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Yield Characteristics of Sorghum (*Sorghum bicolor (L.) Moench*) and Sorghum x Sudan Grass Hybrids (*Sorghum bicolor* (L.) *Moench* x *Sorghum Sudanense Stapf.*) Cultivated as Second Crop after Barley in Ercis-van Ecological Condition

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Abstract: This study was conducted to find out the possibilities of growing some sorghum and sorghum x sudangrass hybrid cultivars as second crop after barley in Erciş-Van ecological condition in 2003. The experiment was designed as randomized complete block design with three replications. In the experiment, one sorghum cultivars (Rox) and seven sorghum x sudangrass hybrid cultivars (Grazer, Seweet Sioux, GW-9110, Sugar Leaf, Grass-II, 877 and Gözde-80) were used. Significant differences were determined among the cultivars used in the research. Avarege green herbage, herbage yields changed between 42000-82000 kg ha^{-1}, hay yield 9770-20 550 kg ha^{-1}, respectively. The highest herbage yield was obtained from Seweet Sioux (82 000 kg ha^{-1}), followed by 877-cultivar (74 000 kg ha^{-1}). According to this results, Seweet Sioux and 877 sorghum x sudangrass hybrid cultivars had the highest green herbage and hay yield, therefore this cultivars are suggested as second crop in Erciş-Van ecological condition.

Key words: Sorghum, sorghum x sudangrass hybrid cultivar, second crop, herbage yield, hay yield

INTRODUCTION

One of the most important issues of animal production in Van districts of the eastern Anatolia is insufficient hay. The hay deficit in winter season is more impossible than those of spring and summer seasons due to harsh climate conditions of these districts. Therefore, the most suitable plants for the region should be cultivated in order to minimize hay deficit in long winter months. For this aim, Sorghum can be cultivated as main product or after wheat, barley, vetch, gruel and rape in winter months cultivated in field areas, corn and sorghum plants can be cultivated as second crop in June and July months (İptaş, 1993).

In an investigation in Samsun province carried out by Aydın and Tokluoğlu (1986), it was reported that by using 40 cm row gaps, green forage yield obtained from Sorghums sown in waterless condition was found as 40 000 kg ha^{-1} .

Oğraş and Altınay (1986) reported that herbage averages of composite silage sorghum and hybrid silage sorghum were found as 55000 and 100000 kg ha^{-1} in field experiment carried out using 40 cm row gaps in the second crop production conditions. Sağlamtimur *et al.* (1988) stated that plant height, herbage yield of sorghum varieties (for silage) cultivated as second crop ranged from 183-355 cm and from 32550-63800 kg ha^{-1}, respectively.

In a field study conducted to determine seed quantity of sudangrass and sorghum x sudangrass hybrids under Çukurova conditions sudangrass and seven sorghum x sudangrass hybrid cultivars, Tansı (1989) determined that herbage and hay yields ranged from 47100-71580 kg ha^{-1} and from 6720-22460 kg ha^{-1}, respectively.

Tcacenco *et al.* (1989), who studied on sorghum used for silage under Brazil condition, declared that hay yield ranged from 7 000-14 000 kg ha^{-1}.

Özbilen (1991), who examined the effects of various N fertilizer doses on some sorghum cultivars used for silage under Samsun ecological condition, mentioned that averages of wet hay yield, (dry) hay yield and plant height were determined as 60 110, 14 920 kg ha^{-1} and 231 cm, respectively.

İptaş (1993), who worked on some agricultural characteristics on several sorghum cultivars under Tokat condition, reported that as regards data harvested at their early maturity periods averages of herbage yield, dry matter yield and plant height were determined as 65670, 17660 kg ha^{-1} and 198 cm, respectively.

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Kara and Soya (1993) cultivated sorghum and sorghum x sudangrass hybrids as second crop under watery conditions of Ege Region and then performed 2-3 harvests. The authors reported that herbage yield from these cultivars ranged from 70-80 Ton ha^{-1}.

Avcıoğlu and İptaş (1994) stated that the highest herbage and dry matter yields under Tokat Kazova condition were obtained from P-988, which is a Sorghum x SudanGrass hybrid. Aydın and Albayrak (1995) stated that averages of herbage and hay yields for Sorghum cultivars produced as second crop under Samsun conditions were determined as: 49500 and 9660 kg ha^{-1}, respectively.

