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CORRELATION COEFFICIENTS AND PATH ANALYSIS FOR GRAIN YIELD AND YIELD CONTRIBUTING TRAITS IN BROWN MIDRIB SORGHUM [*SORGHUM BICOLOR* (L.) MOENCH]

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ABSTRACT

The current investigation was carried out during 2022-23 at Sorghum Research Station, VNMKV, Parbhani. The experiment was laid out in Randomized Block Design with two replications using twenty eight genotypes. The analysis of trait relationships is critical for determining the efficiency of combined selection for two or more attributes. Further, path coefficient analysis allows for more efficient selection by splitting the correlation coefficient into direct and indirect contributions from various variables to the dependent variable. The results of the correlation analysis revealed that there was an inherent relationship between the several traits under study indicating that genotypic correlation often being stronger than phenotypic correlation. The characters *viz.* plant height, number of leaves, number of primaries per panicle, panicle width, stem girth, 100-seed weight revealed significant and positive correlation with grain yield per plant. Among the 11 characteristics studied as causative variables, a path co-efficient analysis revealed that the traits, number of primaries/panicle, number of leaves, width of panicle, and fodder yield per plant all had a direct and positive effect upon grain yield per plant as responsive variable. Therefore, direct selection for the above mentioned positively correlated traits will indirectly bring in improvement in grain yield.

***Keywords* :** Correlation, Path co-efficient, Brown Midrib Sorghum, Grain yield.

Introduction

Sorghum is an important food and fodder crop, majorly cultivated in the wide areas of Africa and Asia. This crop is capable of growing under drought conditions and low soil fertility. As sorghum is a major C_4 crop, it has high potential for biomass production. It is a key staple food for the poorest and most food insecure populations in the semi-arid tropics across the globe. It is grown in 35.35 lakh hectares, with production and productivity of 38.14 lakh tonnes and 989.33 Kg per hectare respectively (Ministry of Agriculture & Farmers Welfare, Govt. of India). Sorghum is the nutritional standout among *kharif* fodders and because of its fast growth, high biomass output, resistance to drought, and efficient nutrient uptake, sorghum is regarded as a model biomass feedstock (Mathur *et al.*, 2017).

Brown midrib mutants had a lower amount of enzyme-resistant lignin and improved palatability and digestibility (Rook *et al.*, 1977; Cherney *et al.*, 1991). "Brown midrib" is the gene responsible for significant decrease in amorphous hydrophobic polymer and a component of plant cell wall with phenolic content and composition. Brown midrib (Bmr) mutations have been discovered naturally, but they may also be generated artificially.

As a matter of fact, the crop improvement programme needs the knowledge of genetic diversity, the nature of the relationship between yield and its component characters and how attributes impact one another to express the features of interest. Appropriate parent selection is critical in crossing nurseries to improve genetic recombination and possible yield growth. The correlation coefficient measures the link between the traits and indicates the extent to which particular crop characteristics are connected with productivity. If distinct yield-related features have been thoroughly established, selection based on yield components is desirable (Pohelman *et al.,* 1995). Path analysis is a powerful statistical tool for quantifying the interdependence of many components and their direct and indirect impacts on feed output. Characters may be rated using this yield contributing approach, and particular qualities causing a certain association can be identified (Rao *et al*., 2006).

Materials and Methods

The experimental study comprised of 28 brown midrib sorghum genotypes in total including the three checks (Parbhani Moti, CSV 22R and CSV 43 BMR). The experimental laid out in the randomized block design with two replications at Sorghum Research Station, VNMKV Parbhani during *rabi* 2022-23. The experimental plot of each genotype consisted of 4 rows of 4 meter length spaced apart at 45 cm. Suitable cultural practices which are required to raise the crop were followed along with the application of recommended dosage of fertilizers.

Morphological Traits Recorded

The data was recorded on 5 randomly selected plants of each genotype for each replication, on the following traits; plant height (cm), number of primaries/ panicle, days to 50% flowering, panicle length (cm), panicle width (cm), leaf area (cm^2), stem girth (cm), number of leaves, leaf : stem ratio, fodder yield per plant (g), 100-seed weight (g), grain yield per plant (g). The basic correlation coefficient was computed using the formulas proposed by Johnson *et al.* (1955). Using path coefficient analysis, which was first proposed by Wright (1921) and further described by Dewey and Lu (1959), the genotypic correlation coefficients between yield and its components were further divided into direct and indirect effects.

Results and Discussion

Correlation

A statistical constant called the correlation coefficient shows how closely related several traits are to one another. The genotypic correlation was comparatively larger than the phenotypic correlation, demonstrating that many qualities are inherently associated. Table 1 (a,b). Grain yield is a complex trait that is affected by a large number of constituent components. As a result, research into the relation between character and grain yield becomes more crucial in crop improvement programmes. It is critical to determine the relative contribution of each component character to yield in order to provide weight during selection.

