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Production potential of fodder sorghum (*Sorghum bicolor*) varieties under different nitrogen levels and sowing dates

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ABSTRACT

A field experiment was conducted during 1996–98 at Jhansi, to find out the productivity of 3 sorghum [*Sorghum bicolor* (L.) Moench] varieties ('HC 171', 'JS 10' and 'HD 15') at low, medium and high fertility levels (40, 80 and 120 kg N/ha) and early, medium and late planting conditions (beginning, mid and end of July). Analysis of 3 years mean data indicated that plant height, number of green leaves, leaf and stem weight/plant were significantly superior in 'HD 15'(244 cm, 9.9/plant, 85.9 and 287.1 g/plant, respectively), sowing in beginning of July and 120 kg N/ha. However, plants/m and leaf:stem ratio of different varieties did not differ significantly. These characters were at par with 80 and 120 kg N/ha. The highest green fodder (39.7 tonnes/ha), dry matter (7.6 tonnes/ha) and crude protein (510 kg/ha) yields were obtained in 'HD 15'. Forage and crude protein yields were significantly higher when crop was sown in the beginning of July. Significant increase in green fodder (5.9 tonnes/ha) and dry matter (0.94 tonne/ha) yields were recorded when nitrogen level increased from 40 to 80 kg/ha. Further, increase in nitrogen levels could not increase the yields significantly, however crude protein yield increased significantly up to 120 kg N/ha. Interactions between varieties and sowing dates, varieties and nitrogen levels, and nitrogen levels and sowing dates were found significant.

Key words: Fodder productivity, Crude protein, Fodder sorghum, *Sorghum bicolor*, Nitrogen, Sowing dates, Yield

Sorghum [*Sorghum bicolor* (L.) Moench] is an important crop widely grown for grain and forage owing to its ability to grow under varying soils and agro-climatic situations. As forage it is fast growing, palatable, nutritious and utilized as silage and hay besides fresh feeding. When harvested at flowering stage, the forage contains about 6–7% crude protein, 30–31% crude fibre and 9–10% mineral matter. The crop occupies around 30% of the cultivated area under forages and therefore attracts greater attention of researchers for improvement in herbage productivity and quality. 'JS 10' and 'HD 15' are the new varieties of fodder sorghum evolved at IGFRI, Jhansi with better yield potential. These varieties required to be tested against the check 'HC 171' for their performance under early, medium and late maturing and low, medium and high fertility conditions and, therefore, the present experiment was undertaken.

MATERIALS AND METHODS

A field experiment was conducted at the Institute, Jhansi for 3 consecutive years from 1996 to 1998. The soil was sandy clay loam, low in available nitrogen (210 kg/ha), medium in available phosphorus (21.6 kg P/ha) and high in available potassium (314.6 kg K/ha) with *p*H 7.6. The treatments comprised of 3 varieties ('HC 171' check, 'JS 10' and 'HD 15'), 3 sowing dates (beginning, mid and end of July) and 3 nitrogen levels (40, 80 and 120 kg N/ha). The design of experiment was 3^3-partial confounding with 2 replications. Crop received 709, 607 and 880 mm precipitation during July to September of 1996, 1997 and 1998, respectively. The other important weather parameters during experimentation are presented in Fig 1.

The crop was sown in line 25 cm apart using 40 kg seed/ha. Basal fertiliser dose consisting of 17.5 kg P and 24.9 kg K/ha was applied uniformly to all plots through single superphosphate and muriate of potash, respectively. Nitrogen was applied as per treatment through urea using half dose of nitrogen at sowing and remaining half as top dressing at 30 days after sowing. The harvesting was done when crop attained 50% flowering. The crop was harvested on 12, 15 and 10 September when sown on 3, 5 and 1 July and harvested on 18, 19 and 16 September when sown on 15, 16 and 14 July, and 28, 29 and 25 July during 1996, 1997 and 1998, respectively. Green forage yield was recorded and forage samples were taken for dry matter estimation and chemical analysis for nitrogen following standard procedures. Mean data of three years were analysed.

