VARIABILITY AND INTERRELATIONSHIP OF SOME AGRONOMIC AND FIBRE QUALITY TRAITS IN MULTI-ADVERSITY COTTON (*GOSSYPIUM hirsutum L.*)

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Abstract

Twenty-five cotton lines comprising 9 multi-adversity resistant lines from USA and 16 Fs lines derived from crosses between the variety S295 and the multi-adversity lines were evaluated for two years at one location in Samaru in Nigeria. The objective of this study was to assess genetic variability and correlations among some agronomic quality traits for genetic improvement. The line variance was significant except for plant height to the first fruiting branch, number of fruiting branches and number of bolls. The Line x year interaction was significant only for lint percent, seed index and seed cotton yield. In all cases the genotypic and phenotypic correlations have the same trends. Based on results the seed cotton yield was positively, phenotypically correlated with yield components, lint percent (0.385), number of bolls (0.343) and number of fruiting branches (0.160). The presence of a wide range variability in the materials studied could be exploited to improve lines of interest.

Key words: Correlation, genetic variability, genotypic, phenotypic, variance.

INTRODUCTION

The multi-adversity resistance (MAR) system for genetic improvement of cotton has a major impact on developing of cotton cultivars possessing gene combinations giving resistance to all pathogens, nematodes, insects and stresses and is capable of producing of a high volume and quality of the desired products (Bird, 1994). The MAR system makes easier to produce cultivars with stable resistance to two or more adversities than to develop those with resistance to only one adversity. The ultimate aim of every breeder in any cotton improvement programme is to increase cotton seed yield and improve the fibre technological qualities. To achieve this aim, a breeder must exploit variability of quantitative characters existing within a collection of genotypes. Therefore, the objectives of the present investigation are to assess the genetic variability of some agronomic quality traits among the multi-adversity resistant cotton lines and investigate the nature of interrelationships between these traits.

MATERIALS AND METHODS

The investigations were carried out during 1996/97 and 1997/98 raining periods at the Institute for Agricultural Research Farm Samaru (11□11' N, 7□38′ E) in the northern Guinea savanna zone of Nigeria with annual mean rainfall of 1050 mm distributed within 5 months using the following twenty-five lines composed of TAMCOT SP 37, TAMCOT SP 21S, TX CDP 37 HH-1-83, TAMCOT-CAMD-E, TX-CABUCS-2-1-83, TX-CABCHUS-1-84, TX-LEBOCAS-3-1-85, TX-CABCUS-2-84, TX-CABS-1-83 from the multi-adversity resistance (MAR) programme (USA) and (S295 x TX-CDP 37 HH-1-83) 119(95), (S295 x TX-CDP 37 HH-1-83) 1191(95), (S295 x TX-CDP 37 HH-1-83) 1212(95) , (S295 x TX-CDP 37 HH-1-83) 1244(95), (S295 x TX-CDP 37 HH-1-83) 1175(95), (S295 x TAMCOT SP 21S) 211(95), (S295 x TAMCOT SP 21S) 251(95), (S295 x TAMCOT SP 21S) 239(95), (S295 x TAMCOT SP 21S) 299(95), (S295 x TAMCOT SP 21S) 295(95), (S295 x TAMCOT-CAMD-E) 324(95), (S295 x TAMCOT-CAMD-E) 37(95), (S295 x TAMCOT-CAMD-E) 32(95), (S295 x TAMCOT-CAMD-E) 320(95), (S295 x TAMCOT-CAMD-E) 346(95), (S295 x TAMCOT-CAMD-E) 344(95) advanced cotton lines developed from a cross between (S295) a variety that is resistant to all known isolates of bacterial blight pathogens and a multi-adversity resistant lines. The experiment was laid out in a 5 x 5 triple lattice design with three replications. Plots were single rows, 10m in length and 0.90m apart with 0.40m plant spacing. Six seeds were sown per hole. The seedlings were thinned to two plants per hill at 4 weeks after sowing. NPK fertilizer was applied at thinning. Insect pests were controlled using three fortnightly sprays of Cymbush 10 EC at the rate of 2.5 litres/ha starting from nine weeks after sowing. All cultural practices carried out were as recommended by the Institute for Agricultural Research (IAR).

Data were collected from five plants randomly selected for each cotton line in each plot and observations were recorded on the following nine characters: Days to the first opened boll (DOB), plant height (PH), height of first fruiting branch (HFFB), number of fruiting branches (NFB), number of opened bolls (NOB), boll weight (BW), lint percent (LP), seed index (SI), cotton seed yield (SCY) . A combined analysis of variance for the two experiments in the two years for each character was computed on plot means. The phenotypic and genotypic correlations were estimated using the model suggested by Mode and Robinson (1959).

