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Yield components analysis in American Cotton *(Gossypium hirsutum* L.)

U.V. KALE, H.V. KALPANDE, S.N.ANNAPURVE AND V.K. GITE
Department of Agricultural Botany, Marathwada Agricultural University, Parbhani - 431 402 (MS)

Abstract: Evaluation of 42 upland cotton genotypes revealed high heritability with high GCV and genetic gain for number of bolls, number of sympodia, boll weight and plant height and these could be improved by simple selection. Correlation and path analysis studies revealed that number of sympodia, number of bolls, number of seeds and boll weight had significant positive association with seed cotton yield per plant in addition to exhibiting direct positive effect on it.

Key words: Cotton, Variability, Correlation, Path analysis.

Introduction

The success of any breeding programme usually depends upon the quantum of genetic variability present in the breeding material. Improvement in yield and its components depends on the nature and magnitude of genetic variability available in the material for exploitation. Thus, knowledge of genetic variability, heritability and genetic advance in cotton is very essential for breeder to choose good parents and to decide the appropriate breeding methodology for crop improvement. To make selection more effective, it is always desirable to understand and to identify different yield attributes. Correlation of characters is a measure of strength of relationship between group of characters. The estimation of correlation coefficient is an important step in planning selection experiments, as it forms the basis for developing a selection index. Path coefficient analysis provides an effective means of finding the direct and indirect causes of association. To cater to the above needs, the present study was formed to get knowledge regarding variability, character association and path analysis for yield and yield components in American Cotton *(Gossypium hirsutum* L.).

Materials and Methods

The experimental materials consisted of 42 genotypes including 35 F_4 populations advanced from four crosses, five parents along with two checks. The experiment was conducted in Randomized Block Design with two replications during *kharif* 2002 at Department of Agricultural Botany, Marathwada Agricultural University, Parbhani. Recommended package of practices and plant protection measures were adopted to raise a good crop. Each genotype was grown in five rows of 6m length by adopting spacing of 60 x 60 cm. Observations were recorded on twenty randomly selected plants for seed cotton yield per plant (g) and its components *viz.*, days to 50 per cent flowering, days to maturity, plant height (cm), number of monopodia per plant, number of sympodia per plant, number of bolls per plant, number of seeds per plant, 100 seed weight (g), boll weight (g), ginning outturn (%) and staple length (mm). From mean values of each character,

Table 1. Estimate of mean, components of variance, heritability (broad sense) and expected genetic advance in respect of twelve characters in cotton.

Character	Range		Mean	Variance		Coefficients of variation		Heritability (%)	Genetic advance (GA)	Expected genetic advance (% of mean)
	Minimum	Maximum		Pheno-typic	Geno-typic	Phenotypic (PCV)	Genotypic (GCV)			
Days to 50% flowering	68.85	78.39	73.62	6.64	2.65	3.56	2.25	40.00	2.12	2.88
Days to maturity	100.81	114.34	105.48	15.89	9.22	3.78	2.88	58.00	4.67	4.54
No.of monopodia plant^{-1}	5.95	9.67	3.63	1.72	0.42	17.87	8.85	24.50	0.66	8.96
No.of sympodia plant^{-1}	15.01	24.75	18.74	11.90	11.87	11.41	18.39	99.80	7.06	37.67
Plant height (cm)	81.01	103.60	92.72	129.43	120.31	12.27	11.83	92.90	21.77	23.47
No. of bolls plant^{-1}	33.51	64.59	47.65	244.12	238.64	32.79	32.42	97.70	31.46	66.02
No. of seeds boll^{-1}	23.21	29.31	25.78	3.83	1.97	7.60	5.45	51.50	2.08	8.06
100 seed weight (g)	5.05	7.96	7.05	0.736	0.24	12.17	7.05	33.60	0.59	8.36
Boll weight (g)	2.71	5.55	3.49	0.420	0.39	18.57	18.02	94.20	2.56	73.35
Ginning outturn (%)	33.16	47.53	38.21	66.52	43.04	18.95	11.17	64.70	8.01	20.96
Staple length (mm)	22.15	35.61	24.99	52.95	31.78	29.12	22.56	58.40	1.24	4.96
Seed cotton yield plant^{-1} (g)	80.05	123.25	93.13	95.06	66.86	10.47	8.78	70.30	5.79	6.21

