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Research Article

STUDIES ON VARIABILITY, CORRELATION AND PATH COEFFICIENT ANALYSIS IN SORGHUM [*Sorghum Bicolor* L. Moench]

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Abstract: Genetic variability, heritability, genetic advance, correlation and path analysis were studied in 25 sorghum genotypes. Significant genetic variability was observed among the genotypes studied. Highest PCV and GCV values were observed for dry fodder yield per plant, primary branch per panicle and tannin. In the present investigation, high heritability accompanied with high genetic advance as percent mean was observed for days to 50% flowering, primary branches per panicle, 100 seed weight, dry fodder yield per plant, grain yield per plant and tannin, suggesting the influence of additive genes and provides scope for selection. Correlation studies indicated that grain yield per plant was found to be significantly and positively associated with panicle length and protein suggesting that selection for plant with long panicle will result in higher grain yield. Path analysis indicated highest positive direct effects on grain yield per plant for days to maturity, dry fodder yield per plant, tannin, panicle length and 100 seed weight.

Keywords: Sorghum, variability, heritability, Correlation, Path analysis

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Introduction

Sorghum [*Sorghum bicolor* L. Moench] is one of the major cereal crops of the semi-arid tropics. It is the fifth most important cereal grain after wheat, rice, maize and barley at world level both in area and production. Major producers of sorghum in the world are USA, India, Nigeria, China, Mexico, Sudan and Argentina. Success of any crop improvement program depends upon the genetic variability present in the material. A large amount of variation is necessary in a breeding population to enable the breeder to carry out effective breeding program. The present study provides information of the genetic parameters such as variance, coefficients of variation, heritability, genetic advance and the influence of environment on the expression of these characters to evolve suitable cultivars. The trait grain yield, being an important and complex character, is a function of several component characters. In the integrated structure of a plant, most of the characters are interrelated. The direct selection based on yield alone is not very effective and it has been pointed out that it would be more meaningful if the structure of yield is probed through its components rather than direct approach [1]. Hence, it is necessary to study these yield components, their inter-relationships with yield and their contribution. The phenotype of a plant is the result of interaction of a several component factors. Correlation coefficient helps in determining the direction of selection and number of characters to be considered in improving the grain yield to exploit correlated response. Path coefficient analysis was performed to deduce direct and indirect contributors of yield components and developmental traits to grain yield.

Material and Methods

The experimental material consisting of 25 sorghum genotypes were grown in a Randomized Block Design with three replications during the kharif, 2017 at College Farm, N. M. College of Agriculture, NAU, Navsari. The plant to plant distance was 15 cm and row to row distance was 45 cm. The data were recorded from five randomly selected plants for each genotype in all the replications for eight characters, *viz*., primary branches per panicle, plant height, panicle length, 100 seed weight, grain yield per plant, dry fodder yield per plant, protein and tannin, while days to 50 % flowering and days to maturity were observed on population basis. Various genetic parameters *viz*., phenotypic coefficient of variation [2] (PCV), genotypic coefficient of variation [3] (GCV), heritability [4] (h^2) and genetic advance as percent of mean (GAM) were calculated. Path coefficient analysis was done using genotypic correlation coefficients by the method of Dewey and Lu (1959) [5].

Table-1 List of 25 sorghum genotypes used in the experiment

SN	Name of Genotypes	SN	Name of Genotypes
1	GJ-36	14	GJ-38
2	GJ-41	15	SR-2812
3	NIZER GOTI	16	SR-2949
4	GJ-35	17	SR-2972
5	SR-2970	18	SR-2960
6	SR-2973	19	GJ-39
7	SR-2914	20	SR-2975
8	SR-2957	21	ICSR-13008
9	GJ-40	22	BP-53
10	SR-2987	23	RS-627
11	SURAT LOCAL	24	SR-2872
12	GJ-42	25	GNJ-1
13	SR-2958		

Results and Discussion

The analysis of variance revealed significant differences for yield and yield components indicating the presence of high genetic variability [Table-2]. Wide variability has also been reported by various workers [6-8]. The phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) for all the characters studied [Table-3]. Higher PCV and GCV values were observed for dry fodder yield per plant, primary branch per panicle and tannin, whereas, low GCV and PCV values were recorded for days to maturity and protein.

