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FEED QUALITY TRAITS OF BAGASSE OF SOME SWEET SORGHUM GENOTYPES (Sorghum *bicolor* (L.) *Moench ssp. Saccharatum)*

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ABSTRACT

This study was conducted to determine some feed quality characteristics of silage made from bagasse after juice extractioning of stalks of sweet sorghum (Sorghum *bicolor (L.) Moench ssp. Saccharatum*). The research was carried out from June to November in 2016 and 2017. Twenty one sweet sorghum genotypes were used as treatments were used under randomized complete block design with four replications According to the two-year averages; there were statistically significant differences in sweet sorghum genotypes in terms of all examined characteristics. According to the research results, digestible dry matter yield (DDMY), crude protein yield (CPY), dry matter intake (DMI) ratio, relative feed value (RFV), digestible dry matter (DDM) ratio and net energy (NEI) were ranged from 6472.3 – 16500.5 kg ha^{-1}, 418.0 – 996.3 kg ha^{-1}, 1.775 – 3.050%, 73.5 – 162.8, 53.43 – 69.84% and 1.225 – 1.575 Mcal kg^{-1} KM respectively. While UNL-hybrid-3, Thesis and Smith genotypes can be recommended for silage quality characteristics. No41 and Gulseker genotypes performed poorly in terms of silage quality.

Keywords: Sweet sorghum, bagasse crude protein, digestible dry matter, yield

1. INTRODUCTION

The origin of the sweet sorghum (Sorghum *bicolor* (L.) *Moench ssp. Saccharatum*) is the continent of North and East Africa. It has been reported that plants of sweet sorghum have a root system that goes deep into the soil and have a high tolerance to drought stress (Koppen et al., 2009). Because, the growing period of the sweet sorghum is short (3-4 months), it can be cultivated under second crop conditions. Sweet sorghum is used as both human food and animal feed. As it is a plant tolerant to marginal areas and extreme climatic conditions, the sweet sorghum plant can be grown easily in different regions and climates of the world (Smith et al., 1987). It has been reported that despite of applying with little amount of nitrogen (N) fertilizer, sweet sorghum has a genetic structure which give the maximum yield (Geng et al., 1989). It has been reported that high yield and ethanol are obtained in sweet sorghum plants in some parts of the world without applied nitrogen (N) fertilization (Smith and Buxton, 1993). Sweet sorghum plant can be grown with much less fertilizer and irrigation than corn and sugar cane and sugar beet and found to be more tolerant than these plants (Grassi, 2000).

European continent which does not have enough sunlight and temperature and has a high number of cloudy days is not suitable for sweet sorghum cultivation (Wodds, 2000). Biomass yield is high in places where there are high light intensity and average temperature (Guiying et al., 2003). Unlike Europe, Turkey is located in 36°- 42 ° north and receives intense solar light and heat, that is why, make its her climatic conditions ideal for growing sweet sorghum. Most of the sweet sorghum grown in the world is used as green feed or silage in animal feeding. It is also cultivated to extract sweet sap from stalks (Geren et al., 2019). The bagasse remaining after extraction is used in silage and dry forms for animal feeding (Kucuksemerci and Baytekin, 2017). Due to the fact that the sweet sorghum plant is covered with a waxy layer, it minimizes water loss by transpiration (Acar et al., 2001).

The sweet sorghum plant can be cultivated as an alternative plant to silage corn in the production areas where irrigation is limited in the GAP region. Since some sorghum varieties contain prussic acid, animal health deteriorates when sweet sorghum plants are fed green to animals. It has been reported that animal health will be protected if sweet sorghum varieties are used as dry grass or silage (Langer and Hill, 1982). Therefore, in the this study after drying the bagasse of the sweet sorghum varieties, the feed quality characteristics were investigate.

2. MATERIAL AND METHOD

2.1 Experimental materials

Twenty one different Sorghum genotypes from different sources were used as materials in this research. The names and source of the genotypes tested in this study were as follows: **1)** Corino, Cowley, Grassi, M81-E, N98, Nebraska sugarcane, PI579753, Ramada, Rio, Roma, Smith, Theis, Topper 76, Tracy, UNL-Hybrid -3 ((26297xM81 E), Williams, Wray; **2)** no91 USDA-Taiwan, no5 USDA South Africa, no41 USDA-Z; **3)** Local check Gulseker were supplied by UNL (University of Nebraska, Lincoln, USA) and Western Mediterranean Agricultural Research Institute-Antalya/Turkey (supplied from ICRISAT and USDA gene bank) and University of Uludag, Bursa, Turkey), respectively.

