Türk Tarım ve Doğa Bilimleri Dergisi 6(3): 388-395, 2019

https://doi.org/10.30910/turkjans.595170

TÜRK
TARIM ve DOĞA BİLİMLERİ
DERGİSİ

TURKISH
JOURNAL of AGRICULTURAL
and NATURAL SCIENCES

www.dergipark.gov.tr/turkjans

Research Article

Yield and Quality Feature of Some Silage Sorghum and Sorghum-Sudangrass Hybrid Cultivars in Ecological Conditions of Kırşehir Province

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Received: 27.12.2018 Received in Revised: 24.04.2019 Accepted: 25.06.2019

Abstract

This current study was conducted to determine adaption and quality characters of sorghum and sorghum-sudangrass hybrid during 2016-2017 summer growing seasons in Kırşehir province. The experimental was a randomized complete block design with three replications, three sorghum cultivars (Gözde 80, Early Sumac, Rox) and six sorghum-sudangrass (Aneto, Greengo, Teide, Sugar Graze, Gardavan, Jumbo) hybrid cultivars. There were significant differences in tested characters among sorghum and sorghum-sudangrass hybrid cultivars. According to average two years; dry matter yield of the cultivars was between 11855.3 (Gözde 80) and 28957.3 (Jumbo) kg ha^{-1}, crude protein yield was between 877.5 (Gözde 80) and 2799.8 (Jumbo) kg ha^{-1} and digestible dry matter yield was between 7396.5 (Gözde 80) and 17908.3 (Jumbo) kg ha^{-1}. Crude protein ratio ranged from 7.3 (Gözde 80) to 10.4 (Aneto) %, ADF from 30.1 (Rox) to 37.4 (Early Sumac) %, NDF from 44.6 (Rox) to 57.2 (Early Sumac) %, ADL from 4.2 (Early Sumac) to 5.6 (Teide) % and digestible dry matter from 59.7 (Early Sumac) to 65.5 (Rox) %. To conclude; Greengo and Jumbo that had better results among the studied cultivars, are suggested as alternative forage crops in Kırşehir ecological condition.

Key words: Sorghum**,** yield, quality, crude protein, ADF, digestible dry matter.

Kırşehir Ekolojik Koşullarında Bazı Silajlık Sorgum ile Sorgum-Sudanotu Melez Çeşitlerinin Verim ve Kalite Özelliklerinin Belirlenmesi

Özet

Bu araştırma Kırşehir ilinde 2016-2017 yaz yetiştirme sezonunda bazı sorgum ve sorgum-sudanotu melez çeşitlerinin verim ve kalite özelliklerini belirlemek amacıyla tek lokasyonda yürütülmüştür. Bölünmüş parseller deneme desenine göre üç tekerrürlü olarak yürütülen bu çalışmada, üç sorgum (Gözde 80, Early Sumac, Rox) ve altı sorgum-sudanotu (Aneto, Greengo, Teide, Sugar Graze, Gardavan, Jumbo) melez çeşidi kullanılmıştır. Denemeye alınan sorgum ve sorgum-sudanotu melez çeşitleri arasında özellikler bakımından önemli derecede farklılıkların olduğu belirlenmiştir. İki yıllık ortalama sonuçlara göre; çeşitlerin kuru madde verimleri 1185.3 (Gözde 80) – 28957.3 (Jumbo) kg ha^{-1}, ham protein verimleri 8777.5 (Gözde 80) ve 2799.8 (Jumbo) kg ha^{-1} ve sindirilebilir kuru madde verimleri 7396.5 (Gözde 80) ve17908.3 (Jumbo) kg ha^{-1}. Protein oranı % 7.3 (Gözde 80) - 10.4 (Aneto), ADF oranı % 30.1 (Rox) - 37.4 (Early Sumac), NDF % 44.6 (Rox)- 57.2 (Early Sumac), ADL % 4.2 (Early Sumac) - 5.6 (Teide) SKMO % 59.7 (Early Sumac) - 65.5 (Rox) arasında değişmiştir. Kırşehir ekolojik koşullarında verim ve kalite bakımdan Jumbo çeşidi ile Greengo çeşidi alternatif bir yem bitkisi olarak yetiştirilebileceği belirlenmiştir.

