



Studies on Genetic Variability, Heritability and Genetic Advance in Upland Cotton

T Haritha, M Lal Ahamed, V Satyanarayana Rao and Y Ashoka Rani

Department of Genetics and Plant Breeding, Agricultural College, Bapatla 522 101, Andhra Pradesh

ABSTRACT

Forty genotypes of upland cotton (*Gossypium hirsutum* L.) of diverse origin were studied to observe their genetic variability, heritability and genetic advance in yield, yield contributing and fibre quality characters along with some physiological characters. The analysis of variance revealed that sufficient variability was present in the material studied for all the 21 characters. The phenotypic coefficient of variation (PCV) was slightly higher in magnitude than genotypic coefficient of variation (GCV) for all the characters indicating the influence of environment. Higher heritability coupled with high genetic advance observed for characters like plant height, number of sympodia plant⁻¹, boll weight, lint index, ginning out turn, leaf area index at 120 DAS, crop growth rate at 60-120 days and seed cotton yield plant⁻¹ indicating the preponderance of additive gene action making selection effective. Seed index, uniformity ratio, micronaire, fibre elongation and specific leaf weight at 120 DAS showed high heritability and moderate genetic advance indicating presence of both additive and non-additive gene actions. The characters, 2.5 % span length and relative water content at 60 DAS had shown low heritability and low genetic advance making direct selection ineffective.

Key words : Cotton, GCV, Genetic advance, Heritability, PCV .

In the agro-based economy of the country cotton is one of the most important commercial crops. By virtue of its wider adaptability it is grown in irrigated as well as rainfed conditions in India contributing 85 per cent to the national production. In any successful crop improvement programme, the availability of adequate variability in basic genetic stocks and their proper use through breeding for building up improved strains are very necessary. The genetic improvement of plant population depends on the presence of magnitude of genetic variability and the extent to which the desirable traits are transmissible. Thus, besides genetic variability, knowledge on heritability and genetic advance plays a predictive role in breeding, expressing the reliability of phenotype as a guide to its breeding value. The higher the heritability the greater would be the response to selection that is gained in yield as heritability is directly proportional to genetic advance making selection more effective (Burton, 1952 and Swarup and Chaugle, 1962). So, the magnitude of heritable variability is the most important aspect of genetic contribution of the breeding material, which has close relationship on its response to selection (Panse, 1957).

MATERIAL AND METHODS

The experiment was conducted during *kharif* 2010-11 in randomized block design with 40 germplasm lines obtained from all over India with three replications following spacing of 120 x 60 cm at Agricultural College Farm, Bapatla, Andhra Pradesh. The soils are black cotton type with clay texture. Each plot consisted of two rows of 6m length and observations were recorded on five randomly selected plants from each genotype per replication for characters *viz.*, plant height (cm), number of sympodia plant⁻¹, number of bolls plant⁻¹, boll weight (g), seed index (g), lint index (g), ginning out-turn(%), specific leaf weight (mg/cm²), relative water content (%), leaf area index and crop growth rate (g m⁻² day⁻¹). The data on days to 50% flowering, ginning out turn (%), bundle strength (g/tex), uniformity ratio, 2.5% span length (mm), micronaire (10⁻⁶g/in) and fibre elongation (%) were recorded on plot basis.

RESULTS AND DISCUSSION

Analysis of variance indicated sufficient variability in the material under study (Table-1). The mean, range, PCV, GCV, heritability and genetic advance as per cent of mean were presented in Table-2. The narrow difference between genotypic and phenotypic variance was observed for all the

Table 1. Analysis of variance for yield and yield components in cotton.

Source	d.f.	Days to 50% flowering	Plant height (cm)	No. of sympodia plant ⁻¹	No. of bolls plant ⁻¹	Boll weight (g)	Ginning- out-turn (%)	Seed index (g)	Lint index (g)	2.5% span length (mm)	Micronaire (10 ⁻⁶ g/in)	
Mean squares												
Replications	2	2.158	21.333	3.391	19.644	0.082	0.180	0.143	0.143	2.3617	0.176	
Treatments	39	26.237**	1044.453**	13.489**	33.480**	1.620**	47.393**	1.434**	1.909**	6.273**	0.622**	
Error	78	1.449	75.386	2.367	6.870	0.030	0.162	0.100	0.100	2.192	0.070	
Mean squares												
Source	d.f.	Bundle strength (g/tex)	Uniformity ratio	Fibre Elongation (%)	CGR at 60-120 days (g/ m ² /day)	RWC at 60 DAS (%)	RWC at 120 DAS (%)	SLW at 60 DAS (mg/cm ²)	SLW at 120 DAS (mg/cm ²)	Leaf area index at 120 DAS	Harvest index	Seed cotton yield/ plant (g)
Mean squares												
Replications	2	0.757	6.989	0.006	0.053	18.058	4.232	0.023	0.045	0.071	0.004	246.173
Treatments	39	3.250**	56.484**	0.260**	7.748**	68.467**	40.940**	0.448**	0.924**	0.968**	0.006**	828.631**
Error	78	0.710	4.533	0.004	0.086	25.621	12.830	0.060	0.224	0.065	0.001	83.155

**significant at 1% level

Table 2. Mean, genetic variability, heritability (broad sense) and genetic advance as per cent of mean for seed cotton yield and morpho-physiological components in cotton.

