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Research Article

Character association and path coefficient analysis among the derived lines of B × B, B × R and R × R crosses for productivity traits in *rabi* sorghum (S*orghum bicolor* (L.) Moench)

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Abstract:
An investigation was carried out at RARS, Bijapur and MARS, Dharwad during *rabi* 2007-08, using a total of 120 F_6 generation lines derived from B × B, B × R and R × R crosses along with 20 checks (varieties, existing B and R lines and parents) in RCBD with 2 replications. The study aimed to assess the nature of association between yield and its component traits and the direct and indirect effects of yield component traits on yield. Character association studies revealed that plant height, number of leaves per plant, number of internodes per plant, panicle length, panicle breadth, number of primaries per panicle, test weight, number of grains per panicle and fodder yield per plant had positive association with grain yield per plant at both the locations (Bijapur and Dharwad). On the other hand, days to 50% flowering had negative association with grain yield per plant. The characters *viz.,* number of primaries per panicle and number of grains per panicle had the highest direct positive effect on grain yield. Hence, it would be rewarding to lay stress on these characters in selection programme for increasing yield.

Key words:
Derived lines, correlation, direct and indirect effects, sorghum

Introduction

Sorghum (*Sorghum bicolor* (L.) Moench) is an important food and feed crop in the semi-arid regions of the world where it is grown under rainfed and irrigated conditions (House, 1985). Sorghum crop exhibits considerable differences in plant traits, panicle and grain characteristics including physiological responses to selection and is highly influenced by environmental factors (Ezeaku *et al*., 1997).

The study of relationships among quantitative traits is important for assessing the feasibility of joint selection of two or more traits and hence for evaluating the effect of selection for secondary traits in genetic gain for the primary trait under consideration. A positive genetic correlation between two desirable traits makes the job of the plant breeder easy for improving both traits simultaneously. Even the lack of correlation is useful for the joint improvement of the two traits. On the other hand, a negative correlation between two desirable traits impedes or makes it impossible to achieve a significant improvement in both traits. However, simple correlations do not give an insight into the true biological relationships of these traits with yield. Yield, being quantitative in nature is a complex trait with low heritability and depends upon several other components with high heritability (Grafius, 1959). These traits are in turn interrelated. Their interdependence influences the direct relationship with yield and as a result the information obtained on their association becomes unreliable (Khairwal *et al.,* 1999).

The path coefficient analysis initially suggested by Wright (1921) and described by Dewey and Lu (1959) allows partitioning of correlation coefficient into direct and indirect contributions (effects) of various traits towards dependent variable and thus helps in assessing the cause-effect relationship as well as effective selection. Hence, this study is aimed to analyze and determine the traits having greater interrelationship with grain yield utilizing the correlation and path analysis.

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 × B, B × R and R × R crosses at RARS, Bijapur and are now in F_6 generation. Before involving these lines in heterosis breeding programme, nature of association between different traits and their direct and indirect effects on yield existing in these derived lines needs to be assessed, as this is an essential requirement of successful hybrid breeding programme.

Material and Methods

The experimental material comprised advanced generation (F_6) derived lines of B × B (19 lines), B × R (69 lines) and R × R (32 lines) crosses along with 20 parents/checks in *rabi* sorghum, planted in a randomized complete block design with two replications at both Regional Agricultural Research Station (RARS), Bijapur and Main Agriculture Research Station (MARS), Dharwad, during *rabi* season 2007-08. 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 were followed to raise a good crop. Observations were recorded on five competitive plants chosen at random in each sub-plot. Measurements were made on eleven on 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 following recommendations of ICRISAT descriptor list for sorghum (IBPGR/ICRISAT, 1993). The mean of five plants in each replication for each character was used for analysis of variance. Correlation coefficient was computed from variance and covariance components as suggested by Wright (1960 and 1968) and Narasimharao and Rachie (1964). The correlation coefficient was partitioned into direct and indirect causes according to Dewey and Lu (1959), and Wright (1960).

