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Quality Characteristics of Sorghum (*Sorghum bicolor* (L.) *moench*) and Sorghum×Sudan Grass Hybrids (*Sorghum bicolor* (L.) *Moench*×*Sorghum sudanense stapf.*) Cultivated as Second Crop after Barley in Erciş-Van Ecological Condition

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Abstract: The aim of this study was to compare their grass qualities by determining hay yields, crude protein ratios and yields of some sorghum and sorghum×sudan grass hybrid cultivars as second crop after barley in Erciş-Van ecological condition in 2003. The experimental data were analyzed using randomized complete block design with 3 replications. In the present study, sorghum cultivars (Rox) and 7 sorghum×sudangrass hybrid cultivars (Grazer, Seweet Sioux, GW-9110, Sugar Leaf, Grass-II, 877 and Gözde-80) were used. For all cultivars, average of hay yield ranged from 9770-20550 kg ha^{-1}. It was found in the present study that, cultivars with the highest hay yield were 877-cultivar (20550 kg ha^{-1}) and Seweet Sioux cultivar, cultivars having the highest crude protein ratio were determined as Sugar Leaf (11.0%), Grazer (10.8%) and Sweet Sioux (10.5%), respectively. Cultivars with highest crude protein yield were determined as Sweet sioux (2140 kg ha^{-1}) and Grazer (1750 kg ha^{-1}). As a result, Sweet sioux and Grazer cultivars can be recommend to farmers in Erciş-Van ecological conditions in terms of yield and quality, but 877-cultivar and Sweet Sioux sorghum×sudangrass hybrid cultivars can be suggested in terms of only yield.

Key words: Sorghum, sorghum×Sudangrass hybrid, second crop, hay yield crude protein rate, crude protein yield

INTRODUCTION

It is possible that sorghum and sorghum×sudan grass hybrid cultivars can be produced too much grass per acre. In spite of being tropic plants, they cultivate with object of silage production for animal nutrition in the countries where adaptation capacity is well. When cultivated under unfavorable condition (high temperature and inadequate precipitation), the cultivars can produce feeds with high quality and feeding values (Friborg *et al*., 1976). In most developed countries, sorghum cultivars used for silage production are used instead of corn silage. At present day, sorghum is used for more animal nutrition and partly industry. Sorghum grain including ample starch contains more plentiful protein than corn. It is known that Crude protein of Sorghum increases with N fertilizer (Bajwa *et al*., 1983).

Cacares and Santana (1987) who carried out on Sorghum in Cuba, reported that the highest crude protein ratio was found to be 10.1%. Tcacenco *et al*. (1989) stated that crude protein ratio out of all plant became equal to 11%. In an investigation performed by Özbilen (1991), average crude protein ratio and yield was found as 7% and 10400 kg ha^{-1}, respectively.

It was found in a study on sorghum varieties cultivated in Tokat district that crops harvested at early maturity phase had 26.8% dry matter ratio and 6.2% crude protein ratio (İptaş, 1993).

Avcıoğlu and İptaş (1994), who studied on determination of cut time and number for Sorghum and Sorghum×Sudangrass hybrid, stated that the highest green forage and dry matter yield was obtained from P-988 cultivar, which is Sorghum and Sorghum×Sudangrass hybrid and hay produced by using these hybrids with irrigation and fertilizer application was higher than green forages, with low production level in the second cut.

Plant height, green forage yield, hat yield, leaf ratio, stem ratio, bunch ratio of Sorghum-silage cultivated as the second crop in Harran savanna-watery conditions was found as: 290 cm, 9309, 2395 kg ha^{-1}, 18.3, 76.5 and 5.1%, respectively.

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Aydın and Albayrak (1995), studied on Sorghum cultivars cultivated as the second crop in Samsun ecological conditions, mentioned that crude protein ratio and yield were 9% and 910 kg ha^{-1}, respectively. Yılmaz and Sağlamtimur (1997) reported that corresponding values was 8.2% and 570 kg ha^{-1}, respectively.

Hosaflıoğlu (1998), worked on sorghum and Sorghum×Sudangrass hybrids (Grazer, Sugar Leaf, Gözde-80, GW-9110 and Rox) cultivated as the second crop in Van conditions, stated that crude protein ratio and yield ranged from 7.2-8.7% and from 890-1260 kg ha^{-1}, respectively. Cultivars having the best quality and yield were determined as Grazer, Gözde-80 and Sugar Leaf, respectively.

With aim of silage production, Gül and Başbağ (1999) studied on sorghum and Sorghum×Sudangrass hybrids (Grazer, Sugar Leaf, Gözde-80, GW-9110 and Rox) cultivated as the second crop in Diyarbakir watery conditions, green hay yield, hay yield, plany height and stem ratio ranged 41560-52350 kg ha^{-1}, 9340-13590 kg ha^{-1}, 148-267 cm and 61.1-83.9%, respectively. The authors stated that the best cultivars were FS 25E, Pioner-988 and Gözde-80 among Sorghum×Sudangrass hybrids.

