STABILITY ANALYSIS IN DESI COTTON (*Gossypium arboreum* L.) FOR SEED COTTON YIELD AND ITS RELATED TRAITS

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Abstract

The present study was conducted on stability analysis for seed cotton yield and its component traits in four desi cotton varieties and its F1 fybrids crossed by diallel fashion under three different locations within Taminadu. Observations were recorded for days to 50% flower, plant height (cm), number of sympodial branches /plant, number of bolls/ plants, boll weight (g), number of seeds/boll, seed index (g), seed cotton yield/ plant (g) and harvest index (g). This experiment has resulted in identification of two parents *i.e.* PA 785, HD 432 which were found to be stable and responsive to the low yielding environment which can be used as parents for improving yield stability of the cotton genotypes. The results showed that the stable crosses for the seed cotton yield per plant were PAIG 346 x PA 785, PAIG 346 x HD 432, PA 785 x PAIG 346 which have also responded well to favourable environments.

Keywords: desi cotton, yield related traits, stability

Introduction

Cotton, *G. arboreum* is grown in India under a wide range of climatic conditions. Cotton a sensitive crop to weather fluctuations, it shows higher magnitude of genotype x environment interaction (Campbell and Jones, 2005). Climatic, soil, insect, disease and cultural conditions also differ from one state of the country to another and frequently from year to year at any one location. The agro ecological diversity of environments complicates breeding and testing of improved genotypes with adequate adaptation, but it also permits identification of extreme environmental conditions that guarantee selection pressure from important stresses. In crop performance, three factors are very important i.e. genotype, the environment in which the crop is grown, and the interactions between genotype and environment (G × E) (Gomez, Gomez, 1984).

Estimation of phenotypic stability has proven to be a valuable tool in the assessment of varietal adaptability. It is generally agreed that, the more stable genotypes can somehow adjust their phenotypic responses to provide some measures of uniformity in spite of environmental fluctuations. More knowledge about causes of G x E interaction is needed and would be useful for establishing breeding objectives, identifying the best test condition and finding areas of optimal cultivar adaptation.

Cotton plant has indeterminate growth habit which is greatly influenced by environmental conditions. Under high fertility conditions, cotton plant can attain more plant height, more nodes, more sympodia, delayed flowering whereas under stress conditions the plants may remain stunted with less monopods, sympodia and nodes or may initiate flowering very early.Similarly the final yields of cotton, which is governed by polygenes and which are highly influenced by environment is a very complex character and have several components. To improve yield, in actual practice a breeder has to select individuals on the basis of phenotypic expression. Many characters of economicworth are quantitatively inherited and manifesthigh genotype environment effects.

In stability analysis, Finley and Wilkinson (1963) considered linear regression as a measure of stability, whereas Eberhart and Russell (1966) emphasized that with linear (bi) and non-linear (S^2di) components of genotype – environment interaction be considered while judging the phenotypic stability of a genotype. The present study was carried out to determine the effect, of G x E interaction on the seed cotton yield and its related traits in desi cotton.

Materials and methods

The experimental material for the present investigation comprised of four desi cotton genotypes HD 324, HD 432, PAIG 346 and PA 785. These genotypes were sown and crossed during kharif season of the year 2016 in diallel mating design with reciprocals to obtain 12 crosses with 4 selfed ones. Four genotypes and 12 crosses were grown in randomized block design with three replications at four different locations within Tamilnadu i.e. Chidambaram, Attur, Coimbatore and Virudhunagar. Each cross and parent was grown in a 2 row plot of 4.5 m length at a spacing of 60 x 60 cm. The observations recorded on days to 50 % flowering, plant height (cm), number of sympodial per plant, number of boll per plant, boll weight (g), number of seeds per plant, seed cotton yield per plant (g), seed index (g) and harvest index (%). The data on seed cotton yield and yield components was analyzed for stability analysis according to Eberhart and Russell (1966) model.

Results and discussion

From the ANOVA it was evident that mean squares for genotypes x environment were non-significant for all the characters except number of bolls per plant, boll weight and seed cotton yield (Reddy *et al.*, 2003) which indicated inconsistency of performance of cotton genotypes across the environments for these characters. The significance of environment linear component for all the characters indicated considerable differences among the environments and their predominant effects on the traits. The significance of genotypes x environment linear component for plant height, number of sympodia per plant, number of bolls per plant, number of seeds per boll, seed cotton yield per plant, harvest index for most of the characters indicated preponderance of linear component in these traits and hence prediction appeared possible. The pooled deviation formost of characters except number of sympodia per plant and number of bolls per plant was non-significant indicated the performance of the genotypes for these traits could be predictable. Singh *et al.* (2004) observed similar results.