Anahtar kelimeler: Sorgum, verim, kalite, ham protein, ADF, sindirilebilir kuru madde.

Introduction

The increasing high-quality forage needs as well as decreasing water resources seriously limit the production of forage crops. Irregular distribution of precipitation in arid and semi-arid regions creates a great risk in corn cultivation and makes irrigation the most important factor of the crop yield (Gençoğlan and Yazar, 1999). The decrease in the water resources used for agricultural production causes the farmers inevitably to change the crop pattern. The cultivation of sorghum is gradually increasing due to the efficient water use, low fertilizer requirement, advantages in erosion and weed control. Therefore, the importance of sorghum in animal feeding is better understood day by day. Breeding of sorghum cultivars with high adaptability, yield and quality makes sorghum a source of alternative summery forage crop. In addition, sorghum is the best crop adopted to arid ecologies having irregular seasonal rainfall distribution and high temperatures during the summer period. Sorghum is not sufficiently known in the Central Anatolia; thus, the cultivation area is very limited. Identifying the regional adaptation capabilities of sorghum and sorghum-sudangrass hybrids in the regions where water is scarce and extending the cultivation of varieties with well adapted and desired characteristics will benefit the economy of the region and the country (Tiryaki, 2005). Therefore, determining the quality characteristics is very important in sorghum and sorghum-sudangrass hybrid cultivation besides the selection of appropriate and efficient cultivars in the regions. The ADF and NDF ratios are the best indications of the energy capacity of a forage. The high NDF ratio in forage decreases the forage consumption by animals (Yavuz, 2005). Canbolat (2012) emphasized that crude protein content of sorghum was 7.4%, NDF ratio 53.7%, ADF ratio 30.1%, ADL ratio 6.3% and digestible dry matter (DDM) ratio 63.9%, and increased ADL ratio adversely affected the DDM ratio. The dry matter yields of five silage sorghum cultivars in Tokat ecological conditions were varied between 16615 and 9638 kg ha^{-1}, crude protein ratio between 12.98 and 8.31%, ADF ratio between 47.05 and 36.35% and NDF ratio between 71.39 and 59.98% (Karadağ and Uygur, 2013) Similarly, Pires et al. (2017) reported that NDF, ADF and lignin ratios of 19 sorghum and sudangrass in Brazil were ranged from 56.1 to 62.8%, from 32.7 to 38.8% and from 4.1 to 6.8%, respectively. Hemicellulose, compared to cellulose is easily reduced to volatile fatty acids by the bacterial flora in rumen. Pushparajah and Sinniah (2018) stated that crude protein ratio, ADF ratio and NDF ratio of Sugar Graze and Jumbo Plus cultivars were reported between 8.8 and 7.5%, 47.1 and 45.5% and 69.4 and 70.6%, respectively.

The aim of this study was to determine the yield and quality components of sorghum and sorghum-sudangrass hybrid cultivars in Kırşehir province which has a significant potential in livestock.

Material and Method

This research was carried out for two years in 2016 and 2017 under arid ecological conditions of Kırşehir province (39° 08' N, 34° 06' E ve 1084 m altitude). Three sorghum cultivars (Gözde 80, Early Sumac, Rox) and six sorghum-sudangrass hybrids (Aneto, Greengo, Teide, Sugar Graze, Gardavan, Jumbo) cultivars were used in the experiment. Soils of the experimental site were clayey, slightly alkaline (pH 7.96), non-saline (0.02%), highly calcareous (35.29%), low in organic matter (%1.09) and available phosphorus (19 kg ha^{-1}) and rich in potassium content (480 kg ha^{-1}) (Kacar and Katkat, 2014). Mean air temperatures from June to October in 2016, 2017 and long term were 22.33, 22.38 and 20.98 ºC and total precipitations were 63.9, 34.8 and 66.4 mm (Table 1).

