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Genotype × Environment analysis for fibre quality traits in inter-specific hybrids of cotton (*Gossypium hirsutum* L. × *Gossypium barbadense* L.)

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Abstract: The present investigation was carried out during *kharif* 2014-15 at three locations viz., Regional Agricultural Research Station, Lam Farm, Agricultural Research Station, JM Puram and Agricultural College Farm, Bapatla. Seventy two inter-specific cotton hybrids were tested over three environments to identify the stable performing hybrids. The Eberhart and Russell stability model analysis was carried out to study the genotype × environment interaction for all the fibre quality traits along with lint yield plant^{-1}. The variance due to genotypes, environments (linear) was significant for all the characters whereas, Genotypes × Env (Lin.) variance was significant for all the traits except for fibre elongation. The hybrid SCS 793 × GSB 40 had recorded higher grand mean with regression coefficient nearly one and non-significant deviation from regression (s^2d_i) and was found to be stable for 2.5 % span length and bundle strength over three locations. Hence, this hybrid may be exploited commercially for cultivation over a wide range of environments after thorough testing over number of locations in different seasons.

Key words: Inter-specific cotton hybrids, Quality traits, Eberhart and Russell model

Introduction

Cotton (*Gossypium* spp.) popularly called "White Gold" and "King of Fibre Crops" is the most widely used renewable natural fibre crop of global importance. It occupies a pre-eminent place among cash crops as it guides the destiny of a large section of the farming community as well as that of a flourishing textile industry. The performance of any crop hybrid/variety is the result effect of its genotype and environment in which it grows. It is a sensitive crop to weather fluctuations; it shows higher magnitude of genotype × environment interaction (Campbell and Jones, 2005). The differential response of a genotype or cultivar for a given trait across environments is defined as the genotype × environment interaction (G × E). G × E is an important and essential component of plant breeding programs because the genotypes or hybrids performing well under a particular environment may or may not perform well over other environments due to genotype-environment interactions (G × E). Hence, the study of G × E interaction using suitable biometrical techniques is essential for identification of stable genotypes either for commercial release or for using in future breeding programmes.

Materials and Methods

The present study was carried out during *kharif*, 2014-15 at three locations viz., Regional Agricultural Research Station (RARS), Lam Farm, Agricultural Research Station (ARS), JM Puram and Agricultural College Farm, Bapatla. The basic material for the present investigation was comprised of 72 inter-specific cotton hybrids produced by crossing 12 *Gossypium hirsutum* L. genotypes with 6 *Gossypium barbadense* L. genotypes in line × tester fashion. Data was recorded on five randomly selected competitive plants of each genotype in every replication for 2.5% span length (mm), uniformity ratio, micronaire value (10^{-6} g/inch), bundle strength (g/tex), fibre elongation percent and lint yield plant^{-1}. The experiment was laid out in a randomised complete block design with 3 replications at each location. The experimental plot comprised of 3 rows of each 6 m length with a spacing of 120 cm × 60 cm. All the recommended package of agronomic practices for inter-specific hybrids of cotton was followed to raise a good crop at all the three locations. Mean values for all the characters were worked out for calculating phenotypic stability as per Eberhart and Russell (1966) model.

Results and Discussion

The data obtained from three locations was subjected to statistical analysis as per Eberhart and Russell model and the analysis of variance for stability is presented in Table 1. Stability analysis of variance revealed mean sum of squares due to genotypes were significant for all the characters indicating presence of sufficient variability among the genotypes. The environments showed significant differences for all the characters. The genotype × environment interaction component showed non-significance for all the traits except for micronaire value. Significance of environment (linear) component for all the characters confirms the observations of widely differing environments, in the analysis of variance. The environment + (genotype × environment) component significant for all the traits except for uniformity ratio. The genotype × environment (linear) interaction component exhibited significance for 2.5% span length, micronaire value, bundle strength, uniformity ratio and lint

Table-1: Analysis of variance for stability of performance for six characters in inter-specific hybrids of cotton (*Gossypium hirsutum* L. × *Gossypium barbadense* L.) during *kharif*, 2014-15

Source	d.f	2.5% span length (mm)	Uniformity ratio	Micronaire value (10^{-6} g/inch)	Bundle strength (g/tex)	Fibre elongation (%)	Lint yield plant^{-1} (g)
Rep within Env.	6	0.26	0.16	0.00	0.25	0.00	3.83
Genotypes	71	4.60**	2.13**	0.10**	3.12**	0.05**	461.01**
Env+ (Genotypes × Env.)	144	3.55**	0.81	0.14**	3.17**	0.04**	166.70**
Environments	2	185.06**	1.90	7.91**	153.38**	1.71**	3711.95**
Genotypes × Env.	142	1.00	0.79	0.04**	1.06	0.01	116.76
Environments (Lin.)	1	370.12**	3.81*	15.82**	306.76**	3.43**	7423.91**
Genotypes × Env.(Lin.)	71	1.28**	0.95*	0.05**	1.28*	0.01	139.40*
Pooled Deviation	72	0.70**	0.63	0.02**	0.83**	0.02**	92.82**
Pooled Error	426	0.39	0.48	0.00	0.24	0.01	7.29
Total	215	3.90	1.24	0.13	3.16	0.04	263.89

