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Research Article

Studies on genetic variability among the derived lines of B x B, B x R and R x R crosses for yield attributing traits in rabi sorghum (*Sorghum bicolor* (L.) MOENCH)

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Abstract :
Studies were carried out to estimate the extent of genetic variability for yield and its component traits among the 120 F_6 lines derived from B x B, B x R and R x R crosses in *Rabi* sorghum at RARS, Bijapur and MARS, Dharwad during *rabi* 2007-08. Significant mean squares were obtained for yield and its component traits among different groups (B x B, B x R and R x R derivatives) studied at both locations, thus indicating that the genotypes under study were highly diverse. At both locations, derivatives of B x B and B x R exhibited higher PCV and GCV compared to R x R group for number of grains per panicle and grain yield per plant while R x R derivatives showed high PCV and GCV for these characters; number of primaries per plant, number of grains per panicle and grain yield per plant.Derivatives of B x B and B x R exhibited high heritability coupled with genetic advance for all the characters under study except number of leaves and number of internodes at both locations. The R x R derivatives recorded high heritability coupled with genetic advance for the characters *viz.,* plant height, number of leaves, number of internodes, panicle length, panicle breadth, number of primaries, test weight, number of grains per panicle, fodder yield per plant and grain yield per plant at both the locations. Hence, selection made through these characters would be effective. At both locations, low variability for days to 50 percent flowering was observed among the derivatives of B x B, B x R and R x R crosses, thus suggesting negligible contribution of this trait to total variability.

Key words:
Sorghum, variability, heritability, genetic advance, derived lines, BxB, BxR, RxR corsses.

Introduction

Sorghum (*Sorghum bicolor* (L.) Moench) is widely grown throughout the world (Asia, Africa, North and Central America and Europe) for food, feed and fodder. It is fifth major cereal crop of world following wheat, rice, maize and barley in terms of production and utilization. Recent FAO statistics indicate a world production of 58.50 million tonnes of grain sorghum from 42.07 million hectares of land having a productivity of 1391 kg per hectare. In India, it is third major cereal after rice and wheat and cultivated in both *kharif and rabi* seasons. However, the productivity in *kharif* is significantly high (1082 kg/ha) compared to *rabi* (726 kg/ha). This gap is mainly due to the large-scale cultivation of highly heterotic hybrids in kharif while in rabi major area is still occupied with varieties and local land races.

In the past, focused breeding efforts on rabi sorghum led to the development of *rabi* sorghum varieties, such as CSV8R, Swati, CSV14R, CSV 18R, CSV216R and CSV22R. Heterosis breeding led to the release of hybrids like CSH8R, CSH12R, CSH13R, CSH15R and CSH 19R. However, the varieties have become more popular compared to hybrids, a situation diagonally opposite to kharif. Though these hybrids are heterotic for grain yield but poor in grain quality and most vulnerable to biotic and abiotic stresses. It appears that in future the rabi sorghum hybrids will have tangible impact only when the A and R lines have the season adaptability with desired combining ability. Earlier, several experimental studies on heterosis in rabi sorghum have revealed that maximum heterosis could be obtained in rabi CMS x derived R lines of rabi followed by rabi CMS x rabi land race combinations. At present the rabi hybrid programme is still not packed with rabi adapted parental lines with desired combining ability. Keeping these things in view, a new set of parental lines with rabi adaptability have been developed involving genetically diverse 'B' and 'R' lines through B x B, B x R and R x R crosses at All India Sorghum Improvement Project, RARS, Bijapur. However, before involving these lines in heterosis breeding programme, nature of genetic variability for different traits in these derived lines

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needs to be assessed, as this an essential requirement of successful hybrid breeding programme.

Material and Methods

The present investigation was carried out during *rabi* season 2007-08 both at Regional Agricultural Research Station (RARS), Bijapur and Main Agriculture Research Station (MARS), Dharwad to know the genetic variability for different characters in the advanced generation (F_6) derived lines of BxB, BxR and RxR crosses in *Rabi* sorghum for grain yield and other productivity traits. The randomized block design with two replications was followed. Each treatment was of two rows of 4.0 meter length with inter row spacing of 60 cm at Bijapur and 45 cm at Dharwad and intra row spacing of 15 cm. All the recommended package of practices was followed to raise a good crop. From each entry in each replication five randomly selected plants were selected and tagged for recording observation on all the quantitative characters *viz.,* days to 50% flowering, plant height (cm), number of leaves, number of internodes, panicle length (cm), panicle breadth (cm), number of primaries per panicle, thousand grain weight (g), number of grains per panicle, fodder yield per plant and grain yield per plant. Mean of the five plants for each entry for each character was worked out for using in statistical analysis. The mean of five plants in each replication for each character was used for analysis of variance. The differences among the genotypes were tested by 'F' test. Estimation of genetic parameters like Phenotypic and genotypic variance (as given by Lush (1990) and Chaudhary and Prasad (1968)), genotypic and phenotypic coefficients of variability (as per the method suggested by Burton and Devane (1953)), Heritability in broad sense expressed as percentage (as suggested by Hanson *et al.* (1956)) and genetic advance was estimated by using the formula given by Johnson *et al.* (1955).

