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Effect of seed rate on forage production and quality of forage sorghum (*Sorghum bicolor*) varieties

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ABSTRACT

A field study carried out during 1987, 1989 and 1990 showed that 'GFS 3' [*Sorghum bicolor* (L.) Moench] gave the highest green-forage yield during 1989 as well as on pooled basis and 'MP Chari' sorghum gave the highest dry-matter yield during 1987, 1990 as well as on pooled basis. Varieties 'GFS 3', 'MP Chari' and 'SSG 59-3' were at par for green-forage and dry-matter yields on pooled basis and all these varieties found significantly superior to 'S 1049'. Variety 'SSG 50-3' gave the highest crude protein yield, followed by 'MP Chari' on an average of 3 years. A seed rate of 60 kg/ha recorded the highest green-forage yield during 1989 and on pooled basis, however, the difference were not significant. Seed rates of 60, 80 and 100 kg/ha were at par and gave significantly higher dry-matter yield than seed rates of 20 and 40 kg/ha. Economics of different seed rates revealed that seed rate of 60 kg/ha gave the maximum total return as well as net incremental cost : benefit ratio. This treatment also produced the highest crude protein on an average of 3 years. The highest digestible dry-matter production yield was also noted from the same seed rate.

Sorghum [*Sorghum bicolor* (L.) Moench] is grown for grain as well as forage production, and it is one of the best crops to obtain higher forage production with better nutritive value for animals. Since scarce information is available regarding seed requirements of different forage sorghum varieties, a study was taken up on 4 sorghum varieties along with 5 seed rates.

MATERIALS AND METHODS

The field experiment was conducted during the rainy seasons (*kharif*) of 1987, 1989 and 1990 at Anand. The treatments consisted of 4 varieties of forage sorghum ('1049', 'SSG 59-3', 'MP Chari' and 'GFS 3') and 5 seed rates (20, 40, 60, 80 and 100 kg seed/ha) were replicated thrice in a factorial randomized block design. The crop was sown at 30 cm apart on 8, 12 and 11 July in 1987, 1989 and 1990 respectively, using seed as per treatment. Fertilizers were applied @ 40 kg N and 40 kg P_2O_5/ha as basal and 40 kg N/ha at 30 days after sowing. The crop was harvested at 50% flowering stage. The green- and dry-matter yields were recorded and crude protein was estimated by determining total N in forage samples through micro-kjeldahl's method.

RESULTS AND DISCUSSION

Effect of varieties

Variety 'GFS 3' gave significantly higher green-forage yield than all the other varieties during 1989 and it also gave the higher green-forage yield on pooled basis (Table 1). 'MP Chari' gave significantly higher dry-matter yield than all the 3 varieties during

Table 1. Green-forage, dry-matter and crude protein yields of forage sorghum as affected by varieties and seed rates

Treatment	Green-forage yield (q/ha)				Dry-matter yield (q/ha)				Protein yield (g/ha)			
	1987	1989	1990	Pooled	1987	1989	1990	Pooled	1987	1989	1990	Mean
Variety												
'S 1049'	409	269	211	296	98.0	65.0	58.8	74.0	10.00	7.09	4.29	7.13
'SSG 59-3'	474	323	300	366	132.6	106.3	88.1	109.0	13.00	7.48	5.04	8.51
'MP Chari'	447	311	298	352	143.7	107.8	94.7	115.4	11.50	7.67	5.40	8.19
'GFC 3'	477	401	289	389	129.3	127.5	83.4	113.4	9.60	9.62	3.74	7.65
CD (P = 0.05)	NS	33	21	49	10.2	10.5	6.1	18.8				
Seed rate (kg/ha)												
20	464	231	250	345	126.7	94.0	71.2	97.3	11.80	7.82	3.95	7.86
40	465	321	261	349	120.0	99.8	73.6	97.8	10.40	8.07	4.35	7.61
60	464	335	282	360	129.9	101.0	86.3	105.7	10.80	8.19	5.19	8.06
80	459	328	289	359	129.5	104.7	88.5	107.6	11.10	8.03	4.66	7.93
100	406	325	291	341	123.3	108.7	86.6	106.2	11.10	7.70	4.94	7.91
CD (P = 0.05)	NS	NS	23	NS	NS	NS	6.8	5.8				

Table 2. Crude-protein content and ancillary characters of forage sorghum varieties as influenced by seed rates

Treatment	Protein content (%)				Plant height (cm)				Tillers/m row				Leaves/plant			
	1987	1989	1990	Mean	1987	1989	1990	Mean	1987	1989	1990	Mean	1987	1989	1990	Mean
Variety																
'S 1049'	10.3	11.0	7.3	9.6	243.6	181.2	175.4	200.1	28.2	34.8	23.0	28.7	9.0	7.2	9.4	8.5
'SSG 59-3'	9.8	7.0	5.7	7.5	240.2	193.9	201.1	211.7	75.2	36.6	35.8	49.2	9.2	10.0	9.6	9.6
'MP Chari'	8.0	7.1	4.4	6.5	239.0	195.6	224.4	219.7	60.6	29.0	30.6	40.1	10.4	9.8	10.2	10.1
'GFC 3'	7.4	7.6	4.6	6.5	176.8	197.7	204.8	193.1	20.0	12.4	18.0	16.8	12.4	12.8	10.4	11.9
Seed rate (kg/ha)																
20	9.6	9.0	5.7	8.1	232.8	197.9	205.0	211.9	29.8	18.3	17.8	22.0	10.8	9.5	9.5	9.9
40	8.7	8.5	6.2	7.8	224.5	295.7	206.7	209.0	43.5	24.5	24.3	30.8	10.3	10.3	9.8	10.1
60	8.4	8.3	6.1	7.6	228.3	187.4	199.9	205.2	43.8	31.0	29.0	34.6	9.8	10.0	10.5	10.1
80	8.6	7.9	5.3	7.3	216.3	190.2	196.9	201.1	57.0	31.5	31.0	39.8	10.0	10.0	10.0	10.0
100	9.1	7.3	5.8	7.4	222.8	189.4	198.7	203.6	56.0	35.8	32.3	41.4	10.5	10.0	10.0	10.2