Table 1. Climate data of the experimental site

Months	**Mean temperature (°C)**			**Total precipitation (mm)**		
	2016	**2017**	**Long Term**	**2016**	**2017**	**Long Term**
June	21.0	20.7	19.6	16.1	18.4	36.8
July	24.2	23.9	23.1	5.8	0.4	6.8
August	25.7	23.5	22.9	-	16.0	4.9
September	18.4	21,4	18.2	42.0	-	11,6
Mean	22.3	22.4	21.0			
Total				63.9	34.8	66.4

The average temperatures were sufficient for sorghum, while total precipitations during the vegetation period was far below the desired annual precipitation (165.1 mm). Sorghum can be grown in areas with annual rainfall of 400-600 mm without irrigation, however, corresponding amount of required water should be met by irrigation in areas where rainfall is not sufficient (Açıkgöz, 2001). The seed beds of 4-5 cm depth were opened using a hand marker at four rows spaced apart 60 cm from each other in each plot. Sowing was performed manually on June 2 in both years using 15 kg ha^{-1} seeds. The experiment was conducted with a randomized block design with three replicates. The plot size in experimental field was 2.4 m x 5 m = 12 m^2. Fertilizers at a rate of 200 kg ha^{-1} N and 100 kg

ha^{-1} P_2O_5 and K_2O were used in sorghum plots (Salman and Budak, 2015). At the time of harvest, one row at the edge of each plot and 30 cm edges of the two middle rows were not evaluated due to the side effect (Karadağ and Özkurt, 2014). Sorghum cultivators and sorghum-sudangrass hybrids cultivators harvested at the soft dough stage (Geren and Kavut, 2009). Nitrogen contents of the cultivars were determined by Kjeldahl method and these values were multiplied by coefficient of 6.25 to calculate the crude protein ratios (AOAC, 2005). Crude protein yield was determined by multiplying the crude protein ratio by dry matter yield. Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) contents were determined using the ANKOM200 Fiber analyzer (Canbolat, 2012; Anonymous, 2019) according to the method reported by Van Soest et al. (1991). Digestible Dry Matter Ratio (DDMR) was calculated by using the equation (DDMR = 88.9-0.779 x ADF%) defined by Horrocks and Valentine (1999). Digestible dry matter yield (DDMY) was calculated by multiplying the DDMR by dry matter yield. The results were analyzed with the variance analysis according to the randomized block design with MSTAT-C statistical software, and the differences among the treatments were compared with the Duncan test (Petersen, 1994).

Results and Discussion

Dry matter yield

The effects of cultivars and year x cultivar interaction on dry matter yield were statistically significant at $P<0.01$ level, but the impact of the year was not significant (Table 2). The highest dry matter yield (28957.3 kg ha^{-1}) was obtained from Jumbo cultivar. Dry matter yield of Gözde 80 (11855.3 kg ha^{-1}), Gardavan (12607.3 kg ha^{-1}), Sugar Graze (14326.7 kg ha^{-1}) and Rox (14957.0 kg ha^{-1}) cultivars were not significantly different from each other and included in the low statistical group (Table 3). Early Sumac and Gardavan cultivars which were in the same statistical group for the first year were placed at the different groups in the second year of the study. The dry matter yield variation of Early Sumac and Gardavan cultivars in years led to the importance of year x cultivar interaction (Table 2). The dry matter yields obtained in this study were higher than those of Güneş and Acar (2005) and Karadağ and Özkurt (2014) and were lower compared to those of Acar et al. (2002), Salman and Budak (2015) and Özköse et al. (2015). The differences between the reported results may be due to the differences in harvest times and ecological conditions of research areas, status of the first and the second crop cultivations, and the genetic characteristics of the cultivars used in studies.