Güçük and Baytekin (1999), worked on corn-silage sorghum and Sorghum×Sudangrass hybrids-silages cultivated as the second crop in Şanlıurfa Bozova watery conditions, mentioned that yield dry matter ratio ranged from 18.2-26.6% and the most suitable harvest time was early maturity phase.

Yılmaz (2000), worked on some sorghum and Sorghum×Sudangrass hybrids (Rox, Gözde-80, Grazer, Sugar Leaf, GW-9110, 877 Seweet Sioux, Grass II), reported that Green forage yield, hay yield, plant height, stem ratio, leaf ratio, bunch ratio ranged from 36580-57380 kg ha^{-1}; from 10210-19750 kg ha^{-1}, from 114-249 cm , from 65.1-73.2%, from 17.3-24.2% and from 7.1-15.2%, respectively. Besides, it was reported by the author that cultivars with the highest herbage yield and hay yield were GW-9110, Sugar Leaf, Grass II and Seweet Sioux. In another study under same condition, it was mentioned by Oral (2001) that crude protein ratio and yield of sorghum and Sorghum×Sudangrass hybrids (Grazer, Grass II, GW-9110, Gözde-80) cultivated as second crop were found to be 6.0-6.5% and 780-1210 kg ha^{-1}, respectively.

The present study was conducted to compare their grass qualities by determining hay yields, crude protein ratios and yields of some sorghum and sorghum×sudan grass hybrid cultivars as second crop after barley in Erciş-Van ecological condition.

MATERIALS AND METHODS

As plant materials, one sorgum (Rox) cultivar and seven sorgum×sudanotu hybrids (Grazer, Seweet Sioux, GW-9110, Sugar Leaf, Grass II, 877, Gözde-80) from Agricultural Faculty University of Yuzuncu Yil were used. In the field experiment, 100 kg ha^{-1} N_2 and 80 kg ha^{-1} P_2O_5 were used in each plot.

The field experiment was arranged at Randomized Complete Design with 3 replications. Each block was divided into 8 plots. Total 8 Cultivars were assigned randomly into each block. Each plot set at 10 m^2 (2×5). The experiment was carried out on (54×10 m) 540 m^2.

Statistical analysis: The experimental data were analyzed using randomized complete block design with three replications. Statistical analysis was performed using SPSS package program. Mean separation was tested by Duncan's Multiple Range Test (Düzgüneş *et al*., 1987).

RESULTS AND DISCUSSION

Hay yield: Results of ANOVA for Hay yield, Crude protein yield and ratio values of sorghum cultivar and sorghum×sudan grass hybrids are given in Table 1. As seen from Table 1, the effect of variety on hay yield and crude protein yield was found to be significant ($p<0.01$), but the effect of variety factor on Crude protein ratio was non-significant. The block effect was only non-significant on hay yield.

Table 1: ANOVA Results for Hay yield, Crude protein yield and ratio values of sorghum cultivar and sorghum×sudan grass hybrids

	F Values			
Variation source	Degree of freedom	Hay yield	Crude protein ratio	Crude protein yield
Block	2	1.97	5.21*	3.90*
Variety	7	5.97**	2.27	6.14**
Error	14			
Total	23			

*p<0.05

Table 2: Results of average hay yields and Duncan's Multiple Range Test of sorghum cultivar and sorghum×sudan grass hybrids

	Hay yield (kg ha^{-1})			
Cultivars	Replication 1	Replication 2	Replication 3	Mean.*
Rox	19350	16750	16290	17460^{ab}
Sugar leaf	16060	11240	12560	13280^{bc}
GW-9110	14730	17130	20660	17500^{ab}
Grazer	16230	16310	16290	16270^{ab}
Grass II	17640	10080	14280	14000^{bc}
877	22460	20960	18230	20550^{a}
Seweet sioux	22440	20000	18690	20370^{a}
Gözde-80	9340	5490	14480	9770^{c}
Mean.*	17280	14740	16430	16150

The difference between means with different letter was significant at 5% level

Table 3: Results of crude protein ratio and duncan's multiple range test of sorghum cultivar and sorghum×sudan grass hybrids

	Crude protein ratio (%)			
Cultivars	Replication 1	Replication 2	Replication 3	Mean.*
Rox	9.0	9.8	9.2	9.3^{ab}
Sugar leaf	11.0	11.5	10.5	11.0^{a}
GW-9110	10.7	8.0	7.6	8.8^{ab}
Grazer	12.5	12.7	7.1	10.8^{a}
Grass II	10.3	9.0	6.8	8.7^{ab}
877	8.3	8.9	7.4	8.2^{b}
Seweet sioux	10.2	10.6	10.7	10.5^{ab}
Gözde-80	8.7	9.9	7.5	8.7^{ab}
Mean.*	10.1	10.6	8.3	9.5