Results and Discussion

Correlation The correlation between all the pairs of variable at both locations are shown in the Table 1 and 2. Days to flowering had negative and non significant association with panicle length (-0.108, -0.130 & -0.119, -0.113), number of grains per panicle (-0.125, -0.145 & -0.068, -0.042), fodder yield per plant (-0.090, -0.114 & -0.038, -0.068) and grain yield per plant (-0.039, -0.014 & -0.061, -0.043) at both phenotypic and genotypic level across both locations. This indicates that it is difficult to derive early maturing and high yielding lines. These results are in accordance with the findings of Pokriyal *et al.* (1976) Potdukhe *et al.* (1992) and Patil *et al.* (1995). Plant height had positive and highly significant correlation with number of leaves per plant (0.399, 0.576 & 0.422, 0.580), number of internodes per plant (0.399, 0.576 & 0.422, 0.580) and fodder yield per plant (0.269, 0.351 & 0.279, 0.330) at both genotypic and phenotypic levels at both the locations. Its relationship with panicle length was negative and significant (-0.090, -0.186 & -0.249, -0.351) at phenotypic and genotypic level both locations. This indicates that using existing *rabi* sorghum lines it is difficult to derive dwarf with long panicle lines. This result confirmed the findings of Yang and Yang (1995) and Setimala *et al.* (1998). Association of plant height with test weight was positive and significant (0.399, 0.576 & 0.422, 0.580) at both locations. Similar results were reported by Sunku *et al.* (2002), Umakanth *et al.*(2004), Deepalakshmi and Ganesamurthy (2007).

Number of leaves had positive and highly significant correlation with number of internodes per plant (1.00, 1.00 & 1.00, 1.00) both at phenotypic and genotypic levels at both locations. However, number of leaves had positive and non significant (0.068, 0.112 & 0.029, 0.073) correlation with grain yield per plant at both phenotypic and genotypic levels. Studies made by Deepalakshmi and Ganesamurthy, (2007) show that number of leaves was positively and significantly correlated with seed yield.

The association of panicle length with panicle breadth was positive and highly significant (0.362, 0.560 & 0.423, 0.534) at both genotypic and phenotypic level at both the locations. It had positive and non significant association with grain yield per plant (0.113, 0.126 & 0.132, 0.130) at both phenotypic and genotypic levels at both locations. Studies made by Umakanth *et al.* (2004) and Deepalakshmi and Ganesamurthy, (2007) revealed that panicle length was significant and positively correlated with seed yield. At both locations panicle breadth had positive and highly significant association with test weight (0.180, 0.228 & 0.189, 0.265), and grain yield per plant (0.316, 0.373 & 0.228, 0.279) at both phenotypic and genotypic level.

At both genotypic and phenotypic level, number of primaries had positive and highly significant correlation with test weight (0.438, 0.495 & 0.416, 0.489), fodder yield per plant (0.323, 0.356 & 0.333, 0.398) and grain yield per plant (0.477, 0.541 & 0.482, 0.593) at Bijapur and Dharwad. Umakanth *et al*. (2004) and Deepalakshmi and Ganesamurthy, (2007) obtained the similar results.

Test weight had positive and highly significant correlation with fodder yield per plant (0.197, 0.238 & 0.243, 0.281) and grain yield per plant (0.408, 0.483 & 0.345, 0.399) at both phenotypic and genotypic level at both Bijapur and Dharwad. In contrast, both at phenotypic and genotypic level, test weight had negative and highly significant correlation with number of grains per panicle (-0.276, -0.214 & -0.338, -0.321) at both Bijapur and Dharwad. This indicates the difficulty in development of genotypes with bold seeds and high grain number. Nimbalkar *et al.*(1988), Taurchi and Rizai (1997), and Umakanth *et* al. (2004).

According to Liang *et al.*(1969) negative correlation between grain weight and seed number could arise primarily from developmentally induced relationships such as two developing components competing for limited nutrient and water supply. Blum (1970) also obtained negative correlation between grain weight and number of grains both in hybrids and parents. It was further shown that hybrids having the parents with highest seed weight in their percentage were the lowest in number of grains.

The association of number of grains per panicle with fodder yield per plant (0.637, 0.758 & 0.524, 0.644) and grain yield per plant (0.751, 0.743 & 0.754, 0.731) was positive and highly significant at both phenotypic and genotypic levels for both the locations. Similar results were obtained by Liang *et al.,*(1969) and Blum(1970).