Crude protein yield

The effects of cultivars and cultivar x year interaction on crude protein yield were statistically important whereas the difference between years was insignificant ($P<0.01$) (Table 2). Crude protein yield, which is directly related to dry matter yield and crude protein ratio, is very important in animal nutrition (Keskin et al., 2005). Jumbo cultivar was included in the high statistical group in terms of crude protein content. The highest crude protein yield (2799.8 kg ha^{-1}) was obtained from Jumbo cultivar due to the excess dry matter yield of the per unit area (Table 3). Gözde-80 cultivar that was in the low crude protein and dry matter yield group, was also in the lowest crude protein yield (877.5 kg ha^{-1}) group. Rox and Teide cultivars were in the same statistical group in the first year of the study, while they took place in different group for the second year of the study. The difference between years caused year x cultivar interaction to be important (Table 2). The findings obtained in this study are in consistent with the results of Acar et al. (2002), Güneş and Acar (2005), Keskin et al. (2005), Geren and Kavut (2009), Salman and Budak (2015).

Crude protein ratio

Year and cultivars had a statistically significant effect on the crude protein ratio and caused differences among the cultivars, however the effect of year x cultivar interaction was insignificant ($P <0.01$) (Table 2). The highest crude protein ratio was obtained from Aneto cultivar with 10.4%, and the lowest was found in Gözde-80 with 7.3% (Table 4). The crude protein content (9.2%) in the first year was higher compared to the crude protein content (8.6%) of the second year (Table 4). Keskin et al. (2005) stated that the mean crude protein ratio of Gözde-80 cultivar varied between 5.2 and 5.9% in Van conditions and delaying harvest time would lead to a reduction in crude protein ratio. Parlak and Özaslan (2006) indicated that crude protein ratios of Rox and Early Sumac cultivars under ecological conditions of Ankara were between 7.9 and 10.0% and 8.1% to 10.6%. Salman and Budak (2015) reported that crude protein ratios of Aneto, Greengo and Gardavan cultivars in Ödemiş location were 8.8%, 9.0% and 9.6% while crude protein ratios in Bayındır location were 7.0%, 7.1% and 9.6%, respectively. Pires et al. (2017) found that crude protein ratios of 19 sorghum and sorghum-sudangrass hybrid cultivars were between 11.8 and 15.5% in a study conducted at Embrapa-National Corn and Sorghum Research Center. The differences in ecological conditions, cultivars, maintenance and treatments caused the differences in crude protein ratios reported by various researchers.

Table 2. Summer of variance analysis

Analysis of Variance	Df	Dry matter yield (kg ha^{-1})	Crude protein yield (kg ha^{-1})	Crude protein (%)	ADF (%)	NDF (%)	ADL (%)	Digestible dry matter (%)	Digestible dry matter yield (kg ha^{-1})
Year	*1*	*ns*	*ns*	**	**	**	*	**	*ns*
Error1	*4*								
Cultivars	*8*	**	**	**	**	**	**	**	**
YxC	*8*	**	**	*ns*	**	**	**	**	**
Error	*32*								
CV(%)		*11.4*	*10.3*	*5.2*	*2.0*	*2.2*	*8.7*	*0.8*	*11.3*

CV: Coefficient of variation. Y: Year, C: cultivar , ns: non significant ** p<0.01 * p<0.05.

Table 3. Dry matter and crude protein yield of some silage sorghum and sorghum-sudangrass hybrid cultivars.

	Dry matter yield (kg ha^{-1})			Crude protein yield (kg ha^{-1})		
	2016	**2017**	**Mean**	**2016**	**2017**	**Mean**
ANETO	15782.3 c++	17014.7 cd++	16398.5 cd++	1658.8 b++	1759.7 bc++	1708.8 bc++
EARLY SUMAC	15877.3 c	19087.3 bc	17482.3 bcd	1317.3 cd	1561.0 c	1439.2 cde
GARDAVAN	13527.7 c	11687.0 e	12607.3 e	1351.3 cd	1086.0 d	1218.7 e
GÖZDE 80	13984.0 c	9726.7 e	11855.3 e	1093.3 e	661.7 e	877.5 f
GREENGO	18367.7 b	22540.7 b	20454.2 b	1633.0 b	1921.0 b	1777.0 b
JUMBO	28480.3 a	29434.3 a	28957.3 a	2830.7 a	2769.0 a	2799.8 a
ROX	15869.3 c	14044.7 de	14957.0 de	1499.3 bc	1196.7 d	1348.0 de
SUGAR GRAZE	14857.7 c	13795.7 de	14326.7 de	1241.7 de	1078.3 d	1160.0 e
TEİDE	15890.7 c	21277.6 bc	18584.2 bc	1518.7 bc	1722.3 bc	1620.5 bcd
MEAN	16959.8	17623.2	17291.4	1571.5	1528.4	1549.9

++ Means followed by the same letter in the same column are statistically not significant (p<0.01).