Table-2 Analysis of variance for grain yield and yield contributing traits in 25 genotypes of sorghum

Source of variation	D.F.	Days to 50 % flowering	Primary branches per panicle	Days to maturity	Plant height (cm)	Panicle length (cm)	100 seed weight (g)	Dry fodder yield per plant (g)	Protein (%)	Tannin content (ppm)	Grain yield per plant (g)
Replication	2	34.68	61.06	21.28	81.16	10.53	0.03	69.75	0.12	4.51	0.2
Genotypes	24	224.48**	602.02**	212.30**	1616.43**	25.56**	0.38**	3396.43**	0.57*	261.81**	39.67**
Error	48	18.84	28.38	31.89	322.21	8.26	0.02	157.07	0.27	10.55	5.9
S.Em$\pm$		2.51	3.08	3.22	10.36	1.66	0.08	7.23	0.31	1.87	1.4
C.D at 5 %		7.13	8.75	9.17	29.47	4.72	0.23	20.57	0.87	5.33	3.99
C.D at 1 %		9.5	11.66	12.23	39.31	6.29	0.3	27.44	1.15	7.11	5.32
C.V %		5.94	9.23	4.96	9.61	14.15	5.77	13.45	6.58	11.61	10.33

*, ** shows significance at 0.05 and 0.01 levels of probability, respectively.

Table-3 Phenotypic range, general mean, variance components, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (h2bs) and Genetic advance as % of mean for 25 genotypes of sorghum

SN	Characters	Range	Mean	Variance components			GCV (%)	PCV (%)	Heritability (%)	GA as % ($\bar{x}$)
				σ^2g	σ^2p	σ^2e				
1	Days to 50% flowering	60.33 – 92.66	73.08	68.54	87.39	18.84	11.32	12.79	78.4	20.68
2	Primary branches per panicle	41.00 – 94.26	57.74	191.21	219.59	28.38	23.94	25.66	87.1	46.03
3	Days to maturity	102.00 – 143.33	112.57	60.49	91.69	31.2	6.9	8.5	66.01	11.56
4	Plant height (cm)	137.46 – 234.40	186.62	431.4	753.61	322.2	11.13	14.71	57.2	17.34
5	Panicle length (cm)	15.60 – 25.13	20.31	5.76	14.03	8.28	11.82	18.44	41.1	15.6
6	100 seed weight (g)	1.80 – 3.00	2.39	0.12	0.14	0.019	14.55	15.65	86.4	27.87
7	Dry fodder yield per plant (g)	56.85 – 161.90	93.14	1079.78	1236.86	157.07	35.27	37.75	87.3	67.9
8	Protein (%)	6.84 – 8.74	8.04	0.097	0.37	0.28	3.87	7.63	25.7	4.04
9	Tannin content (ppm)	15.93 – 47.90	27.97	83.75	94.3	10.55	32.71	34.71	88.8	63.51
10	Grain yield per plant (g)	18.65- 31.58	23.53	11.25	17.15	5.9	14.25	17.6	65.6	23.78

Table-4 Genotypic correlations of grain yield per plant with other characters in 25 genotypes of sorghum

Characters	Days to 50 % flowering	Primary branches per panicle	Days to maturity	Plant height (cm)	Panicle length (cm)	100 seed weight (g)	Dry fodder yield per plant (g)	Protein (%)	Tannin content (ppm)	Grain yield per plant (g)
Days to 50 % flowering	1									
Primary branches per panicle	0.221	1								
Days to maturity	0.716**	0.673**	1							
Plant height (cm)	0.17	0.654**	0.335**	1						
Panicle length (cm)	-0.645**	-0.031	-0.319**	-0.299**	1					
100 seed weight (g)	0.068	0.449**	0.006	0.665**	-0.328**	1				
Dry fodder yield per plant (g)	0.335**	0.735**	0.512**	0.546**	0.183	0.363**	1			
Protein (%)	0.117	-0.542**	-0.082	-0.342**	0.15	-0.361**	-0.07	1		
Tannin content (ppm)	0.167	-0.181	-0.221	0.113	-0.336**	0.039	-0.201	0.184	1	
Grain yield per plant (g)	-0.186	-0.105	-0.152	-0.083	0.502**	-0.234*	0.176	0.500**	0.113	1

*, ** shows significance at 0.05 and 0.01 levels of probability, respectively.

