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Genetic parameters for seed cotton yield and its contributing traits in upland cotton (*Gossypium hirsutum* L.)

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ABSTRACT : Thirty upland cotton genotypes were studied to observe mean, range and genetic variability for seed cotton yield and its contributing characters. The present study was undertaken at Cotton Research Area, CCS Haryana Agricultural University, Hisar during *kharif,* 2015-2016. The considerable genetic differences among genotypes for various traits were evident in view of highly significant varietal differences in the analysis of variance in all the environments. Coefficient of variation was low for almost all traits in all the environments, which indicates precision of the experiments conducted. The value of phenotypic coefficient of variation (PCV) is greater than genotypic coefficient of variation (GCV); it means that the apparent variation is not only due to genotypes but also due to influence of environment. GCV was the highest for monopods/ plant whereas the lowest for sympods/ plant and also for ginning outturn. Among the characters studied the highest estimate of heritability was recorded for lint yield / plant (92.30%) but sympods / plant showed the lowest heritability with 5.39 per cent. High heritability estimates coupled with high genetic advance were recorded for seed cotton yield / plant.

Key words: GCV, PCV*, Gossypium hirsutum,* mean, range, seed cotton yield, variability

Cotton is one of the most important cash crops in India. On account of its agricultural, as well as industrial importance, it is also called as 'White Gold'. The productivity of cotton has not made headway particularly in *Gossypium hirsutum*. Therefore, there is a need to break plateau of yield potential by developing a high yielding cotton varieties or hybrids. Information on the nature and the extent of genetic variability is an important prerequisite in framing any crop improvement programme. Genetic variability of a character indicated the possibility and extent to which improvement was feasible through selection on phenotypic basis. Therefore, the present study was under taken to find out the genetic variability of various yield and its components traits in *G. hirsutum.*

The experimental material for the present experiment comprised of 30 diverse elite breeding lines of upland cotton. The material was collected from Cotton Section, Department of Genetics and Plant Breeding, CCS, Haryana Agricultural University, Hisar. Experimental material was planted under three environments which had been created through different date of sowing of the genotypes (early, timely and late) during *kharif, 2015* at the Cotton Research Area, CCS Haryana Agricultural University, Hisar. The row of 6 m length and spacing of 67.5 x 30 cm had been maintained. All the recommended package of practices had been adopted for raising a good crop of cotton. The observations on five

randomly selected plants from each replication in each environment were recorded for plant height (cm), monopods/ plant, sympods/ plant, days to first flower, bolls/ plant, boll weight (g), seed index (g), lint index (g), lint yield/ plant (g), ginning outturn (%) and seed cotton yield/ plant (g). The data were subjected to examine variability parameters, such as coefficient of variation, association among seed cotton yield and component traits and to study stability for various traits.

The analysis of variance for randomized block design was carried out for 11 traits in three environments. The results of the analysis of variance are presented in Table 1. It is evident from the results that mean squares due to genotypes were highly significant for almost all the traits. This indicated that wide genetic variability existed among the genotypes for almost all the traits. The coefficient of variation was low for almost all the traits in all the environments, which indicated precision of the experiments conducted. The mean values over all the genotypes for all the traits along with their range are given in Table 2. All the traits had maximum mean values in E1 (Early sown environment) indicating that E1 was the best environment favouring all the 11 traits followed by E3 (Late sown environment) favouring seven traits including seed cotton yield/ plant in comparison with E2 (Timely sown environment). Performance of early sown environment (E1) was better than those of timely sown (E2) and late sown (E3) environments for seed cotton yield/ plant and all its component traits.

Based on pooled analysis, it was observed that highest mean value (100.33 cm) for plant height and lowest for monopods/ plant (1.92). Highest range was observed for all the traits in E1. The E2 environment had shown higher range for boll weight, seed index, and sympods/ plant in comparison with E3. Whereas, higher range for most of the traits, *viz.*, plant height, monopods/ plant, bolls/ plant, lint index, lint yield/ plant, ginning outturn and seed cotton yield/ plant but had lower range for days to first flower (desirable earliness) in E3 as compare to E2. Similar results also reported by Dewdar, (2013) that significant differences among cotton genotypes for seed cotton yield/ plant, lint yield/ plant, bolls/ plant, boll weight, lint per cent and lint index.

This revealed that high variability was expressed in E1 followed by E3 whereas in E2 low variability was expressed. Based on pooled analysis, it was noticed that higher range was for seed cotton yield/ plant followed by plant height and the lowest was for seed index. Hence, similar report was also studied by Dewdar, (2013).

Phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) were also calculated for all the traits studied in three environments. A perusal of Table 3 revealed that PCV was higher than GCV for all the traits under study indicating the role of environmental variation. GCV was the highest for monopods/ plant in E2 whereas the lowest for sympods/ plant in E1 and E3 and also for ginning outturn in E1 and E2 but contrast report was also studied by Muhammad *et al.*, (2016) regarding these traits. Traits having higher GCV indicate higher magnitude of variability among the genotypes.

