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Heterosis and combining ability for seed cotton yield and its component traits of *desi* cotton (*Gossypium arboreum* L.)

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ABSTRACT *:* Line x tester analysis was attempted to study the heterosis and combining ability and yield attributing traits in 40 hybrids of *desi* cotton (*G. arboreum* L.) developed by using 4 lines and 10 testers. These were evaluated for seed cotton yield and yield components. Out of 40 hybrids, 3 hybrids were heterotic and had positive and significant sca effects for seed cotton yield. The genotypes GMS 1, GAK 20, HD 450, HD 432 and HD 324 identified as good general combiner for seed cotton yield and other traits and are having better mean performance with high gca effects for seed cotton yield and most of the traits. The hybrids GAK 20 x HD 432, GMS 1 x HD 432 and GMS 1 x GCD 22 registered high *per se* performance, coupled with significant heterobeltosis and sca effects in desired direction and involved good general combiner parents for seed cotton yield.

Key words : Combining ability, *Gossypium arboreum,* gca, heterosis, sca, seed cotton yield

Desi cotton (*Gossypium arboreum* L.) is very well adapted to the fluctuating rainfall and adverse climatic conditions. *Desi* cottons are still under cultivation because of their inherent ability to resist major pest and diseases. After the introduction of *Bt* cotton, there was significant decrease in area of *desi* cotton because of their smaller boll size and low yield potential 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. Cotton is highly amenable for heterosis breeding. Commercial exploitation of heterosis has achieved a spectacular success in India. Considering the importance of the crop, there is a need to generate more information on heterosis, combining ability, nature of gene action, correlation and adaptabilities among different sets of parents, therefore, it is necessary to develop hybrids by testing combining ability.

MATERIAL AND METHODS

Four lines *viz.,* GMS 1, GMS 4, GAK 20 and GMS 21 and 10 testers *viz.,* HD 450, P 541, GCD 101, GCD 308, GCD 22, HD 107, P 494, HD 123, HD 324 and HD 432 were crossed into line x tester mating design in 2013-2014 to generate 40 hybrids. These 40 hybrids along with 14 parents were evaluated in randomized block design with 3 replications during *kharif,* 2014-2015 at Cotton Research Area, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar. Each entry was sown in 2 rows of 6 m length with a spacing of

67.5 cm between rows and 30 cm between plants. Observations were recorded on randomly selected 5 plants from each replication for seed cotton yield/plant (g), plant height (cm), monopods and bolls/plant. The data was analyzed on line x tester mating design for combining ability efforts and heterosis was worked out.

RESULTS AND DISCUSSION

The analysis of variance for combining ability for different characters expressed significant mean squares due to crosses and parents indicating that the hybrids and parents were significantly divergent in all the characters. The differences due to lines were highly significant for the characters *viz.,* plant height (cm), monopodia, bolls and seed cotton yield/plant (g), whereas, testers were highly significant for almost all the characters. The line x tester interaction differences was highly significant for all the characters except monopodia/plant. High significant mean squares due to single difference contrast 'parents *v/s* crosses' showed presence of heterosis in hybrids for all traits. The estimates of variance due to gca and sca showed additive gene action predominant for character *i.e.* plant height (cm). Similarly, bolls/plant, monopodia and seed cotton yield/plant (g) showed non additive genetic control. Patel *et al.*, (2009) also reported non additive type of gene action for these traits. The *per se* performance and estimates of gca effects are given in Table 1. The lines *viz.,* GMS 1 and GAK 20 had positive and significant gca effect for seed cotton yield and these were good combiners among lines for most of the characters. The line GMS 21 found good combiner for plant height followed by GAK

Table 1. Mean performance and gca effect of parents for yield and other characters

Parents	Plant height (cm)		Monopods/ plant		Bolls/ plant		Seed cotton yield / plant (g)	
	Mean	gca	**Mean**	gca	**Mean**	gca	**Mean**	gca
GMS 1	**187.23**	-13.025**	**2.13**	-0.253*	**20.43**	1.881**	**35.07**	6.568**
GMS 21	**209.00**	10.438**	**4.27**	-0.133	**18.90**	-1.756**	**34.60**	-3.536**
GAK 20	**176.10**	3.692**	**2.53**	0.123	**17.43**	0.348	**31.57**	1.188**
GMS 4	**195.57**	-1.105	**3.43**	0.243*	**17.33**	-0.472*	**28.53**	-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	**195.00**	-3.555	**3.00**	0.317	**22.33**	2.359**	**39.37**	1.948**
P 541	**172.57**	0.228	**3.77**	-0.517*	**20.33**	-1.266**	**33.70**	-2.219**
GCD 101	**183.90**	-1.830	**2.67**	-0.083	**17.10**	0.859*	**27.90**	-0.111
GCD 308	**184.47**	-0.247	**3.50**	0.283	**21.77**	2.434**	**36.30**	1.256
GCD 22	**177.23**	6.678**	**4.57**	-0.267	**17.90**	-0.474	**27.90**	-1.869*
HD 107	**148.33**	-11.238**	**4.33**	-0.325	**17.77**	-3.832**	**27.83**	-6.769**
P 494	**193.33**	1.228	**6.00**	-0.067	**23.20**	-0.683	**37.57**	-6.286**
HD 123	**175.00**	-4.872*	**4.67**	0.183	**19.90**	-2.532**	**40.70**	-0.836
HD 324	**186.10**	-0.355	**4.47**	0.133	**22.53**	1.118*	**43.33**	4.806**
HD 432	195.57	13.962**	**4.50**	0.342	**21.10**	2.018**	**43.60**	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