Results and discussion

To improve the productivity in rabi there is need to develop heterotic hybrid for grain and fodder yield coupled with bold and lustrous seeds, tolerance to pest and diseases. This task has become difficult due to non availability of rabi adapted 'B' lines with Maldandi grain traits and non availability of potential, good combining 'R' lines.

Keeping these things in view, a new set of lines have been developed involving diverse 'B' and 'R' lines through B x B, B x R and R x R crosses at RARS, Bijapur and are now in F_6 generation. Before involving these lines in heterosis breeding programme, nature of genetic diversity for different traits existing in these derived lines needs to be assessed, as this an essential requirement of successful hybrid breeding programme. Perhaps one of the reasons why the rabi sorghum hybrid programme has not made sufficient head way so far, is lack of systematic assessment of genetic diversity between 'B' and 'R' lines before using them in hybrid combination. Information about the variability, heritability, genetic advance for yield and yield attributes is also important to meaningfully utilize these derived lines in breeding programme.

Apart from this, few selected lines based on the performance in the first year were grown over two locations *viz*., Dharwad and Bijapur along with the checks to further confirm their mean performances. Results obtained on these aspects are being discussed in this paperr under different headings

1. Analysis of variance
2. Genetic variability, heritability and genetic advance
3. Comparison of variability parameters for yield and yield components among different groups (B x B, B x R and R x R derivatives)

1. Analysis of Variance

The mean sum of squares (MSS) of different characters among different groups (B x B, B x R and R x R derivatives) at both Bijapur and Dharwad are presented in Table 1 and 2 respectively. At both the locations the MSS were found to be highly significant for all the eleven characters studied indicating greater distinctness among BxB, BxR and RxR derivatives of *rabi* sorghum, thus indicating that the genotypes under study are having high genetic variability.

2. Genetic Variability, Heritability and Genetic Advance

Effectiveness of selection depends on the magnitude of genetic variability in a particular character. It is necessary to study variability in respect of quantitative characters with reference to genetic parameters such as genotypic variance, phenotypic variance, heritability and genetic advance. The absolute values of phenotypic and genotypic variance cannot be used for comparing the magnitude of variability for different characters since the mean and units of measurement of the characters may differ. Hence, the coefficients of variation expressed in percentage at phenotypic and genotypic levels have been used to compare the variability observed among the different characters. An assessment of heritable and non-heritable components in the total variability observed is indispensable in adopting suitable breeding procedure. The heritable portion of the overall observed variation can be ascertained by studying the components of variation such as phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV).

The genotypes showed a wide range of variation for all the characters except days to 50 per cent flowering. Wide range of variation provides ample scope for selection of superior and desired genotypes by the plant breeders for further improvement in these characters (Table 3 and 4).

2.1 Genotypic (GCV) and phenotypic (PCV) coefficient of variation

The phenotypic coefficient of variation (PCV) was moderately higher than genotypic coefficient of variation (GCV) for all the traits under study at both locations (Table 3 and 4) which suggested that environmental influence was moderate on these traits. Similar results have been reported by Sindagi *et al.* (1970). At both locations, higher values of PCV and GCV were obtained for number of grains per panicle (23.67%, 20.89% at Bijapur and 22.34% and 19.69% at Dharwad) and grain yield per plant indicating that variation for these characters contributed markedly to the total variability. These results are in accordance with the results obtained by Kumar and Singh (1986), Nimbalkar *et al.* (1988), Berenji (1990), Khanure (1993), Biradar (1996), Rao and Patil (1996), Reddy *et al.* (1996), Can and Yoshida (1999) and Lata Chaudhary *et al.* (2001).

Moderate values of PCV and GCV were noticed for plant height, number of leaves per plant, number of internodes per plant, panicle breadth panicle length, number of primaries per panicle, test weight and fodder yield per plant both at Bijapur and Dharwad locations. These results are in conformity with the reports of Liang (1967), Khanure (1993), Raut *et al,.*(1994), Asthana *et al.,*(1995) and Reddy *et al.,* (1996).

The range of variability was comparatively low for days to 50 percent flowering indicating negligible contribution of this trait to total variability. Similar observations were also made by Patel *et al.,* (1980), Raja and Parikh (1980) and Nimbalkar *et al.,* (1988). It also suggests that there is little scope to improve further for earliness through selection.