* Significant at 5% level & ** Significant at 1% level - When tested against pooled error

Table-2: Environment index values (I_j) for six characters in inter-specific hybrids of cotton (*Gossypium hirsutum* L. × *Gossypium barbadense* L.) during *kharif,* 2014-15

Character	Environment		
	Bapatla	J M Puram	Lam Farm
2.5% span length (mm)	0.05	1.58	-1.63
Uniformity ratio	0.11	0.08	-0.19
Micronaire value (10^{-6} g/inch)	-0.04	0.35	-0.31
Bundle strength (g/tex)	0.05	1.43	-1.48
Fibre elongation (%)	-0.02	0.16	-0.15
Lint yield plant^{-1} (g)	-6.54	-1.14	7.68

yield plant^{-1}. Pooled deviation component was significant for all the traits except for uniformity ratio. Environmental index values for different traits in varying environments were calculated and presented in Table 2. Bapatla location recorded positive values for 2.5% span length (0.050), bundle strength (0.047) and uniformity ratio (0.109). All the characters except lint yield plant^{-1} exhibited positive environmental index values in J M Puram and Lam Farm locations.

2.5% span length (mm): The data pertaining to stability parameters are presented in Table 3. Mean values for 2.5% span length ranged from 32.64 (MR 786 × GSB 40) to 37.97 mm (MCU 5 × SUVIN) with an overall mean of 34.91mm. The regression coefficient (b_i) values ranged from -0.29 (BS 37 × TCB 37) to 2.37 (L 1058 × SUVIN). The hybrids, SCS 793 × GSB 40 (b_i=0.98) and ADB 532 × TCB 37 (b_i=1.00) had recorded mean 2.5% span length higher than grand mean with unit regression coefficient (b_i) and non-significant deviation from regression (s^2d_i). Whereas, the hybrids *viz.,* H 1442 × DB 16 (b_i=0.07), ADB 542 × DB 16 (b_i=0.04*), ADB 532 × DB 16 (b_i=0.63), ADB 532 × GSB 41 (b_i=0.64), ADB 532 × TCB 37 (b_i=0.31), TSH 0250 × GSB 40 (b_i=0.09), BS 37 × GSB 40 (b_i=0.23), BS 37 × DB 16 (b_i=0.79), BS 37 × GSB 41 (b_i=0.39), MCU 5 × GSB 41 (b_i=0.68), L 1058 × DB 11 (b_i=0.75) and L 1058 × TCB 37 (b_i=0.88) had more mean than general mean with b_i<1. Regression values (b_i) greater than one recorded by H 1442 × SUVIN (b_i=1.57), ADB 542 × TCB 37 (b_i=1.23), ADB 542 × SUVIN (b_i=1.21), WGCV 48 × GSB 40 (b_i=1.33), WGCV 48 × TCB 37 (b_i=1.61), TSH 0250 × DB 16 (b_i=1.64*), TSH 0250 × SUVIN (b_i=1.99), BS 37 × DB 11 (b_i=1.64), BS 37 × SUVIN (b_i=1.87), SCS 793 × TCB 37 (b_i=1.63), MCU 5 × DB 16 (b_i=1.29), L 1058 × GSB 41 (b_i=1.27) and L 1058 × SUVIN (b_i=2.37) with mean greater than the grand mean and non-significant deviation from regression.

