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Combining ability study on seed cotton yield and its components in *desi* cotton (*Gossypium arboreum* L.)

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ABSTRACT *:* The analysis of variance indicated the presence of variability among hybrids and their parents and revealed significant GCA and SCA mean squares for most of the traits. Among the tester parents; HD 450, HD 324 and HD 432 were desirable as it manifested higher estimates of GCA effects for seed cotton yield/plant (g) and bolls/plant of the traits while tester parent HD 432 and GCD 22 were good general combiner for plant height. The hybrids GMS 21 x P 541, GAK 20 x P 494 and GAK 20 x HD 123 exhibited significantly higher SCA effect for majority of the characters under study. For seed cotton yield/plant (g) and bolls/plant, the hybrids GMS 1 x GCD 22, GMS 1 x HD 107, GMS 21 x HD 450, GMS 21 x GCD 101, GAK 20 x HD 432 and GMS 4 x HD 324 exhibited highly significant SCA effect. The crosses involving diverse type of parents and showing high SCA effects for seed cotton yield/plant could be successfully utilized for exploitation of hybrid vigour.

Key words : Combining ability, cotton, gca effects, *Gossypium arboreum*, sca effects

Desi cotton (*Gossypium arboreum* L.*)* are still cultivated in India because of their good agronomic base of strong resistance to disease and pest, drought tolerance and suitability under rainfed conditions. After the introduction of *Bt* cotton, there was significant decrease in the area of *desi* cotton because of their smaller boll size and low potentiality of yield but now there is a big demand of short staple cotton for denim and surgical cotton. Thus, breeders tend to select genetically diverse parent having different genes. Knowledge on combining ability is useful for selection of desirable parents for exploitation of hybridity and transgressive expressions. Combining ability studies also elucidate the nature and magnitude of gene action involved in the inheritance of seed cotton yield and its related characters which will be useful to follow segregating material. Line x tester analysis would reveal general combining ability (GCA) effects of parents and specific combining ability (SCA) effects of hybrids.

The genetic population was developed through line x tester (4 x10) mating design. Four well adapted male sterile lines (GMS 4, GMS 21, GAK 20 and GMS 1) were used as lines and were hand crossed with 10 cotton genotypes treated as testers (HD 450, P 541, GCD101, GCD 308, GCD 22, HD 107, P 494, HD 123, HD 324 and HD 432) and their 40 crosses were grown in randomized block design with 3 replications at Cotton Research Area, CCS HAU, Hisar during *kharif* 2014-2015. Two rows of each treatment having 6.0 m length and spacing of 67.5 cm between rows and 30 cm between plants was sown. Observations were recorded on 5 randomly selected plants in each plot on seed cotton yield (g)/plant, plant height, boll/plant and monopods/ plant. After recording the observations for each character, the analysis of variance was carried out. The mean square from line x tester design and the general combining ability (GCA) and specific combining ability (SCA) variance and

effects were calculated. The combining ability variance was computed for 4 characters.

RESULTS AND DISCUSSION

The estimates of general combining ability (GCA) variances for female and male were significant for plant height, bolls/plant, and seed cotton yield (g)/plant, it indicated the variability present in the population. Whereas, specific combining ability (SCA) variances for F x M interaction were significant and highly significant for all the characters. The significance of GCA and SCA mean squares

Table 1. Analysis of variance for combining ability for different characters in cotton

Source of Variation	DF	Plant height (cm)	Monopods/plant	Bolls/plant	Seed cotton yield /plant (g)
Replications	2	409.079	3.877	38.85	138.642
Males	9	542.978**	1.072	54.588**	299.400**
Females	3	2934.525**	1.514	69.640**	748.453**
Males X Females	27	264.792**	0.844	44.667**	140.556**
Error	78	80.029	0.609	2.179	7.179
CD (p=0.01)		18.845	1.644	3.110	5.644
CD (p=0.05)		14.316	1.249	2.362	4.290
Estimates					
COV(HS)		70.189	0.021	0.831	18.256
COV(FS)		201.965	0.121	15.824	80.97
$ó^2$ GCA		70.189	0.021	0.831	18.256
$ó^2$ SCA		61.588	0.079	14.162	44.459
$ó^2$ GCA/ $ó^2$ SCA		1.140	0.266	0.059	0.411
$ó^2$ ADDITIVE (F = 1)		140.377	0.043	1.662	36.511
$ó^2$ DOMINANCE (F = 1)		61.588	0.079	14.162	44.459

