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Effect of level and method of nitrogen application and moisture-conservation practices on growth and yield of rainfed sorghum (*Sorghum bicolor*) under light-textured, eroded soils of central Uttar Pradesh

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ABSTRACT

A field experiment was conducted during the rainy season (*kharif*) of 1986 and 1988 at Kanpur to find out optimum level of nitrogen, suitable method of its application and moisture-conservation practice for rainfed 'Varsha' sorghum [*Sorghum bicolor* (L.) Moench] on light-textured, eroded soils of central Uttar Pradesh. Application of 60 kg N/ha in 2 splits (half at planting in furrows 2–3 cm below the seed and remaining half side-dressed about 5 weeks after planting) significantly increased the yield and its attributes, viz. length and girth of panicle, grain weight/panicle, number of grains/panicle and 1,000-grain weight and fodder yield over the control, with a difference of 9.1 q and 40.4 q/ha in yield of grain and fodder respectively. Furrowing + mulching combinedly recorded significantly higher yield attributes and yield over the control, where difference of 15.3 q and 52.2 q in grain and fodder yields respectively was obtained. The individual effect of furrowing and mulching was intermediate in this respect.

Crop production in drylands is limited not only by inadequate availability of moisture but also by required nutrients, because the drylands are not only thirsty but hungry as well. This belief is substantiated by the results of a large number of experiments conducted all over the country on different dryland crops during the recent past where adequate fertilization, particularly the nitrogen, resulted in substantial increase in crop yields (Gahlot *et al.*, 1979; Nagre, 1981). The response and optimum dose of nitrogen, however, would depend on the amount of available moisture particularly during the active growth period of the crop. Hence the present study was undertaken to find out optimum dose of N and suitable method of its application in relation to moisture-conservation practice in rainfed 'Varsha' sorghum [*Sorghum bicolor* (L.) Moench], grown on eroded soils at Kanpur.

MATERIALS AND METHODS

The field experiment was conducted during the rainy season (*kharif*) of 1986 and 1988 at Kanpur. The soil was sandy loam having organic carbon 0.56% and available N, P_2O_5 and K_2O 290, 18 and 240 kg/ha respectively, with pH 7.4. The experiment was laid out in split-plot design with

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combinations of 4 levels of N (0, 30, 60 and 90 kg/ha) and 2 methods of its application (broadcast and placement) in main plots and 4 moisture-conservation practices (control, furrowing, mulching and furrowing + mulching) in subplots with 3 replications.

Sorghum 'Varsha' was planted on 3, 17 and 5 July during 1986, 1987 and 1988 respectively using a seed rate of 15 kg/ha. Sowing was done behind *desi* plough in rows spaced at 45 cm. A common dose of 25 kg P_2O_5/ha and half dose of N (as per treatment) were applied at planting through *nai* behind the *desi* plough in furrows 2–3 cm below the seed. At 30–35 days after planting the crop was weeded and remaining half dose of N was top-dressed. The treatments of furrowing and mulching individually and combined were applied just after the application of second half dose of N. In furrowing, soil of the furrows was put on the sides of the plants followed by shaping of ridges manually. For mulching, farm residue @ 3 tonnes/ha was used, which was applied in between the rows providing 80–90% coverage of soil surface. Plant-protection measures were adopted as and when desired.

Data of number of grains/panicle (X) were transferred to log values (Y) with the help of the formula $Y = \log_{10} x$. The log values (Y) were transformed back to (x) with the help of the formula $x = 10^y$.

The total rainfall during the crop season in 1986, 1987 and 1988 was 753.4, 386.4 and 663.8 mm respectively. In 1987, a drought year, about 50% of the total rainfall during the crop season was received during September and another about 21% of the total rainfall on 19 October. The remaining period was almost dry, resulting in acute moisture stress failure of crop.

RESULTS AND DISCUSSION

Effect of level of N

The various yield attributes including panicle length and girth, grain weight/panicle, number of grains/panicle and 1,000-grain weight increased with increasing levels of N. The yield increased significantly up to 60 kg N/ha. Warsi (1973) also did not find response of rainfed sorghum beyond 60 kg N/ha.

Effect of methods of N application

The various yield epithets and grain and fodder yields were higher with placement of N compared with its broadcast application, though these 2 methods did not differ significantly. N being a highly mobile nutrient, is subjected to greater leaching losses in highly permeable light-textured soils in the form of nitrates besides being subjected to volatilization and denitrification losses. Therefore, placement showed its superiority to broadcast application. These findings confirm those of Bandyopadhyay and De (1986).

