

Assessment of genetic variability, heritability and genetic advance in upland cotton (*Gossypium hirsutum* L.)

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ABSTRACT

The study was conducted during the *kharif* season 2024-25 at Regional Agricultural Research station, Lam Farm, Guntur. On present experiment 56 genotypes of cotton (*Gossypium hirsutum* L.) were evaluated for genetic variability, heritability and genetic advance as per cent of mean for 19 quantitative traits. Analysis of variance revealed significant differences for all the characters under study. High genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were observed for the characters viz., no. of monopodia per plant, seed cotton yield per plant (g) at 140 days after sowing, seed cotton yield per plant (g) at 165 days after sowing, total seed cotton yield per plant (g) and proline content whereas the characters plant height, no. of sympodia per plant, no. of bolls per plant, boll weight, seed index, lint index and micronaire recorded moderate PCV and GCV values. No. of monopodia per plant, seed cotton yield per plant (g) at 140 days after sowing, seed cotton yield per plant (g) at 165 days after sowing, total seed cotton yield per plant and proline content exhibited high heritability coupled with high GCV and high genetic advance as per cent of mean indicating direct selection could be effective for improvement of these characters.

Key words: Cotton, Genetic advance, Heritability and Variability.

Cotton (*Gossypium* spp.) popularly called “White gold” is a highly valuable fibre crop with significant commercial and export importance. Often referred to as the “King of Fibre Crops”, it plays a significant role in the Indian economy (Boopathi *et al.*, 2011). It is cultivated in tropical and subtropical regions across more than 80 countries worldwide and holds a prominent position among commercial crops. In India, it fulfils approximately 65% of the total raw material requirements of the textile industry (Sirisha *et al.*, 2019).

In India, Gujarat, Maharashtra and Telangana have emerged as the leading cotton-producing states in India, accounting for approximately 72.64% of the cotton-growing area and these states also contributed to around 72.76% to the nation's cotton yield. In Andhra Pradesh, the total area under cotton cultivation is 4.53 lakh hectares, with a production of 9.41 lakh bales and a productivity of 353 kg per hectare. (ICAR- All India Coordinated Research Project on Cotton, Annual Report, 2024-25).

The development of an effective plant breeding programme is dependent upon the magnitude of genetic variability. The identification of superior varieties or populations is only achievable when there is sufficient genetic variability within the gene pool. Plant breeders must assess variability using parameters such as the phenotypic coefficient of variation, genotypic coefficient of variation, heritability and genetic advance. The phenotypic and genotypic coefficients of variation are used to assess and compare the variability among different traits, further understanding variability through these parameters is crucial for implementing a successful breeding program in crops like cotton.

Heritability estimates are useful for identifying the genetic contribution to phenotypic variation, aiding plant breeders in selecting superior genotypes from diverse populations. Hence, this study focused on analysing genetic variability, heritability estimates and genetic advance in various cotton genotypes.

MATERIAL AND METHODS

The study was conducted during *kharif*, 2024-25 at Regional Agricultural Research Station, Lam Farm, Guntur, Andhra Pradesh. The experimental material used in the present study comprised of 56 genotypes (*G. hirsutum* L.) developed by ANGRAU with different genetic backgrounds. Among the 56 genotypes, NDLH-1938 and NDLH-2035-5 were obtained from RARS, Nandyal while remaining genotypes from RARS, Lam. The experiment was laid in Alpha lattice design with two replications adopting 105x60 cm spacing. To ensure healthy crop stand, recommended agronomic practices and integrated plant protection measures were diligently implemented all through the evaluation time.

Data was recorded for 19 characters *viz.*, days to 50% flowering, plant height (cm), number of monopodia per plant, number of sympodia per plant, number of bolls per plant, boll weight (g), seed index (g), lint index (g), seed cotton yield per plant (g) at

140 days after sowing, seed cotton yield per plant (g) at 165 days after sowing, total seed cotton per plant (g), ginning outturn (%), upper half mean length (mm), micronaire ($\mu\text{g}/\text{inch}$), tenacity (g/tex), uniformity index (%), oil content (%), proline content (%) and seed oil content (%). To evaluate the fiber quality attributes, the seed cotton from the studied plants was mixed, ginned and the resulting lint was analysed. 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. Additionally, the percentage of oil content in cotton seeds was analysed for each sample using Soxhlet apparatus at IIOR, Hyderabad.