The characters plant height (G = 0.56, P = 0.52), number of leaves (G = 0.55, P = 0.51), panicle width (G 0.45, P = 0.34) and 100 seed weight (G = 0.41, P = 0.28), demonstrated a significant and positive correlation with the grain yield per plant. Verma and Biradar (2021), found a positive and significant correlation of plant height with grain yield per plant. Chaudhary and Arora (2001), Rohila *et al.* (2020) reported a significant and positive correlation of this trait with grain yield. Comparable results were shown by Vendruscolo *et al.* (2016) for positive correlation of panicle width character with grain yield. Significant and positive correlation of 100 seed weight was observed by Patil *et al.* (2014), Verma and Biradar (2021) for grain yield per plant. Similarly, comparable results for significant and positive correlation of grain yield per plant were shown by Prasad and Sridhar (2019) for plant height, Verma and Biradar (2021) for stem girth and Arunkumar (2013) for panicle length and panicle width.

Table 1(a) : Genotypic matrix of correlation coefficient for yield and its associated characteristics.

Sl No.	Characters > Genotypes	Days to 50% flowering	Plant height (cm)	Number of primaries /panicle	Number of leaves	Panicle length (cm)	Panicle width (cm)	Leaf area (cm^2)	Stem girth (cm)	Leaf : Stem ratio	100-seed weight (g)	Fodder yield per plant (g)	Grain yield per plant (g)
		1	2	3	4	5	6	7	8	9	10	11	12
1	Days to 50% flowering	1	-0.48**	0.30	-0.42*	0.60**	0.07	-0.39*	-0.20	0.17	-0.13	0.03	-0.26
2	Plant height (cm)		1	0.46 *	0.73 **	-0.12	0.43 *	0.35	0.41 *	-0.38 *	0.20	0.21	0.56 **
3	Number of primaries/ panicle			1	0.36	0.07	0.39 *	0.25	0.17	0.14	0.10	0.23	0.57 **
4	Number of leaves				1	-0.03	0.51 **	0.56 **	0.34	-0.03	0.34	0.05	0.55 **
5	Panicle length (cm)					1	0.50 **	-0.01	-0.34	0.58 *	0.07	0.16	0.02
6	Panicle width (cm)						1	0.53 **	0.29	0.38 *	0.63 **	0.09	0.45 *
7	Leaf area (cm^2)							1	0.29	0.14	0.12	0.20	0.36
8	Stem girth (cm)								1	-0.60 **	0.28	0.69 **	0.57 **
9	Leaf : Stem ratio									1	0.17	-0.19	-0.13
10	100-seed weight (g)										1	0.09	0.41 *
11	Fodder yield per plant (g)											1	0.29
12	Grain yield per plant (g)												1

Table 1(b) : Phenotypic matrix of correlation coefficient for yield and its associated characteristics.

Sl No.	Characters > / Genotypes	Days to 50% flowering	Plant height (cm)	Number of primaries/ panicle	Number of leaves	Panicle length (cm)	Panicle width (cm)	Leaf area (cm^2)	Stem girth (cm)	Leaf : Stem ratio	100-seed weight (g)	Fodder yield per plant (g)	Grain yield per plant (g)
		1	2	3	4	5	6	7	8	9	10	11	12
1	Days to 50% flowering	1	-0.24	0.17	-0.22	0.26	0.00	-0.23	-0.23	0.33 *	-0.03	0.01	-0.11
2	Plant height (cm)		1	0.45 **	0.70 **	-0.11	0.32 *	0.26 *	0.30 *	-0.35 **	0.30 *	0.20	0.52 **
3	Number of primaries/ panicle			1	0.34 **	0.03	0.28 *	0.16	0.08	0.12	0.06	0.20	0.54 **
4	Number of leaves				1	0.01	0.34 **	0.41 **	0.25	-0.02	0.33 *	0.08	0.51 **
5	Panicle length (cm)					1	0.35 **	0.00	-0.15	0.47 **	0.11	0.18	-0.03
6	Panicle width (cm)						1	0.45 **	0.17	0.25	0.26 *	0.07	0.34 **
7	Leaf area (cm^2)							1	0.33 *	0.09	0.21	0.17	0.25
8	Stem girth (cm)								1	-0.32 *	0.23	0.50 **	0.34 *
9	Leaf : Stem ratio									1	0.11	-0.13	-0.13
10	100-seed weight (g)										1	0.06	0.28 *
11	Fodder yield per plant (g)											1	0.23
12	Grain yield per plant (g)												1

Table 2(a): Genotypic matrix of path coefficient for yield and its associated characteristics.