The difference between means with different letter was significant at 5% level

Table 4: Results of crude protein yield and Duncan's Multiple Range Test of sorghum cultivar and sorghum×sudan grass hybrids

	Crude protein yield (kg ha^{-1})			
Cultivars	Replication 1	Replication 2	Replication 3	Mean.
Rox	1750	1640	1500	1630^{ab}
Sugar leaf	1770	1290	1320	1460^{b}
GW-9110	1580	1380	1570	1510^{b}
Grazer	2040	2070	1150	1750^{ab}
Grass II	1820	910	970	1230^{bc}
877	1880	1880	1350	1700^{ab}
Seweet sioux	2280	2130	2000	2140^{a}
Gözde-80	810	540	1080	810^{c}
Mean	1740	1480	1370	1530

The difference between means with different letter was significant at 5% level

Results of average hay yields and Duncan's Multiple Range Test of sorghum cultivar and sorghum×sudan grass hybrids are presented in Table 2.

Hay yield of Sorghum cultivar and sorghum×sudan grass hybrids ranged from 9770-20550 kg ha^{-1}. Cultivar with the highest hay yield was determined as 877-cultivar (20550 kg ha^{-1}), whereas the lowest cultivar was found as Gözde-80 cultivar.

The finding was partly in consistent with findings of Yılmaz (2000), working with same genotypes, who found to range from 10210-19750 kg ha^{-1} in Van condition. The author's advantage order was determined Grass II, Sugar Leaf, Seweet Sioux and GW-9110. Our finding was in agreement with that of Oral (2001), who stated to ranged from 10360-9910 kg ha^{-1}. The finding on hay yield in the present study was found to higher than the findings of Aydın and Albayrak (1995) (9660 kg ha^{-1}); Gül and Başbağ (1999) (9340-13590 kg ha^{-1}), Özbilen (1991) (13400 kg ha^{-1}); Tcacenco *et al.* (1989) (7000-14000 kg ha^{-1}), but lower than 23950 kg ha^{-1}).

The differences among results of studies on hay yield in literature may be due to environmental and genetic factors.

Crude protein ratio: Results of crude protein ratio and Duncan's Multiple Range Test of sorghum cultivar and sorghum×sudan grass hybrids are summarized in Table 3. In our field experiment, crude protein ratio (%) of Sorghum cultivar and sorghum×sudan grass hybrids ranged from 8.2-11. Of cultivars, cultivar having the highest crude protein ratio was Sugar Leaf. Order of the others (from the highest to the lowest) was determined as: Grazer (10.8%), Seweet Sioux (10.5%), Rox (9.3%) GW-9110 (8.8%), Grass II (8.7%), Gözde-80 (8.7%) and 877-cultivar (8.2%).

In Van condition, findings obtained from Oral (2001), (6.0-6.5%) and Hosaflıoğlu (1998), (7.2-8.7%) were found to be lower than our finding. The differences may be arisen from N amounts.

The finding was in line with findings of Aydın and Albayrak (1995); Cacares and Santana (1987) and Yılmaz and Sağlamtimur (1997) who found as 9.0, 10.1 and 8.2%, respectively; but was found to be lower than that of Tcacenko *et al.* (1989) who found as 11 (%) and higher than those of Özbilen (1991) and İptaş (1993), who found to be 7 and 6.2%,

The differences among results of studies on hay yield in literature may be due to environmental and genetic factors.

Crude protein yield: Table 4 presents results of crude protein yield and Duncan's Multiple Range Test of sorghum cultivar and sorghum×sudan grass hybrids. As seen from Table 4, In our field experiment, crude protein yield of Sorghum cultivar and sorghum×sudan grass hybrids ranged from 810-2140 kg ha^{-1}. Of cultivars, one with the highest crude protein yield was Seweet Sioux (2140 kg ha^{-1}), the lowest one was determined as Gözde-80 (810 kg ha^{-1}).

Our finding on average crude protein yield was found to be higher that of Oral (2001), who found that the cultivars with highest crude protein yield was Grazer, Grass II, GW-9110 and Gözde-80 ones. Hosaflıoğlu (1998) reported that average crude protein yield ranged from 890-1260 kg ha^{-1} and ones with the best yield were determined as Gözde-80, Grazer, Sugar Leaf, GW-9110 and Rox cultivars. Reason of the differences on crude protein yield may be arisen from crude protein ratio.

This finding was found to be higher those of Özbilen (1991), Aydın ve Albayrak (1995) and Yılmaz and Sağlamtimur (1997) who found as 1040, 910 and 570 kg ha^{-1}, respectively;

It was found in the present study that:

- The highest crude protein ratio was obtained from Sugar Leaf, Grazer ve Seweet Sioux.
- Cultivars with the highest crude protein yield were determined as Seweet Sioux, Grazer ve 877-cultivars.

As a result, Sweet Sioux and Grazer cultivars can be recommend to farmers in Erciş-Van ecological conditions in terms of yield and quality.

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