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Evaluation of sorghum genotypes under varied fertilizer levels for fodder yields and quality

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Abstract
Sorghums are the most popular fodder crops in the country. A study was conducted to evaluate the performance of different released fodder genotypes *viz*., Safed Moti (hybrid), SH 825 (hybrid), CSH 20MF (hybrid), CSH24 MF (hybrid), Sudex Chari (hybrid), along with the popular checks *viz*., SSG-59-3 (variety) and M.P. Chari (variety) for yields and quality. Physical characteristics of genotypes were also studied. Three cuts were taken in all genotypes invariably. Highest green and dry fodder yields were observed in hybrids *i.e*., CSH 20MF (75 t ha^{-1}), Safed Moti (73.9 t ha^{-1}) and Sudex chari (72.14 t ha^{-1}). Crude protein per cent was higher in third cut compared to other cuts. Response in terms of green fodder yields, dry matter yields and protein was found significant only upto 120% recommended dose of fertilizers. CSH20MF, Safed Moti and Sudex Chari were the most promising forage sorghum hybrids for this agro-climatic zone with the recommended fertilizer schedule of 120:48:36::N: P_2O_5:K_2O kg ha^{-1}.

Keywords: Fertilizers doses, Quality, Sorghum genotypes, Yields

Sorghum is a wonder crop identified for food and fodder (Saad *et al*., 2016). It is known for high adaptability, drought resistance and commendable performance even under stress conditions. In recent decades multicuts are in vogue with high green fodder potential replacing the traditional single cuts. Year after year several new high yielding genotypes are released most of them being hybrids. The state recommendation of fertilizer is very old. Further, this dose would not meet the requirements of new released genotypes which are mostly hybrids. Owing to high biomass production potential of hybrids, there is necessity to test their performance under varying fertilizer levels. There is also an undisputed responsibility of testing the performance of these genotypes at every agro-climate to recommend the best yielding, adaptable genotype for the zone. Earlier several attempts were also made to compare sorghum genotypes to arrive at the ideal genotype for particular agro-climatic zone. The present study was undertaken to evaluate the performance of different released fodder genotypes for yields and quality.

A field experiment was conducted during *kharif* 2015 under All India Coordinated Research Project on Forage Crops and Utilization at Agricultural Research Institute, Rajendranagar, Hyderabad. The average rainfall of the area was 750 mm which occurs during July to September months of the year. The mean temperature fluctuated between 20.6 and 26.9°C. The soil of the experimental site was well drained, sandy loam in texture with moderately deep. The soil reaction was 7.8 with an electrical conductivity of 0.22 dS m^{-1}. The texture was sandy loam with low available N (152 kg ha^{-1}), medium phosphorus (26.0 kg ha^{-1}) and high K (293.0 kg ha^{-1}).

The treatment consisted of seven sorghum genotypes including five hybrids (Safed Moti, SH 825, CSH 20MF, CSH 24MF, Sudex Chari) and two varieties (SSG-59-3 and M.P. Chari) and three fertilizer levels (100%, 120% and 140% RDF). These treatments were evaluated in randomized block design with replicated thrice. The recommended dose of fertilizer was 100: 40:30 kg N, P_2O_5 and K_2O ha^{-1}, respectively. Full dose of phosphorus and potassium were applied in the form of single super phosphate and muriate of potash as basal after the last ploughing and field layout. However, nitrogen was applied in the form of urea in two equal splits (½ basal and ½ at knee high stage - 35 days after sowing. After each cut 20 kg of N ha^{-1} was applied invariably in all treatments. Recommended crop management practices were adopted. The plot size was 4 × 3 m. Three cuts were taken from all the seven genotypes and representative samples were drawn at each cut. Dried samples were analysed for total N using the Kjeldahl

Table 1. Growth parameters of different sorghum genotypes (mean of 5 plants)

Sorghum genotypes	Plant height (cm)	Stem girth (cm)	Internodes plant^{-1}	Leaves plant^{-1}	L: S ratio
Sudex Chari	201.0	6.2	9.3	10.3	0.14
SH 825	225.7	6.3	8.0	8.7	0.14
Safed Moti	236.7	6.0	9.0	7.7	0.10
CSH 20MF	171.0	5.7	6.7	7.0	0.12
CSH 24MF	167.0	6.0	5.3	7.0	0.18
SSG 59-3	200.0	4.0	7.0	5.7	0.10
M.P. Chari	174.7	3.3	5.3	5.7	0.12
S.Em±	13.89	0.46	0.54	0.51	0.02
C.D (P<0.05)	42.8	1.41	1.65	1.57	NS

method (Piper, 1966), and crude protein (CP) was calculated by multiplying the N content by 6.25. The statistical analysis was performed using the analysis of variance (ANOVA). Critical differences (CD=0.05) provided detailed information about the differences among treatment means.

Various growth parameters *viz.*, plant height, stem girth, number of internodes, number of leaves and Leaf to stem ratio (L:S) were studied taking five plants from each genotype at the first cut (Table 1). Among the seven genotypes studied, a varied range was observed regarding plant height (167 to 236.7 cm), stem girth (3.3 to 6.3 cm), number of internodes (5.3 to 9.3), number of leaves (5.7 to 10.3) and L: S ratio (0.10 to 0.14). High amount of variation in these traits might be due to genetic variability among the genotypes (Pawar *et al*., 2015). The hybrid outperformed the varieties with regard to most of the parameters. Pahuja *et al.* (2014) also observed better performance of hybrids over the varieties.

