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GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN TETRAPLOID SPECIES OF COTTON

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ABSTRACT

Twelve *G. hirsutum* genotypes and 14 *G. barbadense* genotypes were studied for genetic variability, heritability and genetic advance for seed cotton yield, halo length, ginning outturn, lint index, seed index, bolls per plant and boll weight. In *G. hirsutum* cotton, LRA 5166 and TKH 4-3 were superior for seed cotton yield, MCU 5, MCU 9 and MCU 11 were superior for halo length and RKR 4145 and HLS 321729 were superior for ginning outturn. In *G. barbadense* cotton, BCS 9-95 and TCB 87-6 were superior for seed cotton yield; IMS 0721, IMS 2722 and Suvin were superior for halo length and TCB 87-6, BCS 23-18-7 and RBS 85 were superior for ginning outturn. These genotypes could be exploited by inter-varietal hybridization within the species (pedigree breeding) for evolving a superior variety or by interspecies hybridization between the species (heterosis breeding) for developing a superior interspecific hybrid combining high yield and good fibre quality.

Key words: Variability, heritability, genetic advance, *Gossypium hirsutum, G. barbadense.*

Tetraploid cottons play a major role in cotton production. The success of a good breeding programme usually depends upon the quantum of genetic variability present in the breeding materials. Thus, knowledge on genetic variability, heritability and genetic advance in tetraploid cotton is very essential for a breeder to choose good parents and to decide the correct breeding methodology for crop improvement. With this objective, the present study was made.

MATERIALS AND METHODS

Widely variable cotton genotypes from tetraploid species, viz. *G. hirsutum* and *G. barbadense* were taken for study. Twelve *G. hirsutum* varieties, viz. LRA 5166, TKH 4-3, RKR 4145, ACP-71-12-3, MCU 9, MCU 11, AHO 61-38-2, AHO 66-107-1/1, HLS 321729, JK 119-25-54, MCU 5, and RAS 311; and 14 *G. barbadense* varieties, viz. BCS 9-95, TCB 87-6, BCS 23-18-7, TCB 273-1-15, RBS 14, TCb 2-95, RBS 85, IMS 0721, TCB 292, IMS 2722, C 17, Suvin, IMP 0131 and IMP 1021, received from different states under All India Coordinated Varietal Trials were raised in randomized block design with three replications in separate trials at

cotton Breeding Station, Coimbatore under winter irrigated conditions. Data on seed cotton yield, halo length, ginning outturn, lint index, seed index, number of bolls per plant and boll weight were collected and analysed statistically. The differences were significant at 5% level, indicating wide variability.

RESULT AND DISCUSSION

The results of estimated genetic variability, heritability and genetic advance for yield and other characters for *G. hirsutum* are presented in Table 1 and for *G. barbadense* in Table 2. Analysis of variance showed that the differences among varieties for different traits were significant in both species, indicating presence of wide variability. Genotypic variance (σ^2_g) and genotypic coefficient of variation (GCV) were much less than phenotypic variance (σ^2_p) and phenotypic coefficient of variation (PCV), respectively, for most of the traits in both species which indicated that all these traits were highly influenced by environment. The magnitude of variability was more for seed cotton yield and number of bolls per plant in both the species as indicated by high coefficient of variation (CV) values. Magnitude of variability was reported to be low for seed cotton yield and ginning outturn in *G. barbadense* [1].

Heritability in broad sense (h^2) was high (> 65%) for seed cotton yield, halo length, ginning outturn, lint index and seed index in *G. hirsutum*. It was also high for all the above characters except seed index in *G. barbadanse*. Boll number and boll weight showed high heritability in rainfed American cotton [2]. Boll number, boll weight, halo length, lint index and seed index showed high heritability in upland cotton [3].

Genetic advance was high for seed cotton yield (37.5%), followed by lint index (25.2%) in *G. hirsutum*, while it was high for boll weight (97.9%) followed by seed cotton yield (50.8%) in *G. barbadense*. High genetic advance for boll number and boll weight was also reported earlier in *G. hirsutum* [2].