Uniformity ratio: Mean values for uniformity ratio ranged from 43.87 (MCU 5 × DB 16) to 47.5 (MR 786 × TCB 37) with an overall mean of 45.72. The regression coefficient (b_i) values ranged from -9.54 (SCS 793 × TCB 37) to 11.55 (ADB 542 × SUVIN). The hybrids, H 1442 × DB 16 (b_i=-0.33), H 1442 × TCB 37 (b_i=-0.54), ADB 542 × DB 11 (-0.15), ADB 532 × DB 11 (b_i=-0.60), MR 786 × GSB 40 (b_i=0.01), BS 37 × GSB 41 (b_i=0.36), SCS 793 × GSB 40 (b_i=0.42) and L 1058 × DB 11 (b_i=0.31) had recorded regression coefficient (b_i) less than unity. Whereas, NDLH 1938 × GSB 41 (b_i=-1.69), ADB 542 × DB 16 (b_i=-3.44), ADB 542 × TCB 37 (b_i=-3.86), ADB 532 × GSB 40 (b_i=-7.45), WGCV 48 × SUVIN (b_i=-2.79), MR 786 × DB 18 (b_i=-2.22), MR 786 × DB 11 (b_i=-5.01), MR 786 × TCB 37 (b_i=-4.03), BS 37 × GSB 40 (b_i=-6.53*), SCS 793 × DB 16 (-2.08) and SCS 793 × TCB 37 (b_i=-9.54) had recorded higher than grand mean with more than unity negative regression coefficient (b_i) and non-significant deviation from regression (s^2d_i). Regression values greater than one was registered by the hybrids *viz.,* NDLH 1938 × GSB 40 (b_i=7.79*), NDLH 1938 × DB 16 (b_i=4.39**), NDLH 1938 × DB 11 (b_i=2.00), NDLH 1938 × TCB 37 (b_i=1.31), H 1442 × GSB 40 (b_i=5.57), H 1442 × DB 11 (b_i=6.29), ADB 542 × GSB 40 (b_i=7.36), ADB 542 × GSB 41 (b_i=3.39), ADB 532 × GSB 41 (b_i=7.35), WGCV 48 × GSB 41 (b_i=2.26), MR 786 × GSB 41 (b_i=6.08), TSH 0250 × DB 11 (b_i=1.78), SCS 793 × GSB 41 (b_i=2.84), MCU 5 × GSB 40 (b_i=6.05) and L 762 × GSB 40 (3.72) had recorded mean higher than grand mean and non-significant deviation from regression.

Bundle strength (g/tex): Bundle strength registered the mean values ranged from 24.99 (MR 786 × DB 11) to 30.17 g/tex (MCU 5 × GSB 40) with an overall mean of 27.02 g/tex. The regression coefficient (bi) values ranged from -0.12 (BS 37 × GSB 40) to 2.26 (MCU 5 × DB 11). The hybrids *viz.,* ADB 542 × SUVIN (b_i=0.97), ADB 532 × GSB 41 (b_i=1.01), WGCV 48 × DB 16 (b_i=1.07), TSH 0250 × DB 16 (b_i=1.09) and SCS 793 × GSB 40 (0.90**) had recorded higher grand mean with regression coefficient nearly one and non-significant deviation from regression (s^2d_i). Whereas, the hybrids H1442 × DB 16 (b_i=0.30), ADB 542 × GSB 41 (b_i=0.11), ADB 532 × GSB 40 (b_i=0.14), ADB 532 × DB 16 (b_i=0.58), ADB 532

Table-3: Stability parameters for six charactersin inter-specific hybrids of cotton (*Gossypium hirsutum* L. × *Gossypium barbadense* L.) as per Eberhart and Russell model during *kharif*, 2014-15

