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EVALUATION OF FORAGE SORGHUM HYBRIDS [*SORGHUM BICOLOR* (L.) MOENCH]

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SUMMARY

Forage as a feed for livestock in emergency period has always been a dire need of the time. Hybrid production offers a solution to this problem. The objective of the present study was to select the best parents and then utilized them in interspecific hybridization programme to produce hybrids that could provide palatable green fodder over longer period of time. The materials were sown in random block design and evaluated for some agronomic and forage quality traits. Field experiments were conducted during 2012 at Warangal to estimate overall performance of hybrids over the checks. Seventeen forage sorghum hybrids [*Sorghum bicolor* (L.) Moench] and six checks (including two public and three commercial hybrids and SSG 59-3 released variety) were tested at Warangal. Highly significant differences were found between the hybrids and checks for plant height, number of tillers, leaf length, leaf breadth, stem girth, number of leaves/plant, and green and dry fodder yield (q/ha). Some of the locally developed hybrids significantly outyielded for both green and dry fodder yield as compared to introduced commercial ones. The hybrid 56A x COFS 29 was unique in combining high forage yield with plant height, leaf length, etc., therefore, expected to meet the farmer's preference in producing high quantities of forage in a relatively short period of time and we can also use 56A male sterile line in future for further hybrid production programme. Along with that quality aspects are also very crucial in breeding for forage crops. Therefore, in future programmes, screening for the nutritional value should be carried in the earlier stages of the breeding programme.

Key words : Characterization, evaluation, fodder yield, quality, forage sorghum

Sorghum [*Sorghum bicolor* (L.) Moench] also called "Global Grain" is a crop of world-wide importance due to its multipurpose use being a 4F (food, feed, fodder and fuel) crop. The tremendous increase in demand for animal products in 21st century has led to great expansion in the area allocated for fodder crops, especially under sorghum production. Although, sorghum besides use as a grain and energy crop is also widely used for the production of forage and silage for animal feed; its leaves are broader having high palatability and provide green fodder over a longer period of time. But the required quantity of quality green fodder is not available throughout the year. According to FAO (2007) world food production in the next 30 years should increase by more than 75 per cent to feed about 8000 million people by 2025. Due to unavailability of fodder in terms of quality as well as quantity livestock of developing countries is producing below than optimum potential. According to an estimate demand for milk and meat will be doubled till 2020 which directly depends upon the availability of nutritious fodder over a longer period of time (Bibi *et al.*, 2012).

Male sterility of female parent is an important biological mechanism for the commercial production of hybrid seed. This should be explored to produce hybrid sorghum for commercial production which could offer a reliable solution to this problem. Sorghum is the first self-pollinated cereal staple crop, wherein heterosis has been commercially exploited to improve its productivity. Although Conner and Karper (1927) demonstrated the heterosis in sorghum, but its commercial exploitation was possible only after the discovery of a stable and heritable cytoplasmic-nuclear male-sterility (CMS) mechanism (Stephens and Holland, 1954). This CMS system has been designated as A_1 (*milo*) and this single cytoplasm *milo* is present in all forage sorghum hybrids

(Pahuja *et al.,* 1999). Since then a large number of hybrids have been developed and released/marketed for commercial cultivation in Asia, Australia, Africa and America. Commercial hybrids development has contributed significantly to increased grain and forage yields in several countries. In India, hybrid parents' research was initiated at ICRISAT in 1978 at its headquarters at Patancheru with a global mandate to improve the productivity of sorghum as one of the five crops for food use in the semi-arid tropics. First commercial hybrid (CSH 1) in India was adopted over much of the rainy season sorghum areas. In India, over 85 per cent of the rainy season sorghum area is planted to hybrids.

Thus, keeping the above in view, we have planned the present study for selection of promising female parents and then their utilization in hybridization programme to produce hybrids that could provide palatable green fodder over longer period of time.

MATERIALS AND METHODS

Seventeen forage sorghum hybrids and eight checks (including two public and three commercial hybrids and SSG 59-3 released variety) were tested at Warangal during **rabi** 2012. The trial was sown in random block design having plot size of 20 m^2 with row to row and plant to plant spacing of 45 and 15 cm, respectively for evaluating them along with check for various yields and forage quality related traits. Data were recorded for plant height, number of tillers, leaf length, leaf breadth, stem girth, number of leaves/plant, green (GFY) and dry fodder yield (DFY) after 1st and 2nd cut. Plant height, number of tillers, leaf length, leaf breadth, stem girth, number of leaves/plant were measured from five randomly chosen plants. First cut was taken at 50 per cent flowering and green fodder yield was taken. For DFY 500 g of green fodder was dried and then weighed to calculate DFY q/ha. The data recorded were analyzed for mean, coefficient of variation and critical difference by OPSTAT.

