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GENETICS OF YIELD, YIELD ATTRIBUTES AND THEIR IMPLICATIONS IN BREEDING OF COTTON (*GOSSYPIUM HIRSUTUM* L.)

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ABSTRACT

A 9 x 9 diallel cross analysis indicated predominance of additive variation for seed cotton yield per plant and six other yield attributes including bolls per plant. Genotype Laxmi was a good general combiner for five of the seven traits including bolls per plant. DS-4 and DS-56 were also good combiners, the latter showing significant gca effects for seed cotton yield per plant and bolls per plant. Potential cross combinations were also identified for giving good yields. Three crosses, DS-56 x RRD-417, RRD-425 x DP-1635 and DS-4 x FORN-1 based on sca effects were considered ideal for exploitation of heterosis.

Key words: Gca, sca, heterosis, cotton.

Progress in the genetic improvement in any crop species depends much on the genetic information of quantitative traits. Breeding or selection schemes designed on the basis of such information are expected to result in achieving useful gains. An attempt is made here, wherein the results of genetic analysis of seed cotton yield and its related attributes are discussed along with their implications in breeding for higher yield.

MATERIALS AND METHODS

The experimental material comprised nine parents (DS-4, DS-56, DS-59, RRD-425, RRD-417, RRD-371, DP-1635, FORN-1 and Laxmi) and their diallel crosses excluding reciprocals. The resulting 45 entries (nine parents and 36 F_1s) were evaluated in R.B.D. with three replications at A.R.S. Dharwad Farm. Each entry was planted in three rows of 2.7 m length with a spacing of 60 cm between and 30 cm within the rows. The data recorded on

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five random plants for seven quantitative traits were used to estimate combining ability as per the method of [1].

RESULTS AND DISCUSSION

Highly significant gca variance and nonsignificant sca variance obtained for squares per plant, monopodia per plant and seed cotton yield per plant (Table 1) indicated the prevalence of additive variation for these characters. The ratio of $2\sigma^2g/\sigma^2s$ was also more

Table 1. Analysis of variance for combining ability for yield and its attributes in cotton

Source	d.f.	Squares per plant	Mono-podia per plant	Sympodia per plant	Fruiting points per plant	Flowers per plant	Bolls per plant	Seed cotton yield per plant
Gca	8	11.5**	0.23**	6.17*	245.3**	47.2**	5.3**	134.3**
Sca	36	2.6	0.08	0.34	60.2*	9.7**	0.8*	31.4*
Error	88	2.9	0.07	0.55	33.4	4.6	0.5	15.5
σ^2g		0.8	0.02	0.53	16.8	3.4	0.4	9.4
σ^2s		−0.2	0.01	−0.21	26.8	5.1	0.3	15.9
$\frac{2\sigma^2g}{\sigma^2s}$		—	4.0	—	1.3	1.3	2.5	1.2

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

than unity in case of monopodia per plant further confirming the importance of additive variation for these traits as reported earlier [2–4].

Both additive and nonadditive variation appeared to be important in respect of the three other yield attributes, (flowering points per plant, flowers per plant, bolls per plant and seed cotton yield) which was also reported earlier [5]. However, preponderance of additive variation for all the traits was clearly evident from $2\sigma^2g/\sigma^2s$ ratio being more than unity. However, predominance of additive gene action for seed cotton yield and bolls per plant in cotton was demonstrated by several other studies [4, 6, 7].

The gca effects of nine parents involved in the study for seed cotton yield per plant and six related traits are presented in Table 2. These observations demonstrate the importance of cv. Laxmi as a good general combiner which showed significant desirable gca effects for five out of the six yield attributes. DS-4 was the next best general combiner showing

Table 2. General combining ability effects of nine parents for different characters in cotton

Parent strain	Squares per plant	Monopodia per plant	Sympodia per plant	Fruiting points per plant	Flowers per plant	Bolls per plant	Seed cotton yield per plant
DS-4	0.916	0.052	0.501*	4.732**	1.390*	0.069	1.511
DS-56	0.564	0.157	- 0.113	0.085	- 0.050	0.654*	4.446**
DS-59	- 1.663**	0.101	- 1.051**	- 4.297**	- 2.823**	- 0.081	4.435**
RRD-425	- 0.786	- 0.017	- 0.556**	- 0.551	- 1.650**	0.295	2.899**
RRD-417	0.669	0.127	0.499*	4.379**	2.562**	- 1.275**	- 3.096**
RRD-371	- 0.968*	- 0.255*	0.335	- 4.121*	- 2.141**	- 0.778**	- 4.806**
DP-1635	0.535	- 0.190	0.461*	- 3.227*	1.368*	0.901**	- 0.567
FORN-1	- 0.607	- 0.066	- 1.095**	- 5.061**	- 1.296*	- 0.235	- 3.619**
Laxmi	1.340**	0.092	1.019**	8.062**	2.642**	0.449*	- 1.202
SE (gi)	0.483	0.074	0.211	1.643	0.610	0.201	1.118

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

significant desirable gca effects for seed cotton yield per plant, flowering points and no. of flowers per plant. DS-56 exhibited significant gca effects only for seed cotton yield per plant and bolls per plant. RRD-371 and FORN-1 were poor combiners with negative gca effects for six and four traits, respectively including seed cotton yield per plant.

