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Genetic Variability, Heritability and Genetic Advance Studies for Yield and Fibre Quality Traits in Cotton (*Gossypium Hirsutum* L.)

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ABSTRACT

In the present study, forty five hybrids along with their ten parents and standard check were estimated for genetic variability, heritability and genetic advance for seed cotton yield, yield components and fibre quality traits. The analysis of variance revealed that sufficient variability was present in the material for all the characters. The Phenotypic Coefficient of Variation (PCV) was slightly higher than Genotypic Coefficient of Variation (GCV) for all the characters indicating the influence of the environment. The variability studies indicated that high PCV and GCV was observed in case of number of monopodia plant^{-1} and seed cotton yield plant^{-1}. High heritability coupled with high genetic advance as percent of mean was observed for number of monopodia plant^{-1}, number of bolls plant^{-1} and seed cotton yield plant^{-1} which provides better scope for advancement through direct selection.

Key words: *Genetic advance, Gossypium hirsutum, Heritability, Seed cotton yield, Variability.*

Cotton is an important fibre crop of global importance which is grown in tropical and subtropical regions of more than 60 countries of the world. Despite threat from synthetic fibre or manmade fibre, cotton retains its reputation as "King of the fibre". For multiple uses of lint and byproducts, cotton is also referred to as "white gold". In any crop improvement programme knowledge on nature of gene action and inheritance of traits is essential so as to choose a suitable breeding methodology in crop improvement. The information on the extent of genetic variability, heritability and genetic advance present in the material is an important pre requisite in framing any crop improvement programme. Genetic variability along with heritability of a character indicates the possibility and extent to which improvement was feasible through selection on phenotypic basis. High heritability coupled with high genetic advance as per cent of mean would bring out the progress expected from selection. Therefore, the present study was undertaken to find out the genetic variability, heritability and genetic advance of various yield components and quality parameters to establish appropriate criterion for selection to improve the yield status of cotton.

MATERIAL AND METHODS

The present investigation was carried out with 56 genotypes obtained from the ten parents *viz*., L788, HYPS-152, L770, L1493, SCS-1207, PBH-13, GJHV-497, GSHV-177, GTHV-13/32 and L1231 and forty five intra-specific cross combinations were made in half-diallel fashion. The evaluation of hybrids along with parents was done at Regional Agricultural Research Station, Lam, Guntur district, Andhra Pradesh during *kharif*, 2017-18. Each entry was sown in 1 row with a spacing 105 x 60 cm with a row length of 6m. Recommended doses of fertilizers, 120 N, 60 P_2O_5 and 40 K_2O kg/ha were applied in split doses. Observations were recorded on five randomly selected plants from each genotype per replication for the characters *viz*., plant height (cm), number of monopodia plant^{-1} , number of sympodia plant^{-1}, number of bolls plant^{-1}, boll weight (g), seed index (g), lint index (g) and seed cotton yield plant^{-1} (g). The data on days to 50% flowering, ginning out turn (%), 2.5% span length (mm), micronaire value (10^{-6}g/ inch), bundle strength (g/tex) and uniformity ratio were recorded on plot basis. The fibre quality parameters were studied at Central Institute for Research on Cotton Technology (CIRCOT), Regional Unit, RARS, Lam, Guntur, Andhra Pradesh by using HVT Expert 1201 high volume fibre tester instrument. The data was statistically analysed to estimate Phenotypic Coefficient of Variation (PCV) and Genotypic Coefficient of Variation (GCV) as indicated by Burton (1952). Heritability in broad sense was estimated as per formula given by Hanson *et al*.(1956) and genetic advance as per of mean as suggested by Johnson *et al*.(1955).

RESULTS AND DISCUSSION

Analysis of variance indicated significant differences among the genotypes for all the characters under study indicating the existence of sufficient amount of variability in the material. The Phenotypic Coefficient of Variation (PCV) was slightly higher in

Table 1. Analysis of variance for yield and yield components in cotton (*Gossypium hirsutum* L.) during *kharif* 2017-18

Source of variation	d. f.	Plant height (cm)	Days to 50% flowering	Number of monopodia plant^{-1}	Number of sympodia plant^{-1}	Number of bolls plant^{-1}	Boll weight (g)	Seed index (g)
Mean sum of squares								
Replications	2	42.82	3.59	0.07	0.97	10.32	0.01	1.7
Treatments	55	481.72**	12.02**	1.21**	12.07**	111.52**	0.50**	3.18**
Error	110	91.65	4.03	0.09	2.68	19.46	0.03	0.73

Source of variation	d. f.	Lint index (g)	Ginning outturn (%)	2.5% span length (mm)	Micronaire value (10-^{6} g/inch)	Bundle strength (g/tex)	Uniformity ratio	Seed cotton yield plant^{-1} (g)
Mean sum of squares								
Replications	2	0.18	2.73	0.03	0.02	0.5	0.25	15.74
Treatments	55	1.24**	6.81**	8.41**	0.18**	4.53**	2.97**	1942.95**
Error	110	0.47	1.02	0.73	0.03	0.41	1.55	216.69

d. f = degrees of freedom ***,**** Significant at 5% and 1% level

Table 2. Estimates of mean, variability, heritability (broad sense) and genetic advance as per cent of mean for yield and its components in cotton (*Gossypium hirsutum* L.) during *kharif*, 2017-18