Tab.1. : Mean performance of the twenty-five cotton lines grown in Samaru for 1996 and 1997 combined..

	1	2	3	4	5	6	7	8	9
TAMCOT SP 37	116.83 cdefghi	85.00 abcdefg	20.83 abcd	10.50 a	19.00 abcd	4.31 cde	37.63 ghi	8.82 bcd	747.80 abcd
TAMCOT SP 21S	118.88 bcdef	82.00 abcdefg	19.33 cd	10.00 ab	17.83 abcd	4.29 cde	39.85 def	8.41 defgh	601.70 bcdef
TX-CDP 37HH-1-83	116.50 cdefghi	83.33 abcdef	22.33 ab	9.83 ab	20.33 abc	4.37 bcde	42.08 abc	8.67 cde	758.30 abcd
TAMCOT CAMD-E	115.50 defghi	84.67 abcdefg	22.17 abc	10.17 ab	15.83 abc	4.17 cde	38.90 efg	8.68 cde	663.70 bcde
TX-CABUCS-2-1-83	123.33 a	91.17 abc	22.83 ab	10.00 ab	17.83 abcd	4.00 cde	35.47 j	9.46 a	365.2 f
TX-CABCHUS-1-84	114.83 fghi	79.83 bcdefg	18.33 d	9.50ab	15.33 bcd	4.34bcde	38.93 efg	8.25 defgh	516.80 cdef
TX-LEBOCAS-3-1-85	121.17 ab	78.00 cdefg	21.33 abcd	9.50 ab	15.67 abcd	4.57bcd	37.33 ghi	9.14 abc	555.00 cdef
TX-CABCUS-2-84	116.17 cdefghi	76.00 defg	21.00 abcd	9.33 ab	14.33 cd	4.19cde	36.48 ij	9.08 abc	454.20 ef
TX-CABS-1-83	117.17 bcdefghi	88.17 abcd	19.67 bcd	10.50 a	21.17 ab	4.21 cde	36.13 ij	9.45 defg	533.30 ef
(S295 x TX-CDP 37 HH-1-83) 119(95)	113.67 i	78.33 cdefg	22.83 ab	9.33 ab	19.50 abc	3.95 cde	40.95 cd	8.40 defgh	938.30 a
" 1191(95)	114.33 hi	81.00 bcdefg	20.00 abcd	10.33 a	18.67 abcd	4.21 cde	38.77 efg	8.08 efgh	565.30 cdef
" 1212(95)	119.17 bcde	74.67 efg	22.17 abc	9.67 ab	17.67 abcd	4.35 bcde	41.50 bcd	8.21 defgh	692.70 abcde
" 1244(95)	116.17 cdefghi	84.83 abcdefg	22.67 abc	9.67 ab	16.00 abcd	4.48 bcde	39.93 def	8.58 cdef	732.00 abcd
" 1175(95)	115.33 efghi	91.83 ab	22.33 abc	10.33 a	22.33 a	4.43 bcde	43.32 a	8.08 efgh	775.80 abc
(S295 x TAMCOT SP 21S) 211(95)	114.50 ghi	78.00 cdefg	22.17 abc	8.17 b	13.67 a	5.29 a	38.58 fgh	9.15 abc	685.00 abcde
" 251(95)	118.67 bcdefg	71.67 g	20.67 abc	9.00 ab	16.67 abcd	4.23 cde	37.05 hij	8.57 cdef	543.8 cdef
" 239(95)	120.00 abc	94.50 a	22.00 abc	10.00 ab	16.83 abcd	4.59 be	43.00 ab	7.82 h	631.00 bcdef
" 299(95)	117.50 bcdefgh	79.67 bcdefg	21.00 abcd	10.33 a	21.33 ab	3.89 e	37.00 hij	8.35 defgh	597.2 bcdef
" 295(95)	119.67 abcd	81.00 bcdefg	23.33 a	9.17 ab	16.33 abcd	4.47 bcde	40.37 de	8.19 efgh	716.70abcde
(S295 x TAMCOT-CAMD-E) 324(95)	117.50 bcdefgh	75.50 defg	21.17 abcd	9.67 ab	16.00 abcd	4.37 cde	40.07 def	7.94 fgh	495.30 def
" 37(95)	113.17 i	80.33 bcdefg	22.00 abc	9.67 ab	17.00 abcd	4.26 cde	40.58 cd	8.20 defgh	686.30 abcde
" 32(95)	116.67 cdefghi	87.00 abcde	21.00 abcd	10.17 ab	20.67 ab	4.53 bcde	40.85 cd	8.61 cde	869.20 ab
" 320(95)	120.33 abc	73.33 fg	21.00 abcd	8.67 ab	15.67 abcd	4.17 cde	39.83 def	8.30 defgh	536.70 cdef
" 346(95)	114.50 ghi	78.50 bcdefg	21.33 abcd	9.17 ab	15.17 bcd	4.94 ab	38.57 fgh	9.30 ab	680.80abcde
" 344(95)	114.33 hi	84.33 a bcdefg	21.17 abcde	9.67 ab	17.83 abc	3.93 de	40.75 cd	7.90 hg	660.00 bcde
CV%	2.60	11.72	11.44	14.95	26.92	10.33	3.17	5.35	30.67
GM	117.01	81.80	21.43	9.69	17.51	4.33	39.36	8.50	640.09

