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CHARACTERS ASSOCIATION AND PATH ANALYSIS IN SORGHUM (SORGHUM BICOLOR (L.) MOENCH) F_1S AND THEIR PARENTS

S.K. JAIN* AND P.R. PATEL

Sorghum Research Station, S. D. Agricultural University, Deesa-385 535, Banaskanta, Gujarat, India.
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ABSTRACT

The genetic variability and nature of character association was studied in 9 parental lines and their thirty-six f1s of dual sorghum (sorghum bicolor (l) moench) in randomized block design during kharif 2012. High heritability coupled with high genetic advance and gcv were noticed for seed yield/plant and dry fodder yield/plant. Whereas, high heritability combined with low genetic advance was recorded for leaf length and days to 50% flowering. the seed yield /plant showed positive and significant correlation with plant height, number of leaves/plant, 100-seed weight and dry fodder yield/plant. While the dry fodder yield/ plant showed positive and significant correlation with days to maturity, plant height, number of leaves/plant, leaf length, leaf width, 100-seed weight and seed yield/plant. The characters, 100-seed weight, plant height, number of leaves/plant and leaf width had exerted positive and high direct effects on seed yield/plant and dry fodder yield/plant. Hence, due consideration should be given to these characters while planning a breeding strategy for dual sorghum.

Keywords: Sorghum, heritability, variability, correlation, path analysis

INTRODUCTION

Sorghum [*Sorghum bicolor* (L.) Moench] is an often self-pollinating, diploid (2n = 2x = 20) crop with a genome, about 25% the size of maize or sugarcane. It is a C4 plant with higher photosynthetic efficiency and higher abiotic stress tolerance (Nagy *et al*., 1995 and Reddy *et al*., 2009). Sorghum is fifth most important cereal crop globally and is the dietary staple of more than 500 million people in 30 countries. It is grown on 40 m ha in 105 countries of Africa, Asia, Oceania and the Americas. Africa and India account for the largest share (> 70%) of global sorghum area while USA, India, Mexico, Nigeria, Sudan and Ethiopia are the major sorghum producers (Ashok Kumar *et al*. 2011). It is the third most important grain crop in India, next only to rice and wheat. Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh, Rajasthan and Gujarat are the major sorghum growing states of India. Besides being an important food, feed and forage crop, sorghum also provides raw material for the production of starch, fiber, dextrose syrup, biofuels, alcohol, and other products. Improvement in sorghum yield depends on the nature and extent of genetic variability, heritability and genetic advance in the base population (Mahajan *et al.,* 2011). The study of relationship among quantitative traits is essential to assess the feasibility of joint selection for two or more traits. A positive genetic correlation between two desirable traits makes it easy to improve both the characters under consideration simultaneously (Khairwal *et al.,* 1999). In the present study such analysis has been carried out in 9 parents and their thirty-six hybrids developed in half diallel fashion.

MATERIALS AND METHODS

The nine genetically diverse lines of sorghum [*Sorghum bicolor* (L.) Moench] viz., SPV 2113 , SPV 2125 , SPV 1616, SPV 2118, SPV 2110, GFS 5, GJ 39, CSV 15 and SSV 84 were crossed in diallel mating design excluding reciprocals to produce 36 experimental hybrids during *kharif* 2011. The thirty six F_1s, nine parents including a popular local check GJ-39 were grown at the Sorghum Research Station, Sardarkrushinagar Dantiwada Agricultural University, Deesa (Gujarat) during *kharif* 2012. Deesa is situated at latitude of 24.5° N and longitude 72° E and at an elevation of 136 M above the Mean Sea Level. The soil of the field was sandy to deep sandy loam (49.8 % coarse and, 34.0 % fine sand, 9.7 % silt and 6.3 % clay) in texture with pH value of 8.0 having 3.0 g kg^{-1} organic matter and EC 0.26 dSm^{-1}. There was 362 mm rainfall during the growing season and average minimum and maximum temperature was 19.26 and 33.54° C, respectively while average minimum and maximum humidity was 48.44 and 76.25 *%* respectively. The experimental was laid out in randomized block design with three replication in a single-row plot of 6.75 m long, spaced at 0.45 m apart. NPK 120:40:00 fertilizers was applied as half basal dose of nitrogen and full dose of phosphorus at the time of sowing and half nitrogen applied after one month of sowing. Plots were thinned down after two weeks of crop emergence and plant-to-plant distance of 0.15 m was maintained. The all other

recommended agronomical practices were followed to raise a good crop. The biometrical observations were recorded on grain yield/plant (g), dry fodder yield/plant (g), plant height (cm), number of leaves/plant, leaf length (cm), leaf width (cm) and 100- seed weight (g) on five randomly selected competitive plants of each genotype and each replication. The observation for days to 50% flowering and days to maturity (%) were recorded on the plot basis. Statistical analysis was done according to the standard statistical procedures (Burton, 1952; Johnson *et al*., 1955; Al-Jibouri *et al*., 1958 and Dewey and Lu, 1959).