Hybrid	2.5% span length (mm)			Uniformity ratio			Fibre elongation (%)			Micronaire value (10^{-6} g/inch)			Bundle strength (g/tex)			Lint yield plant^{-1} (g)		
	Mean	bi	s²di	Mean	bi	s²di	Mean	bi	s²di	Mean	bi	s²di	Mean	bi	s²di	Mean	bi	s²di
NDLH 1938 × GSB 40	33.98	1.58*	-0.38	46.71	7.79*	-0.47	5.06	1.36	-0.01	3.03	1.59	0.00	27.25	1.24	0.12	66.03	0.77	86.01**
NDLH 1938 × DB 16	33.49	1.15	0.34	46.75	4.39**	-0.47	5.25	0.89*	-0.01	3.26	1.78	0.01*	27.39	1.52	-0.18	68.16	1.60	50.05**
NDLH 1938 × DB 11	32.97	0.96	-0.36	46.31	2.00	-0.47	4.98	1.80	0.01	3.12	1.80	0.00	26.16	1.74	0.20	70.23	1.37	135.16**
NDLH 1938 × GSB 41	33.45	0.93	6.14**	46.45	-1.69	-0.39	4.96	0.97	-0.01	2.73	0.76	0.01	27.04	0.96	1.04*	70.1	0.94	10.06
NDLH 1938 × TCB 37	34.73	1.18	2.33**	45.82	1.31	0.63	4.79	1.28	-0.01	2.65	0.33	0.01	27.18	1.50	1.03*	58.85	-0.05	145.19**
NDLH 1938 × SUVIN	35.32	1.03	0.24	45.43	-7.76*	-0.45	5.06	1.36	0.01	2.95	1.76	0.06**	28.11	1.40	3.30**	43.64	-0.33	29.10*
H 1442 × GSB 40	34.29	1.37	-0.34	46.34	5.57	-0.45	4.92	1.18	-0.01	3.06	1.93	0.00	26.48	1.24	1.10*	60.21	1.16	348.83**
H 1442 × DB 16	36.69	0.07	0.17	46.22	-0.33	-0.23	4.97	2.08	0.00	2.80	0.87	0.02**	29.66	0.30	0.20	78.36	0.05	10.49
H 1442 × DB 11	33.23	1.16	-0.03	46.06	6.29	-0.38	4.97	1.81*	-0.01	2.84	1.47	0.00	26.13	0.83	0.45	58.62	0.05	3.42
H 1442 × GSB 41	33.96	0.07*	-0.38	46.43	-5.82	1.40*	4.94	1.03	-0.01	3.32	1.66	0.13**	26.92	-0.05	0.00	83.71	0.44*	-7.12
H 1442 × TCB 37	34.95	1.17	4.64**	45.87	-0.54	0.43	4.73	0.97	-0.01	2.99	1.56	0.00	26.79	1.25	0.51	52.17	-0.04	108.63**
H 1442 × SUVIN	34.95	1.57	0.11	45.32	-0.43	0.13	4.97	1.46	0.01	3.00	2.01	0.01*	27.01	1.87	0.19	49.54	-0.66	-4.89
ADB 542 × GSB 40	34.07	0.92	-0.14	45.87	7.36	-0.05	4.96	1.43	0.01	3.03	1.22	0.01*	25.59	0.81	-0.19	58.55	0.19	10.78
ADB 542 × DB 16	34.98	0.04*	-0.36	45.96	-3.44	-0.08	5.15	0.20*	-0.01	3.40	1.33	0.03**	27.25	-0.07	-0.15	79.60	0.07	-1.61
ADB 542 × DB 11	34.82	0.60	-0.37	46.30	-0.15	0.44	4.88	1.10	-0.01	2.72	1.00	0.00	26.86	1.22	0.20	63.75	2.91	246.17**
ADB 542 × GSB 41	34.88	0.75	0.44	46.05	3.39	0.93	5.05	0.91	-0.01	2.85	0.53*	0.00	27.79	0.11	-0.19	56.20	0.99	3.44
ADB 542 × TCB 37	35.06	1.23	0.79	45.73	-3.86	-0.17	4.85	0.51	0.00	2.85	1.14	0.01*	26.01	1.02	1.39**	51.79	-0.15*	-7.19
ADB 542 × SUVIN	36.67	1.21	-0.21	45.03	11.55	-0.07	5.06	0.51*	-0.01	3.12	1.68	0.03**	27.22	0.97	-0.16	38.48	0.93	-5.70
ADB 532 × GSB 40	34.76	0.59	1.89*	46.09	-7.45	-0.20	4.88	0.68	0.00	2.57	0.08	0.01	28.19	0.14	-0.08	63.88	3.43	489.43**
ADB 532 × DB 16	35.61	0.63	-0.04	45.04	5.01	1.41*	5.12	1.61	-0.01	2.83	0.83	0.00	28.32	0.58	-0.18	56.45	0.78	28.54*
ADB 532 × DB 11	33.94	1.25	0.17	46.32	-0.60	-0.09	4.96	0.62	-0.01	2.69	0.19	0.05**	26.15	1.52	-0.23	53.5	0.67	201.15**
ADB 532 × GSB 41	35.49	0.64	0.08	45.76	7.35	-0.36	5.04	1.28	0.04*	2.71	0.09	0.00	28.49	1.01	-0.24	54.83	0.62	44.14**
ADB 532 × TCB 37	35.92	0.31	-0.36	44.86	4.29	0.65	4.89	1.15	-0.01	2.91	1.00	0.00	28.45	0.68	-0.01	44.87	-0.70	10.01
