Received: 17 Mar 2021 | Revised: 07 May 2021 | Accepted: 09 May 2021

Electronic Journal of Plant Breeding

Research Article

G x E interactions and stability analysis for seed cotton yield and its components in cotton(*Gossypium hirsutum* L.)

P. A. Vavdiya[1*], V. P. Chovatia[2], N. M. Bhut[3] and G. D. Vadodariya[4]

[1]College of Agriculture, Navsari Agricultural University, Waghai (Dangs), Gujarat, India
[2]Junagadh Agricultural University, Junagadh, Gujarat, India
[3]C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, S. K. Nagar, Gujarat, India
[4]Hill Millet Research Station, Navsari Agricultural University, Waghai (Dangs), Gujarat, India
***E-Mail:** pareshvavdiya@gmail.com

Abstract
A line x tester analysis using 10 lines and five testers were carried out to study the stability of 50 hybrids over environments using three different sowing dates for seed cotton yield and its quantitative traits in cotton. The analysis of variance for stability revealed significant differences among the genotypes for all the characters when tested against the pooled error and pooled deviation. The mean square due to environments (E) was also found significant when tested against the pooled error and pooled deviation for all the characters. G x E interactions were non-significant for all the characters except days to 50% flowering, days to 50% boll bursting, seed index and oil content indicating linear response of different genotypes for various traits under varied environmental conditions. The variance due to environments (linear) was significant for all the traits when tested against pooled error as well as pooled deviation. The stability parameters *viz*., overall mean ($\overline{X}$), regression coefficient (bi) and deviation from regression (S^2di) revealed that the hybrids G.Cot 18 x GSHV 173, G.Cot 18 x GTHV 7/70, G.Cot 12 x GTHV 7/70, G.Cot 12 x G.Cot 20 and GJHV 511 x GSHV 173 were the most widely adapted and stable crosses for seed cotton yield per plant and its components. The parents GJG 101, Deviraj, G.Cot 12, G.Cot 10, GJHV 500, GJHV 511, GJHV 517, GJHV 521, GJHV 536, Suraj, G.Cot 20, GSHV 173 and GTHV 7/70 were identified as the stable genotypes for seed cotton yield and its components and hence, they may be utilized in breeding programmes for incorporation of stability in cotton.

Key words
Cotton, stability, Eberhart and Russell Model, Environments, G x E interaction.

INTRODUCTION

Cotton, the king of fibre, is one of the momentous and important cash crop exercising profound influence on economics and social affairs of the world and plays a vital role as a cash crop in commerce of many countries such as USA, China, India, Pakistan, Uzbekistan, Australia and Africa. Cotton enjoys a pre-eminent status among all the cash crops in the country being the principal material for flourishing textile industries. Apart from world's leading natural fibre, cotton is the world's second most important oilseed (Kohel, 1989). It is the prime raw material (85%) of textile industry which provides employment to millions of people in the world over for various activities such as cultivation, seed production, marketing, industrial utilization and research. The efforts are made to improve the productivity of cotton using different methods. The development of hybrids by using diverse parents, evaluation of the cross combinations and identification of stable genotype forms the important objectives in cotton breeding programmes. Environment plays an important role in the final phenotypic expression of a character. A genotype is known to show a differential phenotypic response in development when introduced in different environments. The genotype x environment (G x E) interaction is particularly important in the expression of quantitative characters, which are controlled by polygenic systems and are greatly modified by the environmental influences. Knowledge of the nature and relative magnitude of various types of G x E interaction are useful in making decisions concerning breeding methods, selection programmes and testing procedures in crop plants. Among the different stability models, Eberhart and Russell (1966) model is the most exploited model for the identification of stable genotypes over locations. The objective of the present study was to identify the stable hybrids by determining GxE interaction effects.