RESULTS AND DISCUSSION

Highly significant differences were observed between the genotypes for plant height, number of tillers, leaf length, leaf breadth, stem girth, number of leaves/plant, total green and dry fodder yield (Table 1). Among all hybrids 56A x IS 2389 showed more plant height (299.833±4.437 cm) as compared to check CSH 20MF (288.167±1.741cm). Total green fodder yield in hybrid 56A x COFS 29 was 2326.367±30.279 q/ha followed by hybrid 467A x IS 2389 (1937.5±43.355 q/ha) and 631A x SGL 87 (1930.567±36.741 q/ha) having more than all checks. Similarly, total dry fodder yield was more in 56A x COFS 29 (569.433±9.114 q/ha) followed by 56A x ICSV 700 (398.6±7.741 q/ha) as compared to all checks and hybrids. Similar results of outperformance of hybrids as compared to local checks and the commercial hybrids in forage yield were reported by Mohammed *et al.* (2012). For all other traits like number of tillers/plant, leaf length, leaf breadth, stem girth and number of leaves/plant all hybrids performed not superior but almost equivalent to the checks. Pothisoong and Jaisil (2011) evaluated 20 sweet sorghum F_1 hybrids for yield potential, heterosis and ethanol production and observed significant improvement for all traits in hybrids as compared to their parents. Significant female, male and female x male interaction effects were also observed for all of the agronomic traits but female groups had a major impact on the performance of the genotypes in all the crosses. But apart from exploiting heterotic potential there is an urgent need to advance these progenies and select those with a combination of stress tolerance along with high fodder yield (Leo, 2005). Akabari *et al.* (2012) and Goyal *et al.* (2013) developed two hybrids Surat-1 x C-10-2, Surat-4 x UP Chari and 94002A x RSSV-9 and NSS 1007A x Ramkel, respectively, showing high green fodder yield over commercial cultivars and checks. Thus, interspecific hybrids will help to overcome the problem of hybrid seed production.

In this evaluation study of forage sorghum hybrids almost in all traits, hybrids performed better as compared to checks and some of the hybrids significantly excelled the introduced commercial hybrids in forage yield. The hybrid 56A x COFS 29 is unique in achieving high forage yield. This has been explained by the successful parental choices involved in this hybrid, especially female parent 56A which will be good combiners for forage yield. This hybrid is expected to meet the farmer's preference in producing high quantities of forage in a relatively short period of time. But further screening for nutritional aspects of 56A x COFS 29, 331A x SGL 87 and 467A x IS 2389, which are superior hybrids, is also required. Although this will be more expensive, yet it is the only way to achieve tangible improvement in forage quality.

TABLE 1

Performance of hybrids along with checks at Warangal during 2012 for various agronomic and fodder yield traits (Bold and italic entries were used as check)

