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Research Article

Components of genetic variance and degree of dominance for grain and fodder yields in sorghum (*Sorghum bicolor* L. Moench)

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Abstract
Genetic analysis for grain and fodder yield in sorghum genotypes using six generation means indicated the major role of additive genetic effects (d) for days to maturity and grain yield in both the crosses viz., EP 82 x CRS 1 and CSV 14R x SPV 1375. The cross EP 82 x CRS 1 indicated additive variance for plant height and grain yield while the cross CSV 14 R x SPV 1375 for days to maturity, plant height, panicle length, test weight and grain yield. Among the epistatic components of genetic variance, the fixable additive x additive component (i) was significant for almost all the traits except, days to 50% flowering in the cross EP 82 x CRS 1 and fodder yield in the cross CSV 14 R x SPV 1375. The characters exhibiting significant and positive additive genetic effects invariably were accompanied by additive x additive (i) interaction effects for plant height in the cross EP 82 x CRS1. However, the presence of positive and significant additive x additive interactions along with additive genetic effects for test weight in the cross EP 82 x CRS1 indicate the predominance of interaction component rather than their direct influence. Additive as well as additive x additive interaction effects with duplicate epistasis were observed in the cross EP 82 x CRS1 for plant height. Grain yield exhibited significant dominance variance in the cross CSV 14R x SPV 1375. Fodder yield exhibited significant dominance and dominance x dominance interactions in the cross CSV 14R x SPV 1375
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Keywords: sorghum, grain and fodder yields, generation mean analysis

Introduction

Sorghum is the third most important cereal crop cultivated extensively in India after wheat and rice with an area of 7.6m.ha and a productivity potential of 7.9 m.t. The crop is preferred by farmers due to its good grain as well as its fodder quality. However, the crop suffered with low productivity because of its cultivation in residual moisture situations. To improve the yield potential substantially, a sound planning of breeding programme and knowledge of inheritance is essential. Even though significant amount of work has been done on development of sorghum genotypes, studies on the genetic architecture conditioning the inheritance of different yield components are meager. For such information, the estimation of various genetic effects from the generation means is quite useful in understanding the inheritance of a character and hence the present study was undertaken to estimate gene action for different yield components in sorghum.

Material and methods

Six generations namely, P1, P2, F1, F2, BC1 and BC2 of two cross combinations of sorghum namely, EP 82 x CRS 1 and CSV 14R x SPV 1375 were raised in a randomised block design with three replications . Ten plants were selected randomly from each of P1, P2, F1, 30 each of BC1 and BC 2 and 50 of F2 generations and utilized for recording of data on seven quantitative characters namely, days to 50% flowering, days to maturity, plant height, panicle length, test weight, grain yield and fodder yield. The data recorded were subjected to weighted analysis of Cavalli (1952) to know the adequacy of additive dominance model. In the presence of epistasis, the data where any of the 4, 5 or 6 parameters found adequate in the model of Jinks and Jones (1968) was subjected accordingly to sequential model in order to obtain more precise estimate for these parameters. The adequacy of these models was tested by X^2 test, respectively.

Results and discussion

The hybrids performed better than their respective parents for all the traits in both the cross combinations except for the plant height, panicle length and test weight in the cross EP 82 x CRS 1. However, the trait mean values for F1 generation were higher than the corresponding values of BC1 and BC2 generations except for plant height and test weight in BC2 generation in the cross EP 82 x CRS1. The values for the F2 generation were lower than F1 generation in both the crosses except for plant height. The mean performance (Table 1) for the BC2 generation was lower than that of the BC1 generation for the days to 50% flowering, days to maturity in both the crosses, plant height, test weight in the cross EP 82 x CRS1, grain yield and fodder yield in the cross CSV 14R x SPV 1375. The expected mean was positive and significant for all the traits in both the cross combinations.

The results pertaining to scaling test and components of variance for all the seven characters are given in the Table 2. The scaling tests A, B, C and D were significant for the characters plant height and grain yield in both the crosses indicating that additive dominance model is inadequate to explain the observed variation. Further, significance of any one of the scaling tests for a character indicates the role of gene interactions on its inheritance, which may be due to additive x additive (i), additive x dominance (j) and dominance x dominance (l) effects. Therefore further analysis was extended to know the different interactions prevailed in the inheritance of these characters in both the crosses.

It has been observed that considerable magnitude of variance due to additive genetic effects (d) prevailed for days to maturity and grain yield in both the crosses. The traits such as days to 50% flowering, plant height, panicle length, test weight and fodder yield lacked this exploitable variance in the cross EP 82 and CRS 1. However, the cross EP 82 x CRS 1 indicated additive variance for plant height and grain yield while the cross CSV 14R x SPV 1375 for days to maturity, plant height, panicle length, test weight and grain yield. The role of additive gene action in the inheritance of these traits has also been reported by Kachave and Nandanwankar (1980).