2.2 Soil and climate characteristics of the experimental site

Soil samples were taken for analysis at the depth of 0-15 and 15-30 cm from the area during 2016 and 2017. The parameters of Harran soil seriesi.e. pH, total salt (EC), Nitrogen (N), organic carbon (OC), phosphorus (P), lime content ($CaCO_3$), sand, silt and clay were ranged from 7.65-7.74, 0.30-0.37%, % 0.05-0.08, % 0.34-0.50, 0.39-0.50 mg/kg, 44.5-47.0%, 28-30%, 26-27%, 44-45% respectively. It was determined that soil texture class of the trial was in clayey (C) structure. During the months of June and July the the temperature was reached above 40 ºC and prominant difference in day and night temperatues was observed (Table 1). 861

Table 1. Important climatic values of experimental location

	Average Temprature(°C)			The highest temperatures (°C)			The lowest temperatures (°C)			Average Humidity (%)		
Month	2016	2017	average for long years.	2016	2017	The highest for long years	2016	2017	The lowest for long years.	2016	2017	average for long years
May	22.6	23.2	22.3	35.5	35.0	40.0	9.3	10.7	6.0	45.0	38.3	44.9
June	27.1	29.8	28.2	40.5	42.0	44.0	13.1	18.9	10.0	42.1	28.0	32.8
July	30.6	33.0	31.9	41.8	43.0	46.8	15.4	20.9	16.0	40.5	25.4	30.1
August	29.2	33.2	31.2	42.2	43.0	44.8	16.2	21.2	16.0	49.8	30.6	33.1
September	26.9	26.4	26.8	36.2	39.3	42.0	14.0	14.7	11.2	48.1	32.1	35.8
October	20.8	22.1	20.2	31.0	33.9	37.0	9.2	12.3	2.5	60.0	35.9	46.4
November	14.0	12.6	12.7	22.4	24.4	29.4	1.7	3.0	-2.7	56.8	42.9	59.9
December	7.0	5.4	7.5	18.0	13.7	26.0	-0.8	-2.2	-6.4	55.6	70.1	69.9
Average	**22.28**	**23.21**	**22.60**	**33.45**	**34.29**	**38.75**	**9.76**	**12.44**	**6.58**	**49.74**	**37.91**	**44.11**

Source: General Directorate of Meteorology of Turkey, 2017

2.3 Method

The research was carried out in Akçakele/Şanlıurfa (36.90231 N, 38.92092 E) second crop conditions (from June to November) during 2016 and 2017 in randomized complete block design (RCBD) with four replications. The experimet area was made ready for sowing in the last week of June after the wheat harvest. Nitrogen, in the form of ammonium nitrate (33% N), was applied at the rate of 50 kg N ha^{-1}, four weeks after sowing, while, nitrogen and phosphorous was added once with seed bed preparation at the rate of. 50 kg N ha^{-1} and 50 kg ha^{-1} P_2O_5 in the form of mixed fertilizer (20.20.0 % N, P_2O_5). The experimet area is rich in potassium. The dimension of the experimental unit was 5 m × 2.80 m. Each was consisted of 4 rows with 5 m in length and 70 cm of row spacing. Plant population of trial was about 95000 plants ha^{-1}. Considering the critical development periods and lack of water, trial's plots were irrigated 7 times (about 650 mm) during the growing season. Stalks were harvested for juice extraction when the grains reached to milk/dough stage.The plants were harvested between 15 October and 15 November according to the milk-paste period of genotype seeds. At the time of harvesting, plants were cut with a sickle directly above ground level, and fresh yield per plot was determined.