Table 2. Estimation of general combining ability effects of parents for different characters in cotton

Parents	Plant height (cm)	Monopods/ plant	Bolls / plant	Seed cotton yield / plant (g)
GMS 1	-13.025**	-0.253*	1.881**	6.568**
GMS 21	10.438**	-0.133	-1.756**	-3.536**
GAK 20	3.692**	0.123	0.348	1.188**
GMS 4	-1.105	0.243*	-0.472*	-4.219**
CD (p=0.01)	3.648	0.317	0.601	1.094
CD (p=0.05)	2.771	0.241	0.457	0.831
HD 450	-3.555	0.317	2.359**	1.948**
P 541	0.228	-0.517*	-1.266**	-2.219**
GCD 101	-1.83	-0.083	0.859*	-0.111
GCD 308	-0.247	0.283	2.434**	1.256
GCD 22	6.678**	-0.267	-0.474	-1.869*
HD 107	-11.238**	-0.325	-3.832**	-6.769**
P 494	1.228	-0.067	-0.683	-6.286**
HD 123	-4.872*	0.183	-2.532**	-0.836
HD 324	-0.355	0.133	1.118*	4.806**
HD 432	13.962**	0.342	2.018**	10.081**
CD (p=0.01)	6.321	0.552	1.042	1.894
CD (p=0.05)	4.802	0.419	0.792	1.44

* Significant at 5 per cent ** Significant 1 per cent

suggests the importance of both additive and non additive variances for all the characters. A comparison was made of the crosses selected on the basis of their SCA effects with their mean performance in various traits. The non additive type of genetic variance was observed to play a central role in case of monopods and bolls/plant and seed cotton yield/plant (Preetha and Raveendran, 2008 and Patil *et. al.*, 2011).

Estimate of general and specific combining ability effects for all the characters are presented in Table 2 and 3, respectively. Among female parents GMS 1 showed positive significant GCA effect for seed cotton yield/plant

Table 3. Estimation of specific combining ability effects of hybrids for different characters in cotton

Hybrids	Plant height (cm)	Monopods/ plant	Bolls / plant	Seed cotton yield / plant (g)
GMS 1 x HD 450	0.792	1.003**	0.611	5.532**
GMS 1 x P 541	-9.558*	-0.263	0.569	1.799
GMS 1 x GCD101	6.500	-0.030	-4.989**	-11.609**
GMS 1 x GCD 308	3.583	-0.730*	1.969**	-1.076
GMS 1 x GCD 22	-0.908	0.153	2.944**	9.116**
GMS 1 x HD 107	-8.425*	0.112	2.136**	6.482**
GMS 1 x P 494	7.875	-0.280	5.219**	1.866
GMS 1 x HD 123	-9.358*	-0.063	-3.598**	-6.884**
GMS 1 x HD 324	-3.442	0.220	-3.148**	-4.426**
GMS 1 x HD 432	12.942**	-0.122	-1.714*	-0.801
GMS 21 x HD 450	2.862	0.097	6.581**	8.469**
GMS 21 x P 541	18.212**	0.797*	6.539**	12.703**
GMS 21 x GCD 101	-8.063	-0.270	4.314**	6.261**
GMS 21 x GCD 308	-5.213	0.630	0.506	-4.006**
GMS 21 x GCD 22	-14.572**	-0.453	-3.253**	-6.781**
GMS 21 x HD 107	10.245*	-0.262	-1.561*	-7.548**
GMS 21 x P 494	-7.788	0.047	-5.511**	-8.064**
GMS 21 x HD 123	-0.055	0.430	-0.761	3.386**
GMS 21 x HD 324	2.128	-0.487	-2.778**	0.077
GMS 21 x HD 432	2.245	-0.528	-4.078**	-4.498**
GAK 20 x HD 450	-1.492	-0.373	-2.256**	-6.154**
GAK 20 x P 541	-2.275	-0.307	-4.464**	-10.921**
GAK 20 x GCD 101	1.450	0.727*	-0.556	1.104
GAK 20 x GCD 308	-7.467	0.327	-2.464**	-0.463
GAK 20 x GCD 22	14.075**	0.410	-0.823	-1.338
GAK 20 x HD 107	-6.375	-0.065	-0.098	4.896**
GAK 20 x P 494	8.392*	-0.323	2.953**	6.146**
GAK 20 x HD 123	11.692**	-0.240	3.269**	2.963*
GAK 20 x HD 324	-1.792	0.243	3.052**	-0.379
GAK 20 x HD 432	-16.208**	-0.398	1.386*	4.146**
GMS 4 x HD 450	-2.162	-0.727*	-4.936**	-7.848**
GMS 4 x P 541	-6.378	-0.227	-2.644**	-3.581**
GMS 4 x GCD101	0.113	-0.427	1.231	4.244**
GMS 4 x GCD 308	9.097*	-0.227	-0.011	5.544**
GMS 4 x GCD 22	1.405	-0.110	1.131	-0.998
GMS 4 x HD 107	4.555	0.215	-0.477	-3.831**
GMS 4 x P 494	-8.478*	0.557	-2.661**	0.052
GMS 4 x HD 123	-2.278	-0.127	1.089	0.536
GMS 4 x HD 324	3.105	0.023	2.872**	4.727**
GMS 4 x HD 432	1.022	1.048**	4.406**	1.153
CD (p=0.01)	10.947	0.955	1.806	3.280
CD (p=0.05)	8.316	0.725	1.372	2.491

