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Effect of nitrogen and harvesting time on yield and quality of sorghum (*Sorghum bicolor*) intercropped with legumes

S.N. RAM[1] AND BHAGWAN SINGH

Department of Agronomy, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh 224 229

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ABSTRACT

A field experiment was conducted during the rainy (*kharif*) season of 1998 and 1999, to study the effect of intercrops, levels of nitrogen and harvesting time on yield and quality of forage sorghum [*Sorghum bicolor* (L.) Moench] under rainfed conditions. Sorghum intercropped with cowpea [*Vigna unguiculata* (L.) Walp.] recorded significantly higher yield and quality of forage sorghum compared with sorghum alone and sorghum intercropped with clusterbean [*Cyamopsis tetragonoloba* (L.) Taubert]. Nitrogen @ 80 kg/ha significantly increased the yield and quality of forage over the control and 40 kg N/ha. Forage and crude protein yields of sorghum were significantly increased when the harvesting was done at 75 days after sowing over harvesting at 45 days, but being at par with the harvesting at 60 days.

Key words : Sorghum, Cowpea, Clusterbean, Harvesting time, Forage yield and quality

Livestock rearing plays a vital role in the rural economy of India by supplementing the family income and providing employment and contributing 25% to the total agricultural income. In this regards, availability of nutritious feed and fodder is vital for the development of livestock, but the present feed and fodder resources of the country are able to meet only 46.6% of the requirement. Intercroping of cereal fodder with legumes is a prospective way to get quality forage in appreciable quantity with added advantage of soil enrichment (Rao and Willey, 1980). Harvesting time is also one of the important management practices which not only influences the yield but also the quality of forage. Nitrogen application is also important for forage production in response of quick growth of plants. Keeping in view the above, a study on the

A part of the Ph.D. thesis submitted by the first author to Norendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh

Present address : [1]GSM Division, Indian Grassland and Fodder Research Institute, Jhansi, Uttar Pradesh 284 003

effect of nitrogen levels and harvesting times on yield and quality of forage sorghum when intercropped with cowpea and clusterbean was conducted.

MATERIALS AND METHODS

The field experiment was carried out during the rainy season of 1998 and 1999 at Agronomy Research Farm of University at Kumarganj, Faizabad. The experiment was laid out in split-plot design, keeping the combinations of 3 intercrops (sorghum alone, sorghum + cowpea and sorghum + clusterbean) and 3 harvesting times (harvesting at 45 days after sowing, 60 days after sowing and 75 days after sowing) in main plots and 3 levels of nitrogen (control, 40 and 80 kg/ha) in subplots and replicated 3 times. Sorghum hybrid variety 'SSG 5000' (Sudan grass) pure stand was sown in lines 30 cm apart using a seed rate of 40 kg/ha. Sorghum was intercropped with cowpea variety 'Russian Giant' ('Type 2') and clusterbean variety 'Bundel Guar 2' in 1:1 sorghum : legumes alternate rows 15 cm apart in additive series using the recommended seed rates. Cowpea was sown @ 30 kg seed/ha, while clusterbean was sown @ 25 kg/ha. The uniform dose of 30 kg P_2O_5/ha and 30 kg K_2O/ha was applied to all the treatments at the time of last ploughing. The crop was maintained under rainfed environment.

The soil of the experimental field was silt loam and low in organic carbon and nitrogen and medium in phosphorus and rich in potassium. The values of pH and electrical conductivity of the experimental field were 8.5 and 0.35 dS/m during 1998 and 8.3 and 0.37 dS/m during 1999 respectively. The total rainfall of 836.40 mm and 1,083.70 mm was received in entire growth period of crop during 1998 and 1999 respectively.

