology Region Records (2007)

RESULTS AND DISCUSSION

Fresh herbage and hay yield: Significant differences in fresh herbage and hay yield at first, second and total yield were determined among cultivars (Table 2). The fresh herbage yield in Jumbo, Sweet Jumbo and Pacific-8386 (97408.2, 85996.3 and 85511.2 kg ha^{-1}, respectively) were higher than that of the others at first harvest. Chopper and Grazer had the lowest yield (42674.0 and 55768.1 kg ha^{-1}, respectively). Among cultivars, higher fresh herbage values than that of the others were obtained from Grazer N2 (18568.6 kg ha^{-1}) and Hayday (16166.0 kg ha^{-1}) at second harvest. While, the highest total fresh herbage yields were obtained from Jumbo, Sweet Jumbo and Pacific-8386 (97408.2, 85996.3 and 85511.2 kg ha^{-1}, respectively) Chopper produced the lowest yield (50041.7 kg ha^{-1}).

There were no significant differences in hay yield between cultivars except for the Chopper at first harvest. The hay yield of cultivars except for the Chopper changed between 16968.0 and 23608.0 kg ha^{-1}. Chopper had the lowest hay yield (11680.3 kg ha^{-1}). The hay yield in Grazer N2 (3277.9 kg ha^{-1}) were higher than the others at second harvest. While, the total hay yield in Pacific-8386, Sweet Jumbo, Pacific Bmr, Jumbo and Grazer N2 (23608.0, 22312.7, 21554.1, 21242.3 and 20791.9 kg ha^{-1}, respectively) were higher than the others, Chopper produced the lowest hay yield (12871.5 kg ha^{-1}).

Total fresh herbage and hay yield of Jumbo, Sweet Jumbo and Pacific-8386 was obtained from a single harvest, but those of the others were obtained from two harvests. Jumbo, Sweet Jumbo and Pacific-8386 were harvested once because they were late-maturing cultivars. Therefore, these cultivars need lower labour requirement than others. Moisture levels of fresh herbage at second harvest stage were extrem (16-17%) for ensilaging and have toxic effect for grazing livestock. In the previous study, conducted in same region with Jumbo, Grazer, GW9110G, Grass II, Elrey, Pioneer-988, Rox, Early sumac and Gözde 80 cultivars, Jumbo produced the highest fresh herbage yield (58900 kg ha^{-1}). The highest hay yield were also obtained from Jumbo and Grazer N2 (16748 and 14371 kg ha^{-1}, respectively) (Cigdem, 2004).

Crude protein ratio and yield: Significant differences in Crude Protein (CP) ratio were determined among cultivars at first harvest (Table 3). The CP ratio in Pacific Bmr, Grazer N2, Hayday, Sweet Jumbo and Pacific-8386 (9.03, 8.60, 8.60, 7.98 and 7.62%, respectively) were higher than that of the others. The CP ratio of cultivars at second harvest changed between 16.32 and 17.57%.

Significant differences in Crude Protein (CP) yield were determined among cultivars at first harvest, second harvest and total yield. The CP yield in Pacific Bmr, Pacific-8386, Sweet Jumbo, Grazer N2, Hayday and Jumbo (1875.7, 1805.9, 1779.0, 1503.1, 1458.3 and 1447.5 kg ha^{-1}, respectively) were higher than that of the others at first harvest. Chopper produced the lowest CP yield (810.5 kg ha^{-1}). While, the highest CP yield was obtained from Grazer N2 (559.4 kg ha^{-1}), the lowest CP yield were obtained from Pacific Bmr, Sugar Graze and Chopper (151.3, 174.9 and 197.1 kg ha^{-1}, respectively) at second harvest. The total CP yields of Grazer N2, Pacific Bmr, Hayday, Pacific-8386 and Sweet Jumbo (2062.5, 2027.7, 1900.4, 1805.9 and 1779.0 kg ha^{-1}, respectively) were higher than that of the others. Chopper and Jumbo had the lowest total CP yield (1007.7 and 1447.5 kg ha^{-1}, respectively). In other studies made in Samsun ecological conditions, CP ratio of Rox and Gozde 80 at milk stage were 7.1 and 8.0%, respectively (Akturk and Acar, 2000); 4.8 and 7.7% for Jumbo and Grazer N2, respectively (Cigdem, 2004). CP production of Rox and Gözde-80 at milk stage were 569.4 and 730.0 kg ha^{-1}, respectively (Akturk and Acar, 2000); 811 and 1113 kg ha^{-1} for Jumbo and Grazer N2, respectively (Cigdem, 2004).