* Significant at 5 per cent ** Significant 1 per cent

(g) and bolls/plant and GAK 20 showed positive significant GCA effect for seed cotton yield/plant (g) and plant height but female line GMS 4 was good general combiner for no. of monopods. Amongst male parents; HD 450, HD 324 and HD 432 were observed to be the top combiner and desirable as it manifested higher estimates of GCA effects for seed cotton yield/plant (g) and no. of bolls/plant of the traits while tester parent HD 432 and GCD 22 were good general combiner for plant height. The hybrid GMS 21 x P 541, GAK 20 x P 494 and GAK 20 x HD 123 exhibited significantly higher SCA effect for majority of the characters under study. For seed cotton yield/ plant (g) and bolls/plant, the hybrids GMS 1 x GCD 22, GMS 1 x HD 107, GMS 21 x HD 450, GMS 21 x GCD 101, GAK 20 x HD 432 and GMS 4 x HD 324 exhibited highly significant SCA effect. The hybrid GMS 21 x P 541 exhibited maximum SCA effect 12.70 for seed cotton yield/plant and it was closely followed by GMS 1 x GCD 22 (9.12). For bolls/plant GMS 21 x HD 450 recorded maximum SCA effect 6.58, closely followed by GMS 21 x P 541 (6.54). Regarding plant height, GMS 21 x P 541, GAK 20 x GCD 22, GMS 1 x HD 432, and GAK 20 x HD 123 were the best specific combiners with the highest SCA effect 18.21, 14.08, 12.94 and 11.69, respectively.

GMS 4 x HD 432, GMS 1 x HD 450 and GMS 21 x P 541 were the highest ranking hybrids for monopods/plant. The best cross combination for different characters usually did not combine the respective best male and female parents. Twelve cross combinations for seed cotton yield showed conspicuous SCA effects. The best specific combination, GMS 21 x P 541, GAK 20 x P 494 and GAK 20 x HD 123 involved good and average combining parent, which also had high SCA effect for seed cotton yield, bolls/plant and plant height. The results regarding significant GCA and SCA effects are in conformity with those of Ahuja and Dhayal (2007).

Hence, the choice of best cross combinations should be based on GCA, SCA or in combination could be more realistic and useful. Almost identical results have been reported by Patel and Chaudhari (2015) and Preetha and Raveendran (2008). The study of combining ability has revealed that selection of bolls and plant height might result in the improvement of yield. Further, more the potential breeding material for yield and its components may be handled through recurrent selection. The crosses involving diverse type of parents and showing high SCA effects for seed cotton yield/ plant could be successfully utilized for exploitation of hybrid vigour. Similar findings were reported by many workers *viz.,* Ahuja and Dhayal (2007), Patel, *et al.*, (2009), Patel and Chaudhari (2015), Preetha and Raveendran (2008) and Patil, *et al.*, (2011).

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