MATERIALS AND METHODS

The experimental material comprised of 10 lines viz.,GJG 101, Deviraj, G.Cot 12, G.Cot 18, G.Cot 10, GJHV 500, GJHV 511, GJHV 517, GJHV 521 and GJHV 536 and five testers namely Suraj, G.Cot 20, GSHV 173, GTHV 7/70 and GBHV 170 and their 50 hybrids derived from line x tester mating design. These 65 genotypes along with a check hybrid (G.Cot.Hy-12) were evaluated in a Randomized Block Design at Cotton Research Station, Junagadh Agricultural University, Junagadh over three environments (sowing dates) during *kharif* 2015-16. Environments were created through different dates of sowing i.e. E_1 = onset of monsoon, E_2 = 20 days after 1st sowing and E_3 =20 days after 2nd sowing. Each entry was accommodated in single row of 6.3m. length spaced at 120cm apart with plant-to-plant spacing of 45cm. Recommended practices and plant protection measures were adopted timely to raise the healthy crop. The observations on five randomly selected plants were recorded for 12 characters *viz.,* days to 50% flowering, days to 50% boll bursting, plant height (cm), the number of monopodia per plant, the number of sympodia per plant, the number of bolls per plant, boll weight (g), seed cotton yield per plant (g), ginning percentage (%), seed index (g), lint index (g) and oil content (%). Stability parameters were estimated by the method described by Eberhart and Russell (1966).

RESULTS AND DISCUSSION

Analysis of variance for stability was carried out as per Eberhart and Russell model (1966) and the results are given in **Table 1**.The stability analysis indicated that the mean square due to E + (G x E) interactions was significant for days to 50% flowering, days to 50% boll bursting, plant height, boll weight, seed cotton yield per plant, seed index, lint index and oil content when tested against the pooled error, while G x E interactions were non-significant for all

Table 1. Analysis of variance for stability for different characters in cotton

Source	DF	Days to 50% flowering	Days to 50% boll bursting	Plant height	Number of monopodia per plant	Number of sympodia per plant	Number of bolls per plant
Genotypes (G)	65	110.31*+	261.58*+	2116.08*+	1.32*+	21.39*+	295.70*+
Environments (E)	2	51.50*+	261.17*+	344.25*+	0.06*+	2.29*+	33.99*+
G x E	130	3.25*	9.11*	5.16	0.01	0.38	1.57
E + (G x E)	132	3.98*	12.93*	10.29*+	0.01	0.41	2.07+
Environments (Lin.)	1	103.00*+	522.34*+	688.50*+	0.13*+	4.58*+	67.99*+
G x E (Linear)	65	3.73*	5.50	5.48	0.01	0.43	1.99+
Pooled Deviation	66	2.73*	12.53*	4.76	0.01	0.32	1.14
Pooled Error	390	1.76	5.41	5.55	0.01	0.59	2.36

Source	DF	Boll weight	Seed cotton yield per plant	Ginning percentage	Seed index	Lint index	Oil content
Genotypes (G)	65	0.70*+	3494.31*+	10.93*+	2.79*+	2.27*+	1.06*+
Environments (E)	2	0.26*+	2397.17*+	17.75*+	2.22*+	2.95*+	1.31*+
G x E	130	0.01	37.73	0.27	0.03*	0.02	0.03*
E + (G x E)	132	0.02*+	73.47*+	0.53+	0.06*+	0.06*+	0.05*+
Environments (Lin.)	1	0.53*+	4794.34*+	35.50*+	4.44*+	5.90*+	2.62*+
G x E (Linear)	65	0.01	29.89	0.30	0.02	0.02	0.03*
Pooled Deviation	66	0.01	44.87	0.23	0.03*	0.02	0.03*
Pooled Error	390	0.01	39.35	0.48	0.02	0.03	0.02

* Significant against pooled error at 5% level, + Significant against pooled deviation at 5% level

the characters except days to 50% flowering, days to 50% boll bursting, seed index and oil content indicating linear response of different genotypes for various traits under varied environmental conditions. A very high proportion of total variance was accounted for the environment (linear) component. Higher magnitude of the mean squares due to environment (linear) indicated that the differences among environments were considerable for all the characters and revealed that these characters were highly influenced by environments, thereby suggesting that the large differences among environments along with the greater part of genotypic response was a linear function of environments. This indicated that the environments created by various sowing dates were justified had mostly linear effect. These results are in agreement with the earlier findings of Tuteja *et al*. (2006),Balakrishna *et al.* (2016), Vanisri et al. (2016), Jamwal *et al*. (2016), Chinchane *et al*. (2018) and Pinki *et al*. (2018).

Eberhart and Russell (1966) defined a stable genotype as one, which has a high mean ($\bar{X}$), regression coefficient around unity ($b_i \cong 1$) and deviation from regression as small as possible ($S^2d_i \cong 0$). A genotype is considered to have an average stability (same performance in all the environments when the bi value is unity). If bi is more than unity, the hybrid or genotypeis having less than average stability and if the bi value is less than unity then hybrids are having more than average stability(good performance in poor environments).

