COMBINING ABILITY STUDY FOR SEED COTTON YIELD AND ITS COMPONENT TRAITS IN UPLAND COTTON (*G. hirsutum* L.)

NAKUM, J. S. AND *VADODARIYA, K. V.

MAIN COTTON RESEARCH STATION
NAVSARI AGRICULTURAL UNIVERSITY
SURAT – 395 007, GUJARAT, INDIA

EMAIL: kvvadodaria@yahoo.co.in

ABSTRACT

A line x tester mating design for the estimation of combining ability was carried out in upland cotton for seed cotton yield and its eight components traits. The results indicated the preponderance of non-additive gene action for numbers of sympodia per plant, numbers of bolls per plant, boll weight, seed cotton yield per plant, lint yield per plant, ginning percentage, seed index and lint index. Among lines and testers, G.Cot.-16, H-1452 and NDIH-1938 were the best general combiners for seed cotton yield and other important traits. For seed cotton yield per plant, the crosses GBHV-148 x H-1452 and GBHV-164 x NDIH-1938 were the best specific combinations to exploit non-fixable components. Crosses showing high sca effects for seed cotton yield also possessed desirable sca effects for important yield attributes and were involved with average x good, average x good, good x average and good x average general combiners.

KEY WORDS: Combining ability, gca, sca, upland cotton

INTRODUCTION

The improvement in seed cotton yield per plant depends on the yield component characters. The knowledge of combining ability not only helps in knowing the inheritance of characters, but also helps in the selection of parents for hybridization and behaviour of the hybrids. The earlier studies on combining ability in cotton were scanty and were deal with a few characters involving limited number of inbred lines. Therefore, the present investigation on planned combining ability for yield and yield contributing characters was planned.

MATERIALS AND METHODS

Eight diverse females (NH-630, H-1452, BS-30, NH-635, NDIH-1938, BS-79, GJHV-358 and H-1353) and four good testers (GBHV-148, GBHV-164, GBHV-177 and G.Cot.16) were used to generate thirty two cross combinations by using line x tester mating design. These thirty two crosses along with twelve parents and two checks (G.Cot.DH-8 and G.Cot.DH-12) were grown in randomized block design with three replications. One row of each hybrid and parents were sown at spacing of 120 x 45 cm during *kharif* 2011-12 at Regional Cotton Research Station, Navsari Agricultural University, Bharuch. Five plants were chosen from each row to record observations on seed cotton yield and its seven contributing traits. The combining ability analysis was calculated as per the method suggested by Kempthorne (1957).

RESULTS AND DISCUSSION

Analysis of variances for combining ability revealed that general combining ability (gca) variances were significant for seed cotton yield per plant and ginning percentage (Table 1). On the other hand, specific combining ability variances were significant for all studied characters except lint yield per plant and seed index. The estimates of components of variances (gca and sca) and their ratio (σ^2gca/ σ^2sca) indicated that both additive and non-additive variances were important in inheritance of characters, that non-additive variance were predominant. Significance of both the variances had been reported by Patel *et al.* (1997), Deshpande and Baig (2003), Nirania *et al*. (2010), Pratap *et al.* (2006), Preetha and Raveendran (2008) and Laxman (2010). Duhoon *et al.* (1983), and Sakhare *et al.* (2005) reported the predominance of non-additive gene action for the expression of seed cotton yield and its attributes traits. The components of genetic variance estimated from the results indicated that the magnitude of variance due to testers (σ^2m) was higher than those of lines (σ^2f) for all the characters. Lines vs. testers were significant for the seed cotton yield per plant and its component traits except lint yield per plant, which suggested that significant variation exhibited between parents and hybrids. However, the mean squares due to sca were higher in magnitude for number of sympodia per plant, numbers of bolls per plant, seed index, lint index, boll weight, seed cotton yield per plant, ginning percentage and lint yield per plant than those due to gca, which implies that cross combinations were divergent than their respective parents.