Estimates of genotypic coefficient of variation (GCV) are useful to compare the extent of genetic variability for different traits. Higher

Table 1. Analysis of variance for seed cotton yield and other traits under different environments

	S.V.	df	Plant height (cm)	Mono-pods/ plant	Sym-pods/ plant	Days to first flower	Bolls/ plant	Boll weight (g)	Seed index (g)	Lint index (g)	Lint yield/ plant (g)	Gin-ning outturn (%)	Seed cotton yield/ plant (g)
E1	Replication	2	14.94	0.01	1.21	1.48	35.01*	0.09	0.08*	0.07*	24.37*	2.93**	118.03*
	Genotypes	29	159.04**	0.49**	2.53	25.74**	49.97**	0.39**	0.35**	0.17**	102.50**	1.70**	621.06**
	Error	58	40.04	0.13	1.86	2.39	6.77	0.03	0.02	0.02	4.78	0.35	26.81
	C.D. (p=0.05)		10.369	0.59	0.0	2.531	4.263	0.291	0.22	0.206	3.582	0.972	8.485
	C.V. (%)		5.168	17.337	6.031	2.53	8.268	5.173	2.258	3.345	5.701	1.531	5.234
E2	Replication	2	88.64*	0.10	2.14	0.13	7.00	0.03	0.01	0.03*	4.25	0.71	21.98
	Genotypes	29	92.20**	0.64**	6.03**	10.13**	47.23**	0.30**	0.30**	0.13**	49.72**	2.20**	368.59**
	Error	58	21.28	0.09	2.24	1.63	5.36	0.03	0.01	0.01	1.37	0.34	10.23
	C.D. (p=0.05)		7.559	0.483	2.451	2.09	3.806	0.295	0.156	0.139	1.92	0.955	5.24
	C.V.(%)		5.443	17.151	7.131	2.286	10.807	6.026	1.677	2.767	5.643	1.662	5.41
E3	Replication	2	2.28	0.01	10.58*	3.63	4.77	0.02	0.02	0.01	0.60	0.41	8.72
	Genotypes	29	177.41**	0.54**	3.09	14.04**	42.08**	0.15**	0.18**	0.15**	50.03**	3.88**	337.57**
	Error	58	22.54	0.16	2.64	1.90	2.38	0.01	0.01	0.01	1.35	0.22	9.75
	C.D. (p=0.05)		7.792	0.647	0.0	2.257	2.527	0.129	0.189	0.152	1.906	0.773	5.115
	C.V.(%)		5.07	20.101	9.533	2.622	6.445	2.649	2.118	2.942	4.775	1.284	4.713

*significant at P = 0.05; ** significant at P = 0.01; E1= Environment 1(early sowing); E2= Environment 2 (timely sowing); E3= Environment 3(late sowing)

Table 2. Mean and range for various traits in cotton under different environments

S. No	Traits	E1		E2		E3		POOLED	
		Mean	Range	Mean	Range	Mean	Range	**Mean**	**Range**
1	Plant height (cm)	**122.43**	105.00-143.33	**84.76**	70.00-100.00	**93.79**	80.00-118.00	**100.33**	**70.00-143.33**
2	Monopods /plant	**2.08**	1.00-3.33	**1.72**	1.00-2.97	**1.96**	1.00-3.00	**1.92**	**1.00-3.33**
3	Sympods/ plant	**22.59**	18.33-24.66	**20.98**	16.00-24.33	**17.04**	14.00-21.00	**20.2**	**14.00-24.66**
4	Days to first flower	**61.04**	54.00-69.00	**55.8**	52.00-61.00	**52.53**	48.00-60.00	**56.46**	**48.00-69.00**
5	Bolls/ plant	**31.46**	22.00-41.66	**21.47**	13.67-32.00	**23.93**	17.00-35.00	**25.62**	**13.67-41.66**
6	Boll weight (g)	**3.43**	2.67-4.12	**2.99**	2.15-3.94	**2.98**	2.32-3.40	**3.13**	**2.15-4.12**
7	Seed index	**5.95**	5.20-6.80	**5.68**	5.05-6.40	**5.44**	4.95-6.00	**5.69**	**4.95-6.80**
8	Lint index	**3.76**	3.24-4.47	**3.07**	2.50-3.52	**3.16**	2.72-3.85	**3.33**	**2.50-4.47**
9	Lint yield/ plant (g)	**38.35**	25.83-52.04	**20.77**	13.34-31.38	**24.36**	15.84-35.72	**27.83**	**13.34-52.04**
10	Ginning outturn (%)	**38.73**	35.90-40.70	**35.09**	32.70-37.30	**36.75**	34.00-39.11	**36.85**	**32.70-40.70**
11	Seed cotton yield / plant (g)	**98.93**	68.00-128.50	**59.12**	39.60-85.07	**66.25**	44.00-95.00	**74.76**	**39.60-128.50**

