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COMBINING ABILITY AND HETEROSIS IN GOSSYPIUM BARBADENSE

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ABSTRACT

A four parent full diallel analysis was made in **Gossypium barbadense** cotton to study the nature of general and specific combining abilities and the magnitude of relative heterosis for yield of seed cotton, halo length and ginning outturn. Yield of seed cotton was predominantly under the control of dominance gene action where as halo length and ginning were predominantly under the control of additive gene action. TCB 295 was the best combiner for halo length and TCB 296 was the best combiner for ginning outturn. Heterosis for seed cotton yield ranged from 18.11% to 90.64% while the magnitude of heterosis was low in respect of halo length and ginning. The hybrid combination TCB 293 x TCB 296 was suggested for exploiting through heterosis breeding for increasing the seed cotton yield.

KEY WORDS : Cotton, Combining ability, Heterosis.

In cotton *Gossypium barbadense* L. oularly known as Egyptian cotton is ed for its quality. Though it is good in ility, it is generally poor in seed cotton d and ginning outturn. In Tamil Nadu, it eing cultivated in about 5000 hectares in districts of Coimbatore, Salem and durai. Suvin is the ruling strain but it has onger duration of 200 days. Therefore, empts were made at Cotton Breeding tion, Tamil Nadu Agricultural University, imbatore to evolve a shorter duration *G. badense* variety. As a result, TNB 1 iety was released in the year 1982 with a orter duration of 175 days. Though this ain is better than Suvin in seed cotton ld, ginning outturn and earliness, it is not as good as Suvin in quality. So, with a view to improve the seed cotton yield, ginning outturn and quality of the strain TNB 1, a four parent full diallel analysis with selected parents was made to study the nature of general and specific combining abilities and the magnitude of heterosis so as to exploit the good combining parents and specific combinations for fulfilling the objectives.

MATERIALS AND METHODS

Four *G. barbadense* parents viz. TNB 1, TCB 293, TCB 295, and TCB 296 were raised during 1985-86 Winter season and crosses were made in a full diallel

Table 1. Combining ability analysis for economic characters

Source	Degree of freedom	Mean sum of squares		
		Seed Cotton yield (g/plant)	Halo length (mm)	Ginning outturn (%)
Replication	2	158.61	0.42	0.31
G C A	3	22.56	6.09*	8.10**
S C A	6	67.64**	1.57*	0.75
Reciprocal	6	22.66	0.08	3.34
Error	30	10.53	0.54	0.57
σ^2 A (Additive)	–	13.04	1.08	1.80
σ^2 D (Dominance)	–	41.53	0.75	0.13
$\sigma^2 A / \sigma^2 D$	–	0.31	1.44	3.85

* = Significant at 5% ** = Significant at 1%

model During 1986-87 winter, the six F_1s, six reciprocals and four parents were raised in a randomised block design with three replications. Each line was raised in one row with 10 plants with a spacing of 75 cm x 30 cm. Picking of seed cotton was done single plant wise and the data on yield of seed cotton (g/plant), halo length (mm) and ginning outturn (%) were assessed on single plant basis and the mean for 10 plants was calculated. The data were analysed for general and specific combining abilities as per Model II and Method I suggested by Griffing (1956). Heterosis over mid parent was worked out,and tested for significance as suggested by Wynne *et al.* (1970).

RESULTS AND DISCUSSION

For yield of seed cotton, the specific combining ability variance alone was significant indicating that yield was governed by non-additive gene action (Table 1). The ratio of $\sigma^2 A / \sigma^2 D$ was 0.31 indicating the predominance of non additive gene action for yield. As such, there is no scope for applying selection pressure in the early stages and so we have to postpone selection to the later stages. Salim *et al.* (1984) also reported highly significant dominance gene action for seed cotton yield in Egyptian and Russian (*G. barbadense*) cultivars. But additive gene action was important for yield in *G. barbadense* cotton varieties according to Chandramathi (1973), Sallam *et. al.* (1984) and Abo EL Zahab (1986). None of the parents showed significant *gca* effect for seed cotton yield. Among the six F hybrids, TCB 293 x TCB 296 had significant and positive *sca* effect for yield. It also possessed the highest, significant and positive relative heterosis (90.64%) for seed cotton yield with highest and significant *per se* performance (44.8 g/plant) over TNB (Table 2). Therefore, for doubling the yield of seed cotton, this specific hybrid combination can be exploited through heterosis breeding. Reciprocal effects were not significant for any of the hybrids for yield. In the present study, relative heterosis for yield ranged from 18.11 to 90.64%. Relative heterosis in *G. barbadense* cotton variety was reported upto 111% by Henry and Munshi Singh (1976) and from 19.94% to 45.95% by Patel *et al.* (1986). The yield potential of the best hybrid *viz.*, TCB 293 x TCB 296 was 1991 kg/ha which was 109% higher than TNB 1.