The estimation of gca effects (Table 2) revealed that among parental lines, GBHV-177 was good general combiner for numbers of sympodia per plant, seed cotton yield per plant, ginning percentage, seed index and lint index, while second line G.Cot.16 was good general combiner for numbers of sympodia per plant, seed cotton yield per plant. Among testers, H-1452 was found good general combiner for number of sympodia per plant, number of bolls per plant, seed cotton yield per plant, lint yield per plant, ginning percentage, seed index and lint index. BS-30 was good general combiner for number of bolls per plant, boll weight, seed index and lint index. High general combining ability effects mostly contribute additive gene effect or additive x additive interaction (Griffing, 1956a and 1956b) and represent fixable portion of genetic variation. Among parental lines, GBHV-177 and H-1452 which showed high gca effects for two or more traits and also high *per se* performance for most of characters are worth considering in future breeding programme and also to help in selecting desirable transgressive segregants from segregating population for seed cotton yield and its component characters. Similar findings have also been postulated by Duhoon *et al.* (1983), Patel *et al.* (1997) and Sakhare *et al.* (2005)

The estimate of sca effects revealed (Table 3) that none of the crosses was consistently superior for all the characters. The highest yielding hybrid GBHV-148 x H-1452 (148.33 g) had also registered significant and positive sca effect for seed cotton yield per plant (22.95). This could be due to average x good general combiner parents. This cross also showed desirable and high sca effect for numbers of sympodia per plant, numbers of bolls per plant, lint yield per plant, seed cotton yield per plant, ginning percentage, but their magnitude varied character to character. Similar situation of good x average general combiner was also observed in the cross combination G.Cot-16 x H-1353 that recorded significant and positive sca effect (10.83) for seed cotton yield per plant. On the other hand, three cross combinations *viz*., GBHV-148 x H-1452, GBHV-164 x NDIH-1938 and G.Cot-16 x NH-635 had higher and desirable sca effect for seed cotton yield per plant which involved poor x good, poor x good and good x average general combiner parents, respectively. This indicated the presence of epistatic gene action and such deviation could be attributed to the genetic diversity in the form of heterozygous loci. This could also be an indication of gene dispersion and genetic interaction between favourable alleles contributed by both the parents. Such combinations could be utilized for intermating segregants in later generations and simultaneous selection for desirable plant types.

While considering number of sympodia per plant, seven crosses showed significant and positive sca effect with range of -4.76 to 4.69. The highest, significant and positive sca effect was reported by GBHV-164 x NH-630 (4.69). In case of number of bolls per plant, five crosses showed significant and positive sca effect with range of -5.71 to 12.15. The highest, significant and positive sca effect was reported by GBHV-148 x H-1452 (12.15). For boll weight, six crosses showed significant and positive sca effect in desirable direction with range of -0.65 to 0.60. The highest, significant and positive sca effect was reported by GBHV-177 x BS-30 (0.60). The extent of sca effects for lint yield per plant was ranged from -7.22 to 12.71. Among thirty two hybrids, three hybrids showed significant and positive sca effect. The cross combination GBHV-148xH-1452 showed highest, significant and positive sca effect for lint yield per plant. The cross combination G.Cot-16 x NDIH-1938 (2.36) exhibited the significant and positive sca effect for ginning percentage. The extent of sca effect for ginning percentage ranged from -2.11 to 2.36. For seed index, sca effect ranged between -1.57 to 0.97. The cross combination G.Cot.16 x GJHV-358 (0.97) showed the highest significant and positive sca effect for seed index. For lint index, sca effect ranged from -1.19 to 1.16. The cross combination GBHV-148 x H-1452 (1.16) showed the highest significant and positive sca effect for lint index.

CONCLUSION

On the basis of *per se* performance and combining ability estimates of seed cotton yield per plant and its components, the crosses GBHV-148 x H-1452 and GBHV-164 x NDIH-1938 appeared to be suitable for exploitation in practical plant breeding programme. Both additive and non-additive gene effects being important, biparental matings as well as mating of selected plants in early segregating generations should be attempted in developing potential populations having optimum levels of homozygosity and heterozygosity. Further, transgressive segregants could be isolated by random intermating and selfing.

REFERENCES

Deshpande, L.A. and Baig, K.S. (2003). Combining ability analysis for yield, economic and morphological traits in American cotton (*Gossypium hirsutum* L.). *J. Res. ANGRAU*, **31**: 28-34.

Duhoon, S. S.; Basu, A. K. and Sahni, V. M. (1983). Heterosis and combining ability studies in cotton (*G. hirsutum* L.). *J. Indian Soc. Cott. Improv.*, **8**: 19-27.