ADF ratio

The ADF ratio was significantly changed between years and cultivars. The effects of year x cultivar had also significant (P<0.01) on ADF ratio (Table 2). Rox and Aneto cultivars were in the low ADF ratio group, Early Sumac had the highest ADF ratio (Table 4). The ADF ratio is inversely proportional to digestibility, thus cultivars with low ADF ratio can be expressed as cultivars of higher quality. The first year mean ADF ratio (33.0%) was lower than the second year (34.5%). Aneto cultivar had a statistically higher ADF ratio compared to Gardavan cultivar in the second year whereas both cultivars were in the same ADF ratio group for the first year of the study (Table 4). The ADF ratios of sorghum and sorghum-sudangrass hybrid cultivars under Tokat ecological conditions were between 36.4 and 47.1% (Karadağ and Uygur, 2013) and 39.1 and 40.9% (Karadağ and Özkurt, 2014). Similar ADF ratios (32.9-36.3%) were also reported by Millner et al. (2011) in New Zealand-Manawatu ecological conditions. However, Pires et al. (2017) reported higher ADF ratios (62.4-56.1%) for sorghum-sudangrass hybrid cultivars in a study conducted at the Brazil Embrapa-Sorghum Research Institute. The difference between the ADF ratios obtained in this study (30.1-37.4%) and the ADF ratios in the other studies was probably related to the differences in cultivars used and ecologies of experimental sites.

NDF ratio

The effects of cultivars, year and year x cultivar interaction on NDF ratio were significantly important (P<0.01) (Table 2). The lowest NDF ratio (44.6%) was obtained with Rox cultivar, while the highest NDF ratio was obtained from Greengo and Early Sumac cultivars (56.8 and 57.2%) (Table 5). Since ADF and NDF have similar cell wall structural compounds, similarity between ADF and NDF ratios in a forage is an expected phenomenon. Therefore, the first year NDF ratio, as in the ADF values, was lower than the second year. The NDF ratios of cultivars varied depending on the years of the study. Aneto, Gardavan, Gözde 80 and Rox cultivars were in the same statistical group for the first year. Similarly, this cultivars, except Rox cultivar was included in the same statistical group for the second year (Table 5). But Rox cultivar was in the statistically low NDF group. The two-year average of

NDF ratio (51.2%) obtained in this study was similar to that of Siefers et al. (1997) but it was lower than those reported by Millner et al. (2011), Nazlı et al. (2013) and Karadağ and Özkurt (2014), Delaying the harvest time of sorghum increases the ratio of cellulosic structures, a cell wall component. The differences among the NDF ratios reported by different researchers may be due to the differences in the ecologies of research areas, as well as the harvesting during different maturity periods.

Table 4. Crude protein and ADF ratio of some silage sorghum and sorghum-sudangrass hybrid cultivars

	Crude protein (%)			ADF (%)		
	2016	**2017**	**Mean**	**2016**	**2017**	**Mean**
ANETO	10.5 a++	10.3 a++	10.4 a++	30.4 e++	31.4 d++	31.0 ef++
EARLY SUMAC	8.3 de	8.2 d	8.3 de	37.4 a	37.5 a	37.4 a
GARDAVAN	10.0 ab	9.3 bc	9.6 abc	30.4 e	33.4 c	31.9 de
GÖZDE 80	7.8 e	6.8 e	7.3 f	32.4 d	34.9 b	33.7 c
GREENGO	8.9 cd	8.5 cd	8.7 de	35.4 b	36.7 a	36.1 b
JUMBO	10.0 ab	9.4 b	9.7 ab	34.1 c	36.4 a	35.2 b
ROX	9.5 bc	8.6 bcd	9.0 bcd	30.6 e	29.5 e	30.1 f
SUGAR GRAZE	8.4 de	7.8 d	8.1 ef	30.7 e	34.0 bc	32.4 d
TEİDE	9.6 bc	8.1 d	8.8 cde	35.2 bc	36.3 a	35.8 b
MEAN	9.2 A**	8.6 B	8.9	33.0 B	34.5 A**	33.7