Fodder yield per plant has positive and highly significant correlation with grain yield per plant (0.740, 0.840 & 0.671, 0.805) at both phenotypic and genotypic level at both locations. Studies made by Umakanth *et al*. (2004) revealed that fodder yield per plant was positively correlated significantly with seed yield.

In *rabi* sorghum both grain and fodder yields are equally important. More than 75 per cent of *rabi* sorghum area is rainfed. Hence genotypes of the early to medium maturity (105-110 days) are suitable for such situation. Though, the correlation between days to 50% flowering is negatively related with grain yield and positively related to fodder yield, we cannot select genotypes of very early maturing type as such very early maturing genotypes suffer due to terminal moisture stress. Therefore, the breeder has to make a compromise at certain point with yield components with fixed maturity and total dry matter to harvest maximum possible both grains and fodder yield of desirable quality.

Grain yield per plant was highly significant and positively correlated with plant height (0.209, 0.236 & 0.110, 0.153), number of primaries per panicle (0.477, 0.541 & 0.482, 0.593), test weight (0.408, 0.483 & 0.345, 0.399) and number of grains per panicle (0.751, 0.743 & 0.731, 0.671) at both locations. Similar results were reported for plant height by Setimala *et al.* (1998) and Desai *et al.*(1999). Umakanth *et al*. (2004) and Deepalakshmi and Ganesamurthy, (2007) observed that seed yield was significant and positively correlated with plant height, panicle length and number of primaries per panicle.

<u>Path analysis</u>: Partitioning of yield and yield components into direct and indirect effects at both location are shown in Table 3 and 4. At both locations plant height had negative direct (-0.011, -0.027 & -0.018, -0.001) effect and positive indirect (0.209, 0.236 & 0.110, 0.153) effect on grain yield at both phenotypic and genotypic levels. These results are in accordance with research findings of Pokriyal *et al.*(1976).

Panicle length had positive direct (0.009) effect on grain yield at genotypic level, while negative direct (-0.002) effect at phenotypic level at Dharwad. Similar to these results Patel *et al.,*(1980) reported positive indirect influence on grain yield and and Ivanar *et al.,* (2001) reported positive direct effect on grain yield. Panicle breadth had positive direct (0.007, 0.022) effect on grain yield at both phenotypic and genotypic level at Bijapur. While it had negative direct (-0.013, 0.028) effect on grain yield at both phenotypic and genotypic level and positive indirect (0.228, 0.279) effect on grain yield at both phenotypic and genotypic levels at Dharwad. This suggests considerable contribution of panicle breadth and its potential for improvement of grain yield.

Number of primaries per panicle had positive direct (0.035, 0.040 & 0.044, 0.048) and indirect (0.477, 0.541 & 0.482, 0.593) effect on grain yield at both phenotypic and genotypic levels at both the locations. Similar results were obtained by Thombre and Patil (1985). The positive direct and highly significant influence on grain yield was exhibited by test weight (0.637, 0.633 & 0.667, 0.697) at both the phenotypic and genotypic levels at both locations. Similar results were obtained by Berenji (1990), Potduhe *et al.*(1992) and Potdukhe *et al.* (1994). Test weight also had positive indirect (0.408, 0.483 & 0.345, 0.399) effect on grain yield. Geremew and Gebeyehu (1993) reported positive indirect influence on grain yield. At both Bijapur and Dharwad number of grains per panicle had positive direct (0.901, 0.829 & 0.979, 0.960) influence on grain yield and indirect (0.751, 0.743 & 0.754, 0.731) highly significant influence on grain yield at both phenotypic and genotypic levels. Similar results were also observed by Geremew and Gebeyehu (1993).

Fodder yield per plant had positive direct (0.028, 0.047) and indirect (0.740, 0.840) influence on grain yield per plant at both phenotypic and genotypic levels at Bijapur. While at Dharwad it had negative direct (-0.011, -0.021) and positive indirect (0.671, 0.805) influence on grain yield per plant.

The path analysis for different characters studied at both Bijapur and Dharwad among the derived lines revealed that out of 11 characters, six characters (Number of internodes, panicle breadth, number of primaries, test weight, number of grains per panicle and fodder yield per plant) had positive and direct effects on grain yield. While the characters which are strongly associated with grain yield and contributing to grain yield indirectly and positively are number of primaries per panicle, test weight, number of grains per panicle and fodder yield. Thus the path analysis results revealed that all these characters would be helpful in increasing the grain yield in sorghum through selection.