The results of the stability analysis for six important yield contributing characters are presented in **Table 2a** and **Table 2b**. For plant height, it was observed that 17 hybrids were tall in height with average responsiveness (bi ≈ 1) and were stable across the environments. Among these, some good hybrids were G.Cot 12 x GSHV 173 ($\bar{X}$ = 149.47), G.Cot 18 x GBHV 170 ($\bar{X}$ = 147.24), G.Cot 12 x GTHV 7/70 ($\bar{X}$ = 146.96) andG.Cot 18 x G.Cot 20 ($\bar{X}$ = 145.51). Out of 17 tall hybrids, eight hybrids had less than unit regression (bi < 1) indicating above average stability.

For number of monopodia per plant, 17 hybrids expressed average responsiveness and stability across environments with high mean as they depicted regression coefficient around unity (bi ≈1) and non-significant deviation from regression. Among these, best hybrids were G.Cot 18 x GSHV 173 ($\bar{X}$ = 3.47), G.Cot 12 x GBHV 170 ($\bar{X}$ = 3.40) and G.Cot 18 x GBHV 170 ($\bar{X}$ = 3.18). Eighteen cross combinations with high mean for the number of sympodia per plant had average responsiveness (bi ≈ 1) and were stable across the environments. Among these 18 hybrids, best five hybrids were G.Cot 12 x GTHV 7/70 ($\bar{X}$ = 22.00), G.Cot 12 x GBHV 170 ($\bar{X}$ = 19.91), G.Cot 18 x GSHV 173 ($\bar{X}$ = 19.80), G.Cot 12 x Suraj ($\bar{X}$ = 19.42) and G.Cot 18 x GTHV 7/70 ($\bar{X}$ = 19.22). Among 18 stable hybrids, 13 hybrids had high mean for the number of sympodia per plant with bi < 1 and non-significant deviation from regression, which indicated above average stability. Same results have been reported by Nidagundi *et al*. (2012) and Sirisha *et al*. (2019) for this trait in cotton.

Twenty one hybrids had higher mean with unit regression coefficient (bi ≈ 1) and least deviation from regression for the number of bolls per plants. Out of these 21 hybrids, best five hybrids were G.Cot 18 x G.Cot 20 ($\bar{X}$ = 64.16), G.Cot 18 x Suraj ($\bar{X}$ = 64.07), G.Cot 18 x GBHV 170 ($\bar{X}$ = 62.91), G.Cot 18 x GTHV 7/70 ($\bar{X}$ = 60.87) and G.Cot 12 x GSHV 173 ($\bar{X}$ = 57.29). Among these, 10 hybrids had higher mean with regression coefficient less than unity (bi < 1) and non-significant deviation from regression which indicated above average stability. These results are in accordance with the results of Patil and Patel (2010), Kavithamani *et al*. (2011), Dewdar (2013) and Sirisha *et al*. (2019).

Fifteen cross combinations with high mean for boll weight had average responsiveness (bi ≈ 1) and were stable across the environments as they depicted regression coefficient around unity and non-significant deviation from regression. Out of these, best cross combinations were G.Cot 18 x GSHV 173 ($\bar{X}$ = 4.69), GJHV 521 x GSHV 173 ($\bar{X}$ = 4.66) and G.Cot 18 x GTHV 7/70($\bar{X}$ = 4.56). Four hybrids *viz*., G.Cot 12 x G.Cot 20, G.Cot 12 x GTHV 7/70, GJHV 536 x GSHV 173 and GJHV 536 x GTHV 7/70 had higher mean for boll weight but less than unit regression coefficient (bi < 1) and non-significant S^2di, thereby revealing above average stability. Same results have been reported by Patil and Patel (2010), Nidagundi *et al*. (2012), Jamwal *et al*. (2016), and Sirisha *et al*. (2019).

Among the 45 stable hybrids for seed cotton yield per plant, eight hybrids *viz.,*G.Cot 18 x GSHV 173 ($\bar{X}$ = 209.10), G.Cot 18 x GTHV 7/70 ($\bar{X}$ = 205.42), G.Cot 12 x GTHV 7/70 ($\bar{X}$ = 147.38), G.Cot 12 x G.Cot 20 ($\bar{X}$ = 140.56), GJHV 511 x GSHV 173 ($\bar{X}$ = 138.19), GJHV 500 x G.Cot 20 ($\bar{X}$ = 132.19), G.Cot 12 x Suraj ($\bar{X}$ = 115.85) and GJHV 536 x GTHV 7/70($\bar{X}$ = 115.68) were high yielders with average responsiveness and adaptability to different environments, as they depicted high mean, regression coefficient around unity and non-significant deviation from regression. Among these high yielding and stable hybrids, four hybrids *viz*., G.Cot 18 x GTHV 7/70, GJHV 500 x G.Cot 20, GJHV 511 x GSHV 173 and GJHV 536 x GTHV 7/70 had regression coefficient below unity (bi < 1) indicating above average stability i.e. performed better under unfavorable environments. Same results of hybrid stability for seed cotton yield have been reported by Patil and Patel (2010), Kavithamani *et al*. (2011), Nidagundi *et al*. (2012), Dewdar (2013) and Sirisha *et al*. (2019).