Effect of moisture-conservation practices

The moisture-conservation practices significantly improved the various yield attributes, viz. length and girth of panicle, grain weight/panicle, number of grains/panicle and 1,000-grain weight, and ultimately the grain and fodder yields compared with the control, which may be attributed to more availability of moisture for plant development. As regards the effect of individual practice, furrowing gave higher yield than mulching. Though furrowing did not increase the grain yield significantly over the mulching, it increased the fodder yield significantly. Brahmbhatt and Patel (1983) also reported superiority of

Table 1. Effect of levels and methods of N application and moisture-conservation practices on yield attributes and yield of 'Varsha' sorghum

Treatment	1986							1988							Pooled mean of yield (q/ha)	
	Panicle length (cm)	Panicle girth (cm)	Grain weight/ panicle (g)	Grains/ panicle	1,000-grain weight (g)	Yield (q/ha)		Panicle length (cm)	Panicle girth (cm)	Grain weight/ panicle (g)	Grains/ panicle	1,000-grain weight (g)	Yield (q/ha)			
						Grain	Fodder						Grain	Fodder	Grain	Fodder
N (kg/ha)																
0	17.6	20.2	47.8	3.33 (2,145)	20.9	32.2	109.6	15.0	15.4	34.8	3.21 (1,620)	20.5	22.5	87.4	27.3	98.5
30	18.8	22.3	56.6	3.41 (2,549)	21.9	38.1	133.6	16.4	16.7	44.5	3.32 (2,094)	20.9	26.9	113.9	32.5	123.7
60	19.4	22.8	60.5	3.42 (2,612)	22.6	43.1	150.8	16.7	17.2	48.6	3.35 (2,221)	21.5	29.7	127.0	36.4	138.9
90	19.6	23.0	61.5	3.42 (2,632)	22.8	44.0	147.3	17.7	18.6	50.6	3.36 (2,298)	21.6	31.9	131.8	37.9	139.6
CD (P = 0.05) (levels)	NS	NS	NS	NS	NS	3.9	NS	NS	1.5	NS	NS	NS	0.9	11.9	2.7	NS
CD (P = 0.05) (control vs levels)	1.2	2.1	NS	NS	1.2	4.2	23.5	1.2	1.6	8.0	0.08	NS	1.0	12.8	2.9	17.9
Method of N application																
Broadcast	19.2	22.8	59.4	3.42 (2,601)	22.4	41.5	138.0	16.5	16.9	46.6	3.33 (2,142)	21.4	28.2	118.2	34.8	128.1
Placement	19.3	22.6	59.7	3.41 (2,594)	22.5	42.0	149.8	17.5	18.1	49.3	3.36 (2,264)	21.3	30.8	130.3	36.4	140.0
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	0.9	1.2	NS	NS	NS	0.7	9.7	NS	NS
Moisture-conservation practice																
Control	18.0	20.5	45.4	3.31 (2,058)	21.5	32.1	110.9	15.8	15.7	36.6	3.24 (1,731)	20.9	21.1	97.4	26.6	104.1
Furrowing	18.8	22.2	55.9	3.40 (2,484)	22.2	41.1	144.7	16.5	17.2	45.7	3.33 (2,139)	21.1	29.2	120.4	35.1	132.5
Mulching	18.8	21.8	55.7	3.40 (2,509)	22.0	41.0	135.2	16.5	16.8	42.9	3.30 (2,014)	21.0	27.3	110.5	34.1	122.8
Furrowing + mulching	20.5	24.9	74.3	3.50 (3.183)	23.0	47.4	165.1	17.9	19.2	59.0	3.42 (2,647)	22.0	36.4	147.6	41.9	156.3
CD (P = 0.05)	0.6	1.1	6.7	0.05	0.7	2.7	9.7	0.6	0.8	4.8	0.05	0.6	1.7	8.1	2.2	8.8

Figures in parentheses are transformed-back values

ridging and furrowing over other practices employed for conserving soil and moisture during crop-growth period. Furrowing + mulching combined showed an additive effect with significantly highest grain and fodder yields of sorghum. More availability of water to crop plants and thereby more availability of nutrients ultimately resulted in increased growth and yield attributes of sorghum.

It was concluded that on the light-textured, eroded soils of central Uttar Pradesh rainfed 'Varsha' sorghum may be fertilized with a dose of 60 kg N/ha (in 2 splits, half at planting in furrows 2–3 cm below the seed and remaining half side-dressed 5 weeks after planting). Besides, furrowing in between the crop rows 5 weeks after planting followed by shaping of ridges and application of organic residue mulch @ 3 tonnes/ha may also be resorted to have higher yields of grain as well as fodder.

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