Indian Journal of Agronomy **47** (2) : 298–303 (June 2002)

Effect of seeding rate and nitrogen fertilizers on forage yield and quality of sorghum (*Sorghum bicolor*) × sudangrass (*Sorghum sudanense*) hybrid

S. IPTAS, A.R. BROHI AND H. ASLAN

Faculty of Agriculture, Gaziosmanpasa University, Tokat-Turkey 60240

Received: October 2001.

ABSTRACT

In a study on effect of seeding rate (15, 30 and 45 kg/ha) and nitrogen fertilizers rates (60, 120, 180 and 240 kg N/ha) on forage yield and quality of sorghum [*Sorghum bicolor* (L.) Moench] x sudangrass [*Sorghum sudanense* (Piper) Stapf] hybrid, seeding rates and nitrogen fertilization did not affect significantly the green forage (GF) yield at the first cutting. The highest green fodder yield (50.8 tonnes/ha) was obtained from 45 kg/ha seed rate at the second cutting. There was no significant effect of N fertilization on dry-matter yield at the first cutting. The highest dry-matter yield was obtained from 60 kg N/ha and 45 kg/ha seeding rate in the second cutting. The effect of seeding rate and N fertilization on crude protein content was not significant at the first cutting, but nitrogen rate had significant effect on it at the second cutting.

Key words : Seeding rate, Nitrogen fertilization, Sorghum x sudangrass hybrids

Sorghum hybrids can be used as a nutritive food for animals during June–October when there is a shortage of production of cool season fodder production. After the year 1960, an increase in the production of sorghum × sudangrass hybrids as a fodder has gained considerable improvement owing to high productivity and quality. Among fertilizers used, nitrogen fertilizers have great effect in increasing the yield of the crops. The response of crops to nitrogen fertilizers depends on climate, soil type, availability of nutrients and variety used (Aydeniz and Brohi, 1991).

The main object of the study was to see the effect of seeding rate and nitrogen fertilizer rates on yield and quality of sorghum × sudangrass hybrid grown as a first crop under Tokat-Kazova in Turkish ecological conditions.

MATERIALS AND METHODS

The experiment was conducted during 1995 and 1996 (May-October) under Tokat-Kazova (40° 13′-40°22′ N, 36° 1′-36° 40° E, elevation 623 m) ecological

conditions. Total precipitation of 182.4, 217.6 and 166.4 mm and average temperature of 18.0, 18.6 and 18.3 °C was recorded during 1995, 1996 and long-duration period respectively. The soil was slightly alkaline (pH 7.77–8.08), medium in calcium carbonate content (9.8–13.8%), medium in P content (80.1–114.0 kg P_2O_5/ha), high in K content (287.0–959.0 kg K/ha) and medium to poor in organic matter content (1.68–2.15%), as reported by Aydeniz and Brohi (1991).

In 1995, the experiment was conducted at Tokat-Fruit Production Station and in 1996 it was conducted at the Agriculture Faculty of Gaziosmanpasa University. Soil tillage operation was done in autumn and the field was left as such up to sowing date of the crop. The experiment was conducted on split-plot design with 3 replications by sowing 'Pioneer 988' sorghum × sudangrass hybrid variety. The seed rates were 15, 30 and 45 kg/ha, whereas nitrogen rates were 60, 120, 180 and 240 kg N/ha. Half of the N was applied at the sowing and second half after first cutting of the crop. The sowing date was 20 May in 1995 and 15 May in 1996. The row spacing was 35 cm. For normal growth of the crop 100 kg P_2O_5/ha was applied before sowing. The first cut of the first crop was done on 10 August 1995 and the first of the second crop was done on 18 August 1996, both at full flowering stage. The second cut of first crop was done on 10 October 1995 and the second cut of the second crop was done on 16 October 1996, both at boot stage. In both cuts the height of the plant was about 100–120 cm. Green forage (GF) yield (tonnes/ha), dry matter (DM) yield (tonnes/ha), crude protein (CP) content (%), crude protein (CP) yield (kg/ha) were recorded. Samples of 500 g taken from each subplot were dried for 48 hr at 70°C to determine the dry matter and then grounded and used to determine N content by the micro-Kjeldahl method. The data for 2 years were therefore analysed as a split-plot and the values presented are means of 2 years.