Overall, based on the results at both the locations, it could be concluded that there is great scope for improvement of number of grains per panicle and grain yield per plant traits by direct selection. Other characters like number of primaries per panicle, test weight and fodder yield per plant were moderately variable and thus appears to be amenable for further improvement (Table 3 and 4).

Comparison of variability parameters among different groups (B x B and B x R derivatives) recorded high PCV and GCV compared to R x R group for number of grains per panicle and grain yield per plant. While among R x R derivatives the characters like; number of primaries per plant, number of grains per panicle and grain yield per plant showed high PCV and GCV. Hence there is great scope for improvement of number of grains per panicle and grain yield per plant among group of B x B and B x R derivatives and for the characters *viz.* number of primaries per plant, number of grains per panicle and grain yield per plant among derivatives of R x R crosses.

At both Bijapur and Dharwad locations among all the groups (B x B, B x R and R x R derivatives), the range of variability was comparatively low for days to 50 percent flowering indicating negligible contribution of this trait to total variability.

2.2 Heritability and genetic advance

Effective selection can be achieved when heritability estimates are high. In the present study, the genotypes were of F_6 generation lines, hence all were near homozygous. Thus, for the prediction of response to selection it is apt to use broad sense heritability because the entire genotypic value is transmitted to the progeny when any selection is advanced through selfing. Further, Johnson *et al* (1955) suggested that heritability in conjunction with genetic advance is more effective and reliable in predicting resultant effect of selection. Swarup and Chagule (1962) observed that high heritability need not be associated with high genetic advance. According to Panse (1957), if heritability is mainly due to non additive effects (dominance and epistasis), the genetic advance will be low, where as if the heritability is due to additive effects it would be associated with high genetic advance.

In the present study, at both Bijapur and Dharwad locations all the characters showed high estimates of broad sense heritability (Table 3 and 4). The characters *viz.*, 50% days to flowering, plant height, number of leaves, number of internodes, panicle length, panicle breadth, number of primaries per panicle, test weight, number of grains per panicle, fodder yield per plant and grain yield per plant exhibited very high heritability. Several workers like ; Patil and Thombre, 1985; Lothorp *et al.,* 1985, Phul and Allah Rang, 1986; Kumar and Singh, 1986; Worthman *et al.,* 1987; Nimbalkar *et al.,* 1988; Cheralu and Rao, 1989; Spivakov, 1989; Khanure, 1993; Biradar, 1996; Rao and Patil, 1996; Reddy *et al.,* 1996; Nguyen *et al.,* 1999, Tiwari , 2003, and Veerabadhiran and Kennedy (2001) have also made similar observations.

Heritability values alone may not provide clear predictability of selections made. Heritability values

along with estimates of genetic advance would be more reliable than heritability alone (Johnson *et al.,* 1955). Heritability values indicate only the magnitude of inheritance of the quantitative character, while genetic advance is helpful in formulating the selection procedure to be adopted (Table 3 and 4).

High heritability coupled with high genetic advance over mean (Table 3 and 4) was obtained for the characters *viz.,* plant height, number of leaves, panicle length, panicle breadth, number of primaries, test weight, number of grains per panicle, fodder yield per plant and grain yield per plant at both the locations. Hence, selection made through these characters would be effective as they are more predominantly controlled by additive gene effect. These results are in confirmation with the results of Bhat (1975), Patil and Thombre (1985), Phul Allah Rang (1986), Nimbalkar *et al.,*(1988), Khanure (1993), Biradar (1996), Reddy *et al.,*(1996), Prabhakar (2001), Veerabadhiran and Kennedy (2001), Umakanth *et al.*(2004), Deepalakshmi *et al.*(2007).

However, days to 50% flowering showed high heritability coupled with low genetic advance at both Bijapur and Dharwad locations. Similar observations were also recorded by Naphade (1973) and Biradar (1996) for days to 50% flowering indicating the presence of non-additive gene effects and high genotype and environment (G x E) interaction. This again reiterates the fact that it is difficult to make the progress in developing early maturing and high yielding genotypes.

3. Comparison of variability parameters for yield and yield components among different groups (B x B, B x R and R x R derivatives)

Comparison of Heritability and genetic advance at both the locations for yield and yield components revealed high heritability coupled with genetic advance among group of B x B and B x R derivatives for the characters *viz.,* plant height, panicle length, panicle breadth, number of primaries, test weight, number of grains per panicle, fodder yield per plant and grain yield per plant at both the locations. While among R x R derivatives high heritability coupled with genetic advance was shown by the characters *viz.,* plant height, number of leaves, number of internodes, panicle length, panicle breadth, number of primaries, test weight, number of grains per panicle, fodder yield per plant and grain yield per plant at both the locations. Hence, selection made through these characters would be effective (Table 5 and 6).