Genotype having high mean, unit regression and least deviation from regression is considered to be superior (Eberhart and Russell, 1966). Among all the character, yield is a very complex character which is controlled by polygenes thereby showing the continuousvariation in interaction with environment. It is also one of the most important characters breeder aims at. Therefore it would be wise to identify stable crosses on the basis of yield followed by other characters as it is the highly prone to environmental differences. Out of four parents, two parents showed highly stable performance across the environments. They exhibited high mean than parental mean and non-significant deviation from regression. Among parental lines PA 785 and HD 432 was found to be highly stable for yield per plant. Out of twelve hybrids, six hybrids were widely stable with high mean and non- significant deviation from regression (Table 1).

Among them PAIG 346 x PA 785 was widely stable followed by PAIG 346 x HD 432, PA 785 x PAIG 346, HD 324 x HD 342 and HD 324 x PA 784. These crosses possessed by value greater than unity indicated their high response towards elevated environmental conditions for crop growth. Among all the characters, days to 50 % flower was the highly stable character as two parents and six crosses found to be highly stable across the environments. It was followed by harvest index and plant height. The lowest stability was observed for seed index followed by seed cotton yield per plant. Similar findings were also reported by Chahal *et al.*, (2001), Shashibhushan and Patel (2003), Nirani *et al.*, (2004), Pund and Dev (2006), Khan *et al.*, (2008) and Gumber *et al.*, (2009).

Among the crosses, PAIG 346 x PA 785, PAIG 346 x HD 432, PA 785 x PAIG 346, HD 324 x HD 342 and HD 324 x PA 784 were identified as best combinations for stability which have also responded well to favourable environments. Their stable performance was partly attributed to the highly stable nature of their parents in the varying environments, stability of the yield contributing traits for which they were observed and their individual buffering capabilities. Thus, in the present study hybrids exhibited superiority over parents for stability. These results are in agreement with the earlier findings Shashibhushan and Patel (2003), Laghari *et al.* (2003), Patel and Patel (2006), Pund and Dev (2006), and Khan *et al.*, (2008).

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Table 1. Stability parameters for seed cotton yield and its related traits under four different environments

Genotypes	Days to 50% flower			Plant height (cm)			Number of sympodia per plant		
	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
PAIG 346	69.89	-0.52	-0.60	96.77	1.20	-8.85	11.48	0.45	-2.23
PA 785	72.65	1.38	-0.62	108.42	0.68*	-9.37	17.90	0.42	-2.42
HD 324	64.47	1.08	-0.45	100.34	0.43	-8.68	13.76	0.35	-2.76
HD 432	71.22	1.10	-0.49	100.45	0.56	-9.14	17.24	0.25	-2.66
PAIG 346 x PA 785	74.78	2.83	-0.83	119.58	-0.81	-11.25	18.55	1.85	-2.58
PAIG 346 x HD 324	70.43	1.98	-0.34	115.32	0.78	-10.32	18.10	1.44	-1.52
PAIG 346 x HD 432	73.33	0.11	-0.54	102.52	0.98	-8.66	15.62	0.96	-1.67
PA 785 x PAIG 346	73.21	0.23	-0.66	112.23	0.03	-3.28	17.46	1.37	-2.44
PA 785 x HD 324	66.76	-0.94	-0.12	93.23	1.34	-1.22	14.46	0.65	8.91*
PA 785 x HD 432	69.34	2.33	-0.02	98.90	0.58	-4.29	17.08	0.91	18.81*
HD 324 x PAIG 346	64.77	-0.53	-0.11	106.84	0.36	-3.88	13.52	0.56	6.76
HD 324 x PA 785	72.98	0.74	-0.57	110.21	1.22	-4.71	16.77	0.87	6.72
HD 324 x HD 432	73.10	0.65	-0.38	110.98	1.48	-7.42	16.35	1.25	-2.66
HD 432 x PAIG 346	70.03	1.25	-0.92	106.47	0.77	-8.32	12.11	0.43	13.42*
HD 432 x PA 785	67.58	1.63	-0.16	98.25	0.28	-4.11	14.89	0.77	-4.68
HD 432 x HD 324	68.87	2.04	-0.49	99.78	0.51	-5.62	11.60	0.63	2.88

Table 1. Contd..