Middle two plant rows of the each plot were harvested, the stalks were squeezed by squeezing machine and the bagasse's silage quality related characteristics were were analyzed. For quality analysis, a bagasse sample of 500 g was chopped into pieces of 4-5 cm length with chopper. Then it was placed in specially prepared 1 kg vacuum bags. Vacuumed silage material was labeled and stored in room conditions. The silage material was left for 60 days for silage quality analysis. After 60 days, all of the silage samples were dried in the drying oven until their weight stabilized at 65 °C, 0.5 kg from each teratmet was dried at 60 °C until constant weight was reached to determine the dry matter (DM) concentration.

All dried silage samples were puverized in a plant mill with a 1-2 mm sieve. Kjeldahl method was used to determine the nitrogen (N) content of the samples. The Crude Protein ratio is determined by the given below formula (Equations 1) (AOAC, 1990). Then Crude protein yield was determined by multiplying the crude protein ratio by dry matter yield (Equations 2) (Kır and Sahan, 2019).

$$Crude\ Protein\ (\%) = N \times 6.25 \qquad (1)$$

Crude Protein Yield (CPY, kg ha^{-1}) = crude protein ratio x dry matter yield (2)

The content of neutral detergent fiber (NDF) % and Acid detergent fiber (ADF)%, which constitutes the cell wall components of the feeds, were determined by ANKOM fiber analyzer (Fiber analyzer) (Van Soest et al., 1991). Neutral detergent fiber (NDF) acid detergent fiber (ADF), and acid detergent lignin (ADL) values determined were proportioned to dry matter and the results were converted to g/kg DM.

Digestible dry matter (DDM) ratio, digestible dry matter yield (DDMY), dry matter intake rate (DMI), Relative feed value (RFV) and Net Energy lactation (NEL) (Mcal/kg^{-1} KM) were calculated by the formulae (Schroeder, 1994).

$$Digestible\ dry\ matter\ ratio\ (DDMR)\% = 88.9 - (0.779\ x\ \%\ ADF) \qquad (3)$$

Digestible dry matter yield (DDMY, kg ha^{-1}) = DDMR x DMY (4)

$$Dry\ matter\ intake\ (DMI)\% = (120\ /\ NDF\%) \qquad (5)$$

$$Relative\ feed\ value\ (RFV)\% = (\mathrm{DDMR} \times \mathrm{DMI})\ /1.29) \qquad (6)$$

$$Net\ Energy\ lactation\ (NEL) = (1.892 - \ (0.0141\ \times\ \mathrm{ADF}) \qquad (7)$$

Data obtained were subjected to analysis of variance through the JMP statistics software. Combined variance analysis was applied for years. The comparison of the genotype means was made using the TUKEY test at 5 % level (Yurtsever, 1984)

3. RESULTS AND DISCUSSION

3.1 Digestible dry matter yield ((kg ha^{-1})

The difference between genotypes, year and genotype × year interaction were found statistically significant for digestible dry matter (DDM) yield ($P \leq 0.01$). In the study, while the highest digestible dry matter yield was obtained from UNL-hybrid-3 (16500.5 kgha^{-1}), Smith (16440.3 kg ha^{-1}) and Theis (15790.6 kg ha^{-1}), the lowest digestible dry matter yield was obtained from Gulseker (6472.3 kg ha^{-1}) genotype (**Table 2**). The results obtained were found below results of Kır and Sahan (2019) (11855.3 - 28957.3 kgha^{-1}) and above results of Karadag and Ozkurt, (2014) (5321-10423 kg/ha^{-1}). It can be said that the different yields are orginate to different applications, varieties and ecology. Compared to the first year of the trial, higher temperatures and lower relative humidity in the second year of the trial negatively affected the plant growth. This situation caused to decrease the crude protein ratios. As the protein ratios of the plants decrease, it is estimated that the digestible dry matter ratios also decrease.

3.2 Crude protein yield (kg ha^{-1})

The difference between genotypes, year and genotype × year interaction were found statistically significant for crude protein (CP) yield ($P \leq 0.01$). In the study, while the highest crude protein yield was obtained from Smith (827.5 kg ha^{-1}) and UNL-hybrid-3 (802.1 kg ha^{-1}) sweet sorghum genotypes, the lowest crude protein yield was obtained from Gulseker (427.2 kg ha^{-1}) genotype (**Table 2**). Animal feeds containing protein were reported to increase dry matter intake rate (Pereira et al., 2008). 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). The results obtained were found below results of Kır and Sahan (2019) (877.5 - 2799.8 kg ha^{-1}).