Mean values for different traits in both the species showed that ginning outturn, lint index and boll weight had higher means in *G. hirsutum* but lower in *G. barbadanse*, while halo length and seed index had higher means in *G. barbadense* but lower in *G. hirsutum*. However, yield of seed cotton and number of bolls per plant were more or less equal in both the species in the materials studied.

Seed cotton yield and number of bolls per plant showed high variability in both species. Since variation is the basis for selection, these two characters can be exploited for hybridization and selection for improving yield of seed cotton in both the species.

High heritability (75% and above) was observed for the halo length, ginning outturn and lint index in both the species, which denotes high proportion of genetic effects in the

Table 1. Character means, variability, heritability and genetic advance for yield and yield components in *G. hirsutum*

Variety	Source	Seed cotton yield (kg/ha)	Halo length (mm)	Ginning outturn (%)	Lint index (g)	Seed index (g)	Bolls per plant	Boll weight (g)
LRA 5166	CICR, Coimbatore	2022*	22.7	37.1	4.2	7.1	10.6	3.7
TKH 4-3	TNAU, Coimbatore	1995*	25.6	37.1	4.3	7.3	11.0	3.7
RKR 4145	CICR, Coimbatore	1925	21.1	41.1*	4.9	7.0	12.0	3.3
ACP 71-12-3	Karnataka	1759	24.2	37.3	5.3	8.8	9.9	4.3
MCU 9	TNAU, Coimbatore	1664	27.8*	37.0	4.9	8.3	10.7	4.0
MCU 11	– Do –	1659	28.4*	36.6	4.8	8.1	11.3	4.5
AHO 61-38-2	Karnataka	1614	24.9	38.9	5.8*	9.2*	10.1	4.7
AHO 66-107-1/1	– Do –	1557	25.4	37.0	4.9	8.4	10.4	4.2
HLS 321729	CICR, Coimbatore	1408	27.3	40.6*	6.5*	9.5*	8.9	5.0*
JK 119-25--54	Karnataka	1128	23.3	38.5	4.9	7.7	8.1	4.0
MCU 5	TNAU, Coimbatore	980	28.4*	33.0	4.0	8.1	8.0	3.7
RAS 311	Karnataka	976	25.5	39.3	5.2	8.0	7.1	4.5
Range		976 to 2022	21.1 to 28.4	33.0 to 41.1	4.0 to 6.5	7.0 to 9.2	7.1 to 12.0	3.3 to 5.0
Mean		1557	25.4	37.8	5.0	8.1	9.8	4.1
MSS (V)		2.9	16.2	13.5	1.4	1.8	6.7	0.7
Whether significant		Yes	Yes	Yes	Yes	Yes	Yes	Yes
SE		134	0.7	0.7	0.2	0.3	0.9	0.3
CD		392	2.0	2.0	0.5	0.8	2.6	0.8
CV (%)		14.9	4.8	3.1	5.6	5.5	15.4	10.8
σ^2_g		0.9	4.9	4.0	0.4	0.5	1.5	0.2
σ^2_p		1.3	6.4	5.4	0.5	0.7	3.6	0.4
GCV		22.0	8.7	5.3	13.3	9.0	12.4	10.4
PCV		26.6	9.9	6.2	14.4	10.5	19.8	15.0
h^2 (broad sense)		68.8	77.1	74.8	84.6	72.6	39.4	47.4
GA		1.6	4.0	3.6	1.3	1.3	1.6	0.6
GA (% of mean)		37.5	15.8	9.5	25.2	15.8	16.0	14.6

*Significant over mean at 5% level.

Table 2. Character means, variability, heritability and genetic advance for yield and yield components in *G. barbadanse*

