Research Article

Genetic Variability and Correlation Studies in elite 'B' and 'R' lines in *Kharif* Sorghum

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Abstract
The genetic variability and nature of character association was studied in 20 B lines and 16 R lines of *kharif* sorghum (*sorghum bicolor* (L) Moench). The genotypic variance was lower than the phenotypic variance for all the characters. High genotypic and phenotypic variance, heritability and genetic advance were observed for the characters panicle length, fodder yield, primary branches per panicle, grains per primary branches, harvest index, grain yield and plant height indicating that additive gene effects were operating for these traits. Positive and significant correlation between grain yield and harvest index, total biomass, fodder yield and leaf area index was observed both at phenotypic and genotypic level, while the characters field grade score ,threshed grade score and days to 50% flowering exhibited negative correlation with grain yield.

Introduction

Sorghum (*Sorghum bicolor*) is the fifth most important cereal grain on world's production basis after wheat, maize, rice and barley. It stands third in respect of area and production among cereals. Its importance is ever increasing as the source of food for rural masses, food for teeming cattle population and raw material for the industries. Also with the present scarcity situation sorghum cultivation is the heart of dry land agriculture, being C4 plant it can utilize sunlight and water efficiently. It is unique to adapt to environmental extremes of a biotic and biotic stresses.

This makes the crop to minimize the risk & enables to fit to a sustainable and economically profitable dry land production system. In spite of this average yield of sorghum is much below the yield potential of this crop. India covers total 34% of the total sorghum area in the world and produces only 17% of the world production. Thus the rate of increase in food grain production is not matching to meet the requirement of food for day by day increasing population and there is little scope to get additional land for cultivation.

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Looking to the present situation there is need to increase productivity of sorghum by utilizing variability and heritability present in genotypes to develop high yielding varieties and hybrids. Knowledge of interrelationship between yield and yield attributing components enables the breeders to plan the breeding programme accordingly. Efforts were made to assess the genetic variability in B and R lines of sorghum for utilizing cytoplasmic genetic male sterility to develop high yielding hybrids.

Materials and Methods

The experimental material consist of 20 B lines including 4 checks and 16 R lines including 3checks. Genotypes were sown in Randomized Block Design with two replication during kharif 2008 at sorghum Research Station , M.A.U. Parbhani. Each line consists of two rows of 4 meters length at 45 cm apart. Plant to plant distance was maintained at 15 cm. Observations were recorded on five randomly selected plants from each genotype for days to 50% flowering, plant height, leaf area Index, fodder yield per plant, harvest index, relative water content, panicle length, width, grains per primary branches, grain yield per plant, test weight, field grade score, Threshed grade score (Garud *et al.,* 1994). The data were subjected to analysis of variance and covariance (Panes and Sukhatme, 1954). The data were further processed for computation of genotypic and phenotypic coefficient of variation, heritability and genetic advance as per the method

suggested by Johnson *et al* (1955). Genotypic and phenotypic correlation coefficients for all the characters were estimated using method suggested by Johnson *et al* (1955).

Results and Discussion

Mean sum of square, standard error and critical differences for all characters are presented in table 1. All the genotypes displayed considerable amount of differences in their mean performance with respect to all the traits studied. Differences among the treatments in respect of all the characters studied were significant at 5 and 1% level indicating the presence of sufficient amount of variability of these characters which provides ample scope for selection of superior and desirable genotypes for plant breeder for further genetic improvement. Kumar and Singh (1986), Prabhakar (2003) and Arunkumar et al., (2004) also observed the similar results.

Genotypic and Phenotypic variation

The results of estimated genetic variability, heritability and genetic advance for grain yield per plant and other traits are presented in table 2. The PCV was higher than the GCV for all the traits which indicated that all traits were highly influenced by environment. But the differences between them were of lower magnitude. High estimates of genotypic and phenotypic coefficient of variation were observed for yield per plant, harvest index, total biomass, fodder yield, plant height, panicle width and panicle length. Similar results were obtained by Nimbalkar et al., (1988) and Hemlata Sharma et al., (2006). Variation in the traits contributed markedly to the total variability (Biradar *et. al*., 1996). Low GCV & PCV were observed for days to 50% flowering (5.86% & 6.85%) and relative water content (7.49 % & 8.38%). Kjein and Rosenow (2006) also reported similar results.