RESULTS AND DISCUSSION

Green-forage yield

Seeding rate did not affect on the green-forage yield of first cut (at full flowering stage), but it significantly increased the yield from 45.4 tonnes to 50.8 tonnes/ha in second cut (Table 1). The highest yield at the second cut was obtained with 45 kg/ha seed rate. Nitrogen doses had no significant effect on the first cut and second cut yields, when applied before sowing. However, maximum yield at first cut, and at second cut was obtained with 30 and 120 kg N/ha respectively. The non-significant effect of N doses may be due to sufficient content of soil N for good growth of this crop. As reported by Wehrmann and Scharpf (1988) that plant utilizes less nitrogen with increasing amount of available soil nitrogen. However, the nitrogen rates have relatively increased the green forage yield in second cut.

Dry-matter yield

Seeding rate increased the dry-matter yield in both cuttings, but differences were not significant. Similar result were obtained by Han and Kim (1992). Nitrogen rates significantly increased the dry matter yield at first cut. Highest dry forage yield was

obtained with 90 kg N/ha. The lowest dry matter yield was obtained with 120 kg N/ha (Table 2). The increasing rates of N increased the dry matter yield in second cut, but this increase was not significant. However, significant increase was obtained with seeding rate × nitrogen rates. The highest dry-matter yield was obtained at 45 kg/ha seeding rate and 60 kg N/ha. Han and Kim (1992) found the highest dry-matter yield in 2-cutting system at 40 kg/ha seeding rate and 300 kg N/ha.

Table 1. Effect of seeding rate and nitrogen fertilization on green-forage yield (tonnes/ha)

Harvest stage	Nitrogen rate (kg/ha)	Seeding rate (kg/ha)			
		15	30	45	Mean
First harvest					
	30	90.2	93.9	103.7	95.9
	60	96.5	81.9	91.3	89.9
	90	97.6	94.5	93.9	95.3
	120	93.3	87.7	91.8	90.9
Mean	94.4	89.5	95.2		
Second harvest					
	30	40.8	51.4	47.9	46.7
	60	48.9	44.0	53.9	48.9
	90	45.0	50.5	50.0	48.5
	120	47.0	48.6	51.3	49.0
Mean	45.4	48.6	50.8		

Second harvest: Seedling rate LSD (P=0.05) : 4.6

Table 2. Effect of seeding rate and nitrogen fertilization on dry-matter yield (tonnes/ha)

Harvest stage	Nitrogen rate (kg/ha)	Seeding rate (kg/ha)			
		15	30	45	Mean
First harvest					
	30	23.0	25.2	28.2	25.5
	60	23.3	22.3	24.5	23.4
	90	26.0	26.1	25.0	25.7
	120	22.4	21.8	25.4	23.2
Mean	23.7	23.9	25.8		
Second harvest					
	30	7.2	9.8	9.3	8.8
	60	8.7	8.3	11.1	9.4
	90	8.7	10.1	8.9	9.2
	120	8.9	8.8	9.2	8.9
Mean	8.4	9.3	9.6		

First harvest : Nitrogen rate LSD 5% : 2:1
Second harvest: Seeding rate × nitrogen rate LSD (P=0.05) : 2.0

Crude protein content and yield

Seeding rate did not influence the crude protein content and the content was 9.41-9.80% in first cut and varied from 14.15 to 15.34% in second cut (Table 3). The crude protein content of the first cut was lower than that compared with second cut. Creel and Fribourg (1981) reported that the crude protein content decreased with the delay in harvest. Koller and Clark (1965) observed a

Table 3. Effect of seeding rate and nitrogen fertilization on crude protein content (%)

Harvest stage	Nitrogen rate (kg/ha)	Seeding rate (kg/ha)			
		15	30	45	Mean
First harvest					
	30	9.35	8.82	8.98	9.05
	60	9.41	10.99	9.27	9.89
	90	9.51	9.40	9.49	9.47
	120	9.58	9.80	9.90	9.83
Mean	9.46	9.80	9.41		
Second harvest					
	30	15.15	15.77	14.76	15.99
	60	15.32	15.99	13.22	14.23
	90	13.35	14.04	16.82	14.20
	120	13.70	14.51	16.33	15.23
Mean	15.25	14.15	15.34		

Second harvest: Nitrogen levels (LSD (P=0.05) : 1.71

Table 4. Effect of seeding rate and nitrogen fertilization on crude protein yield (kg/ha)

Harvest stage	Nitrogen rate (kg/ha)	Seeding rate (kg/ha)			
		15	30	45	Mean
First harvest					
	30	21.5	22.6	25.3	23.0
	60	21.9	24.6	22.7	23.1
	90	24.7	24.5	23.7	24.3
	120	21.5	21.8	25.2	22.8
Mean	22.4	23.4	24.3		
Second harvest					
	30	10.9	15.7	15.7	14.1
	60	13.7	11.1	15.1	13.3
	90	12.9	13.9	12.7	13.2
	120	13.6	12.3	15.0	13.6
Mean	12.8	13.3	14.6		

Second harvest: Seeding rate × nitrogen levels (LSD (P=0.05) : 0.4

decrease in crude protein content of the first cutting with increasing seeding rate and found increased crude protein content in second cutting in 2-cutting system. However, Koller and School (1968) found that increasing the seeding rate had no significant effect on crude protein content in 2-cutting system. This may be due to the tillering ability and fast regrowth after cutting of sorghum × sudangrass hybrids.