Griffing, B. 1956a. Concept of general and specific combining ability in relation to diallel crossing systems. *Aust. J. Biol. Sci.*, **9**: 463-493.

Griffing, B. 1956b. A generalized treatment of the use of diallel cross in quantitative inheritance. *Heredity*, **10**: 31-50.

Kempthorne, O. (1957). *An Introduction to Genetic Statistics.* John Willey and Sons. New York.

Laxman, S. (2010). Diallel analysis for combining ability for seed cotton yield and its components in *desi* cotton (*Gossypium arboreum* L.). *J. Cotton Res. Dev*., **24**: 26-28.

Nirania, K. S.; Jain, P. P. and Tuteja, O. P. (2010). Combining ability estimates for yield and its component traits in cotton (*G. hirsutum* L.). *National Conference on "Paradigm Shift in Cotton Research and Cotton Cultivation*" held at MCRS, NAU, Surat from October 19-21, 2010.

Patel, U. G.; Patel, J. C.; Patel, P. G.; Vadodaria, K. V. and Sutaria, C. M. (1997). Combining ability analysis for seed cotton yield and mean fibre length in upland cotton *G. hirsutum* L. *India J.Genet.*, **57**(3): 315-318.

Pratap, L. K.; Reddy, C. V.; Reddy, K. V. S. and Rao, P. C. (2006). Combining ability for yield and its component traits in cotton. *Andhra Agric. J.*, **53**: 152- 156.

Preetha, S. and Raveendran, T. S. (2008). Combining ability and heterosis for yield and fibre quality traits in line x tester crosses of upland cotton. Int. J. Pl. Breed. Genet., **2**(2): 64-74.

Sakhare, B. A.; Wandhare, M. R.; Ladole, M. Y. and Wakode, M. M. (2005). Combining ability studies in diploid cotton. *J. Cotton Res. Dev*. **19**: 52-54.

Table 1: Mean squares due to general and specific combining ability for different characters in upland cotton

Sources of Variation	d.f.	Number of Sympodia Per Plant	Number of Bolls Per Plant	Boll Weight (g)	Seed Cotton Yield Per Plant (g)	Lint Yield Per Plant (g)	Ginning Percentage (%)	Seed Index (g)	Lint Index (g)
Replications	2	2.82	35.98*	0.01	165.49	21.92	0.070	0.006	0.03
Hybrids	27	23.65**	97.46**	0.41**	357.74**	70.83**	6.13**	1.81**	0.95**
Line effect	3	7.95	66.70	0.06	389.81	34.19	1.35	0.40	0.49
Tester effect	6	14.87	137.74	0.54	420.21	99.87	7.02**	1.87	0.50
Line x tester effect	18	28.81**	73.68**	0.42**	332.33**	66.38	14.22**	1.99**	1.17**
Error	54	2.73	9.50	0.06	110.51	13.81**	1.23	0.08	0.06
σ^2f		0.20	2.29	0.0005	11.36	0.85	0.39	0.01	0.01
σ^2m		0.99	10.51	0.04	25.80	7.18	0.85	0.15	0.03
σ^2gca		0.47	5.03	0.01	16.35*	2.96	0.54*	0.05	0.02
σ^2sca		8.61**	20.66**	0.12**	73.92**	17.55	2.50**	0.64	0.37**
σ^2gca / σ^2sca		0.05	0.24	0.11	0.22	0.16	0.21	0.09	0.06

****, ** Significant at 5 % and 1 % levels, respectively***

Table 2: Estimation of general combining ability (GCA) effects of parents for various characters in upland cotton