However, days to 50% flowering showed high heritability coupled with low genetic advance at both Bijapur and Dharwad locations among all the groups (B x B, B x R and R x R derivatives).

Conclusion

Analysis of variance revealed significant difference among the genotypes at both the locations in respect of all the characters studied indicating high degree of variability among the F_6 generation lines derived from B x B, B x R and R x R crosses. The B x B and R x R group of derivatives recorded high PCV and GCV compared to R x R group for number of grains and grain yield per plant.

Genotypic and phenotypic coefficients of variability were high for number of grains per panicle and grain yield per plant at both the locations. Hence, selection based on these traits would ultimately improve the grain yield.

High heritability was noticed for the traits *viz*., days to 50% flowering, plant height, number of leaves, number of internodes, panicle length, panicle breadth, number of primaries per panicle, test weight, number of grains per panicle fodder yield per plant and grain yield per plant at both locations indicating that simple selection would be sufficient for these traits to bring genetic improvement in desired direction.

References

Asthana, O. P., Sharma, R. L., Hirve, C. D. and Asthana, N., 1995, Genetic variability, heritability and genetic advance in exotic sorghums (*Sorghum bicolor* (L.) Moench). *Advances in Plant Sciences*, **8**(2): 230-237.

Chaudhary, L. B. and Prasad, B., 1968, Genetic variation and heritability of quantitative characters in India mustard (*Brassica juncea*). *Indian Journal of Agricultural Sciences*, **38**: 820-825.

Deepalakshmi, A. J., and Ganesamurthy, K., 2007, Studies on genetic variability and Character association in kharif sorghum {Sorghum bicolor (L.)Moench}. *Indian J. Agricultural Research*. **41** (3): 177-182.

Johnson, H. W., Robinson, H. F. and Comstock, H. F., 1955, Estimates of genetic and environmental variability in soybean. *Agronomy Journal*, **47**: 314-318.

Khanure, S. K., 1993, Variability, correlation, path analysis and stability analysis for quantitative characters in *rabi* sorghum (*Sorghum bicolor* L. Moench). *M. Sc. (Agri.) Thesis*, University of Agricultural Sciences, Dharwad.

Naphade, D. S. and Ailwar, V. L., 1977, Variability, heritability and path analysis in jowar [*Sorghum*

bicolor (L.) Moench]. *College of Agriculture Nagpur Magazine*, **49**: 17-23.

Nguyen, Duycan, Harydnio, T. A. and Yoshida, T., 1999, Genetic variability and character association analysis in grain sorghum. *Journal of Faculty of Agriculture Krishi University*, **43**: 25-30.

Nimbalkar, V. S., Bapat, D. R. and Patil, R. C., 1988, Genetic variability, interrelationship and path coefficient of grain yield and its attributes in sorghum. *Journal of Maharashtra Agricultural Universities*, **13**: 207-208.

Panse, V. G., 1957, Genetics of quantitative characters in relation to plant breeding. *Indian Journal of Genetics and Plant Breeding*, **17** : 318-327.

Patil, R. C. and Thombre, M. V., 1986, Genetic parameters, correlation coefficient and path analysis in F_1 and F_2 generations of a 9 × 9 diallel cross of sorghum. *Journal of Maharashtra Agricultural Universities*, **8**(2): 162-165.

Prabhakar, 2001, Variability, heritability, genetic advance and character association in *rabi* sorghum. *Journal of Maharashtra Agricultural Universities*, **26**: 188-189.

Robinson, H.F., Comstock, P.E. and Harvey, P.H., 1949, Genotypic and phenotypic correlations in corn and their implications in selection. *Agronomy Journal*, **43**: 282-287.

Umakanth, A.V., Madhusudhana, R., Latha., K. M., Rafiq, S. M., Kiran, V. S. S., 2004, Analysis of genetic variation and trait interrelationships in sorghum [*Sorghum bicolor* (L.) Moench]. *National J. Pl. Improv.,* **6** (2): 104-107.

Veerabadhiran, P., and Kennedy, V. J. F., 2001, Correlation and path analysis studies in selected germplasms of sorghum. *Madras Agril. J*, **88** (4/6): 309-310.