For halo length, the *gca* and *sca* variances were significant indicating additive and non-additive gene action. But the proportion of $\sigma^2 A / \sigma^2 D$ was 1.44 indicating the predominance of additive gene action over non-additive (Table 1). As such there is scope for improving this

Table 2. Per se performance, gca, sca, reciprocal effects and relative heterosis of parents, F_1S and eciprocals in 4 percent full diallel

S.No.	Parents/F_1 S/ Reciprocal	Per se performance			gca/sca/reciprocal effects			Relative heterosis (%)		
		Seed Cotton yield (g/plant)	Halo length (mm)	Ginning outturn (%)	Seed Cotton yield	Halo length	Ginning outturn	Seed cotton yield	Halo length	Ginning outturn
	Parents					gca				
1.	TNB 1	21.4	29.3	32.1	-2.04	-0.05	-0.43	–	–	–
2.	TCB 293	24.7	30.0	33.2	1.84	-0.28	0.16	–	–	–
3.	TCB 295	27.2	30.5	31.3	0.78	1.20**	-1.04*	–	–	–
4.	TCB 296	22.3	27.6	36.8**	-0.58	-0.88*	1.32**	–	–	–
	F_1 direct cross hybrids					s c a				
5.	TNB 1 x tcb 293	30.2	29.1	32.2	0.74	-0.80	0.26	31.02*	-1.85	-1.38
6.	TNB 1 X TCB 295	37.3**	32.1**	29.9	2.40	0.98	-0.29	53.50**	7.36**	-5.68*
7.	TNB 1 X TCB 296	33.8*	29.5	35.9**	3.25	0.45	0.39	54.69**	3.69	4.21
8.	TCB 293 X TCB 295	40.5**	31.6*	33.8	4.38	0.50	0.82	56.07**	4.46	4.81
9.	TCB 293 X TCB 296	44.8**	28.7	32.6	5.73*	-0.23	-0.64	90.64**	-0.35	-6.86**
10.	TCB 295 X TCB 296	29.3	31.2	34.3*	-0.56	0.45	-0.59	18.38	7.40**	0.73
11.	TCB 293 X TNB 1	34.6**	28.7	34.4*	-2.20	0.20	-1.10	50.11**	-3.20	5.36*
12.	TCB 295 X TNB 1	28.7	32.2**	33.2	4.30	-0.05	-1.64*	18.11	7.69**	4.73
13.	TCB 296 X TNB 1	31.2*	29.6	33.3	1.30	-0.05	-1.30	42.79**	4.04	-3.34
14.	TCB 296 X TCB 293	37.2**	31.3	32.7	1.65	0.15	0.55	59.15**	3.47	1.40
15.	TCB 296 X TCB293	32.9*	28.6	35.7**	5.95	0.05	-1.55*	40.00**	-0.67	2.00
16.	TCB 296 X TCB 295	33.7*	30.4	31.7	-2.20	0.40	1.30	36.16*	4.65	-6.90**
	S.E. for per se	3.24	0.73	0.75	–	–	–	–	–	–
	C.D. 5% for per se	9.40	2.10	2.20	–	–	–	–	–	–
	C.D. 1% for per se	12.60	2.80	2.90	–	–	–	–	–	–
	S.E. for g c a	–	–	–	1.62	0.37	0.38	–	–	–
	S.E. for s c a	–	–	–	2.29	0.52	0.53	–	–	–
	S.E. for reciprocal	–	–	–	3.24	0.73	0.75	–	–	–

* = Significant at 5% level ** = Significant at 1%

character by recombination breeding. The *sca* and reciprocal effects were not significant for any of the hybrids for this character. The parent TCB 295 alone possessed highly significant and positive *gca* effects for halo length. Therefore, this parent can be exploited as one of the parents in hybridization. Additive gene action was important for halo length according to Chandramathi (1973). In contrast, Vadne and Thombre (1982) and Sallam *et al.* (1984) reported that this character was influenced by dominance gene action in *G. barbadense*. Relative heterosis was very low for halo length and ranged from - 1.85% to 7.69%. However, the hybrid TNB 1 x TCB 295 and its reciprocal recorded significant and positive heterosis of 7.36% and 7.69% respectively with significantly higher *per se* performance of 32.1 mm and 32.2.mm respectively. The involvement of the parent TCB 295, the best combiner for halo length may be the reason attributed for better *per se* performance and heterosis in them. Low to marginal heterosis only were recorded for fibre length in *G. barbadense* by Sallam *et al.* (1984) and Patel *et al.* (1986).

Ginning outturn was predominantly under the influence of additive gene action as indicated by the significant *gca* variance and by the higher proportion of additive variance (θ^2A) over dominance variance (θ^2D) (Table 1). TCB 296 alone had significant and positive *gca* effect for ginning outturn. As such, this parent can be exploited in hybridization for improving this character through pedigree breeding, since it was the best combiner with significantly higher *per se* performance with 36.8% ginning. This is in conformity with the previous results reported by Vadne and Thombre (1982) and Abo El Zahab (1986). But, ginning outturn in *G. barbadens* cotton was predominantly under the contr of dominance gene action according t Chandramathi (1973). Relative heterosis fc ginning outturn was found to be low rangin from -6.90% to 5.36% and the reciproca hybrid TCB 293 x TNB 1 recorded th highest, significant and positive heterosi (5.36%) with significantly higher *per s* performance with 34.4% ginning. Th present study is in line with the earlie report of Patel *.et al.* (1986) who als reported low magnitude of heterosis fo ginning.

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