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Table 1 Effect of variety, sowing time and nirogen on growth and yield characters (mean data of 3 years)

Treatment	Plants/m	Plant height (cm)	Green leaves/plant	Leaf weight/plant (g)	Stem weight/plant (g)	L : S ratio
Variety						
'HC 171'	21.1	158.7	6.7	45.5	143.3	0.32
'JS 10'	22.7	173.6	7.7	51.8	170.0	0.30
'HD 15'	22.2	244.0	9.9	85.9	287.1	0.30
CD ($P = 0.05$)	NS	13.5	0.9	9.1	26.3	NS
Sowing time						
Beginning of July	21.5	226.8	9.5	75.7	246.7	0.31
Mid-July	22.0	183.9	7.7	58.7	194.1	0.30
End of July	22.4	165.6	7.1	48.9	159.7	0.31
CD ($P = 0.05$)	NS	13.5	0.9	9.1	26.3	NS
N (kg/ha)						
40	21.6	166.8	6.8	51.6	156.1	0.33
80	22.2	202.9	8.6	65.5	220.3	0.30
120	22.1	206.5	8.9	66.0	224.2	0.29
CD ($P = 0.05$)	NS	13.5	0.9	9.1	26.3	NS

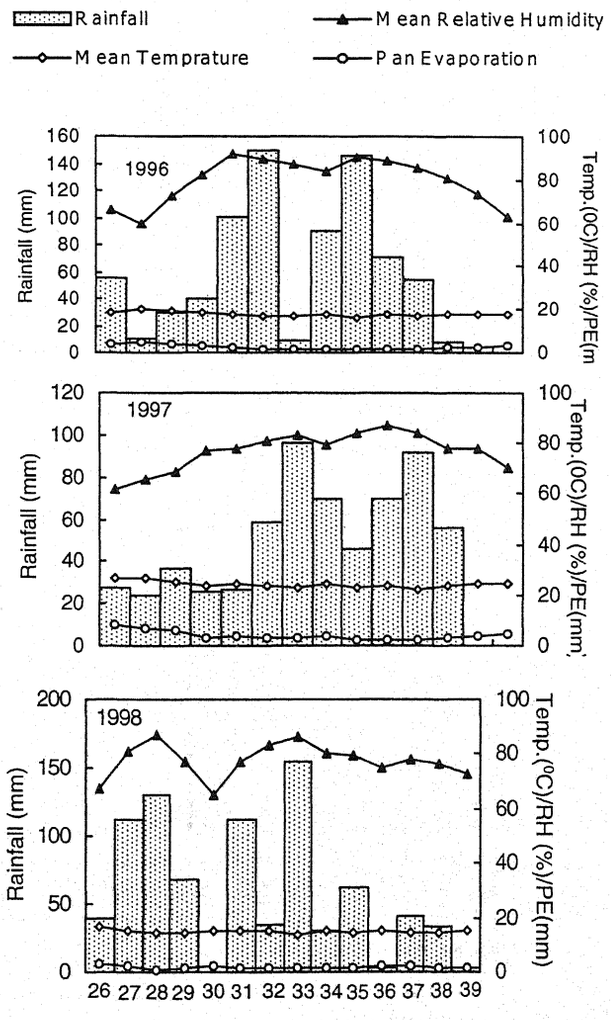


Fig 1 Weekly meteorological parameters during 3 growing seasons (1996–98)

