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HETEROSIS AND COMBINING ABILITY FOR GRAIN YIELD IN SWEET SORGHUM[1]

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ABSTRACT

Seven sweet sorghum B lines were crossed with four grain sorghum B lines in a line x tester design and evaluated for grain yield. Three parameters namely, combining ability effects, heterosis per cent and **per se** performance were analysed and compared. SS 6B and SS 5B among the lines and 648 B among the testers possessed high **gca** effects and high **per se** value. All these parameters answered positively and favourably in the hybrid combination SS 5B x 3660 B and these three parameters can be utilised as criteria for selection of genotypes. In the case of two hybrids, SS 12B x 296 B and SS 4B x 648 B, the per cent hybrid vigour and **sca** effects were very high and the **per se** performance was also high in spite of the fact the **gca** effects of either one or both of the parents were significantly low and these combinations could result in the capitalisation of non additive effects over the super structure of additive gene effects.

KEY WORDS : Sweet Sorghum, Heterosis, Combining ability.

At present sorghum is used mainly for grain and fodder. Sweet sorghums represent another group which have a greater potential for alcohol production by virtue of their high stem sugar concentrations.

The varieties of sweet stalked sorghum available in the germplams are found to be either poor grain yielders or their grain quality and palatability are unacceptable to the consumers. Therefore, breeding for a genotype that combines high grain yield with juice content could be a cheap source of renewable energy in these days of energy crisis.

Moreover the development of B x B populations for improvement of existing parental lines has been effective (Jayamohan Rao *et al.*, 1982). A derived line from B x B population with the desired level of trait combination could either directly be utilised as an improved variety or could be used in a conversion programme for female development.

MATERIALS AND METHODS

Seven sweet sorghum B lines have been crossed with four grain sorghum B lines in a line x tester mating design. The resultant 28 hybrids along with their parents were raised in a randomized block design with three replicates and evaluated for grain yield during summer 1984 in the Millet Breeding Station, Coimbatore. Five random competitive plants were chosen from each variant in each replication to record data. The replicationwise mean values of the genotypes were subjected to statistical analysis.

The combining ability analysis of this experiment was based on the methoddeveloped by Kempthorne (1957). Heterosis, expressed as per cent deviation of the hybrid (H) from its better parent (BP) was calculated.

RESULTS AND DISCUSSION

The mean performance showed that the grain yield per panicle ranged from 16.59 to 33.53 g for the lines and from 23.04 to 37.39 g for the testers. The line SS 5B and the tester 3660 B expressed the highest values for grain yield. The hybrid means ranged from 21.29 to 57.37 g. Among the hybrid, SS 5 B x 3660 B exhibited the highest value.

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Twenty three cross combinations expressed positive heterosis. Superiority over the better parent was best expressed in SS 12B x 296B followed by SS 6B x 3660B (Table 1).

The *gca* effects for the lines varied from -12.06 to 6.70. The lines SS 5B and SS 6B recorded positive and significant *gca* effects. The *gca* for the testers varied from - 7.81 to 3.92. Only two testers were found to have significant *gca* effects of which 648B recorded positive effects (Table 2)

The *sca* effects varied from -12.74 to 11.89 for the crosses (Table 3). The *sca* effects were found to be significant in eight combinations. Only four crosses exhibited positive *sca* effects and the highest *sca* effects were recorded in SS 5B x 3660B followed by SS 4B x 648 B.

The components of variance due to *GCA* and *SCA* pointed out the

Table 1. Mean performance and expression of heterosis

Hybrids	Mean of			Heterosis
	Hybrids (g)	Lines (g)	Testers (g)	
SS 4B X 296 B	35.02	16.59	24.04	45.67
SS 4B X 3660 B	28.57	16.59	37.39	-23.59
SS 4B X 648 B	48.47	16.59	29.27	62.81**
SS 4B X 2219 B	22.22	16.59	23.04	-3.56
SS 5B X 296 B	33.57	33.53	24.04	0.12
SS 5B X 3660 B	57.37	33.53	37.39	53.44**
SS 5B X 648 B	48.73	33.53	29.27	45.33**
SS 5B X 2219 B	33.80	33.53	23.04	0.81
SS 6B X 296 B	55.67	30.38	24.04	66.03**
SS 6B X 3660 B	54.21	30.38	37.39	78.44
SS 6B X 648 B	38.46	30.38	29.27	2.86
SS 6B X 2219 B	28.87	30.38	23.04	4.97
SS 7B X 296 B	26.29	17.67	24.04	9.36
SS 7B X 3660 B	23.86	17.67	37.39	-36.19*
SS 7B X 648 B	30.86	17.67	29.27	3.66
SS 7B X 2219 B	21.29	17.67	23.04	-7.60
SS 11B X 648 B	46.56	32.53	24.04	43.13
SS 11B X 3660 B	30.74	32.53	37.39	-17.79
SS 11B X 648 B	52.00	32.53	29.27	59.85**
SS 11B X 2219 B	36.78	32.53	23.04	11.53
SS 12B X 296 B	50.73	20.64	24.04	111.02**
SS 12B X 3660 B	40.78	20.64	37.39	9.07
SS 12B X 648 B	40.00	20.64	29.27	24.59
SS 12B X 2219 B	31.94	20.64	23.04	38.63
SS 14B X 296 B	27.96	24.43	24.04	14.45
SS 14B X 3660 B	42.24	24.43	37.39	12.97
SS 14B X 648 B	32.24	24.43	29.27	8.33
SS 14B X 2219 B	33.69	24.43	23.04	37.90
S.E.	3.95			