Means followed by similar letter(s) are not significantly different at 5% level of probability (DMRT)

Key

1. BO Days to the opening of bolls
2. PH: Plant height (cm)
3. PHFFB: Plant height to first fruiting branch (cm)
4. NFB: Number of fruiting branches
5. NB: Number of bolls
6. BW Boll weight (g)
7. LP: Lt percent (%)
8. SI: Seed index (g)
9. SCY: Cotton seed yield (kg/ha)

Tab. 2. : Mean squares for a combined analysis of different characters of 25 cotton lines grown in Samaru

Sources	D.f	1	2	3	4	5	6	7	8	9
Replication in years	2	0.847	810.927	2.987	1.727	9.780	0.441	7.608**	0.899*	106510.747
Years	1	902.827**	9141.607**	42.667**	25.637**	174.960**	0.004	0.346	11.064**	37225.127
Lines	24	0.847**	210.384**	8.737	2.009	32.451	0.564**	26.300**	1.204**	100792.738**
Lines x years	24	0.521	95.468	6.097	1.307	21.516	0.184	2.791*	0.365*	79408.543**
Error	72	9.278	91.930	6.011	2.101	22.023	0.201	1.558	0.207	38545.234

* = Significant at 0.05 level.

** = Significant at 0.01 level.

Key :

1 BO5: Days to the opening of bolls

2 PH: Plant height

3 PHFFB: Plant height to first fruiting branch (cm)

4 NFB: Number of fruiting branches

5 NB: Number of bolls

6 BW: Boll weight

7 LP: Lint percent

8 SI: Seed index

9 SCY: Cotton seed yield

Tab. 3. : Phenotypic and genotypic correlations between different characters for 1996/1997.

	BO	PH	PHFFB	NFB	NB	BW	LP	SI	SCY
1 BO	–	0.263 0.002	- 0.028 0.000	0.084 0.001	- 0.168 - 0.002	- 0.031 - 0.001	- 0.087 - 0.002	0.312 0.003	- 0.217 - 0.003
2 PH		–	- 0.003 - 0.000	0.634* * 0.022	0.337 0.044	0.197 0.018	0.135 0.016	0.228 0.010	0.299 0.022
3 PHFFB			–	- 0.188 - 0.017	0.044 0.006	0.170 0.039	0.200 0.059	- 0.026 - 0.003	0.288 0.055
4 NFB				–	0.567* * 0.050	0.031 0.005	- 0.008 - 0.002	0.045 0.003	0.160 0.021
5 NB					–	0.080 0.020	0.093 0.027	- 0.098 - 0.010	0.348 0.064
6 BW						–	0.057 0.030	0.403* 0.076	0.315 0.106
7 LP							–	- 0.363 - 0.089	0.385 0.168
8 SI								–	- 0.033 - 0.005
9 SCY									–

Upper and lower value represent phenotypic and genotypic correlation coefficients/respectively

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

Key :

1. BO Days to the opening of bolls
2. PH: Plant height (cm)
3. PHFFB: Plant height to first fruiting branch (cm)
4. NFB: Number of fruiting branches
5. NB: Number of bolls
6. BW Boll weight (g)
7. LP: Lt percent (%)
8. SI: Seed index (g)
9. SCY: Cotton seed yield (kg/ha)