RESULTS AND DISCUSSION

Intercrops

Sorghum intercropped with cowpea recorded significantly higher green-forage and dry-matter yields of sorghum and sorghum+legumes and sorghum green-forage, yield equivalent compared with sorghum alone and sorghum + clusterbean combinations. Intercropping of sorghum with clusterbean also found significantly superior in respect of green-forage and dry-matter yields of sorghum + legumes intercropping and sorghum green-forage yield equivalent than sorghum alone (Table 1). The higher green-forage and dry-matter yields with the intercropping of sorghum with cowpea may be attributed to complementary effect of cowpea which supplemented nitrogen to sorghum and the better utilization of environmental resources by sorghum + cowpea system. Similar findings were also reported by Sood and Sharma (1992), Mishra *et al.* (1997) and Barik *et al.* (1998).

Intercropping of sorghum with cowpea gave significantly higher crude protein content and crude protein yield of sorghum and sorghum + legumes and lower crude fibre content than sorghum alone and sorghum intercropped with clusterbean. Sorghum alone and sorghum + clusterbean were found at par with each other for these quality parameters. The crude protein yield of sorghum + legumes was also recorded significantly higher when sorghum

Table 1. Green-forage and dry-matter yields of sorghum and sorghum + legumes and sorghum green-forage yield equivalent as influenced by treatment

Treatment	Green forage yield (q/ha)				Dry-matter yield (q/ha)				Sorghum-green forage yield equivalent (q/ha)	
	Sorghum		Sorghum + legumes		Sorghum		Sorghum + legumes		1998	1999
	1998	1999	1998	1999	1998	1999	1998	1999		
Intercrops										
Sorghum alone	359.14	382.52	359.14	382.50	87.87	96.11	87.87	96.11	359.14	382.52
Sorghum + cowpea	421.43	452.79	510.00	545.60	104.18	110.56	120.02	126.97	548.35	577.39
Sorghum + clusterbean	376.37	406.50	410.77	443.70	92.47	100.72	99.48	108.25	422.53	456.59
CD (P = 0.05)	28.82	28.53	27.94	32.52	6.43	7.02	6.32	7.76	28.77	33.96
Harvesting time (DAS)										
40	234.00	267.58	279.20	307.03	49.90	59.40	56.26	65.98	290.00	318.44
60	448.87	475.80	492.14	520.09	108.01	116.21	115.84	124.40	501.38	534.71
75	474.06	498.44	517.56	544.69	126.61	131.78	135.27	140.94	534.95	563.19
CD (P=0.05)	28.82	28.53	27.94	32.52	6.43	7.02	6.32	7.76	28.77	33.96
Nitrogen (kg/ha)										
0	312.05	342.12	359.35	384.37	78.49	86.65	85.95	94.49	373.01	398.84
40	391.39	417.74	433.51	461.97	95.69	103.31	103.47	111.45	447.92	477.12
80	453.50	481.95	496.05	525.46	110.34	117.42	117.95	125.39	509.11	540.52
CD (P = 0.05)	25.71	21.25	22.36	23.03	5.67	5.29	5.56	5.63	22.73	23.84

intercropped with clusterbean compared with sorghum alone (Table 2). The increase in dry-matter yield and crude protein content of sorghum under sorghum + cowpea intercropping system may be valid reason of higher crude protein yield under the same treatment. These findings are in conformity with the results of Sood and Sharma (1992) and Raju *et al.* (1997).

Harvesting time

Sorghum harvested at 75 days yielded significantly higher green-forage and dry matter of sorghum and sorghum + legumes than that harvested at 45 days, but being statistically at par for green-forage yield and significantly higher for dry-matter yield than that harvested at 60 days (Table 1). This might be due to longer duration which increased the value of growth parameters due to more source available for the synthesis of metabolites. These results are in agreement with the findings of Noor Mohammad *et al.* (1988) and Ramamurthy and Vinod Shankar (1998). Harvesting at 75 days significantly increased the sorghum green forage yield equivalent as compared with harvesting at 45 days during both years and harvesting at 60 days during 1998 only. Sorghum green-forage yield equivalent obtained with the harvesting at 60 days was also significantly higher than harvesting at 45 days during both years (Table 1).