The data was statistically analysed to estimate Phenotypic Coefficient of Variation (PCV) and Genotypic Coefficient of Variation (GCV) as indicated by Falconer (1964). Heritability in broad sense was

Table 1. Analysis of variance for all characters studied in cotton (*Gossypium hirsutum* L.)

Source	d. f.	Days to 50 (%) flowering	Plant height (cm)	No. of monopodia per plant	No. of sympodia per plant	No. of bolls per plant	Boll weight (g)	Seed index (g)
Mean sum of squares								
Replications	1	2.009	5.012	0.001	1.338	3.381	0.159	0.47
Treatments	55	37.582**	249.998**	1.734**	4.690**	34.706**	0.624**	1.780**
Blocks	6	4.730	1.234	0	0.612	1.893	0.052	0.198
Error	49	3.642	2.101	0.001	0.527	1.035	0.053	0.164

Source	d. f.	Lint index (g)	Ginning out turn (%)	Seed cotton yield per plant (g) at 140 days after sowing	Seed cotton yield per plant (g) at 165 days after sowing	Total seed cotton yield per plant (g)	Upper Half Mean Length (mm)	Micronaire ($\mu\text{g}/\text{inch}$)
Mean sum of squares								
Replications	1	0.196	8.251	23.954	26.116	11.791	0.495	0.043
Treatments	55	1.190**	19.662**	576.104**	354.270**	1185.103**	5.857**	0.408**
Blocks	6	0.098	3.317	16.163	5.390	6.747	0.126	0.017
Error	49	0.061	2.072	24.146	9.139	92.193	0.204	0.038

Source	d. f.	Tenacity (g/tex)	Uniformity index (%)	Relative water content (%)	Proline content ($\mu\text{ mol. g}^{-1}$)	Oil content (%)
Mean sum of squares						
Replications	1	0.06	0.331	46.907	0.001	1.017
Treatments	55	6.227**	3.616**	51.397**	11.727**	3.125**
Blocks	6	1.395	0.180	10.334	0.005	0.303
Error	49	0.760	0.434	16.317	0.007	0.371

estimated as per Allard (1960) and genetic advance as per cent 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 genotypes studied (Table 1). The phenotypic coefficient of variation (PCV) was slightly higher in 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 coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were high for no. of monopodia per plant, seed cotton yield per plant (g) at 140 days after sowing, seed cotton yield per plant (g) at 165 days after sowing, total seed cotton yield per plant (g) and proline content. Similar results were also reported by Mawblei *et al.* (2022) for no. of monopodia per plant and Sahar *et al.* (2021) for total seed cotton yield per plant. Low PCV and GCV

were recorded for characters *viz.*, days to 50% flowering, ginning outturn, oil content, upper half mean length, tenacity, uniformity index, relative water content. These results were in agreement with the findings of Subalakhshmi *et al.* (2022) for days to 50% flowering and Parre and Patil (2021) for ginning outturn. Moderate PCV and GCV were recorded for characters *viz.*, plant height, no. of sympodia per plant, no. of bolls per plant, boll weight, seed index, lint index and micronaire. Similar findings were previously reported by Krishnan *et al.* (2023) for plant height and Jeyaraj *et al.* (2023) for boll weight.