Table 2. Mean levels of digestible dry matter and crude protein yield in the silage of twenty-one sweet sorghum genotypes

Genotypes	**Digestible Dry Matter Yield (kg/ha⁻¹)**			**Crude Protein Yield (kg/ha⁻¹)**		
	2016	**2017**	**Mean**	**2016**	**2017**	**Mean**
Corina	10241.2 d-l+	8370.1 g-m	9305.7 f-ı	493.1 fgh+	533.2 c-h	513.2 d-g
Cowley	10260.1 d-l	9791.3 f-m	10025.7 d-g	571.2 c-h	539.0 c-h	555.1 c-g
Grassi	11712.3 b-h	7132.4 lm	9422.4 f-ı	525.4 c-h	536.3 c-h	530.9 d-g
M81-E	13150.1 a-f	8550.3 g-m	10850.2 c-f	554.3 c-h	629.1 b-h	591.7 b-g
N98	10693.3 d-k	8851.2 g-m	9772.3 efg	492.0 fgh	631.5 b-h	561.8 c-g
N. sugarcane	9232.0 g-m	10262.5 d-l	9747.3 efg	610.6 b-h	687.4 b-h	649.0 a-e
P1579753	14870.2 ab	9293.0 g-m	12081.6 a-d	694.2 b-h	680.3 b-h	687.3 a-d
Ramada	13621.4 a-d	9882.3 e-m	11751.9 a-e	721.1 a-g	749.6 a-f	735.4 abc
Rio	14534.0 abc	11580.5 b-ı	13057.3 abc	699.2 b-h	799.6 a-d	749.4 ab
Roma	13122.4 a-f	9880.3 e-m	11501.4 b-f	786.3 a-d	653.3 b-h	719.8 abc
Smith	16440.3 a	10130.4 d-l	13285.4 ab	875.3 ab	779.6 a-e	**827.5 a**
Theis	15790.6 a	9962.3 e-m	12876.5 abc	571.2 c-h	653.3 b-h	612.3 b-f
Topper 76	14390.2 abc	7853.2 j-m	11121.7 b-f	627.4 b-h	539.2 c-h	583.3 b-g
Tracy	11190.3 c-j	8031.1 ı-m	9610.7 e-h	497.2 e-h	432.5 h	464.9 fg
UNL-hybrid -3	**16500.5 a**	11222.2 c-j	**13861.4 a**	810.0 abc	794.1 a-d	802.1 a
Williams	7861.4 j-m	6480.4 m	7170.9 ı	457.2 gh	524.3 d-h	490.8 efg
Wray*	9944.6 e-m	6552.2 m	8248.4 ghı	475.1 fgh	556.3 c-h	515.7 d-g
No91	13390.0 a-e	6772.5 lm	10081.3 d-g	528.6 c-h	516.5 d-h	522.6 d-g
No5	11861.2 b-g	7180.5 klm	9520.9 e-h	514.2 d-h	482.4 fgh	498.3 efg
No41	13242.3 a-f	7851.2 j-m	10546.8 def	**996.3 a**	536.0 c-h	766.2 ab
Gülşeker	8200.5 h-m	6472.3 m	7336.4 hı	418.0 h	436.2 g-h	427.2 g
Mean	**12392.8 A**	**8671.5 B**		**615.1**	**604.3**	
CV (%)		11.90			16.50	
F Genotype (G)		**			**	
F Year (Y)		**			Ö.D	
F GxY int.		**			**	

+) According to the Tukey test, There is no statistically significant difference at P≤0.05 level among the averages shown with similar letters in the same column, **) Statistically significant at 1% level, [1]) The average years shown with similar capital letters are non-different from each other as statistically

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3.3 Dry matter intake (%)

The difference between genotypes, year and genotype × year interaction were found statistically significant for dry matter intake (DMI) (P≤0.01). In the study, while the highest dry matter intake rate was obtained from Ramada (3.050%), the lowest dry matter intake rate was obtained from No41 (1.775%) genotype (**Table 3**). Animal feeds containing protein were reported to increase dry matter intake rate (Pereira et al., 2008). The results obtained were found above results of Yucel et al. (2017) and Karthikeyan et al. (2017).