The stability of the genotypes for seed yield per plant has been reported to be the result of stability for its component traits (Grafius, 1959; Luthra *et al.,* 1977). Singh (1983) suggested the utilization of stable and potential genotypes in breeding programmes for incorporation of stability. Hence, stability of the identified genotypes (hybrids) for

Table 2a. Estimates of stability parameters for plant height, number of monopodia per plant and number of sympodia per plant in cotton

S. No.	Genotypes	Plant height			Number of monopodia per plant			Number of sympodia per plant		
		$\overline{X}$	bi	S^2di	$\overline{X}$	Bi	S^2di	$\overline{X}$	bi	S^2di
1	GJG 101 x Suraj	63.07	0.70	-2.34	1.27	1.23	-0.001	13.31	1.75	-0.57
2	GJG 101 x G.Cot 20	64.31	1.64	-3.02	1.09	1.02	-0.006	13.91	1.55	-0.48
3	GJG 101 x GSHV 173	65.16	1.64	-2.27	1.13	0.92	0.001	13.38	1.21	0.26
4	GJG 101 x GTHV 7/70	73.04	0.52**	-5.51	1.13	-0.92	0.001	13.11	2.40	-0.49
5	GJG 101 x GBHV 170	65.82	1.16	-5.45	1.31	1.13	-0.006	12.58	-1.61**	-0.60
6	Deviraj x Suraj	65.42	0.94	-4.62	1.71	1.13	-0.006	13.69	2.94*	-0.56
7	Deviraj x G.Cot 20	65.89	1.71	-1.56	1.91	0.21	0.005	13.36	2.98*	-0.55
8	Deviraj x GSHV 173	73.47	1.05	-5.55	1.93	-3.98	0.025*	15.40	2.39	-0.45
9	Deviraj x GTHV 7/70	67.91	-0.34	9.17	2.07	1.23	-0.001	14.84	1.35	-0.52
10	Deviraj x GBHV 170	64.78	1.00	-5.24	2.16	0.11	-0.004	13.42	1.57	-0.44
11	G.Cot 12 x Suraj	139.89	-0.16	4.28	3.29	3.17*	-0.005	19.42	1.27	-0.27
12	G.Cot 12 x G.Cot 20	150.29	0.51**	-5.50	3.67	2.15**	-0.007	20.31	2.36**	-0.59
13	G.Cot 12 x GSHV 173	149.47	0.95	-2.05	3.73	2.15**	-0.007	21.78	4.90**	-0.45
14	G.Cot 12 x GTHV 7/70	146.96	0.82	-4.04	3.53	2.15**	-0.007	22.00	-3.80	0.38
15	G.Cot 12 x GBHV 170	149.67	-1.05*	3.63	3.40	-1.23	-0.001	19.91	0.69	-0.40
16	G.Cot 18 x Suraj	137.13	-0.03	-2.69	3.36	3.17*	-0.005	13.96	2.08	-0.50
17	G.Cot 18 x G.Cot 20	145.51	0.66	-3.89	3.24	1.13	-0.006	18.62	1.97**	-0.60
18	G.Cot 18 x GSHV 173	149.69	0.77**	-5.57	3.47	-1.23	-0.001	19.80	1.69	-0.55
19	G.Cot 18 x GTHV 7/70	143.44	1.00	-4.40	3.24	3.28**	-0.007	19.22	0.08	-0.51
20	G.Cot 18 x GBHV 170	147.24	-0.44	1.73	3.18	0.21	0.005	18.40	-3.89	0.94
21	G.Cot 10 x Suraj	91.04	1.44*	-5.19	1.89	2.25	-0.005	18.11	-0.64	-0.54
22	G.Cot 10 x G.Cot 20	91.16	1.27	7.98	2.07	7.68**	-0.004	18.04	3.94**	-0.60