Parents	Number of Sympodia Per Plant	Number of Bolls Per Plant	Boll Weight (g)	Seed Cotton Yield Per Plant (g)	Lint Yield Per Plant (g)	Ginning Percentage (%)	Seed Index (g)	Lint Index (g)
Lines								
GBHV-148	-0.40	0.11	0.02	-2.97	-1.29	-0.90**	-0.08	-0.14**
GBHV-164	-0.02	-2.40**	0.04	-3.43	-0.58	0.27	-0.11*	-0.04
GBHV-177	1.26*	1.10	-0.07	5.24*	1.44	0.68**	0.17**	0.20**
G.Cot.16	0.81*	1.19	0.01	5.15*	0.43	-0.05	0.02	-0.02
S. E. (gi)	0.35	0.70	0.04	2.15	0.75	0.22	0.05	0.05
S. E. (gi-gj)	0.50	0.99	0.07	3.04	1.06	0.32	0.08	0.07
Testers								
NH-630	1.85**	1.88	-0.20**	1.40	2.56*	1.49**	-0.37**	0.03
H-1452	-1.84**	6.18**	0.08	7.33*	4.26**	1.03**	-0.26**	0.14*
BS-30	0.37	-4.21**	0.28**	-2.57	-1.63	-0.77*	0.88**	0.27**
NH-635	0.69	-2.06*	0.17**	-1.69	0.56	0.69*	0.13	0.19**
NDIH-1938	0.35	-1.16	0.19**	7.16*	2.47*	-0.02	-0.06	-0.04
BS-79	-0.99	0.07	-0.27**	-9.18**	-3.79**	-0.48	-0.09	-0.13
GJHV-358	-0.27	-3.08**	0.03	-5.77	-2.54*	-0.65*	0.06	-0.11
H-1353	-0.16	2.44	-0.21**	3.32	-1.91	-1.28**	-0.28**	-0.35**
S. E. (gi)	0.50	0.98	0.06	3.03	1.06	0.32	0.08	0.07
S. E. (gi-gj)	0.70	1.40	0.09	4.30	1.51	0.45	0.11	0.10

, ** Significant at 5 % and 1 % levels, respectively

Table 3: Estimates of sca effects for various characters in some selected upland cotton inter specific hybrids

Character	Range	Best Crosses	Mean Performance	sca Effects	Number of Significant Crosses in Desirable Direction
Number of Sympodia Per Plant	-4.76 to 4.69	GBHV-164 x NH-630	26.93	4.69	7
		GBHV-164 x NH-635	25.33	4.25	
		G.Cot-16 x NDIH-1938	25.67	4.10	
		GBHV-148 x H-1452	21.87	3.72	
Number of Bolls Per Plant	-5.71 to 12.15	GBHV-148 x H-1452	54.52	12.15	5
		GBHV-177 x H-1353	30.42	9.24	
		G.Cot-16 x NH-630	43.79	4.65	
		GBHV-164 x NH-635	43.40	4.62	
Boll Weight (g)	-0.65 to 0.60	GBHV-177 x BS-30	4.28	0.60	6
		GBHV-148 x H-1452	4.08	0.04	
		GBHV-164 x H-1353	3.71	0.42	
		GBHV-177 x NH-630	3.58	0.40	
Seed Cotton Yield Per Plant (g)	-19.50 to 22.95	GBHV-148 x H-1452	148.33	22.95	6
		GBHV-164 x NDIH-1938	140.73	15.58	
		G.Cot-16 x NH-635	111.33	13.16	
		G.Cot-16 x H-1353	140.33	10.83	
Lint Yield Per Plant (g)	-7.22 to 12.71	GBHV-148 x H-1452	50.73	12.71	3
		GBHV-164 x NDIH-1938	52.33	6.48	
		GBHV-177 x NH-635	47.25	5.39	
		G.Cot-16 x NH-630	38.10	3.81	
Ginning Percentage (%)	-3.11 to 2.36	G.Cot-16 x NDIH-1938	36.60	2.36	6
		GBHV-148 x BS-30	35.00	2.35	
		GBHV-148 x H-1452	36.20	1.74	
		GBHV-177 x NH-635	37.40	1.70	
Seed Index (g)	-1.57 to 0.97	GBHV-177 x BS-30	9.10	0.48	12
		GBHV-177 x NH-635	8.50	0.62	
		G.Cot.16 x GJHV-358	8.63	0.97	
		G.Cot.16 x BS-30	8.47	0.01	
Lint Index (g)	-1.19 to 1.16	GBHV-148 x H-1452	5.11	1.16	10
		GBHV-177 x NH-635	5.08	0.70	
		G.Cot.16 x NDIH-1938	4.66	0.73	
		GBHV-177 X NH-630	4.57	0.36	

, ** Significant at 5 % and 1 % levels, respectively

[MS received : December 14, 2017] *[MS accepted : December 20, 2017]*