G x E interactions and stability analysis in tetraploid cotton (*G. hirsutum* and *G. barbadense*)

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- **Cotton, the king of fibre, is one of the important cash crop having profound influence on economics and social status of the country.**
- **Cotton is long duration crop and is grown under diverse agro-climatic conditions in India. Therefore, it is much influenced by the environmental factors.**
- **For the systematic and successful breeding programme, the knowledge of G x E interactions and stability parameters is of immense value and provides useful guidance in the selections of stable and high yielding genotypes and hybrids.**

- **The experiment was therefore planned and executed to examine the G x E interactions and stability of parents and resultant hybrids using Eberhart and Russell (1966) model.**

- **A set of 38 entries including six parents of which three belongs to *G. hirsutum* (G.Cot.16, G.Cot.20 and BC-68-2) species and remaining three to *G. barbadense* (Suvin, GSB-39 and GSB-41) species, 30 crosses and two check hybrids were grown at the three cotton research stations *viz*., Surat, Hansot and Achhalia during *kharif* 2011-12.**

- **The hybrids were developed adopting complete diallel mating design.**

- **The characters studied were plant height (cm), sympodia per plant, bolls per plant, boll weight (g), seed cotton yield per plant (g), ginning outturn (%), 2.5% span length (mm), fibre strength (g/tex) and fibre fineness (mv).**

Table : 1 Pedigree and average values of economical characters of the parents

Sr.	Name of parent	Pedigree	Economic characters					
			Boll weight (g)	Seed cotton yield (kg/ha)	G.P. (%)	2.5% span length (mm)	Fiber strength (g/tex)	Micronaire value (mv)
1	G.Cot.16	Pedigree selection from the cross Reba-TK x G.Cot.10	3.1	1543	33.7	26.6	21.8	4.1
2	G. Cot.20	Pedigree selection from the cross JLH-59 x GCBJ-20	3.5	1684	39.9	25.6	22.1	4.3
3	BC-68-2	Selection from the segregating generation of the cross (DS 2-6-5 x G.6) x DS 2-6-5	3.4	1449	33.3	28.1	22.4	4.0
4	Suvin	Pedigree selection from the cross Sujata x SIV-135	2.6	1104	31.1	33.7	27.6	3.5
5	GSB-39	Selection from PTN-10350	2.8	1157	32.4	34.4	27.2	3.5
6	GSB-41	Selection from PTN-10350	2.7	1065	32.3	32.9	25.6	3.8

Table : 2 Analysis of variance with regards to different characters in cotton

Source of variance	D.F	Plant height (cm)	Sympodia per plant	Bolls per plant
Genotype(G)	37	664.035 ++**	10.685 ++**	17.964 ++**
Environment (E)	2	2553.249 ++**	56.573 ++**	245.491 ++**
G x E	74	11.737 ++**	0.355 +	3.038 **
Environment (Linear)	1	5106.499 ++**	113.146 ++**	490.981 ++**
G x E (Linear)	37	17.637 ++**	0.501 ++	4.050 +**
Pooled deviation	38	5.684	0.203	1.974 *
Pooled error	222	6.553	0.685	1.186

+, ++ = Significant when tested against Pooled deviation at 5% and 1% level of probability, respectively
*, ** = Significant when tested against Pooled error at 5% and 1% level of probability, respectively

Table : 2 Continue….

Source of variance	D.F	Boll weight (g)	Seed cotton yield per plant (g)	Ginning outturn (%)
Genotype(G)	37	0.7480 ++**	1095.336 ++**	22.037 ++**
Environment (E)	2	0.2640 ++**	5060.155 ++**	54.840 ++**
G x E	74	0.0008	18.132 ++**	2.410 **
Environment (Linear)	1	0.5280 ++**	10120.311 ++**	109.681 ++**
G x E (Linear)	37	0.0012 ++	27.386 ++**	2.237
Pooled deviation	38	0.0005	8.645	2.514 **
Pooled error	222	0.0009	10.422	0.627

+, ++ = Significant when tested against Pooled deviation at 5% and 1% level of probability, respectively
*, ** = Significant when tested against Pooled error at 5% and 1% level of probability, respectively

Table : 2 Continue….

Source of variance	D.F	2.5% span length (mm)	Fibre strength (g/tex)	Fibre fineness (mv)
Genotype(G)	37	34.462 ++**	18.388 ++**	0.412 ++**
Environment (E)	2	36.571 ++**	42.187 ++**	2.391 ++**
G x E	74	1.950	1.315	0.083 **
Environment (Linear)	1	73.142 ++**	84.374 ++**	4.783 ++**
G x E (Linear)	37	1.978	1.440	0.079 **
Pooled deviation	38	1.871	1.160	0.084 **
Pooled error	222	1.585	1.207	0.039

+, ++ = Significant when tested against Pooled deviation at 5% and 1% level of probability, respectively
*, ** = Significant when tested against Pooled error at 5% and 1% level of probability, respectively

Table : 3 Stability parameters for various characters among parents

Sr. No.	Parents	Plant height (cm)			Sympodia per plant		
		Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
1	G.Cot.16	114.33	0.939	-6.117	9.60	1.197	-0.602
2	BC-68-2	106.49	0.909	-5.491	9.18	0.881	-0.647
3	G.Cot.20	121.80	0.738*	-6.425	12.18	0.813	-0.479
4	Suvin	89.18	0.853	5.684	9.18	0.760	-0.215
5	GSB-39	94.64	0.608	-0.509	10.40	0.501*	-0.683
6	GSB-41	78.00	0.597	-4.460	8.07	-0.037	-0.651
	Parental mean	100.74			9.77		

* Significantly differ from unity at 5% level

Table : 3 Continue….