S. No.	Crosses	Plant height (cm)	No. of tillers/ plant	Leaf length (cm)	Leaf breadth (cm)	Stem grith (cm)	No. of leaves	Total green fodder yield (q/ha)	Total dry fodder yield (q/ha)
		Mean±S. E.	Mean±S. E.	Mean±S. E.	Mean±S. E.	Mean±S. E.	Mean±S. E.	Mean±S. E.	Mean±S. E.
1.	631 A × SGL 87	263.933±5.242	3.267±0.267	89.433±1.273	7.167±0.441	7±0.577	39.767±0.393	1930.567±36.741	370.867±8.333
2.	14 A × SSG PSSG	252.933±4.94	3.333±0.667	88.5±2.021	7.2±0.416	5.867±0.328	39.6±0.702	1902.767±50.086	352.767±3.677
3.	467 A × IS2389	260.6±2.948	4.633±0.367	92.633±1.484	6.867±0.133	5.983±0.109	40.833±0.727	1937.5±43.355	356.933±6.933
4.	56 A × ICSV 700	225.767±2.612	3.5±0.289	85.667±0.882	5.733±0.371	5.517±0.344	39.333±0.882	1631.933±42.234	398.6±7.741
5.	725 A × S 540	244.833±5.199	2±0.577	73.5±0.764	6.5±0.289	5.693±0.271	37.267±1.267	881.933±66.255	190.267±12.117
6.	631 A × S 490	245.5±4.646	4.267±0.371	84.5±1.041	7.333±0.333	6.06±0.095	42.5±2.843	1381.967±34.733	251.4±4.992
7.	56 A × IS2389	299.833±4.437	3.333±0.882	88.6±2.088	7.6±0.306	6.727±0.037	48.267±3.246	840.267±18.375	193.067±3.673
8.	631 A × COFS 29	223.667±4.631	4.1±0.586	82.933±2.034	6.733±0.267	5.527±0.093	36±1.528	440.267±22.365	120.833±10.484
9.	56 A × COFS 29	274±5.508	3.933±0.067	90.433±3.491	7.067±0.521	5.317±0.044	41.667±2.028	2326.367±30.279	569.433±9.114
10.	687 A × S 540-1	240.167±2.619	4.167±0.601	93±2.646	6.133±0.467	5.96±0.07	43.833±2.804	1416.667±63.633	373.633±12.355
11.	27 A × GP 5	242.433±29.293	3.667±0.667	85.167±1.364	6.233±0.393	5.427±0.037	32.167±1.59	694.433±6.932	168.033±5.016
12.	631 A × IS 2389	227.933±6.991	3.267±0.636	74.933±2.034	6.067±0.521	4.71±0.049	34.667±2.848	875±24.076	244.467±5.015
13.	56 A × IS 651	242.933±4.367	3.833±0.601	86.167±1.481	6.633±0.318	5.6±0.058	30.833±2.455	1000±24.075	269.433±6.072
14.	31 A × GP 5	253.833±3.812	4.333±0.333	83.667±2.028	6.333±0.333	5.283±0.232	50.433±2.241	944.433±30.279	247.2±1.4
15.	56 A X S 490	231.6±3.124	4.267±1.157	79.833±3.723	6.233±0.393	4.71±0.049	31.467±1.638	805.567±36.745	256.933±6.072
16.	467 A × COFS 29	251.6±2.387	4.167±0.441	87.6±2.386	7.433±0.296	5.967±0.145	41±2.309	756.933±25.054	195.833±14.617
17.	14 A × IS 651 S	265.833±3.059	3.767±0.393	88.667±2.028	7.4±0.306	6.51±0.067	47.767±0.788	1291.667±24.048	318.067±3.672
18.	***Sugargraze***	***188.833±1.922***	***5.333±0.333***	***95±2.082***	***6±0.577***	***5.9±0.208***	***39.833±1.691***	***666.667±24.046***	***187.5±2.425***
19.	***MFSH 4***	***269±2.646***	***4.333±0.333***	***85.333±1.856***	***6.233±0.393***	***5.017±0.136***	***42.667±0.882***	***916.667±48.122***	***198.633±9.114***
20.	***BMR***	***161±1.528***	***6.5±0.289***	***73.833±2.804***	***5.1±0.493***	***4.15±0.218***	***38.167±1.922***	***750±24.076***	***193.033±5.016***
21.	***CSH 20 MF***	***288.167±1.741***	***5.667±1.202***	***83.667±2.186***	***7.3±0.351***	***5.233±0.186***	***53.667±1.453***	***1194.467±50.084***	***355.567±3.674***
22.	***CSH 24 MF***	***252.5±2.363***	***2.5±0.289***	***94.167±2.489***	***7.533±0.291***	***5.583±0.101***	***38.167±2.167***	***569.433±36.744***	***162.5±10.47***
23.	***SSG-59-3***	***236.1±3.537***	***7.833±0.167***	***85.667±0.882***	***4.267±0.371***	***4.627±0.127***	***36.1±1.429***	***1444.433±60.56***	***340.267±6.967***
	Overall mean	**235.08±4.06**	**3.83±0.49**	**82.05±1.92**	**6.38±0.35**	**5.38±0.15**	**38.69±1.66**	**1093.71±33.15**	**259.78±6.60**
	C. D.	20.815	1.675	5.784	0.945	0.525	3.41	100.795	17.844
	SE (m)	7.279	0.586	2.023	0.33	0.184	1.193	35.246	6.24
	SE (d)	10.294	0.828	2.86	0.467	0.26	1.686	49.845	8.824
	C. V.	5.138	24.302	4.084	8.711	5.696	5.13	5.279	3.936

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