genotypic and phenotypic coefficients of variation, heritability (broad sense), genetic advance, genotypic and phenotypic correlation coefficients were computed using standard statistical procedures as suggested by Johnson *et al.* (1955). The correlations were further partitioned into direct and indirect effects by path coefficient analysis as per Dewey and Lu (1959).

Results and Discussion

Genetic variability

The perusal of data from Table 1 revealed significant differences among genotypes for all the twelve characters studied. The characters *viz.*, number of bolls per plant, staple length, number of sympodia per plant, boll weight, plant height and ginning out turn showed high PCV and GCV estimates. Similar findings were reported for above characters except staple length by Kapoor and Kaushik (2003) and Tuteja *et al.* (2004).

The PCV was higher than the respective GCV for all the characters denoting environmental factors influencing their expression to some degree or other. The differences in the values of PCV and GCV were very less for number of bolls per plant, number of sympodia per plant, boll weight and plant height suggesting their relative resistance to environmental alteration. These findings were in agreement with Kapoor and Kaushik (2003) and Gumber *et al.* (2005). Wide differences between the PCV

Table 2. Genotypic and phenotypic correlation coefficients in cotton.

Character	-	Days to maturity	No.of monopodia plant^{-1}	No.of sympodia plant^{-1}	Plant height (cm)	No.of bolls plant^{-1}	No.of seeds boll^{-1}	100 seed weight(g)	Boll weight(g)	Ginning outturn (%)	Staple length (mm)	Seed cotton yield plant^{-1}
Days to 50% flowering	G	0.617**	-0.128	-0.195	-0.111	-0.339*	0.313*	0.064	0.128	-0.101	-0.151	-0.202
	P	0.258	-0.110	0.129	0.078	-0.221	0.146	0.069	0.173	0.070	0.071	0.125
Days to maturity	G		0.347*	0.444**	-0.350*	0.131	0.395**	-0.606**	-0.246	0.439**	0.027	0.447**
	P		0.039	0.337*	-0.204	0.097	0.213	-0.278	-0.192	0.198	0.040	0.332
No.of monopodia plant^{-1}	G			0.401**	-0.102	0.198	0.028	-0.405**	0.233	0.548**	0.122	0.405**
	P			0.184	-0.072	0.078	0.095	-0.025	-0.058	0.223	0.078	0.190
No.of sympodia plant^{-1}	G				-0.132	0.286	0.338*	-0.271	-0.069	0.718**	-0.166	0.728**
	P				-0.125	0.283	0.243	-0.154	-0.061	0.602**	-0.149	0.687**
Plant height (cm)	G					0.283	-0.043	0.179	-0.203	-0.084	0.239	-0.126
	P					0.278	-0.022	0.130	0.171	-0.076	0.174	-0.132
No. of bolls Plant $^{-1}$	G						0.364*	-0.196	-0.071	0.281	0.240	0.428**
	P						0.235	-0.097	-0.045	0.225	0.214	0.376*
No.of seeds boll $^{-1}$	G							-0.041	0.331*	0.513**	0.165	0.354*
								-0.255	0.128	0.320*	0.061	0.233
100 seed weight (g)	G								0.387*	-0.442**	-0.695**	-0317*
	P								0.263	-0.136	-0.375*	-0.128
Boll weight (g)	G									0.392*	0.087	0.344*
	P									0.190	0.085	0.318*
Ginning outturn (%)	G										0.450*	0.715**
	P										0.322*	0.603**
Staple length (mm)	G											-0.170
	P											-0.145

* Significant at 5% level ; ** Significant at 1% level

and GCV as in the case of staple length, ginning outturn, number of monopodia per plant and 100 seed weight implied its susceptibility to environmental fluctuation.