Table 2: Fresh herbage and hay yield of sorghum x sudan grass cultivars

	Fresh herbage yield (kg ha^{-1})			Hay yield (kg ha^{-1})		
Cultivars	First harvest	Second harvest	Total yield	First harvest	Second harvest	Total yield
Jumbo	97408.2a	-	97408.2a	21242.3ab	-	21242.3ab
Sweet Jumbo	85996.3ab	-	85996.3ab	22312.7ab	-	22312.7ab
Pacifc-8386	85511.2ab	-	85511.2ab	23608.0a	-	23608.0a
Sugar Graze	76482.4b	6198.0b	82680.4b	18599.7ab	1047.6c	19647.3b
Pacific Bmr	74134.1b	5481.7b	79615.9b	20696.0ab	858.1c	21554.1ab
Grazer N2	55768.1cd	18568.6a	74336.7b	17514.0ab	3277.9a	20791.9ab
Hayday	57704.0c	16166.0a	73870.4b	16968.0ab	2699.6b	19667.6b
Chopper	42674.0d	7368.0b	50041.7c	11680.3b	1191.2c	12871.5c
$LSD_{(0.01)}$	13730	2643	13790	11900	372.4	3212

Values within columns with different letters differ significantly ($p<0.01$)

Table 3: Crude protein ratio and yield of sorghum x sudan grass cultivars

	Crude protein ratio (%)		Crude protein yield (kg ha^{-1})		
Cultivars	First harvest	Second harvest	First harvest	Second harvest	Total yield
Jumbo	6.82b	-	1447.5ab	-	1447.5bc
Sweet Jumbo	7.98ab	-	1779.0ab	-	1779.0ab
Pacific-8386	7.62ab	-	1805.9a	-	1805.9ab
Sugar Graze	7.20b	16.71	1338.6b	174.9c	1513.5b
Pacific Bmr	9.03a	17.57	1875.7a	151.3c	2027.7a
Grazer N2	8.60ab	17.06	1503.1ab	559.4a	2062.5a
Hayday	8.60ab	16.32	1458.3ab	442.0b	1900.4ab
Chopper	6.91b	16.50	810.5c	197.1c	1007.7c
$LSD_{(0.01)}$	1.79	ns	454.8	110.7	455.60

Table 4: Crude ash ratio and crude ash yield of sorghum x sudan grass cultivars

	Crude ash ratio (%)		Crude ash yield (kg ha^{-1})		
Cultivars	First harvest	Second harvest	First harvest	Second harvest	Total yield
Jumbo	6.60	-	1405.9abc	-	1405.9ab
Sweet Jumbo	6.92	-	1545.2ab	-	1545.2ab
Pacific-8386	7.41	-	1753.0a	-	1753.0a
Sugar Graze	6.12	14.74	1139.4cd	154.4b	1293.8bc
Pacific Bmr	6.63	14.43	1357.8abc	123.2b	1490.0ab
Grazer N2	6.38	12.99	1120.7cd	425.9a	1546.6ab
Hayday	7.76	13.92	1317.6bc	375.4a	1693.1a
Chopper	6.57	14.36	765.9d	170.5b	936.4c
$LSD_{(0.01)}$	ns	ns	399.1	50.6	396.6

Values within columns with different letters differ significantly ($p<0.01$)

Crude ash ratio and yield: No significant differences among Crude Ash (CA) ratio of cultivars at first and second harvest (Table 4). The CA ratio of cultivars at first harvest changed from 6.12-7.76% and at second harvest between 12.99 and 14.74%.

Significant differences in Crude Ash (CA) yield were determined among cultivars at first harvest, second harvest and total yield. The CA yield in Pacific-8386, Sweet Jumbo, Jumbo and Pacific Bmr (1753.0, 1545.2, 1405.9 and 1357.8 kg ha^{-1}, respectively) were higher than that of the others at first harvest. Chopper, Grazer N2 and Sugar Graze produced the lowest CA yield (765.9, 1120.7 and 1139.4 kg ha^{-1}, respectively) at first harvest. Among cultivars, the CA yields of Grazer N2 and Hayday (425.9 and 375.4 kg ha^{-1}, respectively) were higher than the others at second harvest. The total CA yield in Pacific-8386, Hayday, Grazer N2, Sweet Jumbo, Pacific Bmr and Jumbo (1753.0, 1693.1, 1546.6, 1545.2, 1490.0 and 1405.9 kg ha^{-1}, respectively) were higher than that of the others. Chopper and Sugar graze had the lowest CA (936.4 and 1 293.8 kg ha^{-1}, respectively). According to the results of the previous studies, conducted Samsun ecological conditions, while, CA ratio and CA yield of Rox (Sorghum) and Gozde-80 (Sudan grass) at milk stage were 7.3 and 7.9%; 585.5 and 720.9 kg ha^{-1}, respectively (Akturk and Acar, 2000); Jumbo and Grazer N2 were 8.2 and 8.6%; 1382 and 1243 kg ha^{-1}, respectively (Cigdem, 2004).