Sl No.	Characters	Days to 50% flowering	Plant height (cm)	Number of primaries /panicle	Number of leaves	Panicle length (cm)	Panicle width (cm)	Leaf area (cm^2)	Stem girth (cm)	Leaf : Stem ratio	100-seed weight (g)	Fodder yield per plant (g)	Grain yield per plant (g)
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	Days to 50% flowering	**-0.90**	1.06	0.15	-0.66	-1.10	0.25	0.76	0.23	-0.34	0.20	0.063	**-0.26**
2	Plant height (cm)	0.44	**-2.18**	0.23	1.16	0.23	1.57	-0.68	-0.47	0.18	-0.30	0.38	**0.56****
3	No. of primaries / panicle	-0.28	-1.02	**0.50**	0.57	-0.12	1.41	-0.49	-0.19	-0.06	-0.15	0.42	**0.57****
4	Number of leaves	0.38	-1.61	0.18	**1.57**	0.0	1.86	-1.10	-0.39	0.01	-0.51	0.09	**0.55****
5	Panicle length (cm)	-0.54	0.27	0.03	-0.05	**-1.82**	1.81	0.02	0.39	-0.28	-0.11	0.28	**0.02**
6	Panicle width (cm)	-0.06	-0.95	0.19	0.81	-0.91	**3.60**	-1.04	-0.20	-1.85	-0.96	0.16	**0.45****
7	Leaf area (cm^2)	0.35	-0.76	0.12	0.89	0.02	1.92	**-1.95**	-0.33	-0.06	-0.18	0.36	**0.36****
8	Stem girth (cm)	0.18	-0.90	0.08	0.54	0.63	0.64	-0.57	**-1.14**	0.29	-0.42	1.23	**0.57****
9	Leaf : Stem ratio	-0.63	0.84	0.07	-0.05	-1.05	1.38	-0.28	0.68	**-0.48**	-0.27	-0.33	**-0.13**
10	100-seed weight (g)	0.12	-0.44	0.05	0.54	-0.13	2.28	-0.24	-0.32	-0.08	**-1.51**	0.16	**0.41****
11	Fodder yield per plant (g)	-0.03	-0.47	0.11	0.08	-0.29	0.33	-0.39	-0.79	0.09	-0.13	**1.78**	**0.29**
12	Grain yield per plant (g)	-0.26	0.56	0.57	0.55	0.02	0.45	0.36	0.57	-0.13	0.41	0.29	1.00

Table 2(b) : Phenotypic matrix of path coefficient for yield and its associated characteristics.

Sl No.	Characters	Days to 50% flowering	Plant height (cm)	Number of primaries /panicle	Number of leaves	Panicle length (cm)	Panicle width (cm)	Leaf area (cm^2)	Stem girth (cm)	Leaf : Stem ratio	100-seed weight (g)	Fodder yield per plant (g)	Grain yield per plant (g)
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	Days to 50% flowering	**-0.10**	-0.03	0.06	-0.03	-0.03	0.00	0.02	-0.04	0.05	-0.00	0.00	**-0.11**
2	Plant height (cm)	0.02	**0.15**	0.16	0.12	0.01	0.03	-0.02	0.05	-0.05	0.01	0.01	**0.52****
3	Number of primaries/ panicle	-0.01	0.07	**0.36**	0.05	-0.00	0.03	-0.01	0.01	0.02	0.00	0.01	**0.54****
4	Number of leaves	0.02	0.10	0.12	**0.17**	-0.00	0.03	-0.04	0.04	-0.00	0.03	0.00	**0.51****
5	Panicle length (cm)	-0.02	-0.01	0.01	0.00	**-0.12**	0.03	-0.00	-0.02	0.07	0.01	0.01	**-0.03**
6	Panicle width (cm)	-0.00	0.04	0.10	0.05	-0.04	**0.11**	-0.04	0.03	0.04	0.03	0.00	**0.34****
7	Leaf area (cm^2)	0.02	0.04	0.06	0.07	-0.00	0.05	**-0.10**	0.05	0.01	0.02	0.01	**0.25**
8	Stem girth (cm)	0.02	0.04	0.03	0.04	0.01	0.01	-0.03	**0.17**	-0.04	0.02	0.04	**0.34**
9	Leaf : Stem ratio	-0.03	-0.05	0.04	-0.00	-0.05	0.02	-0.00	-0.05	**0.00**	0.01	-0.01	**-0.13**
10	100-seed weight (g)	0.00	0.02	0.02	0.05	-0.01	0.03	-0.02	0.04	0.02	**0.11**	0.00	**0.28**
11	Fodder yield per plant (g)	-0.00	0.03	0.07	0.01	-0.02	0.00	-0.01	0.08	-0.02	0.00	**0.07**	**0.23**
12	Grain yield per plant (g)	-0.11	0.52	0.54	0.51	-0.03	0.34	0.25	0.34	-0.13	0.28	0.23	**1.00**

