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Genetic Analysis of Yield Characters in Grain Sorghum*

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ABSTRACT

Estimates of additive, dominance and epistatic gene effects for eight quantitative characters, viz., days to flowering, plant height, panicle weight, panicle length, panicle breadth, length of primary branch, grain yield per plant and grain weight have been obtained in grain sorghum. The material studied included the parental lines and the F_1, F_2, B_1 and B_2 derivatives of the crosses SPV 981-1 x GJ 35 and ICSR 89022-3 x GJ 35. The results revealed that most of the characters are under the control of additive and non-additive genetic components, the later being more important. Preponderence of dominance (h) effect was observed for grain yield, grain weight, panicle weight, plant height and flowering. The type of gene action appeared to favour the crosses for exploitation of hybrid vigour.

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INTRODUCTION

Studies on nature of gene action governing complex quantitative characters are of great value to the breeder in selecting appropriate procedure for the improvement of yield contributing characters. Information on the presence of type of epistatic gene effects in the inheritance of various quantitative characters is important for adopting suitable breeding procedures to improve the characters. In the present study, an attempt has been made to know the nature and magnitude of additive, dominance and epistatic gene effects for eight quantitative characters under varying environments.

MATERIALS AND METHODS

Genotypes SPV 981-1, ICSR 89022-3 and GJ 35 were crossed by hand emasculation and pollination in 1991. The F_1, F_2, B_1, B_2 and parental generations were grown at the College Farm, College of Agriculture, Junagadh during summer (S) and kharif (K) season of 1992 with three replications. P_1, P_2 and F_1 were grown in single-row plots, B_1 and B_2 were sown in two-row plots and F_2 in four-row plots. Row length was 5.0 m with a spacing of 45 x 15 cm. Observations on 5 plants in parents and F_1, 10 plants in B_1 and B_2 and 20 plants in F_2 randomly selected per replication were recorded for days to flowering, plant height (cm), panicle weight (g), panicle length (cm), panicle breadth (cm), length of primary branch (cm), grain yield per plant (g) and grain weight (g) in summer (S) and kharif (K) seasons.

The gene effects were estimated by 6 paremeter (Hayman 1958) and 3 parameter

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models (Jinks and Jones, 1958) following the weighted least square technique of Cavalli (1952).

RESULTS AND DISCUSSION

The analysis of variance revealed significant generation differences in cross SPV 981-1 x GJ-35 for dyas to flowering, grain yield per plant and grain weight under both the seasons, whereas for plant height, panicle weight, panicle length, panicle breadth and length of primary branch significant differences were observed only in kharif season. In cross ICSR 89022-3 x GJ 35 significant differences were observed for all the characters except for plant height and panicle weight in summer and panicle breadth in kharif.

Non-significant values for days to flowering in kharif and grain yield in summer in cross SPV, 981-1 x GJ 35, whereas in cross ICSR 89022-3 x GJ 35 for panicle length, panicle breath and length of primary branch in summer indicated the adequancy of additive dominance model. Clear influence of environments was observed for days to flowering and grain yield in cross SPV 981-1 x GJ 35 and for panicle length and length of primary branch in cross ICSR 89022-3 x GJ 35 as the additive dominance model was adequate for another season.

Additive (d) effect was significant in cross SPV, 981-1 x GJ 35 for days to flowering and grain weight in both the seasons and for panicle weight, panicle breadth and grain yield per plant in kharif season only (Table 1). In cross ICSR 89022-3 x GJ 35 significant additive (d) effect was observed for days to flowering and panicle length in both the seasons, panicle breadth and grain weight in summer and plant height, panicle weight, length of primary branch and grain yield per plant in kharif season. Additive type of gene action was also reported for panicle breadth by Hussain Sahib *et al.* (1988).

Dominance (h) effect was significant in cross SPV 981-1 x GJ 35 for grain yield and grain weight in both the seasons, for days to flowering in summer and panicle weight, panicle length, panicle breadth and length of primary branch in kharif season. High magnitude of dominance effect was observed for all the characters in this cross.

In cross ICSR 89022-3 x GJ 35 dominance (h) effect was significant for days to flowering, length of primary branch and grain weight in both the seasons, panicle length and panicle breadth in summer and grain yield in kharif. High magnitude of dominance effect was also observed in this cross (Table 2).

All the epistatic effects were significant in cross SPV 981-1 x GJ 35 for days to flowering in summer and panicle weight and grain yield in kharif season. In cross ICSR 89022-3 x GJ 35 epistatic effect were significant for days to flowering in both the seasons, for grain weight in summer and plant height in kharif.

A perusal of gene action (Table 1 and 2) revealed that additive and non-additive gene effects controlled the inheritance for most of the traits under study which suggested the possibility of obtaining transgressive variation in early generations, Naykar (1973), Rana and Murthy (1978) and Amsalu and Bapat (1990) reported additive and non-additive type of gene action for days to flowering; Kambal and Webster (1965) and Naykar (1973) for plant height; Srihari and Nagur (1980) and Nimoalkar *et al.* (1988) for panicle length.

TABLE 1

Estimates of gene effects for eight characters in SPV 981 - 1 x GJ-35.