Among the epistatic components of genetic variance, the fixable additive x additive component (i)was significant for almost all the traits except days to 50% flowering in the cross EP 872 x CRS 1 and fodder yield in the cross CRS 14R x SPV 1375. The trait panicle length and fodder yield in the cross EP 82 x CRS 1 showed additive interactions which assumes importance for breeding for fodder yield as well as grain yield. Prevalence of additive x additive epistasis for these traits is in conformity with the earlier results reported by Audilakshmi and Aruna (2005). Therefore the selection in early segregating generations of a cross for the improvement of these traits could be advantageous.

The detailed analysis of gene actions revealed that the characters exhibiting significant and positive additive genetic effects invariably were accompanied by additive x additive (i) interaction effects in respect of plant height in the cross EP 82 x CRS 1. However positive and significant additive x additive interactions along with additive genetic effects in respect of test weight in the cross EP 82 x CRS1 indicated the predominance of interaction components rather than their direct influence. Additive as well as additive x additive interaction effects with duplicate epistasis was observed in the cross EP 82 x CRS 1 only for plant height. In this case, rapid improvement by selection programme can be expected to get stabilized in the early segregating generation itself.

The variance due to dominance genetic effects has also been found to be of greater importance in view of their magnitude and significance over additive genetic effects for the traits plant height, panicle length, test weight and fodder yield in the cross EP 82 x CRS 1. The character grain yield exhibited significant dominance variance only in the cross CSV 14R x SPV 1375. However, the predominant role of dominant gene action in the inheritance of pod yield has also been reported by Narain Ved *et, al. (*2007). The opposite signs for dominance x dominance components (l) have been observed for all the traits studied indicating duplicate type of epitasis.

As grain yield and many of yield traits are being influenced mainly by the dominance gene effects which is usual phenomenon in a cross pollinated crop, like sorghum, its genetic improvement using only through pedigree method of breeding may not be effective in isolating superior genotypes. Under the circumstance, the crop demands adoption of alternative breeding strategies to exploit non-additive genetic variance possibly by heterosis breeding. In order to exploit non additive genes conditioning trait; Liang and Walter, 1968 suggested delaying selection until the genotypes are stabilized in homogenous dominance state, so that superior dominant allelic combinations can be selected.

It is evident from the present investigation that there is complexity in the nature of inheritance of different characters since some of the yield traits namely panicle length, test weight and fodder yield in one of the crosses are influenced by additive and non- additive gene actions. Rao *et al.*, (1994) also reported prevalence of similar type of gene actions. Use of reciprocal recurrent selection has been suggested to improve the characters when both additive and non additive gene effects are involved in the expression of traits (Comstock *et al.*, 1949). Presence of dominance gene action for seed yield and test weight indicates that conventional selection procedure may not be effective enough for improvement for yield. Therefore, changes in conventional methodologies in mass selection, bulk method and pedigree method are required for achieving targeted production to satisfy the demand.

References

Audilakshmi, S. and Aruna, C. 2005. Genetic analysis of physical grain quality characters in sorghum. *J. Agril. Sci.*, **143**: 267-273.

Cavalli, L.L. 1952. An analysis of linkage in quantitative inheritance. Ed Reive E CR and Waddington, C.H. pp: 135-144, HMSO, London.

Comstock, R.E. Robinson, H.F. and Harvey, P.H. 1949. A breeding procedure designed to make maximum use of both general and specific combining ability. *Agron. J.*, **41**: 360-367.

Jinks, J.L. and Jones, M. 1958. Estimation of components of heterosis. *Genetics,* **43**: 223-234.

Kachave, K.S. and Nandanwankar, K.G. 1980. Estimates of gene effects for grain yield in sorghum. *Sorghum Newsl.*, 23: 15-16.

Liang, G.H.L. and Walter, T.L. 1968. Heritability estimates and gene effects for agronomic traits in grain sorghum, *Sorghum vulgare* Pers. *Crop Sci.*, **8**(1): 77-81.

Narain Ved., Singh, P.K., Kumar Nand and Singh, V.S. 2007. Gene effects for grain yield and related traits in sorghum (*Sorghum bicolor* L. Moench). *Indian J. Genet.*, **67** (1):128-132.

Rao, M.R., Gururaja, Patil, S. J., and Giriraj, J. 1994. Generation mean analysis of grain yield and some panicle characters in two exotic x Indian rabi sorghum crosses. *Indian J. Genet.*, **54** (2): 249-252.

Table1. Mean values for component traits in six generations of two crosses in sorghum