23	G.Cot 10 x GSHV 173	98.27	1.32	-4.88	2.67	1.23	-0.001	19.11	-0.57	0.75
24	G.Cot 10 x GTHV 7/70	94.87	0.51	5.27	1.87	0.92	0.001	18.04	-2.92	0.29
25	G.Cot 10 x GBHV 170	97.18	1.14	-3.98	2.16	1.02	-0.006	15.20	3.08	0.35
26	GJHV 500 x Suraj	124.64	1.59	-3.26	2.24	0.81	0.013	15.07	1.93	-0.58
27	GJHV 500 x G.Cot 20	121.51	0.35	4.92	2.36	5.32**	-0.005	15.09	1.96	-0.25
28	GJHV 500 x GSHV 173	124.73	2.93**	-4.2	2.78	-0.11	-0.004	15.38	3.46	0.26
29	GJHV 500 x GTHV 7/70	121.04	1.33	-4.51	2.71	-0.11	-0.004	15.82	-3.83**	-0.47
30	GJHV 500 x GBHV 170	121.33	0.84	-1.44	2.42	-2.96	0.015	12.80	0.45	-0.53
31	GJHV 511 x Suraj	119.56	0.74**	-5.57	2.49	1.02	-0.006	15.62	1.26**	-0.60
32	GJHV 511 x G.Cot 20	107.96	1.28	-1.39	2.42	1.34	0.011	11.84	2.35	-0.35
33	GJHV 511 x GSHV 173	124.04	1.36**	-5.37	2.69	1.02	-0.006	15.96	-1.17	0.03
34	GJHV 511 x GTHV 7/70	115.00	1.61	-2.64	2.42	3.49	0.009	14.27	3.00**	-0.57
35	GJHV 511 x GBHV 170	110.67	2.16**	-4.01	2.33	-2.15**	-0.007	13.42	4.20**	-0.50
36	GJHV 517 x Suraj	111.69	2.25**	-4.61	1.89	4.40**	-0.005	17.80	1.97	-0.31
37	GJHV 517 x G.Cot 20	113.07	1.21	-2.56	2.20	0.92	0.001	12.80	2.70**	-0.60
38	GJHV 517 x GSHV 173	123.33	1.27	22.99*	2.69	1.02	-0.006	15.07	1.73	-0.56
39	GJHV 517 x GTHV 7/70	117.38	1.63**	-5.43	2.56	0.11	-0.004	17.11	1.49	-0.44
40	GJHV 517 x GBHV 170	116.60	0.72	-5.10	2.40	0.92	0.001	17.59	-1.07	-0.33
41	GJHV 521 x Suraj	96.47	0.27	5.98	2.20	-0.92	0.001	17.13	-3.48	-0.05
42	GJHV 521 x G.Cot 20	106.80	1.48	1.53	2.02	2.25	-0.005	17.53	1.08	-0.30
43	GJHV 521 x GSHV 173	118.38	1.32	-5.28	2.64	1.13	-0.006	16.98	-3.01	0.29
44	GJHV 521 x GTHV 7/70	109.87	1.90*	-4.07	2.38	-0.42	0.040**	16.00	-2.00	-0.23
45	GJHV 521 x GBHV 170	99.40	-0.55	8.72	1.98	-3.49	0.009	13.62	5.64**	-0.55
46	GJHV 536 x Suraj	80.09	1.01	-3.42	2.09	2.25	-0.005	12.49	0.19**	-0.60
47	GJHV 536 x G.Cot 20	82.02	0.93	-4.77	2.24	3.28**	-0.007	14.80	1.43**	-0.60
48	GJHV 536 x GSHV 173	90.40	1.33	-5.25	2.58	3.28**	-0.007	16.62	0.32	-0.19
49	GJHV 536 x GTHV 7/70	86.73	1.60	-3.66	2.58	2.04	-0.003	15.27	0.71**	-0.60
50	GJHV 536 x GBHV 170	85.36	0.97	-5.10	2.29	3.17*	-0.005	12.42	-4.58	0.03
	Mean	105.10			2.34			15.47		
	SE±	1.50			0.05			0.40		

*, ** Significant at 5 % and 1 % levels, respectively

Table 2b. Estimates of stability parameters for number of bolls per plant, boll weight and seed cotton yield per plant in cotton