Determination of the magnitude and nature of heritable and non heritable components of variation will enable the breeder to know the characters which respond to selection. The genetic advance values should also be considered simultaneously as high heritability combined with high genetic advance is likely to result in maximum functional gain during selection (Johnson *et al.,* 1955). High genetic advance estimates were indicative of additive gene effects and such variations could be effectively exploited by vigorous selection for improvement of particular character.

High heritability coupled with high genetic advance was observed for number of sympodia per plant, number of bolls per plant, boll weight, plant height and ginning outturn indicating the possibility of improvement of these characters through selection. These results were in conformity with those of Kapoor and Kaushik (2003) for number of sympodia per plant, number of bolls per plant, boll weight and plant height and Tuteja *et al.* (2004) for ginning outturn.

Correlation

Studies on correlation revealed that the genotypic correlation coefficients were larger than the phenotypic ones (Table 2), indicating the high proneness to environmental fluctuation. This might have diluted the expression of correlation between characters at phenotypic level (Bhambota *et al.,* 1994). The characters *viz.,* number of sympodia per plant, ginning outturn, days to maturity, number of bolls per plant and boll weight exhibited significant and positive correlation with seed cotton yield per plant both at genotypic and phenotypic level, where as number of monopodia per plant and number of seeds per boll exhibited significant and positive correlation with seed cotton yield per plant only at genotypic level. Similar results were also reported by Ahuja and Tuteja (2001) for ginning outturn, Altaher and Singh (2003) for boll weight and Kaushik *et al.* (2003) for number of bolls per plant, number of sympodia per plant and number of monopodia per plant.

Path analysis

As simple correlation does not provide the true contribution of the characters towards the yield, these genotypic correlations were partitioned into direct and indirect effects through path coefficient analysis.

Path analysis (Table 3) revealed that number of sympodia per plant had the highest positive direct effect followed by boll weight, number of seeds per boll and number of bolls per plant. These results were in agreement with those of Altaher and Singh (2003) for number of bolls per plant and boll weight and Kaushik *et al.* (2003) for number of sympodia per plant and boll weight. The characters *viz.,* ginning outturn, 100 seed weight, days to maturity, number of monopodia per plant, days to 50 per cent flowering and plant height showed negative direct effects on seed cotton yield per plant. Similar results were reported by Gururajan (2000) for plant height and Ladole and Meshram (2000) for days to 50 per cent flowering, number of monopodia per plant and 100 seed weight. The direct effects of ginning outturn, days to maturity and number of monopodia per plant were negative but their positive correlation with seed cotton yield per plant could be due to the high indirect effects through number of sympodia per plant.

Table 3. Path coefficient analysis of yield components on seed cotton yield at genotypic level in cotton.