3.4 Relative feed value (RFV)

The difference between genotypes, year and genotype × year interaction were found statistically significant for relative feed value (RFV) (P≤0.01). Relative feed value ranged between 73.5 (No41) and 162.8 (Thesis) in the genotype × year interaction table (**Table 3**). The relative feed value of the alfalfa, which is rich in protein, plant harvested at its 10% floweringis considered to be of high in quality. It was found that the relative feed value of most genotypes is close to the alfalfa plant in the research and this is a desired condition in terms of feed quality value. Results obtained were quite in line with the findings of Yucel et al., (2019) and Durul (2016).

Table 3. Mean levels of dry matter Intake and relative feed Value in the silage of twenty-one sweet sorghum genotypes

Genotypes	Dry Matter İntake Rate (%)			Relative Feed Value		
	2016	**2017**	**Mean**	**2016**	**2017**	**Mean**
Corina	2.550 a-h⁺	2.100 d-h	2.325 a-f	127.0 a-h	101.5 c-ı	114.3 abc
Cowley	1.925 e-h	1.925 e-h	1.925 e-f	82.0 ghı	87.0 f-ı	84.5 cd
Grassi	2.575 a-g	2.000 e-h	2.288 a-f	134.8 a-g	95.9 c-ı	115.3 abc
M81-E	2.625 a-f	2.075 e-h	2.350 a-f	128.1 a-h	99.6 c-ı	113.9 abc
N98	2.975 abc	1.800 gh	2.388 a-e	159.3 ab	83.8 ghı	121.6 ab
N. Sugarcane	1.900 fgh	2.325 a-h	2.113 a-f	80.4 hı	116.8 a-ı	98.6 a-d
P1579753	1.900 fgh	2.150 d-h	2.025 c-f	84.1 ghı	104.9 c-ı	94.5 bcd
Ramada	**3.050 a**	2.125 d-h	2.588 ab	161.7 a	102.2 c-ı	131.9 a
Rio	2.250 a-h	1.750 h	2.000 def	111.5 a-ı	81.5 hı	96.5 bcd
Roma	2.350 a-h	2.625 a-f	2.488 a-d	121.6 a-ı	142.2 a-e	131.9 a
Smith	2.175 c-h	2.025 e-h	2.100 b-f	102.5 c-ı	96.3 c-ı	99.4 a-d
Theis	3.000 ab	1.900 fgh	2.450 a-d	**162.8 a**	87.3 f-ı	125.0 ab
Topper 76	2.725 a-e	2.350 a-h	2.538 abc	144.7 a-d	120.5 a-ı	**132.6 a**
Tracy	2.900 a-d	2.350 a-h	**2.625 a**	146.8 abc	118. a-ı	132.4 a
UNL-hybrid -3	2.700 a-f	2.300 a-h	2.500 a-d	137.7 a-f	114.8 a-ı	126.3 ab
Williams	2.425 a-h	1.800 gh	2.113 a-f	115.4 a-ı	77.8 h	96.6 bcd
Wray	2.225 b-h	2.000 e-h	2.113 a-f	108.5 b-ı	91.5 d-ı	100.0 a-d
No91	2.425 a-h	2.100 d-h	2.263 a-f	119.5 a-ı	99.0 c-ı	109.3 a-d
No5	2.500 a-h	2.325 a-h	2.413 a-e	126.9 a-h	114.5 a-ı	120.7 ab
No41	**1.775 gh**	1.925 e-h	**1.850 f**	**73.5 ı**	85.9 f-ı	**79.7 d**
Gulseker	2.050 e-h	2.075 e-h	2.063 c-f	89.8 e-ı	99.3 c-ı	94.5 bcd
Mean	**2.429 A**	**2.096 B**		**119.9 A**	**101.0 B**	
CV (%)		**12.44**			**16.97**	
F Genotype (G)		**			**	
F Year (Y)		**			**	
F GxY int.		**			**	

⁺) According to the Tukey test, There is no statistically significant difference at P≤0.05 level among the averages shown with similar letters in the same column, **) Statistically significant at 1% level, 1) The average years shown with similar capital letters are non-different from each other as statistically