S. No	Character	Mean	Range		Coefficient of variation		Heritability (%) (broad sense)	Genetic advance as per cent of mean (at 5% level)
			Minimum	Maximum	PCV (%)	GCV (%)		
1.	Days to 50% flowering	55.81	49.67	62.33	5.58	5.15	85.08	9.79
2.	Plant height	95.11	58.18	121.65	20.99	18.90	81.08	35.05
3.	No. of sympodia plant ⁻¹	14.32	9.11	18.57	17.21	13.45	61.04	21.64
4.	No. of bolls plant ⁻¹	22.74	17.55	30.56	17.45	13.10	56.36	20.26
5.	Boll weight (g)	3.40	2.38	5.29	22.00	21.40	94.57	42.87
6.	Ginning out-turn (%)	35.81	28.35	44.69	11.79	10.73	82.84	20.13
7.	Seed index (g)	8.99	7.56	10.40	8.52	7.25	72.33	12.69
8.	Lint index (g)	5.06	3.47	6.80	16.58	15.35	85.69	29.27
9.	2.5% span length (mm)	27.21	23.59	30.54	6.93	4.29	38.29	5.46
10.	Micronaire (10 ⁻⁶ g/in)	4.58	3.49	5.51	11.02	9.38	72.40	16.43
11.	Bundle strength (g/tex)	21.02	18.22	23.50	5.93	4.38	54.40	6.65
12.	Uniformity ratio	49.8	25.71	53.90	9.39	8.36	79.25	15.32
13.	Fibre elongation (%)	5.75	5.15	6.35	5.20	5.07	94.97	10.18
14.	C.G.R at 60-120 days (g m ⁻² day ⁻¹)	3.57	1.31	8.07	45.50	44.75	96.73	90.67
15.	RWC at 60 DAS (%)	82.93	69.00	89.67	7.62	4.56	35.79	5.62
16.	RWC at 120 DAS (%)	85.15	74.77	91.10	5.53	3.60	42.21	4.81
17.	SLW at 60 DAS (mg cm ⁻²)	5.75	5.18	6.79	7.55	6.25	68.54	10.66
18.	SLW at 120 DAS (mg cm ⁻²)	5.98	5.01	6.84	11.30	8.07	51.05	11.88
19.	LAI at 120 DAS	2.10	1.34	3.49	28.93	26.14	82.20	48.82
20.	Harvest index	0.30	0.21	0.39	17.96	13.43	55.85	20.67
21.	Seed cotton yield plant ⁻¹ (g)	77.07	41.30	122.07	23.63	20.45	74.93	36.47

PCV = Phenotypic coefficient of variation

GCV = Genotypic coefficient of variation

characters indicating that a major portion of phenotypic variation for these characters was contributed by genetic component. The estimates of PCV were slightly higher than corresponding GCV's for all characters which may be due to interaction of genotypes with environment.

High heritability coupled with high genetic advance as per cent of mean was observed for plant height, number of sympodia plant⁻¹, boll weight, lint index, ginning out-turn, crop growth rate at 60-120 days, leaf area index at 120 DAS and seed cotton yield per plant indicating the predominance of additive gene action and direct phenotypic selection may be useful with respect to these traits. High heritability coupled with moderate genetic advance was observed in case of seed index, micronaire, uniformity ratio, fibre elongation and specific leaf weight at 60 DAS revealing the role of additive and non-additive gene action. The other traits *viz.*, days to 50% flowering, number of bolls per plant, 2.5% span length, bundle strength, lint index and relative water content at 60 and 120 DAS showed moderate to high heritability and moderate to low genetic advance indicating the operation of non-additive gene action. They may be exploited through heterosis breeding, cyclic hybridization, biparental mating and diallele selective mating systems.

Thus in the present study genetic advance did not follow the pattern of heritability for all the characters except for plant height, number of sympodia plant⁻¹, boll weight, ginning out-turn, lint index and CGR at 60-120 days, LAI at 120 days, and seed cotton yield plant⁻¹ making selection effective for these traits. Similar results were observed by Reddy and Reddy *et al.*, (2007), Murthy *et al.* (2006), Vijaya Lakshmi (2008), Batool *et al.* (2010) and Kulkarni *et al.* (2011).

LITERATURE CITED

- Batool S, Khan N U, Makhdoom K, Bibi Z, Hassan G, Marwat K B, Mohammad F, Raziuddin and Khan I A 2010.** Heritability and genetic potential of upland cotton genotypes for morpho-yield traits. *Pakistan Journal of Botany*. 42 (2): 1057-1064.
- Burton G W 1952.** Quantitative inheritance in grasses. *Proceedings of the 6th International Grassland Congress*. 277-283.
- Kulkarni A A, Nanda H C and Patil S G. 2011.** Study of genetic parameters on yield, yield contributing and fibre quality characters in upland cotton (*Gossypium hirsutum* L.). *Journal of Cotton Research and Development*. 25 (1): 22-24.
- Murthy J S V S, Chamundeswari N and Udayasree P 2006.** Assessment of genetic variability and relationship of yield attributes in introgressed lines of American cotton. *The Andhra Agricultural Journal*. 53 (3&4): 129-132.
- Panse V G 1957.** Genetics of quantitative characters in relation to plant breeding. *Indian Journal of Genetics and Plant Breeding*. 17: 318-328.
- Reddy Y R and Reddy C V V M 2007.** Genetic variability for yield components and fibre characters in cotton. *Plant Archives*. 7 (2): 759-761.
- Swarup and Chaugle B S 1962.** Studies on genetic variability in sorghum; phenotypic variation and heritable component in some quantitative characters contributing towards yield. *Indian Journal of Genetics and Plant Breeding*. 22: 31-36.
- Vijaya Lakshmi G, Chenga Reddy V, Panduranga Rao C, Satish Babu J and Srinivasulu R 2008.** Character association and path coefficient analysis in cotton (*Gossypium hirsutum* L.). *The Andhra Agricultural Journal*. 55 (2): 156-160.

(Received on 17.06.2011 and revised on 12.08.2011)