Table 2. General combining ability efects

	Parents	gca effects
Line		
	SS 4B	-4.02*
	SS 5B	4.80*
	SS 6B	6.70**
	SS 7B	-12.06**
	SS 9B	3.80
	SS 11B	3.27
	SS 12B	-3.48
	SS 14B	4.12
	SE (gj)	1.98
Tester		
	296 B	1.80
	3660 B	2.09
	648 B	3.92*
	2219 B	-7.81**
	S E (gj)	1.41

prepondrence of non additive gene action as reflected by higher *SCA* variance as also revealed by many workers (Raju *et al.*, 1980; Shinde and Sudewad, 1980). The presence of considerably non additive gene action for grain yield in the present study suggested that once high yielding improved lines are isolated, further yield improvement could be achieved by hybrid programme.

SB 6B and SS 5B among the lines and 648 B among the testers possessed high *gca* effects. The *per se* performance of the corresponding parents were also high. The hybrids between two positive combiners SS 5B x 648 B showed low *sca* effects, indicating lack of genetic diversity. However, the *per se* performance of this hybrid SS 5B x 648 B is fairly high with a significant heterotic expression. Hence these two parents with more of additive genetic effects could be utilised in exploiting hybrid vigour in F_1 and the trait could further be improved by selection in the later generations. All the three parameters *viz.*, yield *per se*, heterosis and *sca* effects were answered positively and favourably in the hybrid combination SS 5B x 3660 B. The *sca* effects of this combination were the highest (11.89) and it was the second best in yield *per se* (57. 37 g) with a fairly high degree of heterosis (53.45%). It is to be noted here that one of the parents *viz.*, 3660 B was a poor combiner.

Among the three parameters, *sca* alone cannot be considered as a criterion for selection of parents since a hybrid with high *sca* and high heterosis may be a failure when its *per se* performance is considered. In practical plant breeding, *per se* performance is more valuable than either the percentage of heterosis in the hybrids or their *sca* effects. A similar view was expressed by Rao (1968). But the observations as evidenced in the hybrid SS 5B x 3660 B indicated that all the three criteria for selection could be satisfied in one and the same hybrid. In the present set of parents used, varieties SS 5B, SS 6B and 648 B appear to be worthy for exploitation.

Table 3. Specific combining ability effects

Parents	296 B	3660 B	648 B	2219 B
SS 4B	-3.58	-7.68	10.99	-3.55
SS 5B	-11.63*	11.89**	1.42	-1.69
SS 6B	9.56*	7.82	-9.76*	-7.63
SS 7B	-1.05	-3.75	1.23	3.57
SS 11B	3.36	-12.74**	6.69	2.69
SS 12B	8.07	-2.17	-4.78	-1.11
SS 14B	7.96*	6.04	-5.80	7.72
S E (Sij)	3.95			

In the case of the two hybrids, SS 12B x 296 B and SS 4B x 648 B, the per cent hybrid vigour and *sca* effects were very high and the *per se* performance was also considerably high, in spite of the fact that the *gca* effects of either one or both of the parents were significantly low. In such cases the high heterosis may be due to contribution of non additive genes from both the parents. The hybrid vigour expressed in the hybrids in which 648 B was involved aptly confirmed the above view. The combinations SS 5B x 3660 B and SS 4B x 648 B considered as high and low combinations could result in the capitalisation of non additive effects over the super structure of additive gene effects.

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PATTERN OF SEGREGATION IN THE F2 PROGENIES OF RICE.

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ABSTRACT

The pattern of transgressive segregation in the crosses was positive in respect of days to flowering, panicle length, grain number per panicle and 100 grain weight, while it showed a negative trend for plant height. Early duration and high yielding segregants were predominant in the cross, Co 37/ADT 16. Four crosses viz., ADT 16/Co 33, Co 33/ADT 16, Co 37/ADT 16 and ADT 16/Co 37 recorded high percentage of late duration and high yielding segregants, while the cross Co 33/ADT 16 yielded a large number of transgressive segregants with profuse tillering, increased number of grains, high grain weight and high yield.

KEY WORDS : Rice, Segregation pattern

The F2 is the critical generation in rice breeding, as it determines eventual success or failure of the hybridization programme. (Jennings *et al.*, 1979). The typical F2 generation from diverse parents consists of a bewildering array of undesirable segregants, with a sprinkling of good ones. If the F2 segregates are not promising, the chances of finding superior recombination in the F3 or later generations are remote.

In the present study, three popular and high yielding varieties, namely, Co 33, Co 37 and ADT 16 were involved in a hybridisation to obtain six crosses. The mean performance, frequency distribution and pattern of segregation, the nature and

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