S. No.	Genotypes	Number of bolls per plant			Boll weight			Seed cotton yield per plant		
		$\bar{X}$	bi	S^2di	$\bar{X}$	Bi	S^2di	$\bar{X}$	bi	S^2di
1	GJG 101 x Suraj	34.16	-0.79	-1.54	3.51	-0.35	-0.005	85.95	-0.38*	-9.3
2	GJG 101 x G.Cot 20	37.87	0.60**	-2.44	3.10	2.12	0.005	79.62	1.06	-8.27
3	GJG 101 x GSHV 173	38.42	1.91	-2.06	3.10	1.00	-0.012	80.83	0.87	-31.51
4	GJG 101 x GTHV 7/70	37.78	0.05**	-2.32	3.03	-1.32	0.023	76.49	-0.56*	-2.35
5	GJG 101 x GBHV 170	31.96	0.33	-1.54	3.03	0.79	-0.002	63.21	0.54**	-40.06
6	Deviraj x Suraj	35.84	0.42**	-2.45	3.57	-0.80**	-0.013	92.81	0.24**	-34.16
7	Deviraj x G.Cot 20	39.31	-0.32**	-2.32	3.62	2.15	-0.010	104.10	1.09	-36.35
8	Deviraj x GSHV 173	44.93	1.95	-1.77	3.55	1.40	-0.013	114.53	1.28**	-39.61
9	Deviraj x GTHV 7/70	40.53	0.74**	-2.45	3.25	1.48**	-0.014	91.36	0.83**	-40.23
10	Deviraj x GBHV 170	37.29	2.05*	-2.16	3.65	1.24	-0.013	99.52	1.30	-35.75
11	G.Cot 12 x Suraj	52.29	0.88	-2.24	3.22	1.63**	-0.013	115.85	1.13	-36.91
12	G.Cot 12 x G.Cot 20	49.80	0.13	6.68	4.10	-0.62	-0.005	140.56	1.36	-31.53
13	G.Cot 12 x GSHV 173	57.29	1.02	-2.44	4.28	1.14	0.443**	163.80	0.83	266.98**
14	G.Cot 12 x GTHV 7/70	49.00	-0.05	-2.12	4.33	-0.99	0.002	147.38	0.54	0.47
15	G.Cot 12 x GBHV 170	54.60	0.69	-1.32	4.18	-1.86**	-0.003	145.17	1.09	168.24*
16	G.Cot 18 x Suraj	64.07	-0.56	-1.14	4.32	1.32	0.001	175.39	1.60**	-37.96
17	G.Cot 18 x G.Cot 20	64.16	0.09	-2.15	4.40	1.49	-0.012	193.77	-1.69**	-1.08
18	G.Cot 18 x GSHV 173	66.67	2.37**	-2.27	4.69	1.12	0.007	209.10	1.16	9.16
19	G.Cot 18 x GTHV 7/70	60.87	0.70	-1.64	4.56	1.33	-0.009	205.42	0.74	103.49
20	G.Cot 18 x GBHV 170	62.91	1.67	3.05	4.40	1.24*	-0.014	192.65	0.15	278.82**
21	G.Cot 10 x Suraj	40.22	0.42	-1.54	3.47	1.24*	-0.014	98.12	0.87	-26.24
22	G.Cot 10 x G.Cot 20	42.62	0.05	-1.82	3.42	2.48**	-0.013	98.35	1.20	53.99
23	G.Cot 10 x GSHV 173	47.02	1.67	-1.25	3.34	-1.33**	-0.008	104.67	1.08	-37.51
24	G.Cot 10 x GTHV 7/70	44.04	0.09**	-2.40	3.42	2.21**	-0.013	99.26	1.50	105.97
25	G.Cot 10 x GBHV 170	42.31	1.53	-2.35	3.66	0.35	0.002	86.57	1.17	-33.64
26	GJHV 500 x Suraj	33.60	0.70**	-2.44	4.04	2.26	-0.005	102.31	1.04	-32.37
27	GJHV 500 x G.Cot 20	39.02	-0.46	-1.37	4.48	-0.89**	-0.013	132.19	0.70	54.65
28	GJHV 500 x GSHV 173	42.07	-1.53**	-1.90	4.59	2.16**	-0.013	137.97	1.43	143.47*
29	GJHV 500 x GTHV 7/70	42.33	2.19	-1.33	4.36	0.62*	-0.014	136.11	1.78**	-39.73
30	GJHV 500 x GBHV 170	38.22	3.58**	-1.84	4.18	1.36	-0.013	119.91	1.92**	-36.98
31	GJHV 511 x Suraj	35.11	1.16	-2.18	3.81	0.85	-0.012	98.55	0.69	-31.60
32	GJHV 511 x G.Cot 20	40.78	0.79	-1.44	4.04	1.32	0.001	105.96	1.90	-3.30
33	GJHV 511 x GSHV 173	33.07	2.37**	-2.29	4.17	1.81**	-0.014	138.19	0.82	-36.38
34	GJHV 511 x GTHV 7/70	36.56	3.21**	-2.07	3.72	1.22	-0.009	110.21	1.04	-37.82
35	GJHV 511 x GBHV 170	42.91	1.02	-1.87	3.62	1.86	-0.012	100.56	1.18	-34.86
36	GJHV 517 x Suraj	42.04	-0.28	-1.87	3.19	1.52**	-0.013	102.96	1.69	-13.55
37	GJHV 517 x G.Cot 20	43.07	1.30	-2.21	3.70	-1.21**	-0.014	116.51	-0.13**	-37.98
38	GJHV 517 x GSHV 173	47.93	1.58**	-2.42	4.36	-1.09*	-0.005	148.98	0.15	365.41**
39	GJHV 517 x GTHV 7/70	45.16	1.30	-2.08	3.80	1.90	-0.011	126.45	1.38**	-39.51
40	GJHV 517 x GBHV 170	46.67	1.95	-2.20	3.72	1.23**	-0.014	120.84	1.42**	-40.24
41	GJHV 521 x Suraj	25.38	2.42	-1.88	4.30	1.54	-0.009	84.05	1.35**	-39.25
42	GJHV 521 x G.Cot 20	25.73	2.09	-1.63	4.47	1.76**	-0.014	89.28	1.36	-34.62
43	GJHV 521 x GSHV 173	23.71	1.77**	-2.44	4.66	1.36	-0.013	96.33	2.53**	-29.07
44	GJHV 521 x GTHV 7/70	27.04	0.37**	-2.44	4.34	1.69	-0.006	90.47	0.61	-34.52
45	GJHV 521 x GBHV 170	30.64	1.58	-1.00	4.30	1.44	-0.012	100.97	1.11	-33.93
46	GJHV 536 x Suraj	34.76	2.09**	-2.43	3.43	1.13	0.005	90.89	1.15	-34.35
47	GJHV 536 x G.Cot 20	38.53	-0.89	-0.05	3.55	3.46*	-0.001	98.21	1.21**	-40.25
48	GJHV 536 x GSHV 173	41.04	2.00**	-2.43	4.42	0.65	-0.009	139.71	1.13*	-40.11
49	GJHV 536 x GTHV 7/70	41.29	1.54	-1.83	4.21	0.98	-0.013	115.68	0.97	-38.85
50	GJHV 536 x GBHV 170	38.07	1.58	-1.15	3.69	1.32	-0.013	100.87	1.07	-37.55
	Mean	**40.77**			**3.81**			**111.40**		
	SE±	**0.76**			**0.08**			**4.70**		