Sr. No.	Parents	Bolls per plant			Boll weight (g)		
		Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
1	G.Cot.16	32.31	1.774*	-2.715	3.45	1.249	-0.0004
2	BC-68-2	30.72	1.863	-2.625	3.33	1.018	-0.0008
3	G.Cot.20	34.38	1.964	-2.435	3.51	1.066	-0.0003
4	Suvin	28.58	0.518*	-2.713	2.41	1.477	-0.0007
5	GSB-39	29.93	1.071	0.528	2.56	1.351	-0.0005
6	GSB-41	30.45	0.377	-1.086	2.23	1.029	-0.0008
	Parental mean	31.06			2.92		

* Significantly differ from unity at 5% level

Table : 3 Continue….

Sr. No.	Parents	Seed cotton yield per plant (g)			Ginning outturn (%)		
		Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
1	G.Cot.16	95.00	1.065	-31.075	35.05	2.369	0.526
2	BC-68-2	89.00	1.205	-27.663	35.04	1.721	-0.610
3	G.Cot.20	102.58	1.037	-26.060	41.63	0.959	-0.261
4	Suvin	60.49	0.630	-30.277	31.17	-1.089	2.792^{+}
5	GSB-39	67.00	0.612	-31.070	30.67	-0.577	5.149^{++}
6	GSB-41	58.69	0.711	-28.975	33.66	-0.234	9.850^{++}
	Parental mean	78.79			34.54		

$^{+}$ Significantly differ from zero at 5% level and $^{++}$ Significantly differ from zero at 1% level

Table : 3 Continue….

Sr. No.	Parents/	2.5% span length (mm)			Fibre strength (g/tex)		
		Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
1	G.Cot.16	26.31	0.914	-1.399	20.85	0.362	1.016
2	BC-68-2	28.35	0.516	-0.832	22.49	-0.177	0.202
3	G.Cot.20	25.92	1.149	-1.392	19.29	0.391	0.586
4	Suvin	34.81	0.615	-1.695	28.07	0.491	-0.948
5	GSB-39	36.41	1.676	-1.305	28.18	0.944	0.058
6	GSB-41	33.91	0.199	-1.497	27.38	1.086	-0.606
	Parental mean	30.95			24.37		

Table : 3 Continue….

Sr. No.	Parents	Fibre fineness (mv)		
		Mean	b_i	S^2d_i
1	G.Cot.16	3.57	0.865	0.537^{++}
2	BC-68-2	3.11	1.203	-0.039
3	G.Cot.20	3.80	2.609	0.066
4	Suvin	3.16	-0.163	-0.005
5	GSB-39	2.79	0.089	0.035
6	GSB-41	3.28	0.482	0.065
	Parental mean	3.28		

$^{++}$ Significantly differ from zero at 1% level

Table : 4 Stability performance of parents for various characters in cotton

Characters \ Parents	G.Cot.16	BC-68-2	G.Cot.20	Suvin	GSB-39	GSB-41
Plant height	√	√	√*	--	--	--
Sympodia per plant	---	--	√	--	√*	--
Bolls per plant	√+	--	√	--	--	--
Boll weight	√	√	√	--	--	--
Seed cotton yield per plant	√	√	√	--	--	--
Ginning outturn	√	√	√	--	--	--
2.5% span length	--	--	--	√	√	√
Fibre strength	--	--	--	√	√	√
Fibre fineness	--	--	√	--	--	--

√=Average stable √*= Above Average stable √+= Below Average stable

Table : 5 Stability parameters for various characters among top yielding five crosses

Sr. No.	Crosses	Plant height (cm)			Sympodia per plant		
		Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
1	G.Cot.20 x G.Cot.16	138.80	1.324	-2.591	15.73	1.215	-0.645
2	G.Cot.20 x BC-68-2	126.80	1.272	-4.445	13.60	1.288	-0.657
3	BC-68-2 x G.Cot.20	124.82	1.352	5.360	12.49	2.157	-0.653
4	BC-68-2 x G.Cot.16	116.60	1.388	6.281	11.27	1.375	-0.450
5	G.Cot.20 x GSB-39	127.98	0.976	-2.013	13.71	1.223	-0.620
	Overall mean for crosses	**109.00**			**10.67**		