RESULTS AND DISCUSSION

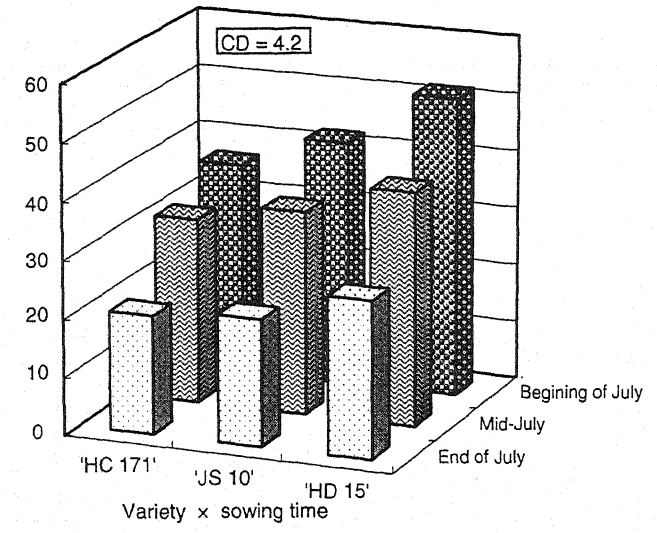
Significant variations were observed in plant height, number of green leaves, leaf weight and stem weight due to varieties, sowing dates and nitrogen levels, however, no differences were recorded in plants/running meter and leaf:stem ratio (Table 1). The varieties, date of sowing and nitrogen levels (Table 2) significantly influenced green fodder, dry matter and crude protein yields of sorghum.

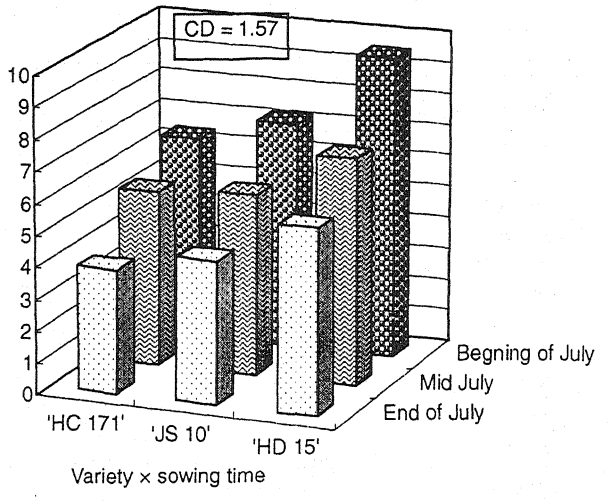
Varietal response

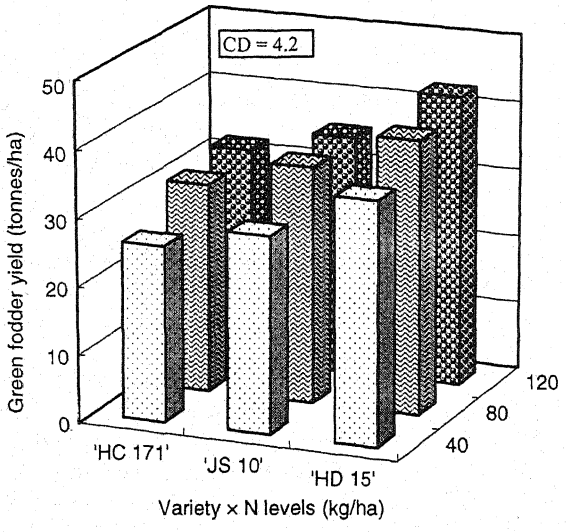
Significant variations were recorded in growth characters, green fodder, dry matter and crude protein yields due to different varieties (Tables 1 and 2). Among varieties, significantly higher green fodder (39.7 tonnes/ha), dry matter (7.6 tonnes/ha) and crude protein (510 kg/ha) yields were obtained from 'HD 15'. It gave 9.6 and 6.8 tonnes/ha higher