*, ** Significant at 5% and 1% levels, respectively

Table 3. The most widely adapted hybrids identified on the basis of seed cotton yield per plant along with their stability for component traits in cotton

S. No.	Hybrids	Stable yield attributes
1.	G.Cot 18 x GSHV 173	Days to 50% flowering, Days to 50% boll bursting, Plant height (cm), Number of monopodia per plant, Number of sympodia per plant, Number of bolls per plant, boll weight (g), Ginning percentage (%), Seed index (g), Lint index (g), Oil content (%)
2.	G.Cot 18 x GTHV 7/70	Days to 50% flowering, Days to 50% boll bursting, Plant height (cm), Number of monopodia per plant, Number of sympodia per plant, Number of bolls per plant, boll weight (g), Ginning percentage (%), Seed index (g), Lint index (g), Oil content (%)
3.	G.Cot 12 x GTHV 7/70	Days to 50% flowering, Plant height (cm), Number of monopodia per plant, Number of sympodia per plant, Number of bolls per plant, boll weight (g), Ginning percentage (%), Seed index (g), Lint index (g), Oil content (%)
4.	G.Cot 12 x G.Cot 20	Days to 50% flowering, Plant height (cm), Number of monopodia per plant, Number of sympodia per plant, Number of bolls per plant, boll weight (g), Ginning percentage (%), Seed index (g), Lint index (g), Oil content (%)
5.	GJHV 511 x GSHV 173	Days to 50% flowering, Days to 50% boll bursting, Plant height (cm), Number of monopodia per plant, Number of sympodia per plant, Number of bolls per plant, boll weight (g), Ginning percentage (%), Seed index (g), Lint index (g), Oil content (%)

seed cotton yield per plant has been characterized with respect to yield attributes and the information is presented in **Table 3**. In this direction, five best high yielding and stable crosses were identified *viz*., G.Cot 18 x GSHV 173, G.Cot 18 x GTHV 7/70, G.Cot 12 x GTHV 7/70, G.Cot 12 x G.Cot 20 and GJHV 511 x GSHV 173, which were also found stable for most of the yield attributing characters and could be utilized further for yield improvement in cotton.