ADB 532 × SUVIN	36.63	1.19	0.04	44.69	3.49**	-0.47	4.88	1.32	-0.01	2.62	0.72	0.00	27.45	1.02	1.80**	47.04	0.88	35.40*
WGCV 48 × GSB 40	35.75	1.33	0.16	45.33	4.92*	-0.47	4.89	1.27	-0.01	2.96	0.98	0.05**	27.16	0.88	-0.18	51.45	1.83	282.60**
WGCV 48 × DB 16	34.69	1.15	-0.38	45.24	2.53	-0.46	4.95	0.67	0.01	2.91	1.12	0.02**	27.37	1.07	0.22	56.14	0.87	3.89
WGCV 48 × DB 11	34.34	1.17	-0.29	47.42	8.07	2.11*	4.96	1.73	0.00	3.01	1.91*	0.00	26.37	1.44	0.47	62.57	2.31*	-6.77
WGCV 48 × GSB 41	33.84	0.98	-0.31	45.88	2.26	-0.39	5.08	0.72	0.09**	3.06	1.47	0.01*	26.13	0.86*	-0.24	53.77	1.45	-5.47
WGCV 48 × TCB 37	36.12	1.61	-0.37	44.55	-3.37	-0.44	4.78	-0.18	0.00	2.91	1.52	0.00	27.52	0.85	-0.22	47.22	0.73	190.62**
WGCV 48 × SUVIN	34.77	0.96	-0.07	45.71	-2.79	1.19	4.89	1.72	0.00	2.98	1.39	0.03**	27.23	1.45	-0.22	42.40	2.01	234.55**
MR 786 × GSB 40	32.64	1.32	0.95	47.27	0.01	-0.05	4.82	1.22	0.00	2.79	0.86	0.04**	25.20	1.45	-0.17	54.48	1.14	5.50
MR 786 × DB 16	33.08	0.61	0.01	46.37	-2.22	0.27	5.09	1.41	0.00	2.94	1.23	0.00	26.31	0.81	-0.16	65.76	0.99	123.13**
MR 786 × DB 11	32.72	0.83	-0.21	46.44	-5.01	1.61*	4.69	0.64	-0.01	2.69	0.24	0.03**	24.99	1.50	-0.20	53.40	1.50	109.64**
MR 786 × GSB 41	33.83	0.11*	-0.38	47.47	6.08	-0.24	5.15	1.38	0.02	3.02	1.57*	0.00	26.49	-0.07	0.07	74.76	0.02*	-6.64
MR 786 × TCB 37	34.21	1.25*	-0.39	47.50	-4.03	-0.11	5.03	1.09	-0.01	2.92	1.58	0.00	27.16	0.54	0.61	54.67	1.88*	-7.20
MR 786 × SUVIN	33.77	1.15	-0.24	44.87	-2.67	-0.47	4.73	0.54	-0.01	2.58	0.57	0.00	25.07	1.64	0.18	56.79	0.84	6.05
TSH 0250 × GSB 40	36.78	0.09	-0.31	44.80	-1.46	-0.18	4.83	0.28	0.05**	3.00	1.16	0.00	27.67	-0.01*	-0.23	83.08	0.66	-6.14
TSH 0250 × DB 16	35.45	1.64*	-0.39	45.31	1.12	0.16	5.04	0.33	0.00	2.80	1.09	0.01*	27.51	1.09	-0.23	49.72	1.29	133.85**
TSH 0250 × DB 11	34.53	1.42*	-0.38	45.82	1.78	1.10	4.86	1.17	0.02*	2.66	0.70	0.00	26.85	2.04	0.20	45.44	1.40	26.15*
TSH 0250 × GSB 41	33.29	0.80	-0.01	45.01	5.69	-0.06	4.85	0.67	0.06**	2.53	0.17	0.05**	26.43	0.82	0.20	48.31	1.03	103.20**
TSH 0250 × TCB 37	36.57	1.57	1.76*	44.45	-1.62	-0.46	4.65	0.67	-0.01	2.73	0.69	0.06**	27.09	1.43	0.29	28.11	0.16	25.57*
TSH 0250 × SUVIN	35.37	1.99	-0.34	44.20	3.62	-0.41	4.55	0.18	0.00	2.61	-0.09	0.00	26.89	1.70	-0.21	32.04	0.34	-5.63
BS 37 × GSB 40	36.62	0.23	-0.01	47.22	-6.53*	-0.46	5.19	-0.51	0.01	2.84	0.81*	0.00	29.26	-0.12*	-0.23	63.63	2.88	127.35**
BS 37 × DB 16	35.44	0.79	-0.16	44.83	9.65	-0.31	4.86	0.87	0.00	2.96	1.11	0.02*	26.41	0.60	0.03	52.26	-0.48	9.48
BS 37 × DB 11	35.61	1.64	0.07	46.38	-3.49	1.83*	4.97	0.84	0.03*	2.69	0.69	0.01	27.37	1.44	-0.04	45.17	0.86	179.35**
BS 37 × GSB 41	35.14	0.39	0.22	45.83	0.36	0.84	5.01	0.84	-0.01	2.87	1.29	0.01*	27.72	0.50	-0.03	63.81	1.14	140.67**
BS 37 × TCB 37	36.89	-0.29	1.22*	44.85	3.45	0.81	5.02	1.12	0.00	2.68	0.58	0.00	27.77	0.82	0.04	40.46	2.59	132.67**