Table 1. Mean sum of squares for yield and yield components among different groups (B x B, B x R and R x R derivatives) at Bijapur during *rabi* 2007-08

B x B Crosses (19 genotypes + 20 parents/checks)					
Traits	**Replication**	**Treatment**	**Error**	**S.Em.±**	**CV (%)**
Days to 50 per cent flowering	6.78	20.27**	1.78	0.94	1.93
Plant height at maturity (cm)	741.54	2049.35**	226.78	10.65	8.38
Number of leaves per plant	0.53	3.4**	0.31	0.39	5.69
Number of internodes per plant	0.53	3.4**	0.31	0.39	5.69
Panicle length(cm)	0.09	9.72**	1.06	0.73	7.08
Panicle breadth(cm)	0.01	1.51**	0.16	0.28	6.92
Number of primaries per panicle	3.2*	210.69**	17.74	2.98	7.44
Test weight(g)	0.01	28.21**	2.28	1.07	5.82
Number of grains per panicle	8562.57*	105527.79**	20146.77	100.37	12.61
Fodder yield per plant(g)	48.49	175.74**	18.95	3.08	7.91
Grain yield per plant(g)	4.07*	104.21**	6.98	1.87	9.05

B x R Crosses (69 genotypes + 20 parents/checks)					
Traits	**Replication**	**Treatment**	**Error**	**S.Em.±**	**CV (%)**
Days to 50 per cent flowering	0.56	16.62**	2.26	1.06	2.22
Plant height at maturity (cm)	259.69	1569.14**	228.08	10.68	7.95
Number of leaves per plant	0.84	2.52**	0.55	0.52	7.58
Number of internodes per plant	0.84	2.52**	0.55	0.52	7.58
Panicle length(cm)	0.19	8.08**	1.3	0.81	7.96
Panicle breadth(cm)	0.02	1.7**	0.23	0.34	7.88
Number of primaries per panicle	4.22*	221.71**	16.49	2.87	6.74
Test weight(g)	0.63	26.02**	2.47	1.11	5.85
Number of grains per panicle	411.39*	158193.84**	16848.13	91.78	10.54
Fodder yield per plant(g)	11.84	229.98**	17.07	2.92	6.79
Grain yield per plant(g)	1.56	109.37**	7.22	1.9	8.19

R x R Crosses (32 genotypes + 20 parents/checks)					
Traits	**Replication**	**Treatment**	**Error**	**S.Em.±**	**CV (%)**
Days to 50 per cent flowering	1.88	23.34**	2.49	1.12	2.32
Plant height at maturity (cm)	719.78	1518.75**	201.99	10.05	7.43
Number of leaves per plant	1.53	3.53**	0.62	0.56	7.83
Number of internodes per plant	1.53	3.53**	0.62	0.56	7.83
Panicle length(cm)	3.47	8.35**	1.35	0.82	8.42
Panicle breadth(cm)	0.01	2.29**	0.23	0.34	8.28
Number of primaries per panicle	3.12*	259.77**	16.76	2.89	7.67
Test weight(g)	0.14	32.29**	2.04	1.01	5.85
Number of grains per panicle	61771.66*	214530.25**	21604.77	103.94	12.46
Fodder yield per plant(g)	6.2	362.86**	12.63	2.51	6.09
Grain yield per plant(g)	22.92*	123.18**	7.39	1.92	9.56

* - Significant at 5 per cent level of probability

** - Significant at 1 per cent level of probability

Table 2. Mean sum of squares for yield and yield components among different groups (B x B, B x R and R x R derivatives) at Dharwad during *rabi* 2007-08

B x B Crosses (19 genotypes + 20 parents/checks)					
Traits	**Replication**	**Treatment**	**Error**	**S.Em.±**	**CV (%)**
Days to 50 per cent flowering	4.63	25.98**	3.55	1.33	2.54
Plant height at maturity (cm)	797.76	2189.57**	235.76	10.86	8.11
Number of leaves per plant	0.73	2.73**	0.51	0.51	7.48
Number of internodes per plant	0.73	2.73**	0.51	0.51	7.48
Panicle length(cm)	0.88	26.27**	2.91	1.21	10.35
Panicle breadth(cm)	0.57	2.08**	0.54	0.52	12.81
Number of primaries per panicle	0.01	211.39**	17.69	2.97	7.03
Test weight(g)	1.78	34.15**	1.81	0.95	4.78
Number of grains per panicle	522.44*	137802.00**	15590.5	88.29	10.19
Fodder yield per plant(g)	11.85	211.18**	18.42	3.04	6.56
Grain yield per plant(g)	2.96*	117.69**	10.29	2.27	9.38