Genotypes	Number of bolls per plant			Boll weight (g)			Number of seeds per boll		
	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
PAIG 346	19.47	0.26	-3.76	2.12	-0.07	-0.0016	19.40	1.10	0.30
PA 785	27.66	0.73*	-3.82	2.77	-2.36	-0.0027	30.36	0.98	0.25
HD 324	22.34	0.78	-3.73	2.37	0.07	-0.0012	20.92	1.61	0.50
HD 432	26.82	0.68	-3.50	2.52	-0.71	-0.0053	29.60	3.93	0.60
PAIG 346 x PA 785	29.58	1.85	27.89**	3.45	4.74	0.0113*	32.46	- 1.41	0.65
PAIG 346 x HD 324	28.99	1.56	15.94**	3.11	2.65	0.0030	31.15	1.02	0.14
PAIG 346 x HD 432	25.27	0.98	-3.54	2.89	-1.23	-0.0037	27.21	1.20	0.12
PA 785 x PAIG 346	28.12	0.75	-2.72	2.95	-1.48	-0.0021	28.56	4.00	0.01
PA 785 x HD 324	16.38	1.08	-4.56	2.12	2.64	-0.0027	26.45	1.00	0.12
PA 785 x HD 432	18.44	0.99	0.83	2.06	-0.32	-0.0021	25.67	0.85	0.80
HD 324 x PAIG 346	25.78	0.89	-0.35	2.22	-0.33	-0.0022	25.14	1.50	0.05
HD 324 x PA 785	20.93	0.56	-3.05	2.56	2.43	-0.0027	26.13	1.65	0.02
HD 324 x HD 432	27.66	1.55	-4.78	2.43	1.68	0.0068	27.66	3.40	0.10
HD 432 x PAIG 346	27.04	0.99	-2.31	2.11	-0.87	-0.0072	24.33	4.40	0.20
HD 432 x PA 785	21.80	1.00	-2.88	2.01	1.10	-0.0017	21.90	2.30	0.25
HD 432 x HD 324	17.23	0.86	-3.01	2.35	1.76	-0.0023	20.34	1.20	0.35

Table 1. Contd..

Genotypes	Seed index (g)			Seed cotton yield per plant (g)			Harvest index (g)		
	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
PAIG 346	5.23	-0.53	-0.0318	50.12	0.70	-14.68	29.57	0.45	-1.27
PA 785	6.85	1.82	-0.0212	75.83	0.62*	-18.90	42.11	0.46*	-1.58
HD 324	5.82	0.45	-0.0157	43.95	0.48	-13.44	32.11	0.64	-1.66
HD 432	6.24	2.24	-0.0223	72.31	0.54*	-19.84	39.75	0.63	-1.92
PAIG 346 x PA 785	8.36	11.65*	0.0532	86.52	0.84*	59.68*	47.88	1.42*	-0.55
PAIG 346 x HD 324	8.07	9.65*	0.0118	84.10	0.47*	-14.65	45.24	0.48*	-1.35
PAIG 346 x HD 432	7.06	0.23	-0.0218	68.71	2.01	-8.56	39.01	1.29	-0.99
PA 785 x PAIG 346	7.84	-0.31	-0.0709	79.60	1.57	-13.01	41.04	0.49	-1.42
PA 785 x HD 324	6.99	2.67	-0.0834	64.27	0.45	-10.13	34.26	1.45	-1.65
PA 785 x HD 432	6.78	-7.32	-0.0267	61.77	1.03	-14.05	34.00	1.08	-0.47
HD 324 x PAIG 346	6.84	-4.28	-0.0186	55.32	0.42	-14.06	31.43	1.54	-0.37
HD 324 x PA 785	7.12	-2.49	-0.0208	73.51	1.50	81.84*	37.65	0.97	-0.26
HD 324 x HD 432	7.84	1.98	-0.0128	76.38	0.77	63.60	39.15	1.47	-1.10
HD 432 x PAIG 346	5.05	0.18	-0.0823	58.10	1.45	-13.33	29.97	1.23	-1.34
HD 432 x PA 785	5.11	-2.89	-0.0568	49.28	0.32	-15.89	30.24	0.49	-0.11
HD 432 x HD 324	6.32	-3.44	-0.0108	60.16	1.20	14.78	33.26	0.77	-0.83