BS 37 × SUVIN	35.13	1.87	0.70	45.07	-0.02	2.89**	4.87	1.18	0.11**	2.88	1.11	0.00	25.62	1.44	-0.21	55.74	-2.64	40.27*
SCS 793 × GSB 40	35.69	0.98	0.07	45.93	0.42	-0.38	5.03	0.64	0.00	2.87	0.86	0.02*	27.34	0.90**	-0.24	40.86	2.31*	-7.08
SCS 793 × DB 16	33.69	0.84	-0.19	46.37	-2.08	-0.35	5.01	0.84	0.00	2.77	1.09	0.00	26.88	0.42	0.27	60.67	0.08*	-7.17
SCS 793 × DB 11	33.84	0.95	-0.21	47.11	-3.21	1.93*	4.99	0.44*	-0.01	2.66	0.38	0.07**	28.42	-0.12	2.23**	55.24	1.35	26.01*
SCS 793 × GSB 41	33.32	0.80	-0.18	47.25	2.84	-0.42	5.00	-0.22	0.02	2.81	0.73	0.00	26.74	0.88	0.37	52.41	-0.67	232.99**
SCS 793 × TCB 37	35.89	1.63	-0.16	46.14	-9.54	-0.41	4.89	0.81	0.00	2.75	1.18	0.01	27.58	1.22	-0.23	37.79	1.30	46.43**
SCS 793 × SUVIN	33.80	0.68	-0.36	45.19	1.73	-0.45	4.78	1.39	-0.01	2.64	0.40	0.00	27.23	0.22**	-0.24	41.91	0.57	62.04**
MCU 5 × GSB 40	37.29	1.05	2.04*	46.11	6.05	0.80	4.96	0.37	0.03*	2.67	0.35	0.00	30.17	0.86	16.89**	28.97	0.00	21.60*
MCU 5 × DB 16	36.57	1.29	-0.36	43.87	2.88*	-0.47	4.76	1.37*	-0.01	2.65	1.00	0.03**	26.70	1.65	0.34	41.88	0.76	80.48**
MCU 5 × DB 11	34.49	1.52	-0.16	45.68	0.14	-0.34	4.78	1.33	-0.01	2.62	0.62	0.00	26.38	2.26	0.31	30.66	1.37	2.53
MCU 5 × GSB 41	35.61	0.68	-0.15	45.18	-3.02	-0.36	4.75	1.50	0.00	2.75	0.58	0.02*	26.32	1.23	-0.15	37.65	0.89	70.23**
MCU 5 × TCB 37	36.92	0.65	1.37*	43.96	2.35	-0.37	4.86	1.50	0.03*	2.79	0.98	0.00	26.83	0.79	0.32	36.57	-0.63*	-6.97
MCU 5 × SUVIN	37.97	1.11	4.98**	44.87	1.88	1.54*	4.83	1.10	-0.01	2.66	0.73	0.01	28.25	0.77	3.43**	31.29	-0.33	1.38
L 1058 × GSB 40	34.74	1.25	-0.35	45.56	-2.17	-0.46	4.92	2.02	0.02	2.82	1.48	0.03**	25.93	1.32	0.10	47.66	1.74	20.35
L 1058 × DB 16	34.61	0.95	0.68	44.91	0.53	-0.03	4.90	1.21	0.12**	2.77	0.69	0.00	26.16	1.18	4.35**	58.42	3.85*	-3.37
L 1058 × DB 11	35.85	0.75	-0.28	45.90	0.31	-0.44	5.05	0.50	-0.01	2.79	0.82	0.00	27.77	0.78	2.34**	57.78	3.16	56.14**
L 1058 × GSB 41	35.86	1.27	-0.38	44.69	0.23	0.05	4.80	0.55	-0.01	2.87	1.09	0.00	27.71	1.12	0.00	56.05	4.18*	-6.62
L 1058 × TCB 37	35.94	0.88	-0.15	44.56	1.96	0.05	4.86	0.80	-0.01	2.72	0.92	0.00	27.12	0.34	-0.19	49.05	2.15	949.54**
L 1058 × SUVIN	37.02	2.37	-0.32	45.39	2.56	0.95	4.94	1.47	0.00	2.73	1.14	0.01*	28.55	1.72	1.73**	48.44	1.37	47.38**
L 762 × GSB 40	33.15	1.03	-0.20	45.75	3.72	-0.34	4.87	0.98	0.00	2.93	1.36	0.01	25.41	1.13	-0.22	53.39	0.98	105.36**
L 762 × DB 16	33.88	1.93	2.07*	46.50	1.16	2.32*	5.12	1.24	0.03*	3.10	0.97	0.03**	25.94	1.88	1.22*	66.54	1.72	96.29**
L 762 × DB 11	33.74	0.77	-0.24	45.26	3.29	-0.17	5.12	1.90	0.00	3.00	1.32	0.01*	25.95	1.24	0.26	59.48	1.15	67.55**
L 762 × GSB 41	33.80	0.48	-0.37	45.61	5.13	-0.04	4.96	1.43	0.00	3.03	1.11	0.00	25.54	0.95	-0.12	49.92	1.39	420.11**
L 762 × TCB 37	33.83	0.94	0.17	45.48	-3.73*	-0.47	4.93	0.47	0.03*	2.99	0.65	0.00	26.04	1.00	0.17	70.77	-0.29	83.15**
L 762 × SUVIN	34.66	1.00	0.19	45.44	4.49	-0.47	4.92	0.98	0.01	2.77	0.54	0.08**	27.05	1.29	-0.23	57.45	2.88	-2.78
Population mean	34.91			45.72			4.93			2.85			27.02			53.90		