estimates of GCV were observed for monopods/ plant, bolls/ plant, lint yield/ plant and seed cotton yield/ plant in E2 whereas lower for sympods/ plant, ginning outturn and days to first flower. Though the magnitude of phenotypic coefficient of variation was higher than that of genotypic coefficient of variation, there was narrow variation in the PCV and GCV values. Similar results have also been reported earlier by Kulkarni *et al.,* (2011) and Patil *et al.,* (2016).

The existence of substantial genetic differences among genotypes for various traits in the present study was evident in view of highly significant mean squares due to genotypes in all the three environments for almost all the traits. This indicated that wide genetic variability existed among the genotypes for almost all the traits studied.

Heritability estimates in broad sense were very high for seed index, lint yield/ plant and seed cotton yield/ plant under all three environments. Among the characters studied the highest estimate of heritability was recorded for lint yield/ plant (92.30%) in E3. Similar trend

Table 3. Phenotypic and genotypic coefficients of variation for various traits under different environments

Sr. No.	Traits	E1		E2		E3	
		GCV	PCV	GCV	PCV	GCV	PCV
1	Plant height (cm)	0.05	0.07	0.06	0.08	0.08	0.09
2	Monopods/ plant	0.17	0.24	0.25	0.30	0.18	0.27
3	Sympods/ plant	0.02	0.06	0.05	0.09	0.02	0.10
4	Days to first flower	0.05	0.05	0.03	0.04	0.04	0.05
5	Bolls/ plant	0.12	0.15	0.17	0.20	0.15	0.17
6	Boll weight (g)	0.10	0.11	0.10	0.12	0.07	0.08
7	Seed index	0.06	0.06	0.06	0.06	0.04	0.05
8	Lint index	0.06	0.07	0.07	0.07	0.07	0.08
9	Lint yield/ plant (g)	0.15	0.16	0.19	0.20	0.17	0.17
10	Ginning outturn (%)	0.02	0.02	0.02	0.03	0.03	0.03
11	Seed cotton yield/ plant (g)	0.14	0.15	0.18	0.19	0.16	0.16

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

of heritability was reported by Rajamani *et al.,* (2015) for traits like seed index, lint index and boll weight and by Hafiz *et al.,* (2013) for traits like monopods/ plant, sympods/ plant, bolls/ plant, plant height and days to first flower. These findings of high heritability indicated that environmental effects less influenced these characters and hence additive gene effects were substantially contributing for these traits. Hence, selection for these traits would be helpful for improvement in seed cotton yield (Hafiz *et al.,* (2013). High heritability was also observed for days to first flower under three environments whereas, plant height and monopods/ plant exhibited moderate estimate of heritability (30-60%). Also sympods/ plant showed lowest heritability in E3 with 5.39 per cent.

In the present investigation, high heritability estimates coupled with high genetic advance were recorded for seed cotton yield/ plant. These findings were in agreement with the findings of Kulkarni *et al.,* (2011); Ranjan *et al.,* (2014); Dhivya *et al.,* (2014) and Muhammad *et al.,* (2015) for this trait. Thus, it can be concluded from above findings that the selection for these traits may accumulate more additive genes leading to further improvement of the characters.

Table 4. Heritability and genetic advance in cotton for various traits under different environments

Sr. No.	Traits	E1		E2		E3	
		h^2_{bs}(%)	GA(%)	h^2_{bs}(%)	GA(%)	h^2_{bs}(%)	GA(%)
1	Plant height (cm)	49.77	9.15	52.63	7.27	69.60	12.35
2	Monopods/ plant	48.14	0.50	67.86	0.73	45.33	0.50
3	Sympods/ plant	10.80	0.32	36.08	1.39	5.39	0.19
4	Days to first flower	76.54	5.03	63.51	2.76	68.07	3.42
5	Bolls/ plant	68.03	6.45	72.26	6.54	84.77	6.90
6	Boll weight (g)	79.24	0.63	73.70	0.53	88.82	0.42
7	Seed index	86.15	0.64	91.61	0.62	80.88	0.43
8	Lint index	75.76	0.40	85.42	0.39	84.02	0.41
9	Lint yield/ plant (g)	87.21	10.98	92.14	7.94	92.30	7.97
10	Ginning outturn (%)	56.09	1.03	64.64	1.30	84.54	2.09
11	Seed cotton yield/ plant(g)	88.08	27.21	92.11	21.61	91.81	20.63

h^2_{bs} = Heritability (broad sense), GA= Genetic Advance

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