Acid detergent fiber, neutral detergent fiber ratio and relative feed value: Table 5 shows that the Acid Detergent Fiber (ADF) values of cultivars at first harvest changed between 40.24 and 48.32%; at second harvest 35.13 and 38.02%. Neutral Detergent Fiber (NDF) values at first harvest ranged from 66.04-74.89%; from 57.71-62.66% at second harvest. The NDF ratios of Grazer N2, Hayday and Pacific Bmr in second harvest (62.66, 61.50 and 59.84%, respectively) were higher than that of the Sugar Graze and Chopper (57.89 and 57.71%). The differences in NDF ratio in the second harvest may be caused by genetic differences and also by the differences in development stages at cultivars. As plants mature, ADF and NDF contents increase due to the increases in structural fibers and lignin contents (Gustavsson and Martinsson, 2004). For this reason, ADF and NDF contents of cultivars found higher in first harvest than second harvest, because first harvest of cultivars was made in a later phenological stage.

Significant differences in Relative Feed Value (RFV) were determined among cultivars at first and second harvest (Table 5). The RFV in Chopper, Sugar Graze, Grazer N2 and Pacific Bmr (81.53, 77.22, 75.75 and 73.66, respectively) were higher than that of the others at first harvest. The RFV of Jumbo was the lowest (63.78) at first harvest. There were no significant differences RFV among cultivars except for Grazer N2 in second harvest. Grazer N2 was lower RFV than the others. RFV of cultivars at first harvest changed between 63.78 and 81.53; 87.77 and 99.17 for second harvest. ADF and NDF ratios lower in second harvest, because plants were harvested earlier than first harvest. As plants mature, ADF and NDF contents increase steadily. Increasing ADF and NDF reduces RFV. Therefore, RFV of hay was higher at second harvest than first harvest. RFV is an index, which combines important nutritional factors (potential intake and digestibility) (Linn and Martin, 1999). Nutritional quality of plants directly affects the performances of the livestock. Poor animal growth and reproductive problems are common even when forage supply is adequate (McDowell, 1997).

Ca, P and Ca/P ratios: As seen from Table 6, Ca contents of cultivars at first harvest were found out between 0.40 and 0.67%; at second harvest 0.58 and 0.78%. Ca contents in forages are recommended at least 0.31% for beef cattle (McDowell, 1997). Ca content in studied cultivars was higher than recommended value at first and second harvest.

P contents of the cultivars at first harvest were between 0.21 and 0.30%; at second harvest 0.41 and 0.46%. It is reported that forages for cattle should contain P between 0.17 and 0.39% (NRC, 1996) and forages for

Table 5: ADF, NDF ratio and RFV values of sorghum x sudan grass cultivars

	ADF (%)		NDF (%)		RFV	
Cultivars	First harvest	Second harvest	First harvest	Second harvest	First harvest	Second harvest
Jumbo	48.32	-	74.89	-	63.78c	-
Sweet Jumbo	45.94	-	73.92	-	66.87bc	-
Pacific-8386	45.05	-	72.13	-	69.52bc	-
Sugar Graze	41.86	35.13	67.97	57.89b	77.22ab	98.73a
Pacific Bmr	43.14	35.36	69.90	59.84ab	73.66abc	95.12ab
Grazer N2	42.78	38.02	68.41	62.66a	75.75ab	87.77b
Hayday	44.24	36.60	74.17	61.50a	68.36bc	91.29ab
Chopper	40.24	35.16	66.04	57.71b	81.53a	99.17a
$LSD_{(0.05)}$	ns	ns	ns	2.995	10.617	7.702