Although there was no significant effect on crude protein content of nitrogen rates in first cutting, the effect of nitrogen rates on CP content was also significant in second cutting. The crude protein content changed from 9.05 to 9.89% in first cutting and from 14.20 to 15.99% in second cutting. Crude protein content of second cutting was higher than in the first cutting. This increase in due to continual terminal growth or tillering, particularly after the first harvest. The seeding rates had no significant effect on the crude protein yield. The crude protein yield in first cut varied from 22.4 to 24.3 kg/ha and in second cut it varied from 12.8 to 14.6 kg/ha (Table 4). The crude protein yield is dependent on crude protein content and on dry-matter yield of the crop. These results are in conformation with the results of Jeon *et al.* (1992). The N rates did not show significant effect on the crude protein yield. Singh *et al.* (1988) reported that crude protein content increased with increasing N application. Similarly, increase in crude protein yield is expected with N application. Vega and Martinez (1981) found the highest crude protein yield at 100 kg N/ha, and Hussein *et al.* (1980) found the highest crude protein yield at 107 kg N/ha.

Economic analysis

Determining the effect of N rate on dry-matter yield and crude protein yield, the second degree regression equations were determined. With these equations r^2=0.19; Y=2505.6+3.18 x–1.19 x^2 was calculated for first cut and hence 13.4 kg N/ha rate was found as an optimum N rate for first cut, whereas r^2=0.93; Y=790.2 + 39.59 x–2.54 x^2 was calculated for second cut and hence 77.3 kg N/ha dose was determined as the optimum N rate for second cut for dry-matter yield. Similarly, r^2= 0.48; Y=155.85–5.86 x + 0.36 x^2 was calculated for first cut and hence 81.3 kg N/ha was determined as an optimum rate for CP yield. Whereas, r^2=0.48; Y=212.1+6.95 x–0.45 x^2 was calculated for second cut and hence 77.2 kg/ha dose was determined as the optimum N level for the crude protein yield.

REFERENCES

Aydeniz, A. and Brohi, A.R. 1991. *Gubreler ve Gubreleme*, Cumhuriyet Universitesi, Ziraat Fakultesi, No 10. Tokat-Turkey.

Creel, R.J. and Fribourg, H.A. 1981. Interactions between forage sorghum cultivars and defoliation management. *Agronomy Journal* **73** : 463–469.

Han, H.R. and Kim, D.A. 1992. Effect of seeding rate and nitrogen fertilization on the carbohydrate reserves, stand reduction and yield of sorghum x sudangrass hybrid. *Herbage Abstracts* **62** : 10,2948.

Hussein, M.A., El-Hattab, H.S., EL-Hattab, A.H., Radwan, M.S. and El-Gawad. K.I.A. 1980. Growth, forage yield and quality of sudangrass and sorghum as affected by time of planting nitrogen and phosphorus. *Herbage Abstracts* **50** (12) : 5634.

Jeon, B.T., Lee, S.M., Shin, D.U., Moon, S.H. and Kim, U.S. 1992. Effect of plant density and

planting pattern on the growth characteristics. dry matter yield and feeding value of sorghum-sudangrass hybrid. *Herbage Abstracts* **62** : 10 : 2949.

Koller, H.R. and Clark, N.A. 1965. Effect of plant density and moisture supply on the forage quality of sudangrass. *Agronomy Journal* **57** : 591–593

Koller, H.R. and School, J.M. 1968. Effect of row spacing and seeding rate on forage production and chemical composition of two sorghum cultivars harvested at two cutting frequencies. *Agronomy Journal* **60** : 456–459.

Singh, V., Singh, A.K., Verma, S.S. and Joshi, Y.P. 1988. Effect of nitrogen fertilization on yield and quality of multi-cut tropical forages. *Tropical Agriculture* **65**: 129–131.

Vega, J.D. and Martinez, R.F. 1981. Evaluation of the yield and quality of forage sorghum under different moisture levels and nitrogen fertilizer rates. *Herbage Abstracts* **51** : 3; 959.

Wehrmann, J. and Scharpf, H.C. 1979. The mineral content of the soil as a measure of the nitrogen fertilizer. *Plant and Soil* **52** : 109–126.