3.5 Digestible dry matter ratio (%)

The difference between genotypes, year and genotype × year interaction were found statistically significant for digestible dry matter (DDM) ratio (P≤0.01). Digestible dry matter rate ranged from 53.43% (No41) to 69.84% (Thesis) in the genotype × year interaction table (**Table 4**). The rate of digestible dry matter in the research related to directly ADF, NDF and ADL quality features. Digestible dry matter rate is directly related to the harvest time of the plants. As the harvest time is delayed, the cellulose ratio in the stalks increases. This is undesirable. Sweet sorghum genotypes have sugar proportion at different levels. İt was reported that as sugar rate increased in the stalks of genotypes, the digestible dry matter rate also increased. This was reported to improve feed digestibility and quality (Blummel et al., 2009). The results obtained were quite compatible with studies of Karadag and Ozkurt (2014), Yucel et al. (2017), Yucel et al. (2019) and Kır and Şahan (2019).

3.6 Net energy (Nel) (Mcal kg^{-1} DM): The difference between genotypes, year and genotype × year interaction were found statistically significant (P≤0.01) for net energy. While the highest net energy was obtained from the Thesis (1.575 Mcal kg^{-1} DM) genotype, while the lowest was obtained from the No41 (1.225 Mcal kg^{-1} DM) genotype (**Table 4**). Because intense sunlight, in the trial area, has positively affected the speed and amount of photosynthesis of the genotypes. It is estimated that intensive photosynthesis promotes the accumulation of dense carbohydrates in the organelles of plants and being the C_4 plants, sorghum uses plenty of sunlight in a bettter way than other foddersand as a result, the energy values of the plants are high (Kaiser et al., 2004). İt was determined that net energy results obtained from the study was accordance with studies of Yucel et al. (2019). The value of obtained was below results of Cattani et al. (2017), while above than the results of Yucel et al. (2017).

Table 4. Mean levels of digestible dry matter rate and net energy in the silage of twenty-one sweet sorghum genotypes

Genotypes	**Digestible Dry Matter Rate (%)**			**Net Energy NEl (Mcal kg^{-1} KM)**		
	2016	**2017**	**Mean**	**2016**	**2017**	**Mean**
Corina*	64.01 a-j[+]	61.76 a-l	62.88 a-d	1.450 a-f	1.400 a-g	1.425 abc
Cowley	54.93 jkl	58.04 e-l	56.48 ef	1.275 fg	1.325 d-g	1.300 de
Grassi	67.44 a-d	61.54 a-l	64.49 a-d	1.525 abc	1.400 a-g	1.463 abc
M81-E	63.29 a-k	61.95 a-l	62.62 a-d	1.400 a-g	1.400 a-g	1.400 a-d
N98*	69.17 ab	60.20 b-l	64.68 abc	1.525 abc	1.375 b-g	1.450 abc
Nebraska Sugarcane	54.34 kl	64.34 a-ı	59.34 c-f	1.300 efg	1.450 a-f	1.375 cde
P1579753	56.78 g-l	61.96 a-l	59.37 b-f	1.325 d-g	1.400 a-g	1.363 cde
Ramada	68.00 abc	61.83 a-l	64.91 abc	1.500 a-d	1.400 a-g	1.450 abc
Rio*	63.55 a-j	60.31 b-l	61.93 a-e	1.425 a-f	1.375 b-g	1.400 a-d
Roma	66.24 a-f	68.98 ab	**67.61 a**	1.475 a-e	1.550 ab	**1.513 a**
Smith	61.21 a-l	61.26 a-l	61.23 b-e	1.400 a-g	1.375 b-g	1.388 b-e
Theis	**69.84 a**	59.42 c-l	64.63 abc	**1.575 a**	1.350 c-g	1.463 abc
Topper 76	68.94 ab	65.78 a-g	67.36 a	1.525 abc	1.475 a-e	1.500 ab
Tracy	65.01 a-h	64.31 a-ı	64.66 abc	1.450 a-f	1.450 a-f	1.450 abc
UNL-hybrid -3	66.26 a-e	64.15 a-ı	65.20 ab	1.475 a-e	1.425 a-f	1.450 abc
Williams	61.42 a-l	55.86 ı-l	58.64 def	1.425 a-f	1.275 fg	1.350 cde
Wray*	62.88 a-k	58.81 d-l	60.84 b-f	1.425 a-f	1.325 d-g	1.375 cde
No91	64.57 a-ı	59.48 c-l	62.03 a-e	1.475 a-e	1.375 b-g	1.425 abc
No5	65.13 a-h	63.21 a-k	64.17 a-d	1.475 a-e	1.425 a-f	1.450 abc
No41	**53.43 l**	57.14 f-l	**55.28 f**	**1.225 g**	1.325 d-g	**1.275 e**
Gulseker	56.32 h-l	60.98 a-l	58.65 def	1.300 efg	1.400 a-g	1.350 cde
Mean	**62.99 A**	**61.49 B**		**1.426 A**	**1.394 B**	
CV (%)		**5.16**			**4.82**	
F Genotype (G)		**			**	
F Year (Y)		**			**	
F GxY int.		**			**	