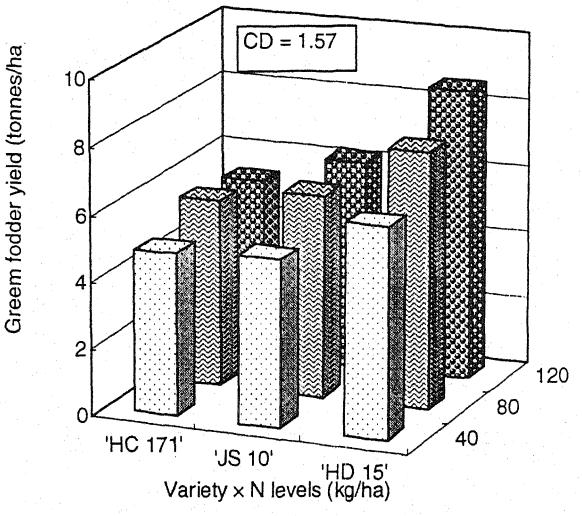
Table 2 Effect of variety, sowing time and nitrogen on yields (mean data of 3 years)

Treatment	Green fodder (tonnes/ha)	Dry matter (tonnes/ha)	Crude protein (kg/ha)
Variety			
'HC 171'	29.6	5.47	328.7
'JS 10'	32.9	6.09	370.4
'HD 15'	39.7	7.60	510.0
CD ($P = 0.05$)	3.2	0.61	38.1
Sowing time			
Beginning of July	43.5	8.16	568.2
Mid-July	35.7	6.28	426.8
End of July	23.1	4.72	321.9
CD ($P = 0.05$)	3.2	0.61	38.1
N (kg/ha)			
40	31.0	5.62	377.2
80	36.9	6.56	450.3
120	37.7	6.99	489.5
CD ($P = 0.05$)	3.2	0.61	38.1









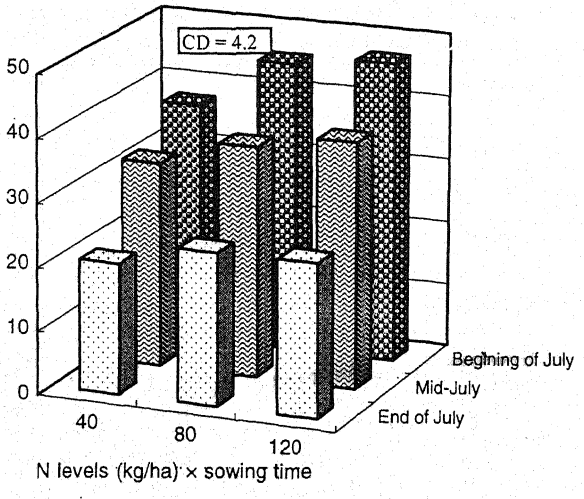


Fig 2 Interaction effect of variety × sowing time, variety × nitrogen and nitrogen sowing time

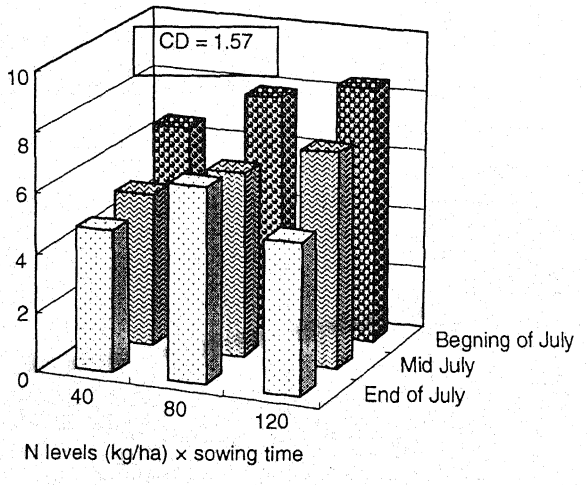


Fig 3 Interaction effect of variety × sowing time, variety × nitrogen and nitrogen × sowing time

green fodder, 2.13 and 1.51 tonnes/ha dry matter, and 181.1 and 139.6 kg/ha crude protein yields over 'HC 171' and 'JS 10', respectively. Plant height (244 cm), number of green leaves (9.9), leaf weight (85.9g) and stem weight (287.1g) per plant were significantly higher in 'HD 15' compared with the other varieties. Greater values of these characters might be contributed to the higher yields of 'HD 15'. Mendhe *et al.* (1995) also reported the similar results.