B x R Crosses (69 genotypes + 20 parents/checks)					
Traits	**Replication**	**Treatment**	**Error**	**S.Em.±**	**CV (%)**
Days to 50 per cent flowering	2.72	18.74**	2.79	1.18	2.28
Plant height at maturity (cm)	194.04	1725.99**	299.51	12.24	8.61
Number of leaves per plant	0.06	2.38**	0.47	0.48	7.06
Number of internodes per plant	0.06	2.38**	0.47	0.48	7.06
Panicle length(cm)	0.25	18.84**	2.35	1.08	9.51
Panicle breadth(cm)	0.01	1.70**	0.29	0.38	9.06
Number of primaries per panicle	74.82*	256.44**	17.12	2.93	6.42
Test weight(g)	4.69	27.23**	2.23	1.06	5.25
Number of grains per panicle	81419.15*	180039.00**	21185.53	102.92	10.58
Fodder yield per plant(g)	0.03	221.47**	18.87	3.07	6.11
Grain yield per plant(g)	20.67*	124.93**	12.63	2.51	9.18

R x R Crosses (32 genotypes + 20 parents/checks)					
Traits	**Replication**	**Treatment**	**Error**	**S.Em.±**	**CV (%)**
Days to 50 per cent flowering	5.54	17.86**	1.71	0.93	1.77
Plant height at maturity (cm)	148.2	1621.88**	221.73	10.53	7.32
Number of leaves per plant	1.49	3.08**	9.44	0.47	6.62
Number of internodes per plant	1.49	3.08**	9.44	0.47	6.62
Panicle length(cm)	1.29	19.67**	1.35	0.82	7.75
Panicle breadth(cm)	0.09	2.27**	0.25	0.35	8.45
Number of primaries per panicle	23.37*	298.27**	16.83	2.9	7.19
Test weight(g)	4.01	40.93**	3.04	1.23	6.46
Number of grains per panicle	10470.45*	226882.00**	21012.54	102.5	11.45
Fodder yield per plant(g)	6.45	352.42**	16.48	2.87	5.93
Grain yield per plant(g)	23.47*	127.46**	10.48	2.29	9.67

* - Significant at 5 per cent level of probability

** - Significant at 1 per cent level of probability

Table 3. Estimation of variability parameters for yield and yield components in 140 *rabi* sorghum genotypes (120 F_6 lines derived from BxB, BxR and R x R crosses + 20 parents/checks) at Bijapur during *rabi* 2007-08

Traits	Mean	Range		GCV	PCV	h^2(%)	GA	GAM
		Min	Max					
Days to 50 per cent flowering	67	63	79	3.66	4.29	72.80	4.34	6.45
Plant height at maturity (cm)	191	128	257	13.38	15.79	72.90	45.28	23.70
Number of leaves per plant	9.95	6.70	12.30	10.04	12.59	63.60	1.64	16.48
Number of internodes per plant	9.95	6.70	12.30	10.04	12.59	63.60	1.64	16.48
Panicle length (cm)	14.25	8.10	18.40	11.64	14.38	65.50	2.76	19.37
Panicle breadth (cm)	5.96	3.90	8.30	15.41	17.42	78.20	1.67	28.02
Number of primaries per panicle	58.94	35.00	86.80	18.27	19.65	86.50	20.63	35.00
Test weight (g)	25.94	17.40	35.45	14.18	15.24	86.50	7.05	27.18
Number of grains per panicle	1246.20	567.49	2044.58	20.89	23.67	77.90	473.36	37.98
Fodder yield per plant (g)	60.48	32.60	84.50	18.03	19.37	86.60	20.90	34.56
Grain yield per plant (g)	32.01	12.80	48.60	21.86	23.43	87.00	13.44	41.99

GCV – Genotypic coefficient of variance
PCV – Phenotypic coefficient of variance
GA – Genetic advance
GAM – Genetic advance as per cent of mean
h^2 – Heritability in broad sense

Table 4. Estimation of variability parameters for yield and yield components in 140 *rabi* sorghum genotypes (120 F_6 lines derived from BxB, BxR and R x R crosses + 20 parents/checks) at Dharwad during *rabi* 2007-08

Traits	Mean	Range		GCV	PCV	h^2(%)	GA	GAM
		Min	Max					
Days to 50 per cent flowering	73	64	87	3.33	4.02	68.50	4.14	5.66
Plant height at maturity(cm)	203	132	268	13.34	15.55	73.60	47.75	23.58
Number of leaves per plant	9.88	7.18	12.50	9.70	11.88	67.00	1.61	16.30
Number of internodes per plant	9.88	7.18	12.50	9.70	11.88	67.00	1.61	16.30
Panicle length(cm)	15.90	8.30	24.10	18.38	20.45	80.80	5.41	34.03
Panicle breadth(cm)	5.87	4.10	8.70	13.86	16.79	68.20	1.38	23.51
Number of primaries per panicle	62.67	40.10	91.10	18.45	19.58	89.00	22.44	35.81
Test weight(g)	27.64	19.00	36.50	13.55	14.6	86.20	7.16	25.90
Number of grains per panicle	1380.63	681.49	2162.06	19.69	22.34	77.70	493.68	35.76
Fodder yield per plant(g)	70.63	38.50	92.90	14.71	15.97	89.94	19.72	27.92
Grain yield per plant (g)	37.74	17.85	56.00	19.45	21.50	81.80	13.68	36.25