Character	Generation	EP 82 x CRS 1	CSV 14 R x SPV 1375
Days to 50% flowering	P1	60.00 ± 0.21	73.38± 0.33
	P2	75.00 ± 0.57	70.33 ± 0.33
	F1	78.36 ± 0.90	75.00± 0.21
	F2	69.65 ± 0.98	71.61 ± 0.33
	BC1	63.82 ± 0.33	71.69 ± 0.12
	BC2	75.00 ± 0.57	69.00 ± 0.21
Days to maturity	P1	118.22 ± 0.21	126.34 ± 0.54
	P2	128.49 ± 0.43	130.62 ± 0.66
	F1	132.67 ± 1.24	132.00 ± 0.65
	F2	128.00 ± 0.57	126.82 ± 0.33
	BC1	118.83 ± 0.33	122.00 ± 0.43
	BC2	127.97 ± 0.45	127.48 ± 0.33
Plant height (cm)	P1	215.69 ± 1.11	209.00 ± 0.78
	P2	206.23± 2.15	193.62 ± 0.98
	F1	179.34 ± 11.41	210.44 ± 0.66
	F2	194.31 ± 1.03	202.26 ± 0.76
	BC1	203.68 ± 1.20	198.19 ± 0.43
	BC2	205.24 ± 1.41	193.42 ± 0.76
Panicle length (cm)	P1	18.32 ± 0.33	17.62 ± 0.33
	P2	15.04 ± 0.65	16.09 ± 0.43
	F1	15.30 ± 0.67	19.45± 0.33
	F2	13.64 ± 0.33	17.08 ± 0.21
	BC1	16.38 ± 0.33	16.36 ± 0.21
	BC2	15.32 ± 0.70	14.69 ± 0.33
Test weight (g)	P1	31.56 ± 0.26	38.44 ± 0.20
	P2	39.92 ± 0.27	36.62 ± 0.42
	F1	39.24 ± 0.42	41.90 ± 0.32
	F2	33.60 ± 0.22	38.52 ± 0.15
	BC1	35.13 ± 0.81	36.36 ± 0.19
	BC2	40.76 ± 0.30	34.43 ± 0.59
Grain yield (kg/ha)	P1	1783 ± 32.26	2461.93 ± 40.08
	P2	1499.24 ± 69.32	1963.62 ± 19.86
	F1	1953.69 ± 18.44	2555.38 ± 39.62
	F2	1675.62 ± 20.41	2058.46 ± 37.73
	BC1	1700.57 ± 30.24	1848.12 ± 18.98
	BC2	1509.08± 40.52	1875 ± 28.26
Fodder yield (t/ha)	P1	7.44 ± 0.21	7.23 ± 0.16
	P2	7.13 ± 0.19	6.76 ± 0.16
	F1	7.16 ± 0.08	7.98 ± 0.04
	F2	5.63 ± 0.14	7.24 ± 0.16
	BC1	6.56 ± 0.18	6.62 ± 0.17
	BC2	6.28 ± 0.19	6.70 ± 0.09

Table 2. Scaling test, components of variance and interaction effects for seven traits in two crosses of sorghum

Cross	Scaling test				Interaction effects					
	A	B	C	D	m	d	h	i	j	l
Days to 50% flowering										
EP 82 x CRS 1	-12.00**	-3.68**	-13.46**	1.00	69.50**	-7.49**	-8.52**	-2.09	-8.38**	17.68**
CSV 14 R x SPV 1375	-5.88**	-7.68**	-7.09**	2.69	77.18**	1.50	-19.83**	-5.63**	2.38	17.52**
Days to maturity										
EP 82 x CRS 1	-14.00**	-5.32**	0.68	10.04**	13.40**	-5.08**	-49.68**	-20.00**	-8.64**	39.34**
CSV 14 R x SPV 1375	-14.89**	-7.32**	-15.64**	3.62**	134.54**	-2.18	-30.16**	-6.80**	-7.04**	27.60**
Plant height (cm)										
EP 82 x CRS 1	12.36**	24.68**	-3.60**	-20.43**	170.52**	4.51**	86.53**	40.68**	-12.32**	-77.68**
CSV 14 R x SPV 1375	-23.67**	-17.66**	-14.67**	13.33**	228.00**	7.67**	-85.33**	-26.67**	-6.00**	68.00**
Panicle length (cm)										
EP 82 x CRS 1	-1.09	0.36	-9.38**	-4.36**	8.09**	1.46	15.34**	8.68**	-1.37	-8.04**
CSV 14 R x SPV 1375	-5.08**	-6.04**	-4.32**	3.34**	23.52**	0.84	-21.86**	-6.69**	1.04	17.68**
Test weight (g)										
EP 82 x CRS 1	-0.54	2.32	-15.68**	-8.72**	18.34**	-4.22**	40.03**	17.40**	-2.86	-19.13**
CSV 14 R x SPV 1375	-7.76**	-9.63**	-4.80**	6.26**	50.03**	0.90	-38.08**	-12.53**	1.94	29.84**
Grain yield (kg/ha)										
EP 82 x CRS 1	-336.14**	-435.34**	-488.12**	141.6**	1925.1**	142.07**	-1026.1**	-283.36**	99.29**	1054.6**
CSV 14 R x SPV 1375	-1320.1**	-768.43**	-1303.2**	392.6**	2997.5**	249.16**	-3315.8**	-785.32**	-551.5**	2873.6**
Fodder yield (t/ha)										
EP 82 x CRS 1	-1.46	-1.78	-6.36**	-1.58	4.15**	0.15	2.91	3.13**	0.30	0.10
CSV 14 R x SPV 1375	-1.93	-1.43	-1.00	1.13	9.26**	0.23	-6.83**	-2.26	-0.60	5.53**