Baytekin *et al.* (1995) found that average plant height and herbage yield of sorghum (for silage) produced as second crop under watery conditions of Harran ova were 290 cm and 93090 kg ha^{-1}, respectively. In another study under same conditions, Baytekin and Şılbır (1996) reported that herbage yield and hay yield ranged from 45000-132000 kg ha^{-1} and from 14170-16550 kg ha^{-1}, respectively. Yılmaz and Sağlamtimur (1997) working on sorghum hybrids under watery conditions of Amik ova found as 51240 kg ha^{-1} for herbage yield and 6890 kg ha^{-1} for hay yield.

Hosaflıoğlu (1998) studied on Sorghum and Sorghum x Sudangrass hybrids (Grazer, Sugar Leaf, Gözde-80, GW-9110, Rox) under Van watery conditions and reported that their dry hay yields and plant heights ranged from 46610-59520 kg ha^{-1} and from 51-138 cm. When yield and quality criteria were taken into consideration, the most suitable cultivars were found to be Grazer, Gözde-80 and Sugar Leaf, respectively.

Güçük and Baytekin (1999), who studied to determine the effect of harvest time on yield and silage characteristics of corn-silage, Sorghum and Sorghum x Sudangrass hybrids cultivated as second product under Şanlıurfa Bozova-watery conditions, stated that herbage yield ranged from 74550-118080 kg ha^{-1}.

Gül and Başbağ (1999) reported that herbage yield, hay yield, and plant height values of Sorghum and Sorghum x Sudangrass hybrids for silage grown as second product under Diyarbakýr watery conditions varied from 41560-52350 kg ha^{-1}, from 9340-13590 kg ha^{-1} and from 148-267 cm, respectively.

Yılmaz (2000), who studied on yield characteristics of sorghum and sorghum x Sudangrass hybrids cultivated as main crop in Van conditions, reported that herbage yield, hay yield and plant height values varied from 36580-57380 kg ha^{-1}, from 10 210-19750 kg ha^{-1} and from 114-249 cm, respectively. In another investigation on sorghum varieties for silage produced as main crop under Van watery conditions, Yılmaz and Akdeniz (2000) stated that corresponding values were found to range from 33960-41860 kg ha^{-1}; from 12680-15 580 and from177-179, respectively. Yılmaz *et al.* (2000) stated that corresponding averages was found to be 49990 kg ha^{-1}, 18040 kg ha^{-1} and 221 cm, from sorghum sudangrass hybrids respectively. Oral (2001) stated that herbage yield, hay yield and plant height values of Sorghum and Sorghum x Sudangrass hybrids produced as second crop under same conditions ranged from 36660-66250 kg ha^{-1}, from 1036-1991 kg ha^{-1} and from 235-263 cm, respectively.

Sevimay *et al.* (2001), reported that the highest herbage yields under Ankara watery conditions were found to 33950 kg ha^{-1} for the first year and 30 060 kg ha^{-1} for the second year.

The aim of this study was to examine adaptation of some sorghum and sorghum x Sudangrass hybrids produced as second crop after barley to Erciş district conditions of Van located in the Eastern Anatolia and to determine the best cultivar (s) having the highest green herbage and hay yields.

MATERIALS AND METHODS

In present study, one sorgum (Rox) cultivar and seven sorgum x sudanotu hybrids (Grazer, Seweet Sioux, GW-9110, Sugar Leaf, Grass II, 877, Gözde-80) from Agricultural Faculty University of Yuzuncu Yil were used. 100 kg ha^{-1} N_2 and 80 kg ha^{-1} P_2O_5 were used for each plot. The field experiment was arranged at Randomized Complete Design with 3 replications. Each block was divided into 8 plots. The eight cultivars were assigned randomly into each block. Each plot set at 10 m^2 (2×5). The total experiment area was on (54×10 m) 540 m^2.

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

RESULTS AND DISCUSSION

Plant height: Results of ANOVA on traits such as plant height, herbage yield and hay yield of Sorghum and sorghum x Sudangrass hybrids are presented in Table 1. As seen from Table 1, the effect of variety factor on plant height ($p<0.05$), herbage yield ($p<0.01$) and hay yield ($p<0.01$) were found to be significant. The effect of block on herbage yield was only significant (Table 1).