REFERENCES

Balakrishna, B., Reddy, C.V. and Ahamed, L.M. 2016. Stability analysis for seed cotton yield & its component traits in inter- specific hybrids of cotton (*G. hirsutum* x *G. barbadense*). *Green Farming,* **7**(5): 1013-1018.

Chinchane, V.N., Deosarkar, D.B. and Kalpande, H.V. 2018. Stability analysis for seed cotton yield and its component traits in hybrids of *desi* cotton (*Gossypium arboreum* L.). *Int. J. Curr. Microbiol. App. Sci*., **7**(9): 1000-1012. [Cross Ref]

Dewdar, M. D. H. 2013. Stability analysis and genotype x environment interactions of some Egyptian cotton cultivars.*African J. Agric. Res*., **8**(41): 5156-5160.

Eberhart, S.A. and Russell, W.A. 1966. Stability parameters for comparing the varieties. *Crop Sci*., **6**(1): 36-40. [Cross Ref]

Grafius, J.E. 1959. Heterosis in barley. *Agron. J.*, **40**(1): 58-83.

Jamwal, N. S., Singla, J., Gumber, R. K., Pathak, D., Rathore, P., Singh, A. D. and Nimitkumar. 2016. Study of genotype x environment interactions and stability among diverse *Gossypium arboreum* L. genotypes for yield and related traits under North Western Plains. *Electronic J. Pl. Breeding*, **7**(3): 684-691. [Cross Ref]

Kavithamani, D., Amala, B.P. and Rajarthinam, S. 2011. Stability analysis of seed cotton yield and its components of *Gossypium barbadense* genotypes. *Madras Agric J*., **98**(10-12): 321-326.

Kohel, R.J. 1989. Cotton in oil crops of the world. McGraw Hill, New Yolrk. pp. 404-405.

Luthra, O.P., Karkar, S.N. and Singh, R.K. 1977. Genotype - environment interactions and ranking of varieties in wheat. *Third International SABRAO Congress*, Australia. Abst.13.

Nidagundi, J.M., Patil, S.S., Salimath, P.M., Kajjidoni, S.T., Patil, B.C. and Hedge, M.G. 2012. Heterobeltiosis in multiple environments for seed cotton yield and yield attributes in cotton (*G. hirsutum* L.). *Karnataka J. Agric. Sci.,* **25**(3): 301-304.

Patil, H.E. and Patel, K.G. 2010. Stability analysis of seed cotton yield and its components of released Bt cotton (*Gossypium hirsutum* L.).*J. Cotton Res. Devel.*, **24**(1): 17-22.

Pinki, Siwach, S.S., Sangwan, R.S., Singh, S. and Mor, V.S. 2018. Stability analysis for seed cotton yield and its components in upland cotton (*Gossypium hirsutum* L.). *Int. J. Curr. Microbiol. App. Sci.,***7**(4): 1630-1638. [Cross Ref]

Singh, S.V. 1983. Phenotypic stability and genetic divergence for yield and quality characters in potato. Ph.D Thesis (Unpublished), Meerut University, Meerut.

Sirisha, A.B.M., Lal Ahamed, M., Ramakumar, P.V., Ratnakumari,S. and Srinivasa Rao, V. 2019. Stability analysis for seed cotton yield and its component traits in upland cotton (*Gossypium hirsutum* L.). *Science Spectrum,* **4**(1-2):18-27.

Tuteja, O.P., Singh, M. and Verma, S.K. 2006. Stability analysis for seed cotton yield and its component traits in intra-specific hybrids of *Gossypium hirsutum*. *J. Cotton Res. Dev*., **20**(2): 171-173.

Vanisri, S., Raju, S., Raju, D., Reddy, P. R. and Suryanarayan, Y. 2016. G x E interaction and stability analysis of promising rice cultures under different sowing dates during kharif. *Electronic J. Pl. Breeding,* **7**(3):794-798. [Cross Ref]