

GENETIC ANALYSIS OF YIELD AND AGRO-MORPHOLOGICAL TRAITS IN CMS BASED HYBRIDS OF RABI SORGHUM

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SUMMARY

Seed yield is a complex character governed by several contributing characters. Hence, variability and the extent of variation along with heritability were assessed for seed yield and its seven attributing traits in CMS based **rabi** sorghum hybrids. The study indicated moderate heritability coupled with low to high genetic advance for various traits. Character association was studied to assess the relationship among yield and its component characters for enhancing the usefulness of the selection criterion to be followed. The study revealed that most of the yield attributing traits viz., days to 50% flowering, days to maturity, panicle length and test weight exhibited positive significant correlation with seed yield. Path analysis revealed that panicle length, number of leaves per plant, test weight and fodder yield exhibited positive direct effects on seed yield at phenotypic level.

Key words : Variability, yield attributing traits, heritability, genetic advance, **rabi** sorghum

Sorghum is an excellent source as food, feed, dry and green fodder and, therefore, is important for the income generation for the rural dry land farmers owing to assured grains and fodders under low input conditions. Sorghum is resilient to different kinds of situations and it can be grown in the areas widely differing for climatic regimes. It is also the base crop on which many inter and sequence cropping systems are built upon. India has the largest area (19%) under sorghum cultivation in the world. However, the area and production have declined drastically but the productivity has increased considerably from 522 to 956 kg/ha during the same period due to the adoption of improved production technologies (DSR Pub. No. 03/2012-13/ compendium of improved technologies). Out of this, 2/3rd area was under rainy (**kharif**) and 1/3rd was under post-rainy season (**rabi**). During rainy season intercropping and mixed cropping of long duration sorghum with pigeonpea was extensively in practice in the black soil belts of the country, where sometimes crop suffered due to moisture stress at the end of the season leading to low productivity. Development and adoption of short duration (90-110 days), semi-dwarf sorghum hybrids during mid sixties helped in productivity improvement.

Sorghum hybrids have specially contributed to improving the productivity of **kharif** sorghum. **Rabi** sorghum cultivation in recent times has become more remunerative owing to rise in commodity prices for both grain and fodder. As drought is one of the major production constraints responsible for destabilizing the **rabi** sorghum productivity, research is now focused on the development of early maturing terminal drought tolerant **rabi** sorghum varieties and hybrids. Therefore, the present study has been carried out to assess the genetic nature of various agro-morphological characters with yield in **rabi** sorghum CMS based hybrids.

MATERIALS AND METHODS

The material for the present study comprised 22 experimental **rabi** sorghum hybrids developed at Agricultural Research Station, Tandur during **rabi** 2011-12. These hybrids were sown in randomized block design with two replications for evaluation during **rabi** 2012-13. The entries were grown in 5 m long two row plots with a spacing of 20 cm between the plants and 45 cm between the rows. Recommended cultural practices were followed to raise a good crop. Under each treatment and each replication, five competitive plants were

randomly selected for recording observations for eight metric characters viz., days to 50 per cent flowering, days to maturity, plant height (cm), panicle length, number of leaves per plant, test weight (g), seed yield (kg/ha) and fodder yield (t/ha). Analysis of variance and estimates of genotypic and phenotypic coefficients of variation, broad sense heritability and expected genetic gain were worked out following conventional methods (Falconer, 1964). The genotypic correlations were worked out by using the formula as suggested by Johnson *et al.* (1955) and path analysis in accordance with Dewey and Lu (1959).

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences for all the eight characters studied. The range of variation was maximum for the characters viz., seed yield (900-2430 kg/ha) followed by fodder yield (2.53-6.08 t/ha), panicle length (7.6-23.0 cm), plant height (100-196 cm) and test weight (1.92-3.15 g), while it was, lowest in case of days to 50 per cent flowering (66-76 days) and days to maturity (128-141 days) followed by number of leaves per plant (5-9). In general, PCV values were marginally higher than GCV values (Table 1). The characters studied in the present investigation showed moderate to low PCV and GCV values. The magnitude of variation was maximum for the character seed yield followed by fodder yield, panicle length and test weight, while it was moderate for plant height and number of leaves per plant. Similar results were also reported by the earlier workers (Narkhede *et al.*, 2001). Low magnitude of variation was observed

for days to 50 per cent flowering and days to maturity. These results are in agreement with the earlier findings of Langhi *et al.* (2011). Phenotypic correlations among the yield and other agro morphological characters in **rabi** sorghum hybrids are presented in Table 1. The genotypic and phenotypic correlations were at par with each other suggesting the negligible role of environment on the genotypic expression. However, high variance values alone are not the determining factors of the expected progress that could be needed in respect of quantitative traits (Falconer, 1981). It was suggested that the GCV together with the high heritability estimates would give better picture of the extent of the genetic gain to be expected.

