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Genetic Variability, Heritability and Genetic Advance Studies for Yield, Yield Contributing Characters and Quality Traits in Cotton (*Gossypium hirsutum* L.)

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ABSTRACT

Forty two hybrids along with their 17 parents and three standard checks were studied to observe genetic variability, heritability and genetic advance for seed cotton yield and its contributing characters. The analysis of variance revealed that the 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 lint yield and high and moderate in case of number of bolls plant^{-1} and seed cotton yield plant^{-1}. High heritability coupled with high genetic advance as percent of mean was observed for number of bolls plant^{-1}, boll weight (g), seed index (g), lint index (g), lint yield (g) 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 formulating in 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 62 genotypes obtained from the 17 parents (14 lines and 3 testers), forty two intra-specific cross combinations and three standard checks (LAHH5, ATM and RCH-659) were made in line × tester fashion by using Randomized block design. 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 represented by following 105 x 60 cm spacing with 1 row for each entry 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), lint yield (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), 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 with regard to all the characters under study indicating the existence of sufficient amount of variability in the material (Table 1). The PCV was slightly higher in magnitude than

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)	Ginning outturn (%)
Mean sum of squares								
Replications	2	70.0147	1.1989	0.0252	6.1617	18.3001	0.0352	3.6293
Treatments	55	682.4232**	28.4764**	0.5511**	2.9223**	307.2558**	1.4467**	10.0854**
Error	110	105.8907	5.7181	0.0979	2.1906	13.4609	0.0564	2.5079

Source os variation	d. f.	Seed index (g)	Lint index (g)	2.5% span length (mm)	Micronaire value (10^{-6}g/inch)	Bundle strength (g/tex)	Uniformity ratio	Lint yield (g)	Seed cotton yield plant^{-1} (g)
Mean sum of squares									
Replications	2	0.5936	0.3971	0.0363	0.0123	0.5841	0.0161	63.3176	152.4854
Treatments	61	8.6644**	8.4364**	7.3098**	0.3641**	7.5747**	3.6185**	749.1364**	6165.9526**
Error	122	0.3119	0.9626	0.7126	0.0386	0.4315	2.3221	78.5171	525.0511

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 per cent of mean
			Minimum	Maximum	PCV (%)	GCV (%)		
1	Plant height (cm)	170.29	132.47	204.97	10.14	8.14	64	13.47
2	Days to 50% flowering	60.77	56	67.67	6	4.53	57	7.05
3	Number of monopodia per plant	3.3	2.2	4.27	15.14	11.79	61	18.92
4	Number of sympodia per plant	17.68	15.5	19.6	8.83	2.79	10	1.82
5	Number of bolls per plant	50.04	25.6	74.13	21.09	19.78	88	38.2
6	Boll weight (g)	4.52	3.28	6.46	15.94	15.05	89	29.27
7	Ginning outturn (%)	32.63	29.3	36	6.83	4.87	50	7.11
8	Seed index (g)	9.18	6.21	12.64	19.16	18.17	90	35.44
9	Lint index (g)	10.66	7.44	15.76	17.43	14.81	72	25.91
10	2.5% span length (mm)	28.93	25	32.1	5.9	5.13	76	9.18
11	Micronaire value (10^{-6}g/inch)	4.18	3.2	4.8	9.18	7.88	74	13.94
12	Bundle strength (g/tex)	22.32	19	25.5	7.47	6.87	84	13
13	Uniformity ratio	47.55	45	49	3.49	1.38	16	1.13
14	Lint yield (g)	74.56	41.44	111.82	23.31	20.05	74	35.53
15	Seed cotton yield per plant (g)	227.55	119.3	332.38	21.55	19.06	78	34.71

PCV = Phenotypic coefficient of variation; GCV = 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 PCV and GCV were high for lint yield (g) as well as high PCV and moderate GCV for number of bolls plant^{-1} and seed cotton yield plant^{-1}. Similar results were also reported by Dhivya *et al.* (2014) and Balakrishna *et al.* (2016). While, low PCV and GCV were recorded for characters *viz*., days to 50% flowering, number of sympodia plant^{-1}, ginning outturn, 2.5% span length, micronaire value, bundle strength and uniformity ratio. These results are in agreement with those of Dhivya *et al*. (2014), Rajamani *et al*. (2015) and Jayshankar (2017). Moderate PCV and GCV were recorded for traits *viz*., number of monopodia plant^{-1} , boll weight, seed index and lint index. While moderate phenotypic coefficients of variation and low genotypic coefficients of variation were recorded for characters *viz*., plant height. These results are in agreement with Dhivya *et al.* (2014), Rajamani *et al*. (2015) and Jayshankar (2017). Wider variability was observed for number of monopodia plant^{-1}, number of bolls plant^{-1} , boll weight, seed index, lint index, lint yield and seed cotton yield plant^{-1}. The characters *viz*., days to 50% flowering, plant height, number of sympodia plant^{-1}, ginning out turn, 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 Dhivya *et al.* (2014), Rajamani *et al.* (2015) and Jayshankar (2017). 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 bolls plant^{-1}, boll weight, seed index, lint index, lint yield and seed cotton yield plant^{-1}. indicating the predominance of additive gene action and the direct phenotypic selection may be useful with respect to these traits. High heritability coupled with low genetic advance as per cent of mean was observed for 2.5% span length. High heritability coupled with moderate genetic advance as per cent of mean was observed for number of bolls plant^{-1} and seed cotton yield plant^{-1} revealing the role of additive and non-additive gene action. Further improvement of these traits would be possible through cyclic hybridization and biparental mating. Moderate heritability and moderate or low genetic advance as per cent of mean were recorded in case of days to 50% flowering, ginning outturn and uniformity ratio. Low heritability coupled with low genetic advance were recorded in case of number of sympodia plant^{-1} 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. The results are in agreement with the findings of Alkuddsi *et al.* (2013) and Jayshankar (2017)

CONCLUSION

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

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