Table-5 Direct and indirect effects of nine causal variables on grain yield per plant in 25 genotypes of sorghum

Characters	Days to 50 % flowering	Primary branches per panicle	Days to maturity	Plant height (cm)	Panicle length (cm)	100 seed weight (g)	Dry fodder yield per plant (g)	Protein (%)	Tannin content (ppm)
Days to 50 % flowering	-0.9847	-0.2176	-0.7054	-0.1679	0.636	-0.0674	-0.3308	-0.1158	-0.1653
Primary branches per panicle	-0.3399	-1.5381	-1.0365	-1.0071	0.0476	-0.6908	-1.1318	0.8344	0.2789
Days to maturity	1.0452	0.9831	1.4589	0.4891	-0.4667	0.009	0.7481	-0.1199	-0.3229
Plant height (cm)	-0.0099	-0.0381	-0.0195	-0.0582	0.0174	-0.0388	-0.0318	0.02	-0.0066
Panicle length (cm)	-0.2998	-0.0144	-0.1485	-0.1389	0.4641	-0.1525	0.0854	0.0696	-0.1563
100 seed weight (g)	0.0222	0.1458	0.002	0.2161	-0.1067	0.3247	0.1179	-0.1174	0.0128
Dry fodder yield per plant (g)	0.284	0.622	0.4334	0.4616	0.1555	0.3069	0.8452	-0.0596	-0.1704
Protein (%)	-0.0158	0.0728	0.011	0.046	-0.0201	0.0458	0.0095	-0.1342	-0.0248
Tannin content (ppm)	0.1122	-0.1212	-0.148	0.0759	-0.2251	0.0263	-0.1348	0.1236	0.6685
Grain yield per plant (g) correlation coefficient	-0.1864	-0.1057	-0.1525	-0.0833	0.5021**	-0.2340*	0.1769	0.5007**	0.1138

*, ** shows significance at 0.05 and 0.01 levels of probability, Residual effect = 0.7457

Similar observations were reported by many workers for number of primary branches [9-11] and dry fodder yield per plant [6,10-15]. In the present study, heritability (broad sense) for all the characters was low to high ranging from 25.70 to 88.80 percent. The values for genetic advance as percentage of mean were low for protein (4.04) whereas, it was high for dry fodder yield per plant (67.90) followed by tannin (63.51), primary branches per panicle (46.03), 100 seed weight (27.87), grain yield per plant (23.78) and days to 50% flowering (20.68). High genetic advance associated with high heritability estimates were observed for days to 50% flowering, primary branches per panicle, 100 seed weight, dry fodder yield per plant, grain yield per plant and tannin, suggesting that variability in these characters is due to additive genetic effects and these traits may respond more favourably to selection. On the contrary, Arunkumar *et al.* (2004)[16], Mallinath *et al.* (2004)[9] and Warkad et al. (2008)[12] reported high heritability associated with high genetic advance for dry fodder yield per plant, grain yield per plant, number of primary branches per panicle, 100 seed weightand days to 50% flowering. Correlation coefficients help in determining the direction of selection and number of traits to be considered in improving the grain yield. The positive and significant association between grain yield per plant and panicle length indicate that selection for plant with long panicle will result in higher grain yield. Similar results were reported by Ravi *et al.* (2003)[17], Arunkumar (2013)[13] and Nyadanu and Dikera

(2014) [11]. Grain yield per plant exhibited positive and significant correlation with protein. Analogous result was observed by Ravi et al. (2003)[17] and Sowmy *et al.* (2015)[18]. In the present study, the highest positive direct effects on seed yield per plant were observed for days to maturity, dry fodder yield per plant, tannin, panicle length and 100 seed weight. Similar results were reported by many workers for dry fodder yield per plant [19-22] and for panicle length and 100 seed weight [13,19,20,23]. In such stipulation, direct selection is profitable.

Application of research: The present study it is revealed that direct selection of such traits will be rewarding to increase grain yield.

Research Category: Genetics and Plant Breeding

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