Characters		*SPV 981-1 x GJ-35*						
		m	*(d)*	*(h)*	*(i)*	*(j)*	*(l)*	*X^2 /Type of epistatic*
Daya to flowering	(S)	69.00	-5.16**	-44.30**	-35.53**	-7.07**	62.47	1692.89**
		+0.17	±0.29	±1.02	±0.91	±0.51	±1.65	D
	(K)	69.43	03.27**	-0.31	—	—	—	7.25
		±0.23	±0.21	±0.44	—	—	—	
Plant height (cm)	(K)	184.10	07.00	-16.83	-13.07	-0.43	-75.53**	0053.49**
		±3.26	±5.32	±17.65	±16.84	±6.11	±27.12	
Panicle weight (g)	(K)	41.33	04.23**	34.07**	22.7**	02.37	-18.53**	0089.09**
		±0.64	±0.70	±3.01	±2.92	±0.83	±4.08	D
Panicle length (cm)	(K)	19.67	-0.90	10.50**	08.33**	00.73	-12.20**	0040.09**
		±0.22	±0.51	±1.40	±1.34	±0.58	±02.35	D
Panicle breadth (cm)	(K)	04.13	-0.43**	02.53**	02.13**	-0.67**	-02.80	0050.77**
		±0.06	±0.15	±0.39	±0.38	±0.16	±00.68	D
Length of primary branch (cm)	(K)	03.88	00.02	04.38**	03.33	-0.10	-3.60**	0052.97
		±0.08	±0.21	±0.59	±0.53	±0.23	±1.03	D
Grain yield per plant (g)	(S)	35.00	-1.94	21.48**	—	—	—	0004.43
		±1.23	±1.24	±2.30	—	—	—	
	(K)	31.23	04.30**	33.67**	21.93**	02.50**	-18.93**	0091.56**
		±06.64	±0.65	±2.94	±2.87	±0.76	±3.88	
Grain weight (g)	(S)	34.89	-2.85**	-10 46	-16.31	00.27	10.56**	0170.44**
		±0.35	±0.40	±1.68	±1.61	±0.46	±2.34	D
	(K)	21.43	1.87*	5.67**	2.93	-0.53	7.20**	0100.20**
		±0.29	±0.53	±1.65		±0.59	±2.59	

TABLE 2

Estimates of gene effects for eight characters in ICSR 89022 - 3 x GJ 35.

Characters		*ICSR 89022 - 3 X GJ 35*						
		m	*(d)*	*(h)*	*(i)*	*(j)*	*(l)*	*X^2 /Type of epistatic*
Days to 50 per cent flowering	(S)	69.32	7.03**	-11.27**	-10.40**	-06.43**	28.47**	342.67**
		+0.13	±0.27	±1.12	±0.75	±0.50	±2.04	D
	(K)	74.87	-4.00**	13.93	11.47**	-9.13**	-25.73**	343.49**
		±0.37	±0.60	±1.99	±1.92	±0.71	±3.02	D
Plant height (cm)	(K)	192.42	-6.67**	-117.83**	-115.67**	-29.17**	183.33**	158.29**
		±2.51	±2.39	±11.96	±11.11	±4.23	±16.46	D
Panicle weight (g)	(K)	42.35	-1.70**	10.70**	3.87	-6.07**	2.53	57.17**
		±0.48	±0.76	±2.58	±2.43	±0.93	±3.97	
Panicle length (cm)	(S)	21.63	3.68**	2.19*	—	—	—	0.45
		±0.54	±0.53	±0.92	—	—	—	
	(K)	23.63	1.47*	0.40*	-21.3	1.00	11.87**	19.28**
		±0.35	±0.58	±2.05	±1.80	±0.68	13.32	
Panicle breadth (cm)	(S)	4.12	0.28	1.12**	—	—	—	5.49
		±0.13	±0.13	±0.19	—	—	—	—
Length of primary branch (cm)	(S)	5.32	-0.03	0.83**	—	—	—	0.73
		±0.07	±0.07	±0.14	—	—	—	—
	(K)	6.33	0.59*	2.98**	1.74**	-0.09	-1.63	15.74**
		±0.07	±0.24	±0.64	±0.56	±0.25	±1.17	—
Grain yield per plant (g)	(S)	42.85	6.80	27.47	19.27	0.47	-65.53*	13.52**
		±3.22	±5.36	±17.15	±16.76	±5.71	±26.04	—
	(K)	32.18	-1.67	11.03**	4.73*	-5.63**	1.20	59.62**
		±0.46	±0.70	±2.46	±2.32	±0.88	±3.73	—
100-Grain weight (g)	(S)	30.53	4.09**	18.14**	15.43**	2.85**	-21.79**	334.54**
		±0.17	±0.32	±1.00	±0.93	±0.38	±1.64	D
	(K)	24.00	-0.07	3.43	1.47	-2.37	-0.47	21.71**
		±0.21	±0.48	±1.37	±1.27	±0.55	±2.32	—

Duplicate type of epistasis was observed for days to flowering and grain weight in summer and for panicle weight, panicle length, panicle breadth, length of primary branch and grain yield per plant in cross SPV 981-1 x GJ 35. In cross ICSR 89022-3 x GJ 35 duplicate type of epistatis was observed for days to fowering in both the seasons, for grain weight in summer and for plant height in kharif. Goyal and Joshi (1984) also reported duplicate type of epistasis for length of primary branch.

In general, the studies indicated that most of the traits are under the control of both additive and non-additive genetic components, the later being more important. Hence maximum improvement may be expected through reciprocal recurrent selection, as they will utilize simultaneously both types of genetic componenets. Since grain yield and panicle components were under the control of dominance gene action, the exploitation of hybrid vigour seems to be beneficial.

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