Table 2 presents results of average plant height and Duncan's Multiple Range Test of sorghum cultivar and sorghum x sudan grass hybrids. Plant height values

Table 1: Anova results for plant height, Herbage yield and Hay yield values of sorghum cultivar and sorghum x sudan grass hybrids

Variation source	Degree of freedom	F-values		
		Plant height	Herbage yield	Hay yield
Block	2	1.70^{ns}	4.76*	1.97^{ns}
Variety	7	3.00*	9.03**	5.97**
Error	14			
Total	23			

*p<0.05 **p<0.01 ^{ns}: non-significant

Table 2: Results of average plant height and Duncan's Multiple Range Test of sorghum cultivar and sorghum x sudan grass hybrids

Cultivars	Plant height (cm)			
	Replication 1	Replication 2	Replication 3	Mean.*
Rox	170	175	140	161^{b}
Sugar leaf	208	211	213	210^{a}
GW-9110	210	191	172	191^{a}
Grazer	170	207	193	190^{a}
Grass II	216	176	191	194^{a}
877	190	205	205	200^{a}
Seweet sioux	206	226	195	209^{a}
Gözde-80	203	201	178	194^{a}
Mean.*	196	199	185	193

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

Table 3: Results of average herbage yields and Duncan's Multiple Range Test of sorghum cultivar and sorghum x sudan grass hybrids

Cultivars	Herbage yield (kg ha^{-1})			
	Replication 1	Replication 2	Replication 3	Mean.*
Rox	84000	74000	62000	73330^{abc}
Sugar leaf	74000	54000	52000	60000^{c}
GW–9110	56000	64000	62000	60660^{c}
Grazer	60000	62000	58000	60000^{c}
Grass II	70000	72000	50000	64000^{bc}
877	80000	72000	70000	74000^{ab}
Seweet sioux	88000	80000	75000	82000^{a}
Gözde–80	50000	32000	44000	42000^{d}
Mean.*	70250	63750	59500	64500

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

Table 4: Results of average hay yields and Duncan's Multiple Range Test of sorghum cultivar and sorghum x sudan grass hybrids

Cultivars	Hay yield (kg ha^{-1})			
	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

of these hybrids ranged from 161-210 cm. As shown in Table 2, it obvious that Cultivar with the lowest plant height was found as Rox (161 cm). The one with highest plant height was determined as Grazer cultivar (210 cm).

These findings obtained from the present paper were partly in agreement with findings of Yılmaz (2000) (114-249 cm), who studied on same Sorghum and Sorghum x Sudan grass hybrids under Van conditions along with those of Gül and Başbağ (1999) (148-267 cm) and İptaş (1993) (198 cm). The findings were found to be lower than those of Oral (2001) (235-263 cm), Sağlamtimur *et al.* (1988) (183-355 cm) and Baytekin *et al.* (1995) (290 cm), but higher those of Hosaflýoğlu (1998) (51-138 cm). The differences in literature may be arisen from environmental and genetics variations.

Herbage yield: Table 3 presents results of average herbage yields and Duncan's Multiple Range Test of sorghum cultivar and sorghum x sudan grass hybrids. In the present paper, herbage yields of these hybrids ranged from 42000-82000 kg ha^{-1} (Table 3). Of cultivars, one with the highest herbage yield was Seweet Sioux (82000 kg ha^{-1}), but the lowest herbage yield were obtained from Gözde-80 cultivar (42 000 kg ha^{-1}).

Our findings on Herbage yield from sorghum cultivar and sorghum x sudan grass hybrids were found to be higher than those reported by many authors Aydın and Albayrak (1995), Gül and Başbağ (1999), Yılmaz (2000), Hosaflıoğlu (1998) and Sevimay *et al.* (2001), but lower than those of Baytekin *et al.* (1995). Our findings were in consistent with those of Oral (2001).

Hay yield: Results of averages of Hay yield and Duncan's Multiple Range Test of sorghum cultivar and sorghum x sudan grass hybrids are presented in Table 4. Hay yield of Sorghum cultivar and sorghum x sudan grass hybrids varied from 9770-20550 kg ha^{-1}. Cultivar with the highest hay yield was determined as 877-cultivar (20550 kg ha^{-1}), but one having the lowest cultivar was determined as Gözde-80 cultivar. Our findings from the present paper were 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 findings from the present paper 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 range from 10360-9910 kg ha^{-1}. The findings on hay yield in the present paper were found to higher than the findings of Aydğn 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 the finding of Baytekin *et al.* (1995), who found as 23950 kg ha^{-1}.

The differences in literature may be due to environmental and genetic factors.

As a result, it can be recommended Seweet Sioux and 877 cultivars among Sorghum x Sudangrass hybrids to farmers in Van conditions because they had the highest herbage and hay yield.

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