References

Berenji, J., 1990, Variability and interrelation of characters in different genotypes of broom corn [*Sorghum bicolor* (L.) Moench]. *Biltenza Hamelj Sivalai: Lekovito Bilju*, **22**: 69.

Blum, A., 1970, Nature of heterosis in grain production by the sorghum panicle. *Crop Sci.,* **10** : 28-31.

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

Desai, S.A., Singh, R., Shratria, P.K., 1999, Heterosis and correlation in sorghum x Sudan grass interspecific crosses. *J. Maharashtra Agril. Univ.,* **24**: 138-142.

Dewey DR, Lu KH (1959). A correlation and path coefficient analysis of components of crested wheatgrass seed production. *Agron. J.,* 51: 515-518.

Ezeaku IE, Gupta SC, Prabhakar VR (1997). Classification of sorghum germplasm accessions using multivariate methods. *African Crop Sci. J.,* 7: 97-108.

Geremew and Gebeyehu, 1993, Correlation and evaluation of Sorghum (S. bicolor) Germplasm from Gambella. *Addis Abada, (Ethiopia),* p.**97**.

Grafius JE (1959). Heterosis in barley. *Agron. J.*, 51: 551-554.

House LR (1985). A guide to Sorghum Breeding. 2nd edition. International Crops Research Institute for the Semi-Arid Tropics, Patancheru, India. p. 206.

IBPGR/ICRISAT (1993). *Descriptors for sorghum*. IBPGR Secretariat, FAO, Rome, Iltay: pp. 1-26.

Ivanar, K., Aapalan, A. and Ramasamy, P., 2001, Correlation and path analysis in sorghum. *Annals of Agril. Res.,* **22**: 495-497.

Khairwal IS, Rai KN, Andrew DJ, Harinarayana G (1999). *Pearl millet Breeding*. Oxford and IBH Publishing Co., New Delhi. p. 511.

Liang, G. H. L., Overlx, C. B. and Casady, A. J., 1969, Interrelations among agronomic characters in grain sorghum (*Sorghum bicolor* L. Moench). *Crop Sci.,* **9**: 299-302.

Narasimharao DV, Rachie KO (1964). Correlations and heritability of morphological characters in grain sorghum. *Madras Agril. J.* ,51:156-161.

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. J.of Maharashtra Agril. Univ., **13**: 207-208.

Patel, R. H., Desai, K. B., Raj, K. R. V. and Parikh, R. K., 1980, Estimates of heritability and genetic advance and other genetic parameters in an F_2 populations of sorghum. *Sorghum Newslr.*, **23**: 22-23.

Patil, D. V., Makne, V. G. and Patil, R. A., 1995, Character association and path coefficient analysis in sweet sorghum. *Punjabrao Krishi Vidypaeeth Res. J.,* **19**(1): 21-24.

Pokriyal, S. C., Mangath, K. S. and Patil, R. R., 1976, Agronomic traits influencing seed yield in pearl millet. *Indian J. Hered.*, **8**: 49-52.

Potdukhe, N. R., Shekar, V. B., Thote, S. G., Wanjari, S. S. and Ingle, R. W., 1994, Estimation of genetic parameters, correlation coefficients and path analysis in grain sorghum. *Crop Res.,* **7**(3): 402-406.

Potdukhe, N. R., Wanjari, S. S., Thote, S. G., Shekar, V. B. and Ingle, R. W., 1992, Path coefficient analysis for yield and its components in sorghum. *Agril. Sci. Digest (Karnal),* **12**(3): 121-123.

Setimela, P. S., Obilana, A. B. and Manthe, C. S., 1998, Evaluation of sorghum cultivar for environmental adoption in Botswana. *Applied Pl. Sci.*, **12**(2): 43-46.

Sunku, S. S. K., Reddy, M. B., and Reddy, P. R. R., 2002, Character association and path analysis in grain sorghum (*Sorghum bicolor* (L.) Moench) vis-à-vis the sudan grass. *Forage Res.*, **28** (1): 42-45.

Taurchi, M. and Rezai, A.M., 1997, Correlation between traits and path analysed for grain yield in sorghum. *Iranian J. of Agril. Sci.,* **28**: 1, 73-86. 30 ref.

