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GENETICS OF CERTAIN BOLL CHARACTERS IN COTTON (*GOSSYPIUM HIRSUTUM* L.)

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ABSTRACT

Gene effects and type of epistasis were studied for nine boll characters in two crosses of cotton. The study revealed that additive effects were operative for most of the characters under study. Additive x additive and additive x dominance effects were significant for boll weight, seeds/boll and seeds/lock in cross EC x K 32 and for lint index in the cross KE x H 77. Early generation selection and intermating is suggested for the improvement of component characters.

Key words: Cotton, *G. hirsutum*, epistasis, generation mean analysis.

Cotton (*G. hirsutum* L.) is an important fibre crop. Several studies [1–3] indicate that boll number and size, which are positively correlated with yield, are the major components of yield. Understanding the genetics of boll related traits will help in formulating suitable breeding programme to improve yield. The present investigation has been taken up to study the gene effects governing various boll characters.

MATERIALS AND METHODS

Four diverse genetic stocks, viz. Kekchi (KE), H 777 (H 77), EC 12661-8-1 (EC), and K 3219 (K 32) were used in the study. The experimental material comprised two crosses, viz. KE x H 77 and EC x K 32. The two parents, F_1, F_2, BC_1 and BC_2 generations from each cross were grown in randomised block design with three replications at the Central Institute for Cotton Research, Regional Station, Coimbatore during winter 1988–89. Each plot of the parents and F_1s had two rows of plants while F_2s had 15 rows and each backcross generations had four rows. The spacing between rows was 75 cm, between plants 45 cm and row length 3 m. Data were recorded on five random plants in the parents, F_1 and from all the available plants in F_2 and backcross generations in each plot. Boll characters studied were boll length, boll breadth, length : breadth (l/b) ratio, boll weight, seeds/boll, seeds/lock, ginning per cent, lint index and seed index.

Scaling test as suggested by Mather [4] and Hayman and Mather [5] were applied to detect nonallelic interaction. Wherever scaling test was inadequate, gene effects, mean (m), additive (d), dominance (h), additive x additive (i), additive x dominance (j), and dominance x dominance (l) were worked out as suggested by Hayman [6]. In the absence of nonallelic interaction, the components m, d and h were worked out following the method suggested by Jinks and Jones [7].

RESULTS AND DISCUSSION

The experimental material for the present study involved extreme types (Table 1). The parents KE and EC were big-boll types with high seed and lint index. H 77 and K 32 were

Table 1. Mean values of different characters over six generations in two crosses of cotton

Cross (female x male)	Female parent	Male parent	F_1	F_2	BC_1	BC_2
			Boll length			
KE x H 77	5.45 ± 0.18	3.88 ± 0.04	4.78 ± 0.02	4.53 ± 0.05	4.88 ± 0.03	4.16 ± 0.10
EC x K 32	4.55 ± 0.09	3.36 ± 0.04	4.35 ± 0.08	4.11 ± 0.05	4.57 ± 0.09	3.80 ± 0.05
			Boll breadth			
KE x H 77	3.56 ± 0.15	2.65 ± 0.03	3.19 ± 0.01	3.09 ± 0.02	3.25 ± 0.06	2.86 ± 0.04
EC x K 32	3.49 ± 0.19	3.19 ± 0.06	2.99 ± 0.08	2.90 ± 0.02	3.22 ± 0.05	2.64 ± 0.02
			L/B ratio			
KE x H 77	1.53 ± 0.01	1.46 ± 0.03	1.50 ± 0.003	1.47 ± 0.006	1.48 ± 0	1.46 ± 0.02
EC x K 32	1.39 ± 0.003	1.53 ± 0.09	1.46 ± 0.02	1.42 ± 0.006	1.43 ± 0.03	1.44 ± 0.01
			Boll weight			
KE x H 77	5.17 ± 0.54	2.50 ± 0.24	3.49 ± 0.15	3.70 ± 0.06	4.02 ± 0.25	3.50 ± 0.19
EC x K 32	4.90 ± 0.08	2.14 ± 0.05	3.80 ± 0.10	3.40 ± 0.10	3.13 ± 0.17	2.70 ± 0.13
			Seeds/boll			
KE x H 77	35.83 ± 1.15	24.97 ± 0.43	32.10 ± 1.13	31.63 ± 0.41	32.87 ± 1.60	29.63 ± 0.64
EC x K 32	34.70 ± 1.16	22.20 ± 0.43	32.90 ± 1.13	32.30 ± 0.91	32.40 ± 1.60	28.90 ± 1.22
			Seeds/lock			
KE x H 77	8.70 ± 0.3	6.30 ± 0.1	8.00 ± 0.2	7.70 ± 0.1	8.10 ± 0.4	7.90 ± 0.1
EC x K 32	8.00 ± 0.03	5.80 ± 0.1	8.20 ± 0.2	8.00 ± 0.1	7.90 ± 0.4	7.30 ± 0.1
			Ginning per cent			
KE x H 77	31.30 ± 0.3	31.30 ± 1.8	29.30 ± 0.4	30.50 ± 0.2	28.80 ± 0.3	31.30 ± 0.7
EC x K 32	33.00 ± 0.3	27.30 ± 0.9	30.70 ± 0.4	31.10 ± 0.5	31.40 ± 0.6	30.20 ± 1.2
			Lint index			
KE x H 77	4.70 ± 0.4	3.00 ± 0.3	3.30 ± 0	3.40 ± 0.1	3.40 ± 0.1	3.10 ± 0.1
EC x K 32	4.80 ± 0.4	2.60 ± 0.1	3.50 ± 0.1	3.40 ± 0.1	3.50 ± 0.21	2.80 ± 0.2
			Seed index			
KE x H 77	10.30 ± 0.4	6.40 ± 0.5	8.10 ± 0.2	8.60 ± 0.2	8.60 ± 0.1	7.30 ± 0.4
EC x K 32	10.00 ± 0.3	7.10 ± 0.1	7.60 ± 0.2	7.30 ± 0.2	7.90 ± 0.3	6.50 ± 0.3

characterized by small bolls, small seeds and low lint index. For most of the characters the F_1 values were closer to the better parent, indicating the importance of additive gene effects.