++ Means followed by the same letter in the same column are statistically not significant (p<0.01).
** Means followed by the same letter in the same line are statistically not significant (p<0.01).

Table 5. NDF and ADL ratio of some silage sorghum and sorghum-sudangrass hybrid cultivars

	NDF (%)			ADL (%)		
	2016	**2017**	**Mean**	**2016**	**2017**	**Mean**
ANETO	45.6 d++	51.8 bc++	48.7 c++	4.7 b++	4.4 b++	4.6 bc++
EARLY SUMAC	57.0 a	57.5 a	57.2 a	3.4 c	4.9 ab	4.2 c
GARDAVAN	45.3 d	51.2 c	48.3 c	5.7 a	5.2 a	5.4 a
GÖZDE 80	45.6 d	51.4 c	48.5 c	5.5 ab	5.5 a	5.5 a
GREENGO	56.0 a	57.5 a	56.8 a	4.9 ab	5.6 a	5.2 ab
JUMBO	54.2 b	54.0 b	54.1 b	3.5 c	5.0 ab	4.3 c
ROX	45.7 d	43.5 d	44.6 d	4.7 b	4.4 b	4.6 bc
SUGAR GRAZE	47.3 c	52.2 bc	49.8 c	5.1 ab	5.2 a	5.2 ab
TEİDE	53.3 b	53.0 bc	53.2 b	5.5 ab	5.6 a	5.6 a
MEAN	50.0 B	52.5 A**	51.2	4.8 B	5.1 A*	4.9

++ Means followed by the same letter in the same column are statistically not significant (p<0.01).
* Means followed by the same letter in the same line are statistically not significant (p<0.05).
** Means followed by the same letter in the same line are statistically not significant (p<0.01).

ADL ratio

The variability in ADL ratios between years were statistically significant at P<0.05 level, in addition the effect of cultivars and year x cultivar interaction on ADL ratio were significant at P<0.01 level (Table 2). The low ADL ratio group was composed of Early Sumac, Jumbo, Aneto and Rox cultivars, while other cultivars were in the high statistical group (Table 5). The mean ADL ratio (5.1%) in the second year of the study was higher than the ADL ratio (4.8%) in the first year. The Aneto and Teide cultivars which were in the same statistical group for the first year took place in the different ADL groups for the second year and the differences led to the year x cultivar interaction to be significant (Table 2). Lignin, a structural carbohydrate provides structural support to the plant tissues as well as hardness. Lignin content varies depending on the plant maturation and weather conditions (Ayaz et al., 2013). The excess of structural carbohydrates such as ADL reduces the quality of hay or feed by reducing the consumption and digestion. The ADL ratios obtained were similar to those reported by Pedersen et al. (1982) and Atis et al. (2012) whereas lower than that of Canbolat (2012). The differences between the ADL ratios reported by the various researchers are related to differences in cultivars used, leaves/stem ratio of cultivars as well as the responses of cultivars to the growing environment.