Thombre, M. V. and Patil, R. C., 1985, Interrelationship between yield and some agronomic characters in a 4 × 5 (line × tester) set of sorghum. *Curr. Res. Reports (Madhya Pradesh Agril. Univ.)*, **1**: 68-73.

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.

Wright S (1921). Systems of mating. *Genet.*, 6: 111-178

Wright S (1960). Path coefficient and path regression: alternative or complementary concepts? *Biometrics,* **16**: 189-202.

Wright S (1968). *Evolution and the genetics of populations 1*. Genetics and Biometrics Foundations. The University of Chicago.

Yang, W. and Yang, W.G., 1995, Studies on the genetic correlation of important traits of sweet sorghum. *J. Tilin-Agril. Univ.,* **17**: 29-31.

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Table 1. Estimates of Phenotypic (P) and Genotypic (G) correlation coefficients for yield and yield components in 140 *rabi* sorghum genotypes (120 F_6 lines derived from B × B, B × R and R × R crosses + 20 parents/checks) at Bijapur during *rabi* 2007-08.

Traits		Plant height at maturity (cm)	Number of leaves per plant	Number of internodes per plant	Panicle length (cm)	Panicle breadth (cm)	Number of primaries per plant	Test weight (g)	Number of grains per plant	Fodder yield per plant (g)	Grain yield per plant (g)
Days to 50 per cent flowering	P	-0.135	-0.004	-0.004	-0.108	-0.084	0.034	0.140	-0.125	-0.090	-0.039
	G	-0.106	0.038	0.038	-0.130	-0.115	0.055	0.200*	-0.145	-0.114	-0.014
Plant height at maturity (cm)	P		0.399**	0.399**	-0.090	0.034	0.053	0.125	0.138	0.269**	0.209*
	G		0.576**	0.576**	-0.186*	0.068	0.094	0.162	0.151	0.351**	0.236**
Number of leaves per plant	P			1.000**	-0.109	-0.076	0.011	0.051	0.027	0.140	0.068
	G			1.000**	-0.213*	-0.096	0.021	0.063	0.077	0.171	0.112
Number of internodes per plant	P				-0.109	-0.076	0.011	0.051	0.027	0.140	0.068
	G				-0.213*	-0.096	0.021	0.063	0.077	0.171	0.112
Panicle length(cm)	P					0.362**	0.176	0.128	0.019	-0.053	0.113
	G					0.560**	0.258**	0.149	0.021	-0.023	0.126
Panicle breadth(cm)	P						0.165	0.180*	0.201*	0.178	0.316**
	G						0.189*	0.228**	0.237**	0.199*	0.373**
Number of primaries per panicle	P							0.438**	0.170	0.323**	0.477**
	G							0.495**	0.209*	0.356**	0.541**
Test weight(g)	P								-0.276**	0.197*	0.408**
	G								-0.214**	0.238**	0.483**
Number of grains per panicle	P									0.637**	0.751**
	G									0.758**	0.743**
Fodder yield per plant(g)	P										0.740**
	G										0.840**

Table 2. Estimates of Phenotypic (P) and Genotypic (G) correlation coefficients for yield and yield components in 140 *rabi* sorghum genotypes (120 F_6 lines derived from B × B, B × R and R × R crosses + 20 parents/checks) at Dharwad during *rabi* 2007-08.