Heritability and Genetic Advance:

High heritab9lity coupled with high genetic advance was reported for the characxters plant hight (90.73 % & 31.45), Threshed grade score (87.14% & 44.60), Panicle length (83.42 % & 29.12), Primary branches per panicle (95.11 % & 68.98), Fodder yield (93.06 % & 71.58), total biomass (91.52 % & 55.79), Harvest index (95.48 % & 72.86) and grain yield per plant (97.80 % & 78.92). This indicates the preponderance of additive gene effect. Which are less affected by environment. The phenotypic selection for these traits will be effective (Rao and Patil 1996) thus while expecting genetic variability due emphasis should be given to these characters. Heritability can be determined with greater , accuracy if it is studied with genetic advance and genetic advance with per cent mean (Johnson *et al*. 1955). Raut *et al* (1994) observed high heritability coupled with high genetic advance for plant height, fodder yield and days to 50% flowering. Kumar and Singh (1986) also reported high heritability for plant hight, panicle weight, 1000 grain weight. Cheralu and Rao (1989) observed high genetic advance for grain yield, ear weight and harvest index.

Character days to 50% flowering had medium heritability (73.11 %) with law genetic advance (10.33 %) suggesting that variations are attributed to high level of non additive gene effects and limited scope for selection. Similar results were reported by Shinde *et al*., (1979) and Prabhakar (2003) for days to 50% flowering.

Correlation:

The genotypic correlation were generally of higher magnitude than phenotypic correlation (table 3) indicating the inherent association between various traits. There was positive and significant genotypic and phenotypic correlation between grain yield per plant and harvest index, total biomass, fodder yield and leaf area index indicating that increase in grain yield is because of increase in one or more of the above character. Similar results were reported by Patil (1985) for number of primaries and secondaries and panicle weight, Bohra et al (1986) for panicle length and harvest inde, Giriraj and Goun (1983) for leaf area index and harvest index.

The characters field grade score, threshed grade score and days to 50 % flowering showed negative correlation with grain yield. The results are in conformity with Nimbalkar et al. (1988). Significant and positive association of panicle width with fodder yield and total biomass was observed at both the levels. But with grains per primary branches and test weight at genotypic level only. Similar results were observed by Throat et al (2004).

The trait test weight had positive and nonsignificant association with grain yield per plant. Giriraj and Goud (1985) found similar results. Grains per primary branches showed positive and non significant correlation with fodder yield, grain yield per plant and total biomass positive association between panicle length test weight grains per primary branches, width and grain yield per plant was observed. The positive association between panicle breadth and grain yield is justifiable as broad panicles will have more secondary branches. These traits could be considered as an important traits for improving grain yield per plant.

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Table 1. Mean sum of squares for 14 characters in kharif sorghum.

Characters	Genotypes	Replication	Error	CD at 5 %
Plant height	1458.82**	1.07	70.94	4.83
Days to 50 % flowering	39.27**	0.02	6.10	16.48
Relative water content	65.72**	10.44	7.32	5.29
Leaf area index	0.03**	0.003	0.005	0.14
Panicle length	45.63**	1.05	4.122	3.97
Panicle width	12.112**	0.93	3.379	3.59
Field grade score	0.824**	0.003	0.096	0.60
Threshed grade score	1.241**	0.014	0.085	0.57
Fodder yield/plant	5804.55**	0.000	208.81	26.27
Test weight	22.327**	0.889	2.688	3.20
Primary branches per panicle	414.694**	3.048	8.910	5.84
Grains per primary branches	1204.097**	1.003	30.182	10.75
Harvest index	189.507**	1.203	4.381	4.09
Yield per plant	976.585**	0.196	10.879	6.45

** Significant at 1 per cent level of probability

Table 2 : Mean and other variability parameters for 14 characters in kharif sorghum