Variety	Source	Seed cotton yield (kg/ha)	Halo length (mm)	Ginning outturn (%)	Lint index (g)	Seed index (g)	Bolls per plant	Boll weight (g)
BCS 9-95	Karnataka	2466*	30.3	33.3	5.0*	10.0	10.2	2.7
TCB 87-6	TNAU, Coimbatore	2275*	30.7	33.9	4.9*	9.5	12.3	2.6
BCS 23-18-7	Karnataka	2098	29.0	34.7*	4.6	8.6	10.7	2.5
TCB 273-1-15	TNAU, Coimbatore	2038	31.9	32.6	4.3	8.7	13.7*	2.4
RBS 14	Karnataka	2030	27.8	33.6	5.1*	9.8	9.3	2.5
TCB 295	TNAU, Coimbatore	1936	29.9	32.5	4.8	10.0	12.3	2.3
RBS 85	Karnataka	1709	28.1	36.1*	4.8	8.8	10.5	2.4
IMS 0721	CICR, Coimbatore	1363	33.1*	28.0	3.7	9.5	8.9	2.4
TCB 292	TNAU, Coimbatore	1245	30.8	31.0	4.2	9.2	10.2	2.4
IMS 2722	CICR, Coimbatore	1325	33.4*	23.0	3.6	9.4	10.2	2.3
C 17	– Do –	1125	31.2	32.8	5.1*	10.3	7.2	2.6
Suvin	– Do –	1079	33.5*	29.2	4.2	10.1	8.7	2.5
IMP 0131	– Do –	1062	31.7	31.7	3.7	7.9	8.4	2.1
IMP 1021	– Do –	907	31.3	31.7	3.7	8.0	8.4	2.1
Range		907 to 2466	27.8 to 33.5	28.0 to 36.1	3.6 to 5.1	7.9 to 20.3	7.2 to 13.7	2.1 to 2.7
Mean		1619	30.9	32.1	4.4	9.3	10.1	2.4
MSS (V)		10.4	9.6	17.2	1.0	1.8	9.7	8.6
Whether significant		Yes	Yes	Yes	Yes	Yes	Yes	Yes
SE		188	0.6	0.6	0.2	0.4	0.9	0.8
CD		545	1.6	1.6	0.4	1.0	2.7	2.2
CV		20.1%	3.2%	2.9%	5.7%	6.6%	26.2%	5.5%
σ^2_g		3.0	2.8	5.4	0.3	0.5	2.4	2.3
σ^2_p		4.4	3.8	6.3	0.4	0.9	5.0	4.0
GCV		29.8	5.4	7.3	12.5	7.5	15.2	63.1
PCV		35.9	6.3	7.8	13.6	10.0	22.1	83.5
h^2 (broad sense)		68.7	75.2	85.9	83.3	55.2	47.1	56.9
GA		2.9	3.0	4.4	1.0	1.1	2.2	2.4
GA (% of mean)		50.8	9.8	13.8	23.4	11.4	21.5	97.9

*Significant over mean at 5% level.

determination of these traits. The quickest and cheapest breeding method of mass selection technique can be adopted for improving these characters.

High genetic advance is another parameter to assess the expected improvement in a character by hybridization and selection. In *G. hirsutum*, seed cotton yield showed high genetic advance (37.5%), followed by lint index (25.2%), and in *G. barbadense*, boll weight showed very high genetic advance (97.9%) followed by seed cotton yield (50.8%). Though boll weight showed high genetic advance, this trait possessed low variability, heritability and mean. Further, this trait was highly influenced by environment as is evident from the high phenotypic variance.

When variability, heritability and genetic advance are considered together, seed cotton yield may be the best reliable trait in both the species that could be exploited for hybridization and selection for improvement since this character recorded high variability, heritability and genetic advance percentage.

Among the genotypes in *G. hirsutum*, LRA 5166 and TKH 4-3 were superior for seed cotton yield; MCU 5, MCU 9 and MCU 11 for halo length; RKR 4145 and HLS 321729 for ginning outturn; AHO 61-38-2 and HLS 32729 for both lint index and seed index, and HLS 321729 for boll weight.

In *G. barbadense*, the varieties BCS 9-95 and TCB 87-6 were superior for seed cotton yield; IMS 0721, IMS 2722 and Suvin for halo length; TCB 87-6, BCS 23-18-7 and RBS 85 for ginning outturn; BCS 9-95, TCB 87-6, RBS 14 and C 17 for lint index; and TCB 273-1-15 for bolls/plant.

The varieties identified as superior genotypes for different traits in both the species could be exploited for inter varietal hybridization within the species (pedigree breeding) for evolving a high yielding variety or they could be exploited for interspecific hybridization (heterosis breeding) for developing high yielding hybrid cotton combining good fibre quality.

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