Character	Days to 50% flowering	Days to maturity	No.of monopodia plant^{-1}	No.of sympodia plant^{-1}	Plant height (cm)	No.of bolls plant^{-1}	No.of seeds boll^{-1}	100 seed weight(g)	Boll weight(g)	Ginning outturn (%)	Staple length (mm)	Correlation with Seed cotton yield plant^{-1}
Days to 50% flowring	**-0.0591**	-0.1013	0.0086	-0.2876	0.0550	-0.0032	0.0229	-0.0323	0.0586	0.0688	-0.0011	-0.2020
Days to maturity	0.0364	**-0.1643**	0.0232	0.6543	0.0175	0.0013	0.0289	0.3076	-0.1129	-0.2993	0.0002	0.4467**
No.of monopodia plant^{-1}	0.0076	0.0570	**-0.0608**	0.5911	0.0051	0.0019	0.0021	0.2053	0.1068	-0.3750	0.0009	0.4047**
No.of sympodia plant^{-1}	0.0115	-0.0127	0.0268	**1.0753**	0.0066	0.0027	0.0248	0.1374	-0.0318	-0.4892	-0.0012	0.7284**
Plant height (cm)	-0.066	0.0575	0.0068	-0.1943	**-0.0500**	0.0027	-0.0032	-0.0909	0.0933	0.0573	0.0017	0.1256
No. of bolls Plant $^{-1}$	0.020	-0.0224	0.0132	0.4226	-0.0142	**0.0396**	0.0267	0.0996	0.0326	-0.1917	0.0017	0.4277**
No.of seeds boll $^{-1}$	0.0185	-0.0650	-0.0019	0.4989	0.0022	0.0035	**0.0732**	0.0207	0.1516	-0.3493	0.0012	0.3536*
100 seed weight (g)	0.0038	0.0996	0.0270	-0.3993	-0.0090	-0.0019	-0.0030	**-0.5076**	0.1776	0.3008	0.0050	-0.3169*
Boll weight (g)	0.0075	0.0404	-0.0156	0.3023	-0.0102	-0.0007	0.0242	-0.1965	**0.4588**	-0.2669	0.0006	0.3439*
Ginning outturn (%)	-0.0060	-0.0722	-0.0366	1.0595	0.0042	0.0027	0.0375	0.2242	0.1797	**0.6812**	0.0032	0.7150**
Staple length (mm)	0.0089	-0.0044	-0.0081	-0.2442	-0.0128	0.0023	0.0121	0.3528	0.0397	-0.3065	**0.0071**	-0.1701

Residual effect = 0.0528 * Significant at 5% level ; ** Significant at 1% level Diagonal values indicated direct effect.

This investigation revealed that it would be rewarding to lay emphasis on number of bolls per plant, number of sympodia per plant and boll weight in selection programme of cotton, as these characters showed high GCV, heritability, genetic advance and also exhibited high positive direct effect confirming its significant positive correlation with seed cotton yield per plant.

References

Ahuja, S.L. and Tuteja, O.P. (2001). Association and genetic variability for yield and fibre quality traits in coloured linted strains of *Gossypium hirsutum* cotton. *J. Cot. Res. Dev.*, **15:** 226-228.

Altaher, A.F. and Singh, R.P. (2003). Yield components anaysis in upland cotton *(Gossypium hirsutum L.). J. Indian Soc. Cot. Improv.*, **28:** 151-157.

Bhambota, S.K., Sood, B.C. and Gartan, S.L. (1994). Contribution of different characters towards seed yield in chickpea *(Cicer arietinum* L.). *Indian J. Genet.*, **54:** 381-388.

Dewey, D.R. and Lu, K.H. (1959). A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J.*, **51:** 515-518.

Gumber, R.K., Chahal, G.S. and Verma, P.K. (2005). Genetic evaluation of *Gossypium arboreum* genotypes for yield and fibre quality. *J. Cot. Res. Dev.*, **9:** 44-48.

Gururajan, K.N. (2000). Yield component analysis in Egyptian cotton *(Gossypium barbadense* L.). *J. Indian Soc. Cot. Improv.*, **25:** 17-22.

Johnson, H.W., Robinson, H.F. and Comstock, R.E. (1955). Estimates of genetic and environmental variability in soybean. *Agron. J.*, **47 :** 314-318.

Kapoor, C.J. and Kaushik, S.K. (2003). Variability, heritability and genetic advance studies in cotton *(Gossypium hirsutum* L.). *J. Cot. Res. Dev.*, **17:** 240-241.

Kaushik, S.K., Kapoor, C.J. and Koli, N.R. (2003). Association and path analysis in American cotton *(Gossypium hirsutum* L.). *J. Cot. Res. Dev.*, **17:** 24-26.

Ladole, MY. and Meshram, L.D. (2000). Correlation and path coefficient analysis in naturally coloured cotton *(Gossypium hirsutum* L.). *J. Cot. Res. Dev.*, **14:** 89-92.

Tuteja, O.P., Sunil Kumar and Puneet Luthra (2004). Variability, heritability and genetic advance studies in CMS based hybrids in upland cotton *(Gossypium hirsutum* L.). *J. Cot. Res. Dev.*, **18:** 42-43.