RESULTS AND DISCUSSION

The significant mean square values obtained from the analysis of variance suggests that differences existed between the sorghum entries for all most all the characters, indicating that they are highly variable. The genetic constants for the characters revealed that the magnitude of phenotypic coefficient of variation (PCV) was higher than the corresponding genotypic coefficient of variation (GCV) for all the traits denoting environmental factors influencing their expression to some degree or other (Table1). Wide differences between PCV and GCV implied their susceptibility to environmental fluctuation, whereas narrow differences between PCV and GCV suggested their relative resistance to environmental alterations. On the basis of mean, the GCV and PCV observed to be high for seed yield/ plant (47.61, 47.86), followed by fodder yield/plant (40.62, 40.69). The least values for GCV and PCV were recorded by days to maturity (2.74, 30.8). A high GCV and PCV value for grain yield/plant and dry fodder yield/plant was also reported by Jain *et al*., (2009) and Chavan *et al*., (2010). However, low GCV and PCV for days to maturity were also reported by Mallinath *et al.* (2004).

Table 1: Analysis of variance and variability parameters for yield and yield traits in sorghum F_1s and their parents

Source of variation	DF	Days to 50 % flowering	Days to maturity	Plant height	No of leaves/plant	Leaf length	Leaf width	100- seed weight	Seed yield /plant	Fodder yield/plant
Replication	2	0.20	3.80	89.10	1.20	24.42**	1.00	0.01	2.00	17.00
Treatment	44	20.82**	30.19**	1782**	5.23**	233.67**	4.96**	0.15**	806.74**	17120.99**
Error	88	0.50	2.40	69.40	0.30	2.90	0.30	0.00	2.80	19.80
Heritability (%)		93.67	79.38	89.16	83.22	96.34	83.66	92.98	98.97	99.65
GCV		3.73	2.74	11.96	10.69	11.45	16.46	7.06	47.61	40.62
PCV		3.85	3.08	12.66	11.72	11.66	18	7.32	47.86	40.69
Genetic advance		5.19	5.58	46.47	2.40	17.73	2.34	0.43	33.54	155.26
GA % means		7.44	5.04	23.26	20.10	23.15	31.02	14.02	97.58	83.53

**, ** indicates significant at 5 % and 1 % level, respectively*

The effectiveness of selection for any character depends not only on the extent of genetic variability but also in the extent to which it will be transferred from one generation to next. High heritability was observed for fodder yield/plant (99.65%), seed yield/plant (98.97%), leaf length (96.34%) and days to 50% flowering (93.67). Moderate heritability estimates were obtained for plant height (89.16%), leaf width (83.66%) and number of leaves/plant (83.22%). Similar results were obtained by Sharma *et al.* (2006) and Chavan *et al*. (2010).The high and moderate degree of heritability estimates for these traits suggested that they are under genotypic control. High genetic advance of per cent mean was observed for seed yield/plant (97.58%), fodder yield/plant (83.53%), leaf width (31.02%) and plant height (23.26). High heritability coupled with high genetic advance and GCV were noticed for seed yield/plant and dry fodder yield/plant. Whereas, high heritability combined with low genetic advance was recorded by leaf length and days to 50% flowering. Occurrence of high heritability with high genetic advance may be inferred that the genotypic variance for these traits were primary due to additive genetic effect and selection based on phenotypic performance could be worth in achieving desired results. Similar results were obtained by Jain *et al*. (2009 and 2011).

Table 2: Phenotypic (p) and genotypic (g) correlations matrix for yield and yield traits in sorghum F_1s and their parents

Characters		Days to 50 % flowering	Days to maturity	Plant height	No of leaves	Leaf length	Leaf width	100- seed weight	Seed yield/ plant
Days to maturity	P	0.201*							
	G	0.237**							
Plant height	P	-0.286**	0.073						
	G	-0.323**	0.098						
No of leaves	P	0.104	0.277**	0.344**					
	G	0.119	0.350**	0.384**					
Leaf length	P	0.074	-0.023	0.199*	0.028				
	G	0.084	-0.036	0.218*	0.027				
Leaf width	P	-0.053	0.090	0.234**	0.093	0.625**			
	G	-0.070	0.118	0.259**	0.118	0.689**			
100- seed weight	P	0.254**	0.045	0.220**	0.207*	0.115	-0.036		
	G	0.280**	0.040	0.246**	0.231**	0.126	-0.030		
Seed yield/ plant	P	-0.022	-0.054	0.386**	0.276**	-0.043	-0.044	0.586**	
	G	-0.027	-0.066	0.410**	0.303**	-0.046	-0.046	0.614**	
Fodder yield/ plant	P	-0.018	0.224**	0.406**	0.313**	0.372**	0.402**	0.314**	0.264**
	G	-0.019	0.252**	0.431**	0.342**	0.380**	0.439**	0.325**	0.266**