Characters	Range		Mean	GCV %	PCV %	Heritability %	Expected genetic advance
	Min.	Max.					
Plant height (cm)	108.6	234.8	164.34	16.029	16.828	90.73	31.451
Days to 50 % flowering	59.05	75.5	69.46	5.863	6.857	73.11	10.327
Relative water content (%)	63	82.5	72.12	7.492	8.379	79.95	13.801
Leaf area index (%)	0.500	1.035	0.77	14.73	17.564	70.42	25.779
Panicle length (cm)	21.375	41	29.44	15.476	16.943	83.43	29.119
Panicle width (cm)	12.75	22.37	16.73	12.489	16.834	56.37	19.317
Field grade score	2	4.25	2.98	20.248	22.771	79.07	37.09
Threshed grade score	2	5.0	3.28	23.194	24.847	87.14	44.601
Fodder yield/plant (g)	57.62	288.12	146.84	36.022	37.342	93.06	71.583
Test weight (g)	19.5	33.5	26.22	11.949	13.487	78.50	21.811
Primary branches per panicle	43.37	103.12	68.18	20.89	21.344	95.79	42.119
Grains per primary branches	32.12	124.0	70.56	34.33	35.205	95.11	62.976
Harvest index (%)	8.63	55.82	26.58	36.199	37.046	95.48	72.865
Yield per plant (g)	12.75	108.41	56.72	38.173	39.173	95.80	78.918

Table 3: Phenotypic (P) and genotypic (G) correlation coefficient between different traits in kharif sorghum

		Plant height (cm)	Leaf area index (%)	Relative water content ((%)	Field grade score	Threshed grade score	Panicle length (cm)	Panicle width (cm)	Primary branch	Grains per panicle	Fodder yield (g)	Total Biomass (g)	Test weight (g)	Harvest index (%)	Yield per plant (g)
Days to 50% flowering	G	0.202	0.476**	0.327*	0.21	0.301	0.228	0.358	0.072	0.495**	0.444**	0.414*	-0.158	-0.328	-0.054
	P	0.139	0.366*	0.217	0.158	0.27	0.186	0.238	0.035	0.435**	0.357*	0.349*	-0.032	-0.303	-0.049
Plant height (cm)	G		0.318	0.299	-0.438	-0.376	-0.467	0.357*	0.083	0.298	0.635**	0.535**	0.544**	-0.333	0.144
	P		0.273	0.264	-0.403	-0.324	-0.363	0.247	0.086	0.28	0.582*	0.47**	0.458**	-0.279	0.14
Leaf area index	G			0.395*	-0.068	0.103	-0.006	0.494**	-0.161	0.487**	0.572**	0.55**	0.311	-0.047	0.358*
	P			0.332*	0.004	0.062	0.006	0.251	-0.09	0.419**	0.446**	0.448**	0.278	-0.042	0.312
Relative water content	G				-0.126	-0.024	-0.192	0.149	-0.036	0.215	0.442**	0.367*	0.403*	-0.067	0.222
	P				-0.115	-0.015	-0.138	0.102	-0.041	0.186	0.34*	0.312	0.361*	-0.03	0.182
Field grad score	G					0.963**	0.415*	-0.056	-0.032	0.074	-0.207	-0.194	-0.296	0.08	-0.073
	P					0.851**	0.332*	0.095	-0.022	0.052	-0.192	-0.16	-0.198	0.03	-0.053
Threshed grad score	G						0.317	0.037	-0.008	0.108	-0.155	-0.113	-0.263	0.053	-0.077
	P						0.296	0.115	-0.013	0.119	-0.153	-0.129	-0.238	0.055	-0.076
Panicle length	G							0.051	0.161	0.273	-0.218	-0.114	-0.323	0.147	0.04
	P							-0.006	0.138	0.26	-0.188	-0.135	-0.231	0.154	0.039
Panicle width	G								0.315	0.457**	0.622**	0.529**	0.361*	-0.048	0.275
	P								0.223	0.318	0.421**	0.389*	0.232	-0.07	0.205
Primary branches per panicle	G									-0.089	0.168	0.207	0.259	-0.145	0.049
	P									-0.081	0.173	0.192	0.21	-0.147	0.043
Grains per primary branches	G										0.277	0.311	0.072	-0.22	0.23
	P										0.261	0.279	0.053	-0.006	0.217
Fodder yield/plant	G											0.99**	0.479**	-0.351	0.427**
	P											0.931**	0.405*	-0.333	0.419**
Total Biomass	G												0.405*	-0.224	0.566**
	P												0.379*	-0.226	0.543**
Test weight	G													-0.069	0.298
	P													-0.056	0.273
Harvest index	G														0.655**
	P														0.629**

* significant at 5 per cent. ** significant at 1 per cent.