GCV – Genotypic coefficient of variance
PCV – Phenotypic coefficient of variance
GA – Genetic advance
GAM – Genetic advance as per cent of mean
h^2 – Heritability in broad sense

Table 5. Comparison of variability parameters for yield and yield components among different groups (B x B, B x R and R x R derivatives) at Bijapur during *rabi* 2007-08

B x B Crosses (19 genotypes + 20 parents/checks)								
Traits	**Mean**	**Range**		**GCV**	**PCV**	**h^2(%)**	**GA**	**GAM**
		Min	**Max**					
Days to 50 per cent flowering	69.00	64.00	79.00	4.40	4.81	83.80	5.73	8.30
Plant height at maturity (cm)	180.00	128.00	231.00	16.79	18.77	80.10	55.65	30.92
Number of leaves per plant	9.77	7.50	11.90	12.73	13.95	83.30	2.34	23.95
Number of internodes per plant	9.77	7.50	11.90	12.73	13.95	83.30	2.34	23.95
Panicle length(cm)	14.56	8.10	18.35	14.29	15.95	80.30	3.84	26.37
Panicle breadth(cm)	5.73	3.90	7.40	14.37	15.96	81.20	1.53	26.70
Number of primaries per panicle	56.59	35.00	78.25	17.36	18.89	84.50	18.59	32.85
Test weight(g)	25.96	19.50	34.40	13.87	15.04	85.00	6.84	26.35
Number of grains per panicle	1126.00	567.49	1593.02	18.35	22.26	67.90	350.82	31.16
Fodder yield per plant(g)	55.07	32.60	73.00	16.08	17.92	80.50	16.37	29.73
Grain yield per plant(g)	29.18	12.90	40.30	23.89	25.55	87.40	13.43	46.02
B x R Crosses (69 genotypes + 20 parents/checks)								
Traits	**Mean**	**Range**		**GCV**	**PCV**	**h^2(%)**	**GA**	**GAM**
		Min	**Max**					
Days to 50 per cent flowering	68.00	59.00	79.00	3.96	4.54	76.10	4.82	7.09
Plant height at maturity (cm)	190.00	134.00	257.00	13.64	15.79	74.60	46.08	24.25
Number of leaves per plant	9.76	6.70	12.00	10.19	12.69	64.40	1.64	16.80
Number of internodes per plant	9.76	6.70	12.00	10.19	12.69	64.40	1.64	16.80
Panicle length(cm)	14.32	8.10	18.40	12.86	15.12	72.30	3.23	22.56
Panicle breadth(cm)	6.07	3.90	7.70	14.15	16.19	76.30	1.55	25.54
Number of primaries per panicle	60.24	39.75	82.40	16.81	18.12	86.10	19.37	32.15
Test weight(g)	26.89	17.40	35.45	12.76	14.04	82.60	6.43	23.91
Number of grains per panicle	1231.61	567.49	2044.55	21.59	24.02	80.70	492.11	39.96
Fodder yield per plant(g)	60.81	32.60	81.50	16.97	18.28	86.20	19.73	32.45
Grain yield per plant(g)	32.81	12.80	48.60	21.78	23.27	87.60	13.78	42.00
R x R Crosses (32 genotypes + 20 parents/checks)								
Traits	**Mean**	**Range**		**GCV**	**PCV**	**h^2(%)**	**GA**	**GAM**
		Min	**Max**					
Days to 50 per cent flowering	68.00	64.00	76.00	4.74	5.28	80.70	5.98	8.79
Plant height at maturity (cm)	191.00	136.00	241.00	13.42	15.34	76.50	46.24	24.21
Number of leaves per plant	10.06	6.70	12.10	11.99	14.33	70.10	2.08	20.68
Number of internodes per plant	10.06	6.70	12.10	11.99	14.33	70.10	2.08	20.68
Panicle length(cm)	13.82	8.10	18.35	13.54	15.95	72.10	3.27	23.66
Panicle breadth(cm)	5.79	3.90	7.40	17.51	19.37	81.70	1.89	32.64
Number of primaries per panicle	53.39	36.90	83.50	20.65	22.03	87.90	21.29	39.88
Test weight(g)	24.44	18.00	34.40	15.91	16.95	88.10	7.52	30.77
Number of grains per panicle	1179.44	567.49	2044.58	26.33	29.13	81.70	578.31	49.03
Fodder yield per plant(g)	58.38	32.60	84.50	22.67	23.47	93.30	26.33	45.10
Grain yield per plant(g)	28.44	12.80	40.75	26.75	28.41	88.70	14.76	51.90