The estimates of components of generation means for three and six generation models for the various characters showed significant additive effects in both crosses for all the characters except l/b ratio and seed index (Table 2). In the case of seed index, additive effects were significant only in cross EC x K 32. In the absence of epistasis, these characters could

Table 2. Estimates of gene effects for different characters in two crosses of cotton

Cross	m	d	h	i	j	l
			Boll length			
KE x H 77	4.53 ± 0.04**	0.72 ± 0.01**	0.05 ± 0.29	− 0.06 ± 0.28	− 0.07 ± 0.14	0.88 ± 0.49
EC x K 32	3.65 ± 0.48**	0.59 ± 0.07**	1.12 ± 1.27			
			Boll breadth			
KE x H 77	3.25 ± 0.31**	3.10 ± 0.13**	− 0.57 ± 0.89			
EC x K 32	2.78 ± 0.30**	0.59 ± 0.17**	0.27 ± 0.86			
			L/B ratio			
KE x H 77	1.47 ± 0.01**	0.02 ± 0.01	0.01 ± 0.01	0	− 0.01 ± 0.02	0.12 ± 0.07
EC x K 32	1.40 ± 0.11*	− 0.01 ± 0.79	0.09 ± 0.03*			
			Boll weight			
KE x H 77	4.33 ± 1.31**	1.33 ± 0.52**	1.79 ± 3.81			
EC x K 32	3.40 ± 0.10**	0.88 ± 0.18**	− 0.98 ± 0.56	− 1.24 ± 0.55**	− 0.49 ± 0.18**	3.47 ± 0.87**
			Seeds/boll			
KE x H 77	32.98 ± 6.69**	5.43 ± 1.07**	16.29 ± 19.02			
EC x K 32	32.16 ± 0.26**	3.50 ± 0.98**	− 1.75 ± 2.43	− 6.20 ± 2.23**	− 2.75 ± 1.21**	6.43 ± 4.35
			Seeds/lock			
KE x H 77	7.70 ± 1.31**	7.50 ± 0.21**	− 0.30 ± 3.90			
EC x K 32	7.96 ± 0.03**	0.66 ± 0.14**	− 0.18 ± 0.39	− 1.47 ± 0.32**	− 0.45 ± 0.15**	1.17 ± 0.62
			Ginning per cent			
KE x H 77	30.53 ± 0.17**	− 2.53 ± 1.84**	− 4.00 ± 2.11	− 2.00 ± 1.83	− 2.53 ± 1.27	3.20 ± 3.97
EC x K 32	31.35 ± 5.93**	2.85 ± 0.80**	− 0.35 ± 15.78			
			Lint index			
KE x H 77	3.43 ± 0.03**	0.33 ± 0.08**	− 1.16 ± 0.35**	0.67 ± 0.22**	− 0.53 ± 0.25*	1.93 ± 0.61
EC x K 32	3.37 ± 0.12**	0.77 ± 0.23**	− 1.15 ± 0.67	− 0.87 ± 0	− 0.38 ± 0.23	2.70 ± 1.06
			Seed index			
KE x H 77	8.95 ± 2.36**	1.95 ± 1.27	− 2.45 ± 6.54			
EC x K 32	7.30 ± 0.15**	1.43 ± 0.47**	− 1.23 ± 1.14	− 0.33 ± 1.12	− 0.03 ± 0.49	− 3.93 ± 2.01

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

be improved by simple pedigree selection. Dominance effects were significant only for l/b ratio in the cross EC x K 32 and for lint index in cross KE x H 77.

Epistatic gene effects were found for all the characters except boll breadth in at least one cross. Marani [8] also observed epistatic gene action for several boll traits. However, Dhillon and Singh [9] did not observe significant epistatic interaction for any of the boll traits studied by them. Additive x additive effects were significant for lint index in cross KE x H 77 and for boll weight, seeds/boll and seeds/lock in cross EC x K 32. This type of epistasis is an indication of getting desirable segregants in the respective crosses.

Additive x dominance effects were significant only in the cross EC x K 32 for boll weight, seeds/boll and seeds/lock. If this type of interaction is associated with complementary epistasis, then it can be fixed in subsequent generations by selection in a particular cross [10].

The dominance x dominance effects were significant only in the cross EC x K 32 for boll weight. The sign of dominance and dominance x dominance effects were opposite in most of the crosses indicating the operation of duplicate epistasis. This type of epistasis is likely to hinder the progress through selection. Since the additive effects were also significant in the above cases, reciprocal recurrent selection as suggested by Comstock et al. [11] is likely to be useful for the effective utilization of additive and nonadditive gene effects.

The present study has revealed the preponderance of additive effects in the expression of most of the component traits of boll size. Among the epistatic components, additive x additive and additive x dominance effects were predominant. Using diverse multiple parents, early generation selection and intermating is likely to help in improving the component characters.

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