[+]) According to the Tukey test, There is no statistically significant difference at P≤0.05 level among the averages shown with similar letters in the same column, **) Statistically significant at 1% level, 1) The average years shown with similar capital letters are non-different from each other as statistically

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4. CONCLUSION

From the twnety one sweet sorghum varieties tested in the study. the UNL-hybrid-3, Thesis and Smith genotypes can be recommended for silage quality characteristics. No: 41 and Gülşeker genotypes performed poorly in terms of silage quality. It was thought that higher temperature and lower relative humidity in the second year compared to the first year of the trial negatively affected the feed quality characteristics of the plants. The silage sorghum varieties to be evaluated as silage should be examined in terms of their yield as well as their quality characteristics.

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REFERENCES

Acar, R., Akbudak, M., & Sade, B. (2002). The Determination of Yield and Some Yield Components of sorghum-Sudangrass Hybrid Cultivars for Silage Production in Konya Ecological Conditions. *Selcuk University Faculty of Agriculture Journal*, 16(29): 88-95

Blummel, M., Rao, S.S., Palaniswami, S., Shah, L., & Reddy, B.V.S. (2009). Evaluation of sweet sorghum (Sorghum bicolor (L.) Moench) used for bio-ethanol production in the context of optimizing whole plant utilization. *Animal Nutrition and Feed Technology*, 9 (2):1-10

Cattani, M., Guzzo, N., Mantovani, R., & Bailoni, L. (2017). Effects of Total Replacement of Corn Silage with Sorghum Silage on Milk Yield Composition and Quality. *Journal of Animal Science and Biotechnology*, 4(3): 8-15, DOI 10.1186/s40104-017-0146-8

Durul, G. (2016). Effect of Different Harvest Times on Sweet Quality of Sorghum (Sorghumbicolor *(L.) Moench var.saccharatum*) and Bean (Phaseolusvulgaris) Silage Mixtures. Ege Unv., Institute of Science, *Field Crops Department*, *M.Sc. Thesis*,; 72 pp

Geng, S., Hill, F.J., Johnson, S.S., & Sah, R.N. (1989). Potential Yields and on Farm Ethanol Production Cost of Corn, Sweet Sorghum, Fodder Beet and Sugar Beet. *J. Agron. Crop Sci.* (162), 21-29

Grassi, G. (2000). Bioethanol - Industrial World Perspectives. Renewable Energy World. Sweet Sorghum: One of the Best World Food-Feed-Energy Crop. [İnternet] Avaible from: http://web.etaflorence.it/uploads/media/LAMNET_sweet_sorghum.pdf.

Guiying, L., Weibin, G., Hicks, A., & Chapman, K.R. (2003). A Training Manual for Sweet Sorghum. Development of Sweet Sorghum for Grain, Sugar, Feed, Fiber, and Value-Added By-Products, in The Arid, Saline- Alkaline Regions of China. FAO - TCP/CPR/0066. (İnternet); Avaible from; http://ecoport.org/ep?SearchType=earticleView&earticleId=172&page=2

Geren, H., Kır, B., Kavut, Y.T. (2019). Effect of Different Harvest Stages on The Yield and Some Forage Quality Components of Sweet Sorghum (Sorghum *Bicolor Var. Saccharatum*) Cultivars. *Ege Univ. Agriculture Fak. J.*, 56 (2):249-255

Kaise, A.G., Plitz, J.W., Burns, H.M., & Griffiths, N.W. (2004). Successful Silage. Dairy Australia NSW Department of Primary Industries, 468 pp

Koppen, S, Reinhardt, G., & Gärtner, S. (2009). Assessment of Energy and Greenhouse Gas Inventories of Sweet Sorghum for First and Second Generation Bioethanol. *Environment and Natural Resources Management Series*, Rome, 30, FAO. 252pp.