S. No.	Character	Mean	Range		Coefficient of variation		Heritability (broad sense) (%)	Genetic advance as per cent of mean
			Minimum	Maximum	PCV (%)	GCV (%)		
1	Plant height (cm)	152.58	117.20	178.40	9.76	7.47	59.00	11.79
2	Days to 50% flowering	62.10	56.33	66.67	4.25	2.56	36.00	3.18
3	Number of monopodia plant^{-1}	2.23	1.33	3.73	30.54	27.38	80.00	50.57
4	Number of sympodia plant^{-1}	16.56	11.60	21.00	14.56	10.68	54.00	16.16
5	Number of bolls plant^{-1}	43.86	29.60	55.93	16.14	12.63	61.00	20.35
6	Boll weight (g)	4.22	3.06	5.02	10.37	9.35	81.00	17.37
7	Seed index (g)	9.85	7.30	13.36	12.65	9.17	53.00	13.69
8	Lint index (g)	6.87	5.56	8.31	12.43	7.39	35.00	9.04
9	Ginning outturn (%)	32.15	29.30	35.15	5.34	4.32	65.00	7.19
10	2.5% span length (mm)	29.75	25.20	33.10	6.10	5.38	78.00	9.76
11	Micronaire value (10 $^{-6}$g/inch)	4.36	3.63	4.83	6.68	5.12	59.00	8.07
12	Bundle strength (g/tex)	23.89	19.83	26.03	5.60	4.90	77.00	8.84
13	Uniformity ratio	48.42	46.00	50.00	2.94	1.42	23.00	1.41
14	Seed cotton yield plant $^{-1}$ (g)	120.69	74.98	180.77	23.32	19.88	73.00	34.90

PCV = Phenotypic coefficient of variation

GCV = Genotypic coefficient of variation

magnitude than Genotypic Coefficient of Variation (GCV) for all the characters (Table.2) indicating that the apparent variation was not only due to genotypes but also due to influence of environment. The Phenotypic Coefficients of Variation (PCV) and Genotypic Coefficients of Variation (GCV) were high for number of monopodia plant^{-1} (30.54 & 27.38) and seed cotton yield plant^{-1}(23.32 & 19.88). Similar results were also reported by Vineela *et al*. (2014). While, low PCV and GCV were recorded for characters *viz*., plant height, days to 50% flowering, ginning outturn, 2.5% span length, micronaire value, bundle strength and uniformity ratio. These results are in agreement with the findings of Dhivya *et al*. (2014), Rajamani *et al*. (2015) and Dahiphale *et al.* (2015). Moderate PCV and GCV were recorded for traits *viz*., number of sympodia plant^{-1} (14.56 & 10.68) and number of bolls plant^{-1} (16.14 & 12.63). While moderate phenotypic coefficients of variation and low genotypic coefficients of variation were recorded for characters *viz*., boll weight, seed index and lint index. Rajamani *et al*. (2015) and Hafiz *et al.* (2013) also reported similar results for boll weight, seed index and lint index. Wider variability was observed for number of monopodia plant,$^{-1}$ number of bolls plant^{-1} and seed cotton yield plant^{-1}. The characters *viz*., days to 50% flowering, plant height, number of sympodia plant,$^{-1}$ boll weight, seed index, lint index, ginning outturn, 2.5% span length, micronaire value, bundle strength and uniformity ratio recorded narrow variability indicating variability among the material studied depicting the possibility of improvement in the yield by further selection in segregating generations. These results are in broad agreement with the findings of Krishna Kishore *et al*. (2011) and Elango Dinakaran (2012). High heritability value was recorded for most of the characters ranging from 23.0 (Uniformly ratio) to 81.0 (Boll weight) which indicated that the preponderance of additive gene action and single selection is effective to improve these characters. These findings are in accordance with previous studies reported by Haritha *et al*. (2012), Kumari Vinodhana *et al*. (2013) and Bayyapu Reddy *et al*. (2016). Heritability estimates along with genetic advance would be more useful in predicting yield under phenotypic selection than heritability estimates alone as suggested by Johnson *et al*. (1955). High heritability coupled with high genetic advance as per cent of mean was observed for number of monopodia plant,$^{-1}$ number of bolls plant^{-1} and seed cotton yield plant^{-1}. Indicating the predominance of additive gene action and the direct phenotypic selection may be useful for improving these traits. High heritability coupled with low genetic advance as per cent of mean was observed for ginning outturn, 2.5% span length and bundle strength. High heritability coupled with moderate genetic advance as per cent of mean was observed for boll weight, revealing the role of additive and non-additive gene action. Further improvement of these traits would be possible through cyclic hybridization, diallel selective mating and biparental mating. Moderate heritability and moderate or low genetic advance as per cent of mean were recorded in case of plant height, days to 50% flowering, number of sympodia plant^{-1}, seed index, lint index and micronaire value. Low heritability coupled with low genetic advance were recorded in case of uniformity ratio indicating the operation of non-additive gene action. The characters which are governed by non-additive gene action need to be exploited by heterosis breeding or population improvement through various forms of recurrent selection. Kale *et al.* (2007) reported the similar results for uniformity ratio.

CONCLUSION

The present study revealed that the genetic advance did not follow the pattern of heritability for all the characters except for number of monopodia plant^{-1}, number of bolls plant^{-1} and seed cotton yield plant^{-1}. Hence, direct selection is effective for improving these traits.

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