**, ** indicates significant at 5 % and 1 % level, respectively*

The phenotype of plant is the result of interaction of a large number of factors. Therefore, final yield is the sum total of several component characters. The phenotypic and genotypic correlation coefficients are worked out among different characters (Table 3) revealed that genotypic correlations coefficients were higher than phenotypic correlations. High genotypic correlation suggested that there was inherent relationship between characters under study. In general the signs and magnitude of correlation at both phenotypic and genotypic level is similar. Grain yield/plant was significant positively correlated with plant height, number of leaves/plant, 100-seed weight and dry fodder yield/plant. Positive association of grain yield with 100-seed weight, plant height, number of leaves/plant and dry fodder yield/plant at both the levels already have been reported by several workers (Mahajan, *et al*. 2011 and Jain *et al*., 2011). The dry fodder yield/plant showed positive and significant correlation with days to maturity, plant height, number of leaves/plant, leaf length, leaf width, 100-seed weight and seed yield/plant. Inter character correlations at genotypic and phenotypic levels also showed positive and significant correlation in most of the characters.

Table 3: Path coefficient analysis for seed yield in sorghum F_1s and their parents

Characters	Days to 50 % flowering	Days to maturity	Plant height	No of leaves/plant	Leaf length	Leaf width	100- seed weight	Dry fodder yield/ plant
Days to 50 % flowering	**-0.063**	-0.026	-0.065	0.012	-0.013	-0.0003	0.136	-0.001
Days to maturity	-0.012	**-0.131**	0.016	0.032	0.004	0.0005	0.024	0.013
Plant height	0.018	-0.009	**0.230**	0.040	-0.035	0.0014	0.117	0.023
No of leaves/plant	-0.006	-0.036	0.079	**0.115**	-0.005	0.0005	0.111	0.018
Leaf length	-0.004	0.0029	0.045	0.003	**-0.176**	0.0037	0.061	0.022
Leaf width	0.003	-0.012	0.053	0.011	-0.110	**0.0060**	-0.020	0.023
100- Seed weight	-0.016	-0.005	0.050	0.024	-0.020	-0.0002	**0.535**	0.018
Dry fodder yield/ plant	0.0012	-0.029	0.093	0.036	-0.065	0.0024	0.168	**0.058**

Residual effect: 0.512

Correlation co-efficient indicates only the general associations between any two traits without tracing any possible causes of such associations. In such situations, the path coefficient analysis at phenotypic level (Table 3) is done to partition the correlation coefficients in to direct and indirect effects. Seed yield and dry fodder yield/plant were taken as dependent variable while computing the path coefficient. The path coefficient analysis revealed that the characters like 100-seed weight, plant height, number of leaves/plant and leaf width which had positive significant association with seed yield/plant and exerted positive and high direct effects on seed yield/plant (Table 3). While Leaf width, 100-seed weight, leaf length, plant height and number of leaves/plant exerted positive and high direct effects on dry fodder yield/plant (Table 4). This confirms the role of these traits in determining the grain yield and fodder yield and therefore, their values in constructing the selection criterion. Similar results were reported by Mallinath *et al.* (2004) and Jain, *et al*. (2009).

Table 4: Path coefficient analysis for fodder yield in sorghum F_1s and their parents

Characters	Days to 50 % flowering	Days to maturity	Plant height	No of leaves/plant	Leaf length	Leaf width	100- seed weight	Seed yield/plant
Days to 50 % flowering	**-0.0702**	0.034	-0.048	0.013	0.013	-0.012	0.053	-0.002
Days to maturity	-0.014	**0.167**	0.012	0.035	-0.004	0.021	0.009	-0.004
Plant height	0.020	0.012	**0.168**	0.044	0.035	0.054	0.046	0.025
No of leaves/plant	-0.007	0.046	0.058	**0.128**	0.005	0.021	0.043	0.018
Leaf length	-0.005	-0.004	0.033	0.004	**0.178**	0.144	0.024	-0.003
Leaf width	0.004	0.015	0.039	0.012	0.111	**0.231**	-0.007	-0.003
100- seed weight	-0.018	0.007	0.037	0.026	0.020	-0.008	**0.210**	0.039
Seed yield/ plant	0.002	-0.009	0.065	0.035	-0.007	-0.010	0.123	**0.066**

Residual effect: 0.611

Thus it is revealed from the present study that the traits like days to 50% flowering, days to maturity, plant height, number of leaves per plant, leaf length, leaf width and 100-seed weight had greater importance. Hence, due consideration should be given to these characters while planning a breeding strategy for increased grain yield/ plant and dry fodder yield/plant.

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