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

× TCB 37 (b_i=0.68), WGCV 48 × GSB 40 (b_i=0.88), WGCV 48 × TCB 37 (b_i=0.85), MR 786 × TCB 37 (b_i=0.54), TSH 0250 × GSB 40 (b_i=-0.01*), BS 37 × GSB 40 (b_i=-0.12*), BS 37 × GSB 41 (b_i=0.50), BS 37 × TCB 37 (b_i=0.82), SCS 793 × SUVIN (0.22**) and L 1058 × TCB 37 (b_i=0.34) had recorded higher mean than grand mean with regression coefficient less than one and non-significant deviation from regression. The hybrids, NDLH 1938 × GSB 40 (b_i=1.24), NDLH 1938 × DB 16 (b_i=1.52), WGCV 48 × SUVIN (b_i=1.45), TSH 0250 × TCB 37 (b_i=1.43), BS 37 × DB 11 (b_i=1.44), SCS 793 × TCB 37 (b_i=1.22), L 1058 × GSB 41 (b_i=1.12) and L 762 × SUVIN (b_i=1.29) had b_i values greater than one with higher mean than grand mean and non-significant deviation from regression.

Fibre elongation (%): The regression coefficient (bi) for fibre elongation percent varied from -0.51 (BS 37 × GSB 40) to 2.08 (H 1442 × DB 16) and mean values ranged from 4.55 (TSH 0250 × SUVIN) to 5.25% (NDLH 1938 × DB 16) with an overall mean of 4.93%. The hybrids, NDLH 1938 × GSB 41 (b_i=0.97), H 1442 × GSB 41 (b_i=1.03), ADB 542 × GSB 41 (b_i=0.91) and MR 786 × TCB 37 (b_i=1.09) had recorded mean fibre elongation percent higher than grand mean with regression coefficient (b_i) nearly one and non-significant deviation from regression (s^2d_i). The hybrids *viz.,* NDLH 1938 × DB 16 (b_i=0.89*), ADB 542 × DB 16 (b_i=0.20*), ADB 542 × SUVIN (b_i=0.51*), ADB 532 × DB 11 (b_i=0.62), WGCV 48 × DB 16 (b_i=0.67), BS 37 × GSB 40 (b_i=-0.51), BS 37 × GSB 41 (b_i=0.84), SCS 793 × GSB 40 (b_i=0.64), SCS 793 × DB 16 (b_i=0.84), SCS 793 × DB 11 (b_i=0.44*), SCS 793 × GSB 41 (b_i=-0.22) and L 1058 × DB 11 (b_i=0.50) had more mean than general mean with b_i <1. Whereas, the hybrids, NDLH 1938 × GSB 40 (b_i=1.36), NDLH 1938 × DB 11 (b_i=1.80), NDLH 1938 × SUVIN (b_i=1.36), H 1442 × GSB 40 (b_i=1.18), H 1442 × DB 16 (b_i=2.08), H 1442 × DB 11 (b_i=1.81*), H 1442 × SUVIN (b_i=1.46), ADB 542 × GSB 40 (b_i=1.43), ADB 532 × DB 16 (b_i=1.61), WGCV 48 × DB 11 (b_i=1.73), MR 786 × DB 16 (b_i=1.41), MR 786 × GSB 41 (b_i=1.38), BS 37 × TCB 37 (b_i=1.12), L 1058 × SUVIN (b_i=1.47), L 762 × DB 11 (b_i=1.90) and L 762 × GSB 41 (b_i=1.43) had b_i values greater than one with higher mean than grand mean and non-significant deviation from regression.

Micronaire value (10^{-6} g/inch): Mean values for micronaire valueranged from 2.53 (TSH 0250 × GSB 41) to 3.4 10^{-6} g/inch (ADB 542 × DB 16) with an overall mean of 2.85 10^{-6} g/inch. The regression coefficient values (bi) ranged from -0.09 (TSH 0250 × SUVIN) to 2.01(H 1442 × SUVIN). The hybrids *viz.,* ADB 532 × TCB 37 (b_i=1.00) and L 1058 × GSB 41 (b_i=1.09) had recorded mean micronaire value higher than grand mean with regression coefficient (b_i) nearly one and non-significant deviation from regression (s^2d_i). Whereas, the hybrids ADB 542 × GSB 41 (b_i=0.53*) and L 762 × TCB 37 (b_i=0.65) had more mean than general mean with b_i <1. The hybrids, NDLH 1938 × GSB 40 (b_i=1.59), NDLH 1938 × DB 11 (b_i=1.80), H 1442 × GSB 40 (b_i=1.93), H 1442 × TCB 37 (b_i=1.56), WGCV 48 × DB 11 (b_i=1.91*), WGCV 48 × TCB 37 (b_i=1.52), MR 786 × DB 16 (b_i=1.23), MR 786 × GSB 41 (b_i=1.57*), MR 786 × TCB 37 (b_i=1.58), BS 37 × SUVIN (b_i=1.11), L 762 × GSB 40 (b_i=1.36) and L 762 × GSB 41(b_i=1.11) had b_i values greater than one with higher mean than grand mean and non-significant deviation from regression.