Traits		Plant height at maturity (cm)	Number of leaves per plant	Number of internodes per plant	Panicle length (cm)	Panicle breadth (cm)	Number of primaries per plant	Test weight (g)	Number of grains per plant	Fodder yield per plant (g)	Grain yield per plant (g)
Days to 50 per cent flowering	P	-0.093	-0.045	-0.045	-0.119	0.095	-0.121	0.031	-0.068	-0.038	-0.061
	G	-0.092	-0.101	-0.101	-0.113	0.072	-0.153	0.020	-0.042	-0.068	-0.043
Plant height at maturity (cm)	P		0.422**	0.422**	-0.249**	0.055	0.098	0.160	0.020	0.279**	0.110
	G		0.580**	0.580**	-0.351**	0.058	0.087	0.172	0.050	0.330**	0.153
Number of leaves per plant	P			1.000**	-0.239**	-0.042	-0.027	0.020	0.028	0.146	0.029
	G			1.000**	-0.297**	-0.046	0.003	0.048	0.060	0.207*	0.073
Number of internodes per plant	P				-0.239**	-0.042	-0.027	0.020	0.028	0.146	0.029
	G				-0.297**	-0.046	0.003	0.048	0.060	0.207*	0.073
Panicle length(cm)	P					0.423**	0.131	0.072	0.080	-0.039	0.132
	G					0.534**	0.158	0.105	0.053	-0.015	0.130
Panicle breadth(cm)	P						0.061	0.189*	0.119	0.169	0.228**
	G						0.068	0.265**	0.124	0.187*	0.279**
Number of primaries per panicle	P							0.416**	0.169	0.333**	0.482**
	G							0.489**	0.221**	0.398**	0.593**
Test weight(g)	P								-0.338**	0.243**	0.345**
	G								-0.321**	0.281**	0.399**
Number of grains per panicle	P									0.524**	0.754**
	G									0.644**	0.731**
Fodder yield per plant(g)	P										0.671**
	G										0.805**

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Table 3. Phenotypic (P) and Genotypic (G) path analysis for yield and yield components in 140 *rabi* sorghum genotypes (120 F_6 lines derived from B × B, B × R and R × R crosses + 20 parents/checks) at Bijapur during *rabi* 2007-08.

Traits		Days to 50 percent Flowering	Plant height at maturity (cm)	Number of leaves per plant	Number of internodes per plant	Panicle length (cm)	Panicle breadth (cm)	Number of primaries per plant	Test weight (g)	Number of grains per plant	Fodder yield per plant (g)	Grain yield per plant (g)
Days to 50 per cent flowering	P	**-0.014**	0.001	0.000	0.000	-0.001	-0.001	0.001	0.089	-0.113	-0.003	-0.039
	G	**-0.020**	0.003	0.000	0.001	0.001	-0.003	0.002	0.127	-0.120	-0.005	-0.014
Plant height at maturity (cm)	P	0.002	**-0.011**	0.000	0.005	-0.001	0.000	0.002	0.080	0.124	0.008	0.209*
	G	0.002	**-0.027**	0.000	0.009	0.002	0.002	0.004	0.103	0.125	0.016	0.236**
Number of leaves per plant	P	0.000	-0.004	**0.000**	0.012	-0.001	-0.001	0.000	0.032	0.025	0.004	0.068
	G	-0.001	-0.015	**0.000**	0.015	0.002	-0.002	0.001	0.040	0.064	0.008	0.112
Number of internodes per plant	P	0.000	-0.004	0.000	**0.012**	-0.001	-0.001	0.000	0.032	0.025	0.004	0.068
	G	-0.001	-0.015	0.000	**0.015**	0.002	-0.002	0.001	0.040	0.064	0.008	0.112
Panicle length(cm)	P	0.002	0.001	0.000	-0.001	**0.006**	0.003	0.006	0.081	0.017	-0.002	0.113
	G	0.003	0.005	0.000	-0.003	**-0.011**	0.012	0.010	0.094	0.017	-0.001	0.126
Panicle breadth(cm)	P	0.001	0.000	0.000	-0.001	0.002	**0.007**	0.006	0.115	0.181	0.005	0.316**
	G	0.002	-0.002	0.000	-0.001	-0.006	**0.022**	0.008	0.144	0.197	0.009	0.373**
Number of primaries per panicle	P	0.000	-0.001	0.000	0.000	0.001	0.001	**0.035**	0.279	0.153	0.009	0.477**
	G	-0.001	-0.003	0.000	0.000	-0.003	0.004	**0.040**	0.313	0.173	0.017	0.541**
Test weight(g)	P	-0.002	-0.001	0.000	0.001	0.001	0.001	0.015	**0.637**	-0.249	0.006	0.408**
	G	-0.004	-0.004	0.000	0.001	-0.002	0.005	0.020	**0.633**	-0.177	0.011	0.483**
Number of grains per panicle	P	0.002	-0.001	0.000	0.000	0.000	0.001	0.006	-0.176	**0.901**	0.018	0.751**
	G	0.003	-0.004	0.000	0.001	0.000	0.005	0.008	-0.135	**0.829**	0.036	0.743**
Fodder yield per plant(g)	P	0.001	-0.003	0.000	0.002	0.000	0.001	0.011	0.126	0.574	**0.028**	0.740**
	G	0.002	-0.009	0.000	0.003	0.000	0.004	0.014	0.151	0.628	**0.047**	0.840**