Table 6: Ca, P and Ca/P ratio of sorghum x sudan grass cultivars

	Ca (%)		P (%)		Ca/P	
Cultivars	First harvest	Second harvest	First harvest	Second harvest	First harvest	Second harvest
Jumbo	0.40c	-	0.28ab	-	1.43	-
Sweet Jumbo	0.46bc	-	0.26abc	-	1.77	-
Pacific-8386	0.45bc	-	0.27ab	-	1.67	-
Sugar Graze	0.59ab	0.78a	0.26abc	0.41	2.27	1.90
Pacific Bmr	0.46bc	0.58b	0.30a	0.46	1.53	1.26
Grazer N2	0.67a	0.65b	0.21c	0.41	3.19	1.59
Hayday	0.61ab	0.65b	0.22bc	0.42	2.77	1.55
Chopper	0.55abc	0.60b	0.25abc	0.42	2.20	1.43
$LSD_{(0.05)}$	0.166	0.103	0.055	ns	-	-

Table 7: K, Mg and K/(Ca+Mg) ratio of sorghum x sudan grass cultivars

	K (%)		Mg (%)		K/(Ca+Mg)	
Cultivars	First harvest	Second harvest	First harvest	Second harvest	First harvest	Second harvest
Jumbo	1.45	-	0.15	-	2.64	-
Sweet Jumbo	1.42	-	0.17	-	2.25	-
Pacific-8386	1.51	-	0.18	-	2.40	-
Sugar Graze	1.40	2.13	0.20	0.22a	1.77	2.63
Pacific-Bmr	1.44	2.35	0.15	0.19b	2.36	3.05
Grazer N2	1.48	2.32	0.14	0.15c	1.83	2.90
Hayday	1.37	2.31	0.16	0.16c	1.78	2.85
Chopper	1.42	2.39	0.19	0.18b	1.92	3.06
$LSD_{(0.05)}$	ns	ns	ns	0.019	-	-

Values within columns with different letters differ significantly ($p<0.05$)

sheep should have P between 0.16- 0.38% (NRC, 1985). P content of cultivars studied in this study was similar to recommended value.

Ca/P ratios of cultivars at first harvest changed from 1.43-3.19 and at second harvest changed between 1.26 and 1.90. When, Ca/P ratio is over 2.00, milk fever may be observed in animals and effectiveness in forage-animal product transformation may decrease (Jacobsen *et al*., 1972; Reid and Jung, 1974). In first harvest Ca/P ratios of Grazer N2, Hayday, Sugar Graze and Chopper were higher than reported values.

K, Mg and K/(Ca+Mg) ratios: As presented in Table 7, K ratio of first harvest changed between 1.37 and 1.51%; 2.13 and 2.39% for second harvest. K contents of all cultivars were higher than recommended (1.0% of the DM for high producing cows reported by NRC (2001). The fact that grass species have generally high K content (Minson, 1990) and level of available K contents of soils might have caused high K contents of cultivars.

Mg content of cultivars at first harvest changed between 0.14 and 0.20%; 0.15 and 0.22% for second harvest. Mg contents of all species were very similar to the recommended value (0.16-0.25%) by NRC (2001).

K/(Ca+Mg) ratio of cultivars at first harvest changed between 1.77 and 2.64; 2.13 and 3.05 for second harvest. It is recommended that K/(Ca+Mg) ratio of forages should be below 2.20 (Mayland and Grunes, 1979; Kidambi *et al*., 1989). K/(Ca+Mg) ratios of Jumbo, Pacific-8386, Pacific Bmr and Sweet Jumbo at first harvest; all of cultivar at second harvest were higher than reported value. In all cultivars K contents were higher than needed increased the K/(Ca+Mg) ratios over 2.20 (Table 6 and 7). The K/(Ca+Mg) ratios over 2.20 may cause tetany, especially, in cool seasons (Mayland and Grunes, 1974; Georgievskii, 1982). Mineral composition of forage plants can be affected by soil factors, growth stages, climate, fertilizer application, drainage, irrigation and interaction among minerals (Gomide, 1978; Acar *et al*., 2001).

In this study, the variation for mineral concentration was affected by genetic difference of cultivars and phenological differences in harvest stages.

CONCLUSION

It was concluded from the present study that Grazer N2, Sweet Jumbo, Pacific-8386 and Pacific Bmr cultivars had higher yield and quality values than others and that Sweet Jumbo and Pacific-8386 need lower labor requirement for harvest compare to other cultivars based on data of one year. Because of the high moisture of fresh herbage for ensilaging at second harvest of Grazer N2 and Pacific Bmr and/or adverse effect on health of grazing animals, cultivate of these two plants with a view to obtain high yield and quality should be treated caution.

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