The significant difference in green and dry fodder yield was observed in sorghum genotypes (Table 2). The highest green (75 t ha^{-1}) and dry fodder yield (16.93 t ha^{-1}) was recorded in genotype CSH 20MF which was at par with Safed Moti and Sudex Chari. However least fodder yield was recorded in sorghum varieties of M.P. Chari and SSG-59-3. Several reports were made on comparison of sorghum genotypes for fodder yields. Singh *et al.* (2010), Kumari *et al.* (2016) and Verma *et al.* (2017) studied variations in fodder yield among sorghum genotypes. Superiority of CSH 20MF over others was also reported by Kumar and Chaplot (2015). It was observed that the hybrids proved superior to varieties owing to their genetic superiority through hybrid vigour.

There was a significant increase in fodder yields upto 120% RDF, further increase in the yields was non-significant (Table 2). Application of 120% RDF increased GFY and DFY by 11.2 and 12.2 per cent over 100% RDF, respectively. This significant increase in GFY could be due to increased availability of nutrients to plants which resulted in increased root shoot growth due to accelerated cell division, enlargement and elongation which ultimately reflected in increased vegetative growth, an important forage trait. These results were in conformity with the findings of Verma *et al.* (2017) and Yadav *et al.* (2019) who reported increase in GFY upto 125% RDF. It is, however, inevitable to understand that these variations could also be due to diverse environments in which they were grown (Hussain *et al*., 2007). These differences could be due to variations in soil type, soil fertility, temperature, rainfall and other climatic factors.

Table 2. Green and dry fodder yield (sum of three cuts) of sorghum genotypes under varying fertilizer levels

Treatment	Green fodder yield (t ha^{-1})	Dry fodder yield (t ha^{-1})
Sorghum genotypes		
Sudex Chari	72.14	16.77
SH 825	63.17	14.67
Safed Moti	73.90	16.44
CSH 20MF	75.00	16.93
CSH 24MF	60.96	13.74
SSG-59-3	59.34	13.42
MP Chari	55.18	12.80
S.Em ±	2.92	0.70
C.D. (P<0.05)	8.10	1.95
Fertilizer levels		
100% RDF	60.61	13.7
120% RDF	67.43	15.38
140% RDF	68.97	15.83
S.Em ±	1.91	0.46
C.D. (P<0.05)	5.30	1.28

Crude protein content in biomass of different sorghum genotype was statistically similar in first cut. However, it was different in second and third cut (Table 3). In general, CP content in sorghum genotypes was highest in third cut was mainly because of coincidence of third cut with comparatively cool season. Low temperature improves protein metabolism in plants. Furthermore, Sudex Chari recorded highest crude protein content (8.4%) in first cut, which was statistically similar to other genotypes. While in second cut, significantly highest CP content (7.4%) was recorded in M.P. Chari and rest of genotypes was at par. Similar trends were reflected even in third cut being highest CP content in M.P. Chari (10.2%) followed by SSG-59-3 (9.0%). Kumar and Chaplot (2015), Kumari *et al.* (2016), Verma *et al.* (2017) and Yadav *et al.* (2019) also reported significant differences in CP values in sorghum genotypes.

Table 3. Crude protein content of sorghum genotypes at different cuts under varying fertilizer levels

Treatments	First cut	Second cut	Third cut
Sorghum genotypes			
Sudex Chari	8.4	5.4	6.5
SH 825	7.4	5.9	8.2
Safed Moti	8.2	5.2	7.6
CSH 20MF	7.4	6.2	7.6
CSH 24MF	6.5	5.5	8.8
SSG-59-3	6.6	6.1	9.0
M.P.Chari	7.2	7.4	10.2
S.Em ±	0.54	0.35	0.49
C.D.(P<0.05)	NS	0.97	1.36
Fertilizer levels			
100% RDF	7.5	6.7	7.6
120% RDF	7.4	8.9	8.5
140% RDF	6.7	6.6	8.8
S.Em ±	0.35	0.23	0.32
C.D.(P<0.05)	NS	NS	0.89

Fertilizer levels significantly influenced CP content in sorghum in third cut only. The CP content improved with the successive levels of fertilizer but significant increase was only up to 120% RDF. Kumar and Chaplot (2015) and Verma *et al.* (2017) found response upto 100% RDF. However, these results were not in conformity with those reported by Rana *et al.* (2013) who observed no significant differences in CP content with increasing fertilizers levels.

Among all genotypes evaluated, the higher fodder yield was recorded in hybrids *i.e.,* CSH 20MF, Safed Moti and Sudex Chari. However, crude protein content was higher in varieties *i.e.*, M.P. Chari and SSG-59-3. Hence, sorghum hybrid CSH 20MF is recommended for this zone with fertilizer schedule of 120 kg N, 48 kg P_2O_5 and 36 kg K_2O kg ha^{-1}.

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