* - Significant at 5 per cent level of probability   Diagonal values indicate direct effects on grain yield   Residual value at   Phenotypic level=0.0231
** - Significant at 1 per cent level of probability   Genotypic level =0.0149

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Table 4. Phenotypic (P) and Genotypic (G) path analysis for yield and yield components in 140 *rabi* sorghum genotypes (120 F_6 lines derived from B × B, B × R and R × R crosses + 20 parents/checks) at Dharwad during *rabi* 2007-08.

Traits		Days to 50 percent Flowering	Plant height at maturity (cm)	Number of leaves per plant	Number of internodes per plant	Panicle length (cm)	Panicle breadth (cm)	Number of primaries per plant	Test weight (g)	Number of grains per plant	Fodder yield per plant (g)	Grain yield per plant (g)
Days to 50 per cent flowering	P	**-0.011**	0.002	0.000	0.000	0.000	-0.001	-0.005	0.021	-0.067	0.000	-0.061
	G	**-0.009**	0.000	0.000	0.001	-0.001	-0.002	-0.007	0.014	-0.041	0.001	-0.043
Plant height at maturity (cm)	P	0.001	**-0.018**	0.000	-0.001	0.000	-0.001	0.004	0.107	0.020	-0.003	0.110
	G	0.001	**-0.001**	0.000	-0.007	-0.003	-0.002	0.004	0.120	0.048	-0.007	0.153
Number of leaves per plant	P	0.000	-0.008	**0.000**	-0.003	0.000	0.001	-0.001	0.013	0.028	-0.002	0.029
	G	0.001	-0.001	**0.000**	-0.012	-0.003	0.001	0.000	0.034	0.057	-0.004	0.073
Number of internodes per plant	P	0.000	-0.008	0.000	**-0.003**	0.000	0.001	-0.001	0.013	0.028	-0.002	0.029
	G	0.001	-0.001	0.000	**-0.012**	-0.003	0.001	0.000	0.034	0.057	-0.004	0.073
Panicle length(cm)	P	0.001	0.004	0.000	0.001	**-0.002**	-0.005	0.006	0.048	0.079	0.000	0.132
	G	0.001	0.000	0.000	0.004	**0.009**	-0.015	0.008	0.073	0.050	0.000	0.130
Panicle breadth(cm)	P	-0.001	-0.001	0.000	0.000	-0.001	**-0.013**	0.003	0.126	0.117	-0.002	0.228**
	G	-0.001	0.000	0.000	0.001	0.005	**-0.028**	0.003	0.184	0.119	-0.004	0.279**
Number of primaries per panicle	P	0.001	-0.002	0.000	0.000	0.000	-0.001	**0.044**	0.277	0.166	-0.004	0.482**
	G	0.001	0.000	0.000	0.000	0.001	-0.002	**0.048**	0.341	0.213	-0.008	0.593**
Test weight(g)	P	0.000	-0.003	0.000	0.000	0.000	-0.002	0.018	**0.667**	-0.331	-0.003	0.345**
	G	0.000	0.000	0.000	-0.001	0.001	-0.007	0.023	**0.697**	-0.308	-0.006	0.399**
Number of grains per panicle	P	0.001	0.000	0.000	0.000	0.000	-0.001	0.007	-0.226	**0.979**	-0.006	0.754**
	G	0.000	0.000	0.000	-0.001	0.000	-0.004	0.011	-0.223	**0.960**	-0.014	0.731**
Fodder yield per plant(g)	P	0.000	-0.005	0.000	0.000	0.000	-0.002	0.015	0.162	0.513	**-0.011**	0.671**
	G	0.001	0.000	0.000	-0.003	0.000	-0.005	0.019	0.196	0.619	**-0.021**	0.805**

* - Significant at 5 per cent level of probability
** - Significant at 1 per cent level of probability

Diagonal values indicate direct effects on grain yield

Residual value at Phenotypic level=0.0223
Genotypic level =0.0168