Sowing dates

Yields of sorghum varieties were significantly influenced by the sowing dates (Table 2). The higher values of biomass yield, plant height, number of leaves, and leaf and stem weight were recorded with early sown crop due to the longer crop duration. Significant reduction in green fodder, dry matter and crude protein yields were recorded from beginning of July to mid-July, and mid-July to end of July. Reduction in green fodder yield was 7.8 and 20.4 tonnes/ha when sowing was delayed from beginning to mid and end of July, respectively. However, the reductions in dry matter and crude protein yields from beginning to mid and end of July were 1.88 and 3.44 tonnes/ha, and 141.9 and 246.3 kg/ha, respectively. Significantly higher green fodder (41.2 tonnes/ha), dry matter (8.16 tonnes/ha) and crude protein (568.2 kg/ha) yields were received when crop was sown in the beginning of July. The crop duration (average of three years) was 72, 65 and 52 days when crop was sown in beginning, mid and end of July, respectively. Hence, there was only a small difference in all the sowing dates in attaining 50% flowering at which harvesting was done. In case of early sowing the higher yield of sorghum might be attributed to the longer growing period. Bhoite and Nimbalkar (1997) reported highest fodder yield and monetary returns from fodder sorghum with the earliest sowing date (18–25 June-early) and lowest with the latest sowing date (2–8 July-late) at Karad, Maharashtra.

Nitrogen levels

Green fodder, dry matter yield and crude protein yields of sorghum increased with successive increase in nitrogen levels (Table 2). However, significant increase in plant height, number of green leaves, leaf and stem weight/plant, green fodder and dry matter yields were recorded when nitrogen level increased from 40 to 80 kg/ha. Further, increase in nitrogen levels did not increase the values of these parameters significantly except crude protein yield, which increased significantly up to 120 kg N/ha. Significant increase in green fodder and dry matter yields were also recorded up to 120 kg N/ha by Ammaji and Suryanarayana (2003). Increase in nitrogen level from 40 to 80 kg/ha, the green and dry matter yield increased 147.5 and 23.5 kg/kg N applied, respectively, however, the increase in yield was only 20 and 10.75 kg/kg N applied when nitrogen level increased from 80 to 120 kg/ha. The green fodder (37.7 tonnes/ha), dry matter (6.99 tonnes/ha) and crude protein (489.5 kg/ha) yields were highest with 120 kg N/ha. Singh *et al.* (1992) and Mahakulkar *et al.* (1996) also recorded the similar results. However, Pankhaniya *et al.* (1997) reported highest dry matter yield with 60 kg nitrogen and increased protein content with increasing N rate.

Interaction effects

Analysis of three years mean data shows significant interactions between V × S, N × V and N × S with respect to green forage and dry matter yields (Figs 2 and 3). The higher green and dry matter yields 51.65 and 9.52 tonnes/ha, respectively were recorded from 'HD 15' sown in beginning of July compared to other treatment combinations. The response of 'HD 15' to nitrogen levels also significant. It produced highest green and dry matter yields at 120 kg N/ha, however, it was at par with 80 kg N/ha but significantly superior over 40 kg N/ha. Yields of beginning of July sown crop with 120 kg N/ha were significantly higher over the other 40 kg N/ha and at par with 80 kg N/ha.

It is concluded that the sorghum crop for fodder should be sown in the beginning of July with the application of 80 kg N/ha to get higher yields of nutritious forage. Among the forage sorghum varieties 'HD 15' can give higher yield sown in beginning of July with the application of 80 kg N/ha.

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