Heritability estimates along with genetic advance as per cent of mean 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 plant height, no. of monopodia per plant, no. of bolls per plant, boll weight, seed index, lint index, seed cotton yield per plant at 140 days after sowing, seed cotton yield per plant at 165 days after sowing, total seed cotton yield per plant and proline content

Table 2. Estimates of genetic parameters for seed cotton yield, yield attributing and fibre quality traits in 56 cotton genotypes

S. No.	Characters	Mean	Range		Coefficient of variation		Heritability (%) (broad sense)	Genetic advance as per cent of mean
			Minimum	Maximum	PCV (%)	GCV (%)		
1	Days to 50% flowering	68.62	61.50	76.50	6.62	6.00	82.33	11.22
2	Plant height (cm)	110.38	94.20	135.20	10.17	10.09	98.33	20.61
3	No. of monopodia per plant	1.94	0.55	3.54	47.89	47.88	99.93	98.59
4	No. of sympodia per plant	14.42	11.20	18.70	11.20	10.01	79.79	18.41
5	No. of bolls per plant	31.25	19.00	40.40	13.53	13.13	94.21	26.25
6	Boll weight (g)	3.67	2.47	5.03	15.88	14.58	84.24	27.56
7	Seed index (g)	7.74	5.90	10.22	12.73	11.60	83.08	21.79
8	Lint index (g)	4.57	2.51	5.80	17.30	16.43	90.18	32.13
9	Ginning out turn (%)	36.67	29.21	41.10	8.99	8.09	80.94	14.99
10	Seed cotton yield per plant (g) at 140 days after sowing	55.39	11.20	103.50	31.28	29.99	91.96	59.25
11	Seed cotton yield per plant (g) at 165 days after sowing	37.06	7.40	94.10	36.38	35.45	94.97	71.17
12	Total seed cotton yield per plant (g)	92.23	56.32	170.20	27.40	25.35	85.56	48.30
13	Upper Half Mean Length (mm)	27.18	24.30	31.10	6.41	6.19	93.27	12.31
14	Micronaire ($\mu\text{g}/\text{inch}$)	4.08	3.00	4.90	11.57	10.53	82.75	19.73
15	Tenacity (g/tex)	27.63	24.10	31.20	6.77	5.99	78.25	10.91
16	Uniformity index (%)	82.21	80.00	85.00	1.73	1.53	78.57	2.80
17	Relative water content (%)	66.13	57.16	75.02	8.80	6.33	51.81	9.39
18	Proline content ($\mu\text{mol. g}^{-1}$)	5.19	1.25	9.85	46.64	46.61	99.89	95.96
19	Oil content (%)	15.24	12.91	18.35	8.68	7.70	78.77	14.08

PCV= Phenotypic Coefficient of Variation; GCV= Genotypic Coefficient of Variation

indicating the predominance of additive gene action and the direct phenotypic selection may be useful for improving these traits. Similar findings were previously reported by Mawblei *et al.* (2022) for plant height, no. of bolls per plant and total seed cotton yield per plant. Premalatha *et al.* (2020) for seed index, lint index and boll weight. High heritability coupled with moderate genetic advance as per cent of mean was observed for days to 50% flowering, no. of sympodia per plant, ginning outturn, oil content, upper half mean length, micronaire and tenacity, 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. Similar findings were previously reported by Subalakshmi *et al.* (2022) for days to 50% flowering. Keerthivarman *et al.* (2023) for no. of sympodia per plant. Sahar *et al.* (2021) for ginning outturn and Hampannavar *et al.* (2020) for upper half mean length. The results were in contrast to the reports of Kumar *et al.* (2019) as they recorded high heritability coupled with high genetic advance for days to 50% flowering and no. of sympodia per plant.

High heritability coupled with low genetic advance as per cent of mean was observed for uniformity index. These results were in agreement with Sahar *et al.* (2021), Chapara *et al.* (2022). Moderate heritability coupled with low genetic advance as per cent of mean was observed for relative water content indicating the preponderance 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.

CONCLUSION

The present study revealed that the traits number of monopodia per plant, proline content, seed cotton yield per plant at 140 days after sowing, seed cotton yield per plant at 165 days after sowing and total seed cotton yield per plant exhibited high phenotypic and genotypic coefficient of variation along with high heritability and high genetic advance, suggesting the presence of additive gene action. These traits can be effectively improved through direct phenotypic selection.

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