Karadag, Y., & Özkurt, M. (2014). Effect of Different Row Spacings on The Yield and Quality of Silage Sorghum (*Sorghum Bicolor (L).Moench*) Cultivars to be Second Crop Grown. *JAFAG*, 31 (1), 19-24

Karthikeyan, B.J., Babu, C., & Amalraj, J.J. (2017). Nutritive Value And Fodder Potential Of Different Sorghum (Sorghum *bicolor L. Moench*) cultivars. *International Journal of Current Microbiology and Applied Sciences*, 6(8): 898-911

Keskin, B., Akdeniz., H. Yilmaz, I.H., & Turan, N. (2005). Yield and Quality of Forage Corn (Zea *mays L.*) as Influenced by Cultivar and Nitrogen Rate. *J. Agron.*, 4(2):138-141

Kuçuksemerci, O., & Baytekin, H. (2017). Effect of Plant Density on Yield and Quality Parameters of Sweet Sorghum in Çanakkale Ecological Conditions. *Turkish Journal of Agricultural and Natural Sciences*, 4(1): 95–100

Kır, H., & Sahan, B.D. (2019). Yield and Quality Feature of Some Silage Sorghum and Sorghum-Sudangrass Hybrid Cultivars in Ecological Conditions of Kırşehir Province. *Turkısh Journal of Agrıcultural and Natural Scıences*, 6(3): 388-395

Langer, R.H.M., & Hill, G.D. (1982). Agricultural Plants. Cambridge University Press. Cambridge. 152pp

Pereira, D.H., Pereira, O.G., Silva, B.C., Leao, M.I., Valadares, F.S.C., & Gacia, R. (2008). Nutrient Intake and Digestibility and Ruminal Parameters in Beef Cattle Fed Diets Containing Bracharíabrizanthasilage and Concentrate at Different Ratios. *Animal Feed Sciences Technology*. 140 (5): 52-56

Schroeder, J.W. (1994). Interpreting Forage Analysis. Extension Dairy Specialist (NDSU), AS-1080, North Dakota State University

Smith, G.A., Bagby, M.O., Lewellen, R.T., Doney, D.L., Moore, H., Hills, F.J., Campbell, L.G., Hogaboam, G.J., Coe, G.E., & Freeman, K. (1987). Evulation of Sweet Sorghum for Fermentable Sugar Production Potential. *Crop Sci*., 27: 788-793

Smith, C.W., & Buxton, D.R. (2003). Temperate Zone Sweet Sorghum Ethanol Production Potential. *Bioresource Technology*. (43): 71-75

Van Soest, P.J. (1994). Nutritional Ecology of the Ruminant. (2nd ed.). Ithaca, NY: Cornell University Press

Woods, J. (2000). Integrating Sweet Sorghum and Sugarcane for Bioenergy: Modelling the Potential for Electricity and Ethanol Production in SE Zimbabwe. PhD thesis, Division of Life Sciences King's College London University of London

Yurtsever, N. (1984). Experimental Statistical Methods, Soil and Fertilizer Research Institute Publications, Ankara,No: 121

Yucel, C., İnal, İ., Gündel, F., Yucel, D., Aktaş, A., Karaağaç, H.A, Hatipoglu, R., & Dweikat, I. (2017). The Determining Silage Quality Parameters of Sap of Sweet Sorghum Extraction for Bioethanol Production. *KSU J. Nat. Science*, 20 (special issue), 144-148

Yucel, C., Yucel, D., Yucel, H., & Oluk, A.C. (2019). Some Quality Parameters of Silage made with Extracted Sorghum Stems. *Sırnak University Journal of Science*, 1(1): 1-15