In the present investigation most of the characters expressed low to moderate heritability estimates except in case of panicle length possessing high heritability value of 75.8 per cent. The characters showing moderate values of heritability were test weight (32.7%) followed by number of leaves per plant (34.6%), seed yield (37.8%), fodder yield (42.9%) and plant height (56.8%), while low heritability values were recorded by days to maturity (11.0%) and days to 50 per cent flowering (3.2%) as the material under study comprised CMS derived hybrids. The genetic advance was highest for seed yield (435.2) followed by plant height (35.11). The rest of the characters recorded very low to moderate values of genetic advance. Moderate values for genetic advance as percentage of mean were recorded by panicle length (51.73%), seed yield (32.78%), fodder yield (26.06%), plant height (23.43%), test weight (13.49%) and number of leaves per plant (12.56%). Very low values of 0.40 and 0.79 per cent for genetic advance as per

TABLE 1
Genetic parameters for agro morphological traits in CMS based hybrids of **rabi** sorghum

Character	Range	Mean±SE	PCV	GCV	Heritability	GA	GA as % of mean
Days to 50% flowering	66-76	71.56±2.60	6.21	6.30	0.032	0.28	0.404
Days to maturity	128-141	136.10±2.61	3.51	3.31	0.110	1.08	0.797
Plant height (cm)	100-196	156.50±11.37	19.16	12.58	0.568	35.11	23.43
Panicle length (cm)	7.6-23.0	11.78±1.11	33.14	16.31	0.758	6.09	51.73
No. of leaves/plant	5-9	7.39±0.61	17.64	14.27	0.346	0.92	12.56
Test weight (g)	1.92-3.15	2.59±0.24	20.01	16.41	0.327	0.35	13.49
Seed yield (kg/ha)	900-2430	1327.3±254.81	42.14	33.25	0.378	435.2	32.78
Fodder yield (t/ha)	2.53-6.08	3.89±0.50	29.48	22.28	0.429	1.02	26.069

TABLE 2
Correlations among the different agro morphological traits in CMS based hybrids of **rabi** sorghum

Character	Days to 50% flowering	Days to maturity	Plant height (cm)	Panicle length (cm)	Number of leaves/plant	Test weight (g)	Fodder yield (t/ha)	Seed yield (kg/ha)
Days to 50% flowering	1.0000	0.9070** (0.8670)**	-0.0382 (0.1170)	0.1804 (-0.4913)**	-0.0494 (-0.9675)**	0.0984 (0.2356)	0.0328 (0.1125)	0.0534 0.4381**
Days to maturity		1.0000	-0.0906 (-0.2785)	0.0518 (-0.1566)	0.0529 (0.7864)**	0.1551 (0.2182)	-0.0318 (-0.3425)**	0.2578 0.3581**
Plant height (cm)			1.0000	0.1437 (0.0065)	0.4400** (0.2595)	0.1174 (0.5065)**	0.1044 (0.2721)	0.0930 0.1731
Panicle length (cm)				1.0000	0.2111 (0.1880)	-0.3303** (-0.5682)**	0.0920 (0.2234)	0.3743** 0.3407**
No. of leaves/plant					1.0000	-0.0947 (0.3212*)	0.1915 (0.4899)**	0.1010 0.2295
Test weight (g)						1.0000	0.0088 (-0.0818)	0.0822 0.5873**
Fodder yield (t/ha)							1.0000	0.1631 0.1835

Figures in parentheses are genotypic estimates.

cent of mean were recorded by days to 50 per cent flowering and days to maturity, respectively. Navale *et al.* (2001) and Mahajan *et al.* (2011) reported similar results in **rabi** sorghum. Most of the characters recorded moderate heritability with low genetic advance indicating that the characters were unstable and environment had major impact on the expression of these traits. Hence, breeder should not rely on the estimates of the heritability alone.