Table 2. Mean performance, heterobeltosis and sca effects of the best 11 hybrids/ crosses for yield and other characters in cotton

Parents	Plant height (cm)			Monopods/ plant			Bolls/ plant			Seed cotton yield / plant (g)		
	Mean	BP	sca	**Mean**	BP	sca	**Mean**	BP	sca	**Mean**	BP	sca
GMS 1 x HD 450	**179.23**	-8.09	0.792	**3.77**	25.56	1.003**	**29.67**	32.84	0.611	**60.03**	52.50	5.532**
GMS 1 x GCD 22	**187.77**	1.29	-0.908	**2.33**	-48.91	0.153	**29.17**	42.74	2.944**	**59.80**	70.53	9.116**
GMS 1 x HD 107	**162.33**	-13.30	-8.425*	**2.23**	-48.46	0.112	**25.00**	22.35	2.136**	**52.27**	49.05	6.482**
GMS 21 x HD 450	**204.77**	-2.03	2.862	**3.00**	-29.69	0.097	**32.00**	43.28	6.581**	**52.87**	34.29	8.469**
GMS 21 x P 541	**223.90**	7.13	18.212**	**2.87**	-32.81	0.797*	**28.33**	39.34	6.539**	**52.93**	52.99	12.703**
GMS 21 x GCD 101	**195.57**	-6.43	-8.063	**2.23**	-47.66	-0.270	**28.23**	49.38	4.314**	**48.60**	40.46	6.261**
GAK 20 x P 494	**208.33**	7.76	8.392*	**2.43**	-59.44	-0.323	**27.43**	18.25	2.953**	**47.03**	25.20	6.146**
GAK 20 x HD 123	**205.53**	16.71	11.692**	**2.77**	-40.71	-0.240	**25.90**	30.15	3.269**	**49.30**	21.13	2.963*
GAK 20 x HD 432	**196.47**	0.46	-16.208**	**2.77**	-38.52	-0.398	**28.57**	35.39	1.386*	**61.40**	40.83	4.146**
GMS 4 x GCD 308	**202.77**	3.68	9.097*	**3.00**	-14.29	-0.227	**26.77**	22.97	-0.011	**48.57**	33.79	5.544**
GMS 4 x HD 324	**196.67**	0.56	3.105	**3.10**	-30.60	0.023	**28.33**	25.74	2.872**	**51.30**	18.39	4.727**
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

20 and GMS 4 was found to be good combiner for monopods /plant, while GMS 1 was good combiner for the bolls/plant and seed cotton yield. Among the testers, HD 450, HD 432 and HD 324 recorded high mean performance and gca effect for seed cotton yield. Tester HD 432 also had significant and positive gca effect for most of the characters *viz.,* plant height, bolls and seed cotton yield/ plant (g). Considering the *per se* performance and gca effects together for seed cotton yield and yield contributing characters, the lines GMS 1 and GAK 20 and the testers HD 450, HD 432 and HD 324 were considered as superior and good combiners.

The estimates of heterosis over better parent and specific combining ability are presented in Table 2. The hybrids, GMS 1 x HD 450, GMS 1 x GCD 22 and GMS 21 x P 541 were identified as the best cross combination showing higher *per se* performance and significant heterobeltosis (60.03, 52.50 and 59.80, 70.53 and 52.93, 52.99, respectively) for seed cotton yield. Average heterosis and heterobeltosis for these traits was also reported by many research workers *viz.,* Bagade *et al.,* (2007), Pole *et al.,* (2008), Reshmi *et al.,* (2007), Patel *et al.,* (2009), Sawarkar *et al.,* (2015) and Eswari *et al.*, (2016)**.** It could be concluded that hybrids exhibited heterosis for seed cotton yield also high heterotic for one or more its component traits. The estimates of sca effects (Table 2) indicated that, out of 40 hybrids, 11 hybrids had positive sca effects for seed cotton yield. The hybrid GMS 21 x P 541 was identified as the best cross combination for seed cotton yield and 3 component traits. The hybrids GMS 21 x P 541, GAK 20 x HD 123 and GAK 20 x P 494 possessed well *per se* performance coupled with significant mid parent heterosis, heterobeltosis and significant sca effects in desirable direction for seed cotton yield and other traits. The parents which possessed favorable gca effects showed no relationship with sca effects of the hybrids resulting from these parents for certain traits and indicated the influence of epistatic gene action. Similar results were also reported by Reshmi *et al.,* (2007) and Yuksel *et al.,* (2011). If all this parameters are associated for the expression of the character, it will be a boon to the breeder to screen such parental combination to exploit them for a successful heterotic breeding. By considering this, the following hybrids *viz.,* GMS 21 x P 541, GAK 20 x HD 123 and GAK 20 x P 494 were considered as superior for well *per se* performance coupled with significant mid-parent heterosis, heterobeltosis and significant sca effects in desirable direction for seed cotton yield and other traits.

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