Table : 5 Continue…

Sr. No.	Crosses	Bolls per plant			Boll weight (g)		
		Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
1	G.Cot.20 x G.Cot.16	35.02	1.059	0.649	4.42	1.159	-0.0008
2	G.Cot.20 x BC-68-2	34.22	1.258*	-2.715	4.22	1.075	-0.0007
3	BC-68-2 x G.Cot.20	36.18	2.085	-1.782	3.99	0.766	-0.0004
4	BC-68-2 x G.Cot.16	35.56	1.524	-2.639	3.68	1.692	0.0010
5	G.Cot.20 x GSB-39	34.89	0.496	-2.430	3.46	1.016	-0.0008
	Overall mean for crosses	**32.91**			**3.18**		

* Significantly differ from unity at 5% level

Table : 5 Continue…

Sr. No.	Crosses	Seed cotton yield per plant (g)			Ginning outturn (%)		
		Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
1	G.Cot.20 x G.Cot.16	138.98	1.447	-1.730	38.89	0.835	-0.173
2	G.Cot.20 x BC-68-2	128.87	1.432	-10.964	36.41	1.244	1.189
3	BC-68-2 x G.Cot.20	125.00	1.376*	-30.988	36.68	0.249	-0.549
4	BC-68-2 x G.Cot.16	115.87	1.275	-20.820	34.54	0.707	-0.567
5	G.Cot.20 x GSB-39	115.78	0.607	-28.176	33.72	0.767	0.457
	Overall mean for crosses	**94.98**			**33.40**		

* Significantly differ from unity at 5% level

Table : 5 Continue…

Sr. No.	Crosses	2.5% span length (mm)			Fibre strength (g/tex)		
		Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
1	G.Cot.20 x G.Cot.16	27.13	0.493	-1.679	21.30	0.745	0.350
2	G.Cot.20 x BC-68-2	28.47	0.941	-1.248	22.61	0.577	-1.108
3	BC-68-2 x G.Cot.20	28.63	0.847	-1.679	22.48	1.192	-0.698
4	BC-68-2 x G.Cot.16	29.38	2.029	-1.730	23.23	1.504	-0.201
5	G.Cot.20 x GSB-39	35.37	0.734	-1.336	25.58	0.985	0.318
	Overall mean for crosses	**32.85**			**25.50**		

Table : 5 Continue…

Sr. No.	Crosses	Fibre fineness (mv)		
		Mean	b_i	S^2d_i
1	G.Cot.20 x G.Cot.16	3.80	2.877	0.088
2	G.Cot.20 x BC-68-2	3.02	1.687	-0.020
3	BC-68-2 x G.Cot.20	3.32	0.502	0.009
4	BC-68-2 x G.Cot.16	3.36	0.305	0.017
5	G.Cot.20 x GSB-39	2.76	1.170	0.015
	Overall mean for crosses	**3.00**		

Table: 6 Stability of top five hybrids for seed cotton yield and other related characters in cotton

Sr. No.	Hybrids	Seed cotton yield per plant (g)	Average stable	Favourable environment	Poor environment
1	G.Cot.20 x G.Cot.16	138.98	Plant height, sympodia per plant, bolls per plant, boll weight, seed cotton yield per plant, Ginning outturn, fibre fineness	--	--
2	G.Cot.20 x BC-68-2	128.87	Plant height,, sympodia per plant, boll weight, seed cotton yield per plant, Ginning outturn	Number of bolls per plant	-
3	BC-68-2 x G.Cot.20	125.00	Plant height, sympodia per plant, number of bolls per plant, boll weight, Ginning outturn,	seed cotton yield per plant	-
4	BC-68-2 x G.Cot.16	115.87	Plant height, sympodia per plant, number of bolls per plant, boll weight, seed cotton yield per plant, Ginning outturn,		-
5	G.Cot.20 x GSB-39	115.78	Plant height, sympodia per plant boll weight, seed cotton yield per plant, ginning outturn, 2.5%span length,		Bolls per plant

Summary

- **Pooled analysis of variance revealed significant values for mean squares among the genotypes and environments for all the characters indicated the variable nature of various entries and locations involved in the study.**

- **The G x E interaction was significant for plant height, sympodia per plant, bolls per plant, seed cotton yield per plant, ginning outturn and fibre fineness which indicated that different genotypes reacted differently to different environmental conditions.**

- **Mean squares due to environment (linear) were significant for all the characters when tested against both pooled deviation and pooled error.**

- **Pooled deviations were significant for bolls per plant, ginning outturn and fibre fineness suggesting that deviation for linear regression also contributed substantially towards the differences in stability of genotypes.**

- **Parents G.Cot.20 and G.Cot.16 for seed cotton yield and its attributes and Suvin, for 2.5% span length and fibre strength found to be average stable over environments.**

- **The hybrids G.Cot.20 x G.Cot.16, G.Cot.20 x BC-68-2, BC-68-2 x G.Cot.20, BC-68-2 x G.Cot.16 and G.Cot.20 x GSB-39 were found to be average stable over environments for seed cotton yield with one or more yield contributing and fiber quality characters.**

Thank you