The genotypic and phenotypic correlations among the yield and yield attributing characters for **rabi** sorghum hybrids are presented in Table 2. The genotypic and phenotypic correlations were highly variable with each other for all the characters suggesting profound influence of environment on the expression of these characters. Days to 50 per cent flowering was positively and significantly correlated with days to maturity and seed yield at both genotypic and phenotypic levels, while negatively correlated with plant height and number of leaves per plant at genotypic level. Plant height showed positive significant association with number of leaves per plant and test weight at phenotypic and genotypic levels, respectively. Negative significant association of panicle length with test weight was observed in the study, while it was positively and significantly correlated with seed yield. Positive significant association of number of leaves per plant with fodder yield and test weight with

seed yield at genotypic level was observed in the material under study. Similar results were reported by the earlier workers (Khapre *et al.* 2007; Vijaykumar *et al.* 2012).

Direct and indirect effects of the yield components on seed yield showed that panicle length showed highest positive direct effect at phenotypic level resulting in positive significant association with seed yield. Positive direct effect of number of leaves per plant, test weight and fodder yield on seed yield was also observed. The direct effects of these above characters on seed yield were also reported by Vijaykumar *et al.* (2012). Hence, selection based on the above traits would be effective in increasing the yield. Days to 50 per cent flowering showed negative direct effect on seed yield in contrast to days to maturity which exhibited positive direct effect of low magnitude. The yield contributing characters viz., days to maturity, plant height, panicle length and test weight had positive indirect effect of high magnitude on seed yield both at genotypic and phenotypic levels (Table 3). These results are in conformity with earlier findings of Tag El- Din *et al.* (2012).

Through the present study of path analysis, it was apparent that maximum direct effects were exerted by plant height at genotypic level and days to maturity, panicle length, number of leaves per plant, test weight and fodder yield at phenotypic level. All the above characters also exhibited positive and significant

TABLE 3
Path analysis among the different agro morphological traits in CMS based hybrids of rabi sorghum

Character		Days to 50% flowering	Days to maturity	Plant height (cm)	Panicle length (cm)	No. of leaves/plant	Test weight (g)	Fodder yield (t/ha)	Seed yield (kg/ha)
Days to 50% flowering	P	-0.1193	-0.1082	0.0046	-0.0215	0.0059	-0.0117	-0.0039	0.0534
	G	-0.1138	-0.9871	-0.0133	0.0559	0.1556	-0.0268	-0.0128	0.4381**
Days to maturity	P	0.0076	0.0084	-0.0008	0.0004	0.0004	0.0013	-0.0003	0.2578
	G	0.3855	0.4446	-0.1238	-0.0696	0.5275	0.0970	-0.1523	0.3581**
Plant height (cm)	P	0.0011	0.0027	-0.0296	-0.0042	-0.0130	-0.0035	-0.0031	0.0930
	G	0.1369	-0.3259	1.1702	0.0076	0.3037	0.5927	0.3184	0.1731
Panicle length (cm)	P	0.0396	0.0114	0.0315	0.2193	0.0463	-0.0724	0.0202	0.3743**
	G	0.4164	0.1327	-0.0055	-0.8475	-0.1593	0.4815	-0.1894	0.3407**
No. of leaves/plant	P	-0.0055	0.0059	0.0487	0.0234	0.1107	-0.0105	-0.0212	0.1010
	G	0.0106	-0.0092	-0.0020	-0.0015	-0.0077	-0.0025	0.0038	0.2295
Test weight (g)	P	0.0175	0.0275	0.0208	-0.0586	-0.0168	0.1775	0.0016	0.0822
	G	-0.4059	-0.3760	-0.8728	0.9790	-0.5535	-1.7531	0.1409	0.5873**
Fodder yield (t/ha)	P	0.0056	-0.0054	0.0177	0.0156	-0.0325	0.0015	0.1698	0.1631
	G	0.0084	-0.0257	0.0204	0.0167	-0.0367	-0.0061	0.0749	0.1835

Diagonal values are direct effects, Residual effect : 0.7526.

correlation with seed yield, therefore, these characters may be considered as the most important yield contributing traits and due emphasis should be placed on these characters while breeding for higher seed yield in **rabi** sorghum hybrids.

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