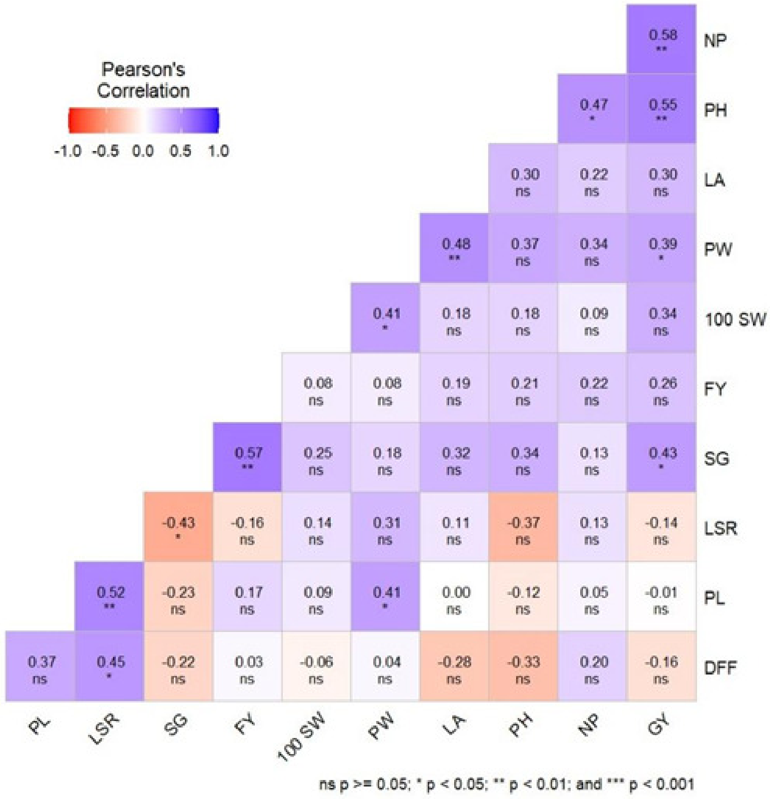

Fig. 1 : Correlation coefficient matrix for yield and its associated characteristics.

Path Analysis

Path analysis is important because, the correlation study only offers information about the extent of correlation of yield with its components but does not provide information about the contribution of each direct and indirect influence of independent variable on yield. The residual effect assesses how well the causal variables account for the variability of the dependent factor (grain yield). If the residual factor value is large or moderate, it indicates that yield is influenced by additional characteristics in addition to the character under analysis.

The traits viz. No. of primaries / panicle, No. of leaves, panicle width and fodder yield per plant had positive and direct effect on grain yield per plant Table 2 (a,b). Days to 50% flowering has shown direct and high negative effect on grain yield at genotypic level (-0.90) and direct and low negative effect (-0.1) at phenotypic level. Deshmukh *et al.* (2018), Khadakabhavi *et al*. (2017) repored the similar results. Leaf : stem ratio has shown direct and high negative effect on grain yield at genotypic level (-0.48). Goswami *et al.* (2020), Arvinth *et al.* (2021) reported the similar results. Stem girth has shown direct and very high negative effect on grain yield at genotypic level (-1.14). 100-seed weight has shown high negative and direct effect on grain yield at genotypic level (-1.51). Iyanar and Khan (2005), Arvinth *et al.* (2021) reported similar results. Grain yield has demonstrated a strong positive and direct relationship with the number of primaries per panicle at both the genotypic (0.50) and phenotypic (0.36) levels. Deshmukh *et al.* (2021) reported similar results.Grain yield has been directly and significantly affected by the number of leaves at genotypic level (1.57) and low positive and direct effect at phenotypic level (0.17). comparative conclusion were drawn by Patil *et al.* (2014), Deshmukh *et al.* (2018), Arvinth *et al.* (2021). At the genotypic level (1.78), the amount of fodder produced per plant has a very strong positive and direct impact on grain yield . Iyanar and Khan (2005), Patil *et al.,* (2014), Shinde *et al.* (2011), Deshmukh *et al.* (2021), Chavhan *et al.* (2022) reported similar results.

Conclusion

In this present study, correlation and path analysis for yield and yield contributing traits was carried out in the 28 genotypes of Brown Midrib Sorghum. The characters *viz.* plant height, number of leaves, number of primaries per panicle, panicle width, stem girth, 100-seed weight, had significant and positive correlation with grain yield per plant. Therefore, direct selection based on phenotypic performance of these characters in the breeding programme will be helpful for bringing improvement in grain yield. The traits viz.

Number of primaries / panicle, panicle width, fodder yield per plant and number of leaves, had direct and positive influence on grain yield per plant, suggesting that these characters contribute for the grain yield hence can be used as a selection criteria for improving the grain yield in the breeding programme.

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