Taking into consideration the performance of cv. Laxmi, one of the standard cultivars, and DS-56, the best parental entry in the present study, 16 crosses were identified as potential which could be of use in further breeding programmes leading to either pure lines or hybrids as discussed later here under. It is clear from Table 3 that these crosses performed better over Laxmi and DS-56 in respect of seed cotton yield per plant and bolls per plant. Table 3 also contains information on the magnitude of heterosis, gca effects of the parents, and sca effect of these crosses for seed cotton yield per plant and bolls per plant. Such an information can be taken as a guiding factor to decide about the way these crosses can be handled. The parents were classified as high (H) or low (L) general combiners based on their gca effects for these two characters following the modified procedure of Arunachalam [8]. The nature of cross combinations in respect of the gca status of the parent shows that all the potential crosses identified (Table 3) are of H x H or H x L type except DS-4 x FORN-1 which under lines the importance of H x H or H x L combinations in realising heterotic and potential crosses. Langham [9] demonstrated that H x L type of crosses generally give transgressive segregations. Such crosses with nonsignificant sca effect could prove to be very useful to

Table 3. Performance of promising crosses in cotton

Cross	Seed cotton yield/plant					Bolls/plant					Gca status of parents
	mean (g)	hete-rosis (%)	gca effects		sca	mean	hete-rosis (%)	gca effects		sca	
			female parent	male parent				female parent	male parent		
DS-4 x DS-56	61.7	30.5**	1.51	4.45**	6.99	11.80	15.69	0.07	0.65**	0.98	L x H
DS-4 x DS-59	58.9	25.0**	1.51	4.44**	4.26	10.67	11.15	0.07	-0.08	0.58	L x H
DS-4 x FORN-1	54.0	38.2**	1.51	-3.62**	7.38*	10.47	11.03	0.07	-0.24	0.53	L x L
DS-56 x DS-59	51.1	5.1	4.45**	4.44**	-6.54	8.88	-8.74	0.65**	-0.08	-1.79**	H x H
DS-56 x RRD-371	52.5	29.6*	4.45**	-4.81**	4.16	10.93	21.85*	0.65**	-0.78**	0.96	H x L
DS-56 x RRD-416	59.1	35.1**	4.45**	-3.10	9.01*	10.87	21.73*	0.65**	-1.28*	1.39*	H x L
DS-56 x DP-1635	58.8	30.2**	4.45**	-0.57	6.20	13.00	20.71**	0.76**	0.90**	1.34*	H x H
DS-56 x FORN-1	50.7	25.2**	4.45**	-3.62**	1.47	11.00	15.06	0.65**	-0.24	0.48	H x L
DS-56 x Laxmi	53.7	19.5	4.45**	-1.20	1.77	11.07	9.39	0.65**	0.45**	-0.14	H x H
DS-59 x RRD-417	54.0	23.8**	4.44**	-3.10**	3.96	9.27	11.29**	-0.08	-1.28**	0.52	H x L
DS-59 x RRD-425	61.4	27.8**	4.44**	2.90**	5.35	11.40	18.89*	-0.08	0.30	1.09	H x H
DS-59 x DP-1635	52.7	16.9	4.44**	-0.57	0.08	10.27	0.98	-0.08	0.90**	-0.66	H x H
DS-59 x FORN-1	55.5	37.3	4.44**	-3.62*	5.93	10.93	21.99*	-0.08	-0.24	1.15	H x L
DS-59 x Laxmi	58.5	30.3**	4.44**	-1.20	6.54	11.32	18.91*	-0.08	0.45*	0.85	H x H
RRD-425 x DP-1635	60.0	34.5**	2.90**	-0.57	8.98*	12.80	19.63	0.30	0.90**	1.50*	H x H
FORN-1 x Laxmi	46.7	26.9*	-3.62**	-1.20	2.82	10.93	17.02	-0.24	0.45*	0.62	L x H

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

isolate true breeding transgressive segregates by employing simple selection schemes since they are supposed to be the crosses in which more of additive variation is operative for the characters of interest. All the crosses, except DS-56 x RRD-417 and RRD-425 x DP-1635, listed in Table 3 are of this type. Some of the crosses are of H x H type, which can also be handled in same way. One cross, viz., DS-4 x FORN-1, was of L x L type which showed significant sca effects for seed cotton yield can be considered promising for the commercial exploitation of heterosis. Two other crosses, DS-56 x RRD-416 and RRD-425 x DP-1635 with significant sca effects which is indicative of prevalence of nonadditive gene action for seed cotton yield and bolls per plant are also promising for heterosis breeding.

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