GCV – Genotypic coefficient of variance PCV – Phenotypic coefficient of variance
GA – Genetic advance GAM – Genetic advance as per cent of mean
h^2 – Heritability in broad sense

Table 6. Comparison of variability parameters for yield and yield components among different groups (B x B, B x R and R x R derivatives) at Dharwad during *rabi* 2007-08

B x B Crosses (19 genotypes + 20 parents/checks)

Traits	Mean	Range		GCV	PCV	h^2(%)	GA	GAM
		Min	Max					
Days to 50 per cent flowering	74.00	69.00	87.00	4.52	5.18	75.96	6.01	8.12
Plant height at maturity (cm)	189.00	132.00	246.00	16.50	18.38	80.56	57.79	30.58
Number of leaves per plant	9.69	7.18	12.30	10.84	13.17	67.76	1.78	18.37
Number of internodes per plant	9.69	7.18	12.30	10.84	13.17	67.76	1.78	18.37
Panicle length(cm)	16.47	8.30	24.10	20.75	23.19	80.06	6.29	38.19
Panicle breadth(cm)	5.74	4.10	7.60	15.29	19.95	58.79	1.39	24.22
Number of primaries per panicle	59.80	41.45	83.00	16.46	17.89	84.55	18.64	31.17
Test weight(g)	28.18	20.50	37.05	14.27	15.05	89.92	7.85	27.86
Number of grains per panicle	1225.05	681.49	1664.23	20.18	22.61	79.67	454.53	37.10
Fodder yield per plant(g)	65.45	38.50	82.50	15.00	16.37	83.95	18.53	28.31
Grain yield per plant(g)	34.22	17.85	46.50	21.42	23.38	83.91	13.83	40.41

B x R Crosses (69 genotypes + 20 parents/checks)

Traits	Mean	Range		GCV	PCV	h^2(%)	GA	GAM
		Min	Max					
Days to 50 per cent flowering	73.00	66.00	87.00	3.85	4.48	74.01	5.00	6.85
Plant height at maturity (cm)	201.00	140.00	268.00	13.28	15.83	70.43	46.17	22.97
Number of leaves per plant	9.70	7.18	12.30	10.08	12.31	67.09	1.65	17.01
Number of internodes per plant	9.70	7.18	12.30	10.08	12.31	67.09	1.65	17.01
Panicle length(cm)	16.12	8.30	24.05	17.82	20.19	77.84	5.22	32.38
Panicle breadth(cm)	5.95	4.10	8.70	14.11	16.77	70.78	1.46	24.54
Number of primaries per panicle	64.42	41.45	90.00	16.98	18.15	87.49	21.08	32.72
Test weight(g)	28.46	21.50	37.05	12.42	13.49	84.85	6.71	23.58
Number of grains per panicle	1375.43	681.49	2162.06	20.49	23.06	78.94	515.83	37.50
Fodder yield per plant(g)	71.04	38.50	92.90	14.17	15.43	84.30	19.04	26.80
Grain yield per plant(g)	38.72	17.85	56.00	19.35	21.42	81.63	13.95	36.03

R x R Crosses (32 genotypes + 20 parents/checks)

Traits	Mean	Range		GCV	PCV	h^2(%)	GA	GAM
		Min	Max					
Days to 50 per cent flowering	74.00	71.00	87.00	3.84	4.23	82.48	5.32	7.19
Plant height at maturity (cm)	203.00	146.00	243.00	13.01	14.93	75.95	47.50	23.40
Number of leaves per plant	10.06	7.18	11.60	11.44	13.21	74.93	2.05	20.38
Number of internodes per plant	10.06	7.18	11.60	11.44	13.21	74.93	2.05	20.38
Panicle length(cm)	15.01	8.30	24.10	20.17	21.60	87.12	5.82	38.77
Panicle breadth(cm)	5.91	4.00	7.60	17.00	18.99	80.18	1.85	31.30
Number of primaries per panicle	57.09	41.50	91.10	20.78	21.99	89.32	23.09	40.44
Test weight(g)	26.99	19.00	37.05	16.13	17.38	86.17	8.32	30.83
Number of grains per panicle	1265.97	681.49	2109.64	25.34	27.81	83.05	602.30	47.58
Fodder yield per plant(g)	68.45	38.50	91.40	18.94	19.84	91.06	25.48	37.22
Grain yield per plant(g)	33.49	17.85	52.75	22.84	24.79	84.79	14.51	43.33

GCV – Genotypic coefficient of variance
PCV – Phenotypic coefficient of variance
GA – Genetic advance
GAM – Genetic advance as per cent of mean
h^2 – Heritability in broad sense