1987 and 1990. It also provided the highest dry-matter on pooled basis. 'SSG 59-3', 'MP Chari' and 'GFS 3' being at par with each other were found significantly superior to 'S 1049' for green-forage and dry-matter yields on pooled basis. The highest cruide-protein yield was recorded by 'SSG 59-3', followed by 'MP Chari' on an average of 3 years. 'SSG 59-3' showed the highest plant height and tillers/m row on an average of 3 years, whereas 'GFS 3' had the maximum leaves/plant (Table 2). Pooled results of a trial conducted at Anand during 1981–1983 suggested that variety 'SSG 59-3' sorghum gave significantly higher green-forage and dry-matter yields than 'S 1049' and recorded the maximum number of tillers and taller plants than the other varieties (GAU, Anand, 1983).

Effect of seed rate

Seed @ 60 kg, 80 kg and 100 kg/ha being at par with each other gave significant higher green-forage yield than that @ 20 kg/ha during 1990 (Table 1). A seed rate of 60 kg/ha produced the highest green forage during 1989 and on pooled basis, however, the differences did not reach the level of significance. Seed @ 80 kg/ha recorded the highest dry-matter yield during 1990 as well as when pooled. However, increasing seed rate up to 60 kg/ha increased the yield significantly. Seed rates @ 60, 80 and 100 kg seed/ha being at par with each other produced significantly higher dry matter than 20 kg and 40 kg seed/ha on pooled basis. A seed rate 60 kg/ha also synthesized the highest crude-protein yield during all the years as well as on an average of 3 years except 1987. Increasing seed rate from 20 kg to 100 kg seed/ha linearly increased the tillers/m row, resulting increased forage production at higher level of seed (Table 2) in our study.

The green-forage and dry-matter yields of forage sorghum hybrid 'X 988' increased significantly with an increase in seed rates from 30 to 50 kg/ha under Jhansi condition (IGFRI, Jhansi 1985). Allen (1970) also reported the highest fodder yield with 53.8 kg seed/ha. A field trial conducted at Anand also revealed that seed rate of 60 kg seed/ha was found significantly superior to 20 kg and 40 kg seed/ha for forage production (GAU, Anand, 1983). Sartaj *et al.* (1984) also observed that increasing seed rates of forage sorghum from 10 to 50 kg/ha decreased the plant height and increased plant population, fodder yields and palatability.

Variety 'GFS 3' showed higher *in-vitro*

Table 3. *In vitro* dry-matter digestibility content (%) of sorghum varieties as influenced by seed rates during 1990

Variety	Seed rate (kg/ha)					
	20	40	60	80	100	Mean
'SSG 59-3'	31.17 (27.80)	27.69 (21.90)	37.78 (33.25)	26.53 (24.99)	23.13 (20.82)	29.26 (25.75)
'MP Chari'	29.86 (25.34)	30.25 (26.37)	41.70 (42.68)	39.72 (38.49)	40.45 (41.28)	36.40 (34.83)
'GFS 3'	33.65 (22.75)	40.63 (31.00)	51.39 (44.50)	38.75 (35.22)	47.80 (45.60)	42.44 (35.81)

Figures in parentheses indicates digestible dry-matter production in q/ha

Table 4. Effect of different packaging materials and the stage of fruit maturity on total titratable acidity (%) of fruits after 4 and 8 days of storage

Treatments	4-day stage			Mean	8-day stage			Mean
	Mature green	Colour Break	Red ripe		Mature green	Colour Break	Red ripe	
Brown Paper	1.4	1.0	0.8	1.0	1.0	1.0	0.6	0.8
Polyethylene gauge 100	1.6	1.3	1.0	1.3	1.4	1.1	0.7	1.1
Polyethylene gauge 200	1.7	1.5	1.2	1.5	1.5	1.2	1.0	1.2
Polyethylene gauge 300	1.8	1.5	1.2	1.5	1.5	1.2	1.0	1.2
Control	1.4	1.2	0.9	1.2	1.2	1.1	0.6	1.0
Mean	1.6	1.3	1.0		1.3	1.1	0.8	
	Stage(s)	Packing (P)	SXP		Stage(s)	Packing (P)	SXP	
CD at 5%	0.00974	0.01258	0.02179		0.00953	0.0123	0.0213	

Table 5. Effect of different packaging materials and the stage of fruit maturity on ascorbic acid content (mg/100 ml) of fruits after 4 and 8 days of storage

Treatments	4-day stage			Mean	8-day stage			Mean
	Mature green	Colour Break	Red ripe		Mature green	Colour Break	Red ripe	
Brown Paper	25.8	30.2	18.5	24.8	18.5	25.2	10.9	18.2
Polyethylene gauge 100	31.8	36.1	23.1	30.3	23.5	28.7	13.8	22.6
Polyethylene gauge 200	35.2	39.5	26.1	33.6	26.1	33.1	15.1	24.8
Polyethylene gauge 300	37.3	42.3	27.9	35.8	28.1	35.3	15.7	26.4
Control	23.2	32.6	20.9	27.2	20.3	27.4	11.8	19.8
Mean	31.7	36.2	23.3		23.3	29.9	13.5	
	Stage(s)	Packing (P)	SXP		Stage(s)	Packing (P)	SXP	
CD at 5%	0.341	0.441	0.76		0.23	0.305	0.52	