Digestible dry matter ratio

The effects of year, cultivars and year x cultivar interaction on digestible dry matter (DDM) ratio were significant (P<0.01) (Table 2). The Rox and Aneto cultivars which had low ADL ratios were included to the high statistical group of DDM ratio (Table 6). Similar to our findings, Geren et al. (2003) indicated that high ADL ratio of plant tissues causes decreases in DDM ratio values. Early Sumac cultivar with high ADL ratio had the lowest DDM ratio (Table 5). The difference in DDM ratio of cultivars between years led to the difference of year x cultivar interaction. Aneto, Gardavan, Rox and Sugar Graze were in the same statistical group for the first year of the study. However, Gardavan and Sugar Graze were in the same DDM ratio group for the second year of the study, and the other cultivars were in different statistical groups. Rox cultivar had the highest DDM ratio in both years (Table 6). The DDM ratios obtained in this study were lower compared to those reported by Kaplan and Kızılşimşek (2012) similar to those of Canbolat (2012) and higher than the findings of Akdeniz et al. (2003).

Table 6. Digestible dry matter ratio and digestible dry matter yield of some silage sorghum and sorghum-sudangrass hybrid cultivars

	Digestible dry matter (%)			Digestible dry matter yield (kg ha^{-1})		
	2016	**2017**	**Mean**	**2016**	**2017**	**Mean**
ANETO	65.2 a^{++}	64.4 b^{++}	64.8 ab^{++}	10288.7 bc^{++}	10966.0 bcd^{++}	10626.8 bcd^{++}
EARLY SUMAC	59.8 e	59.7 e	59.7 f	9474.7 c	12005.6 bc	10740.2 bcd
GARDAVAN	65.2 a	62.9 c	64.0 bc	8821.3 c	6978.0 ef	7899.7 ef
GÖZDE 80	63.7 b	61.7 d	62.7 d	8906.6 c	5887.3 f	7396.5 f
GREENGO	61.3 d	60.3 e	60.8 e	11258.3 b	13592.7 b	12425.5 b
JUMBO	62.4 c	60.6 e	61.5 e	17758.0 a	18058.7 a	17908.3 a
ROX	65.0 a	66.0 a	65.5 a	10319.3 bc	9267.0 cde	9796.2 cde
SUGAR GRAZE	65.0 a	62.5 cd	63.7 c	9653.7 c	8616.3 def	9135.0 def
TEIDE	61.5 cd	60.6 e	61.0 e	9771.3 bc	13135.6 b	11453.5 bc
MEAN	63.2 A**	62.1 B	62.6	10694.4	10945.3	10819.9

++ Means followed by the same letter in the same column are statistically not significant (p<0.01).
** Means followed by the same letter in the same line are statistically not significant (p<0.01).

Digestible dry matter yield

The cultivars factor and year x cultivar interaction had significant effects (P<0.01) on digestible dry matter yield (DDMY) of cultivars, however the effect of year was not significant (Table 2). The highest DDMY (17908.3 kg ha^{-1}) was obtained in Jumbo cultivar which had a low lignin ratio. Gözde 80 (7396.5 kg ha^{-1}), Gardavan (7899.7 kg ha^{-1}) and Sugar graze (9135.0 kg ha^{-1}) cultivars which had high lignin ratios yielded statistically significant low DDM yield (Table 6). Jung and Vogel (1992) stated that high ratio of lignin negatively affects the degradability of cells and decreases the digestibility of feed. The DDMY, calculated by multiplying digestibility and DMY, is directly affected by DDM ratio and DMY (Akdeniz et al., 2003). The DDM yields of cultivars, similar to the DDM ratio and DMY, have also varied between years. The Early Sumac and Gardavan cultivars were in the same group for the first year, whereas they were in the different statistical groups for the second year and two-year averages (Table 6). The DDM ratios obtained in this study were lower compared to those reported by Akdeniz et al. (2003) and higher than the findings of Karadağ and Özkurt (2014).

Conclusion

In this study, the yield and quality components of sorghum and sorghum-sudangrass hybrid cultivars were determined in Kırşehir ecological condition which has significant potential for livestock. The results revealed that Greengo cultivar along with Jumbo can be considered suitable for the Kırşehir and surrounding region with similar ecological conditions. In addition, the cultivation of sorghum and sorghum-sudangrass hybrid which will be helpful to meet the quality forage need should be increased.

Acknowledgement

The first-year data of this two-year study was used in the thesis of Başak DURSUN ŞAHAN whom I have been advising.

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