Harvesting of sorghum at 45 days produced significantly higher crude protein content and lower crude fibre content of sorghum than harvesting at 75 days and 60 days. Harvesting at 60 days also resulted significantly higher value of crude protein content and lower value of crude fibre content than harvesting at 75 days (Table 2). The higher crude protein content and lower crude fibre content with harvesting at 45 days may be ascribed to yonger and succulent plants with higher nitrogen content. Harvesting at 75 days being at par with the harvesting at 60 days resulted in significantly higher crude protein yield of sorghum and sorghum + legumes compared with harvesting at 45 days (Table 2). The increased yield of dry matter with the harvesting at 75 days and 60 days may be valid reason of increase in crude protein yield. These results are in conformity with the findings of Noor Mohammad *et al.* (1998) and Ramamurthy and Vinod Shankar (1998).

Nitrogen

Application of nitrogen @ 80 kg/ha significantly increased green forage and dry-matter yields of sorghum and sorghum + legumes and sorghum green-forage yield equivalent compared with the control and 40 kg/ha. Nitrogen @ 40 kg/ha also proved significantly superior to the control treatment for green-forage yield, dry-matter yield and sorghum green-forage yield equivalent during both the years (Table 1). This is because of the fact that nitrogen is involved in increasing the protoplasmic constituents and accelerating the process of cell-division and elongation which in turn show luxuriant vegetative growth for higher forage productivity. These findings confirm the retults of Sood and Sharma (1992) and Barik *et al.* (1998).

Increasing dose of N from control to 40 kg/ha and from 40 to 80 kg/ha significantly

Table 2. Crude protein and crude-fibre contents of sorghum and crude protein yield of sorghum and sorghum + legumes as influenced by various treatments

Treatment	Crude protein content (%)		Crude fibre content (%)		Crude protein yield (kg/ha)			
					Sorghum		Sorghum + legumes	
	1998	1999	1998	1999	1998	1999	1998	1999
Intercrop								
Sorghum alone	7.55	7.87	32.46	33.95	650.40	748.21	650.39	748.22
Sorghum + cowpea	8.79	9.15	27.95	29.29	909.32	1,001.84	1,190.36	1,294.70
Sorghum + clusterbean	7.90	8.24	31.02	32.30	705.28	816.64	822.35	959.22
CD (P = 0.05)	0.42	0.60	2.28	2.23	74.32	88.31	78.59	105.15
Harvesting time (DAS)								
45	9.09	9.47	26.59	27.93	466.52	578.40	584.39	717.18
60	7.92	8.27	30.66	31.95	866.51	978.58	1,002.17	1,119.79
75	7.22	7.52	34.19	35.65	931.96	1,009.71	1,076.54	1,165.18
CD (P=0.05)	0.42	0.60	2.28	2.23	74.32	88.31	78.59	105.15
Nitrogen (kg/ha)								
0	7.22	7.54	33.42	34.22	546.36	644.05	673.71	795.12
40	8.01	8.35	30.52	31.91	751.27	846.60	886.67	992.39
80	9.00	9.36	27.49	29.40	967.35	1,076.04	1,102.72	1,214.64
CD (P = 0.05)	0.44	0.37	1.79	1.53	68.44	65.93	73.69	75.32

increased the crude protein content and crude protein yield and decreased the crude fibre content of sorghum during both years (Table 2). The increase in crude protein content of sorghum with increasing levels of nitrogen may be attributed to the fact that nitrogen is a main constituent of protein and it involved in the synthesis of amino acids and accumulation of protein in plants. The higher crude protein yield might be owing to increase in protein content and dry-matter yield with increasing levels of nitrogen. These results are in conformity with findings of Noor Mohammad *et al.* (1988), Sood and Sharma (1992) and Raju *et al.* (1997).

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