Lint yield plant^{-1} (g): For lint yield plant^{-1}, mean values ranged from 28.11 (TSH 0250 × TCB 37) to 83.71g (H 1442 × GSB 41) with an overall mean of 53.90 g. The regression coefficient (b_i) values ranged from -2.64 (BS 37 × SUVIN) to 4.18 (L 1058 × GSB 41). The hybrids, NDLH 1938 × GSB 41 (b_i=0.94) and ADB 542 × GSB 41 (b_i=0.99) had recorded mean lint yield plant^{-1} higher than grand mean with unit regression coefficient (b_i) and non-significant deviation from regression (s^2d_i). The hybrids, H 1442 × DB 16 (b_i=0.05), H 1442 × DB 11 (b_i=0.05), H 1442 × GSB 41 (b_i=0.44*), H 1442 × SUVIN (b_i=-0.66), ADB 542 × GSB 40 (b_i=0.19), ADB 542 × DB 16 (b_i=0.07), WGCV 48 × DB 16 (b_i=0.87), MR 786 × GSB 41 (b_i=0.02*), MR 786 × SUVIN (b_i=0.84), TSH 0250 × GSB 40 (b_i=0.66) and SCS 793 × DB 16 (b_i=0.08*) had more mean than general mean with b_i <1 with non-significant deviation from regression (s^2d_i). Whereas, the hybrids, WGCV 48 × DB 11 (b_i=2.31*), MR 786 × GSB 40 (b_i=1.14), MR 786 × TCB 37 (b_i=1.88*), L 1058 × DB 16 (b_i=3.85*), L 1058 × GSB 41 (b_i=4.18*) and L 762 × SUVIN (b_i=2.88) had b_i values greater than one with higher than grand mean and non-significant deviation from regression.

In the present study stability analysis of variance revealed the importance of non-linear component in the genotype-environment interaction. Saini *et al.* (2008); Satish *et al.* (2009); Patil and Patel (2010); Basanagouda *et al.* (2011); Kavithamani *et al*. (2013); Taranjit*et al.* (2012); Dewdar (2013); Patel *et al.* (2013); Verma *et al.* (2013) and Reddy and Sarma (2014) also reported similar results. Environmental index reveals the suitability of an environment for a particular trait. Based on the positive values of environmental index, Bapatla location was found to be most suitable location for 2.5% span length, bundle strength and uniformity ratio. J M Puram and Lam Farm were found to be the most suitable locations for all the traits except for lint yield plant^{-1}. According to Eberhart and Russell (1966) a stable genotype is one which shows (i) a high mean, (ii) a regression coefficient equal to unity (b_i=1) and (iii) a least mean square deviation from regression (s^2d_i). A genotype with high mean performance with near to unity regression and least deviation from regression could perform well under average environmental conditions. If a genotype exhibited high mean with greater than unity regression, it was considered to be stable for favourable environmental conditions. However, if a genotype possessed high mean with less than unity regression, the genotype is considered to be suitable for poor environmental conditions. The hybrids, SCS 793 × GSB 40 and ADB 532 × TCB 37 were found to be stable for 2.5% span length over locations. These findings are in agreement with reports of Taranjit *et al.* (2012) and Verma *et al.* (2013). None of the hybrid recorded average stability for uniformity ratio over locations. The hybrids *viz.,* ADB 542 × SUVIN (b_i=0.97), ADB 532 × GSB 41 (b_i=1.01), WGCV 48 × DB 16 (b_i=1.07), TSH 0250 × DB 16 (b_i=1.09) and SCS 793 × GSB 40 were found to be stable for bundle strength, similar findings were earlier reported by Singh *et al.* (2012), Verma *et al.* (2013) and Sirisha (2015). NDLH 1938 × GSB 41, H 1442 × GSB 41, ADB 542 × GSB 41 and MR 786 × TCB 37 considered to be performing well over environments for fibre elongation %. Sirisha (2015) also reported stable hybrids for this character. The crosses *viz.,* ADB 532 × TCB 37 and L 1058 × GSB 41exhibited stable performance for micronaire value. These findings are in agreement with the results of Verma *et al*. (2013). NDLH 1938 × GSB 41 and ADB 542 × GSB 41 showed average stability over locations for lint yield plant^{-1} and stable hybrids for this trait also reported by Patil and Patel (2010); Kavithamani *et al*. (2013); Nidagundi *et al.* (2012); Taranjit *et al.* (2012); Dewdar (2013) and Patel *et al.* (2013).

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