RESULTS

The mean performance of the lines for the nine characters over two years are presented in the Tab. 1. There were significant differences among lines for all traits. The bolls of the lines (S295 x TAMCOT-CAMD-E) 37(95), (S295 x TX-CDP 37 HH-1-83) 119(95), (S295 x TAMCOT-CAMD-E) 344(95) and (S295 x TX-CDP 37 HH-1-83) 1191(95) opened earlier in 10, 10, 9 and 9 days, respectively than the bolls of TX-CABUCS-2-1-83. The boll weight of the lines (S295 x TAMCOT SP 21S) 211(95) and (S295 x TAMCOT-CAMD-E) 346(95) were larger than the boll weight of (S295 x TAMCOT SP 21S) 299(95) and (S295 x TAMCOT SP 21S) 344(95). The lines (S295 x TX-CDP 37 HH-1-83) 1175(95) and (S295 x TAMCOT SP 21S) 239(95) produced the highest lint percent while the lines TAMCOT SP 37, TX-CABUCS-2-1-83, TX-LEBOCAS-3-1-85, TX-CABCUS-2-84, TX-CABS-1-83, (S295 x TAMCOT SP 21S) 251(95) and (S295 x TAMCOT SP 21S) 299(95) appeared equivalent among themselves and showed the lowest lint percents. The cotton seed yields of the lines (S295 x TX-CDP 37 HH-1-83) 119(95) and (S295 x TAMCOT-CAMD-E) 32(95) were higher than those of the lines TX-CABUCS-2-1-83, TX-CABCUS-2-84 and (S295 x TAMCOT-CAMD-E) 324(95). Variance estimates for lines, years (location) and their interaction are presented in the Tab. 2. The variance estimates for years were significant except for boll weight, lint percent and cotton seed yield. The line variance was significant except for plant height to the first fruiting branch, number of fruiting branches and number of bolls. The Line x year interaction was significant only for lint percent, seed index and cotton seed yield.

Tab. 3 shows the phenotypic and genotypic correlation coefficients for the nine morphological characters measured. Generally the genotypic correlations were very low compared to the phenotypic correlations. Also in all cases the genotypic and phenotypic correlations have the same trends. From the result the cotton seed yield was positively, phenotypically correlated with yield components, lint percent (0.385), number of bolls (0.343) and number of fruiting branches (0.160). Number of fruiting branches was significantly, phenotypically, positively correlated with plant height and number of bolls. There was a significant and positive phenotypic correlation between seed index and number of bolls.

Cotton seed yield was positively genotypically correlated with plant height (rg = 0.022), height of the first fruiting branch (rg = 0.055), number of fruiting branches (rg = 0.021), number of bolls, boll weight (rg = 0.106), lint percent (rg = 0.168). Lint percent was negatively and genotypically associated with seed index (rg = -0.089)

DISCUSSION

Based on our results it was observed that the mean performance of the different cotton lines for the two years presented a wide range of variation for all the characters measured. The cotton lines also revealed differences in performance from the first year to the second year. The mean number of days to the opening of the bolls (BO) in 1996 were higher than in 1997. The same observation was noted for plant height. The height to first fruiting branch and cotton seed yield were different for the two years but cotton seed yield appeared better in 1997. Prasad and Katarki (1969), Singh *et al*. (1969) studying the variability in quantitative characters of cotton have reported similar results. The coefficient of variation was less than 10 per cent for 53 per cent of the traits measured but a high coefficient of variation was recorded for the cotton seed yield (kg/ha) and number of bolls . A similar result was obtained by Kalsy *et al*. (1978), who suggested that the high degree of variability for these characters may be partly due to genetic and partly due to environmental causes.

The significant mean squares of lines noted for days to boll opening, plant height, boll weight, lint percent, seed index and cotton yield seed (kg/ha), confirmed that there was variability in the lines studied. A certain differences among years were not significant for boll weight, lint percent, cotton seed yield (kg/ha), suggesting that these traits are more stable and may not change in different environments. The genotype x environment (year) interaction variance was not significant for all traits except for lint percent and seed index which were significant and for cotton seed yield that appeared highly significant. Thus, it indicates that the environment influences determination of these characters. A similar result was reported by Abou-El-Fittouch *et al*. (1967) for lint percent and seed index. Lint percent and seed index are the main components of yield. And environmental variation of yield components should affect the yield itself.

Correlation studies between yield and other traits have been of immense help in selecting suitable plant type. According to Robinson *et al*. (1951) most of the characters of economic importance such as yield, are complex in inheritance and may involve several related characters and hence the degree of phenotypic and genotypic correlations of the characters is important. Genetic correlations are a measure of the association of genes controlling two characters. That is to say, if two characters have no genes in common, their genetic correlation would be expected to be zero (Mode and Robinson, 1959). The selection for one character results in a progress for all positively correlated characters but a regress to all negatively correlated characters.

There were positive phenotypic and genotypic correlations between cotton seed yield and plant height, height of the first fruiting branch, number of fruiting branches, number of bolls, boll weight and lint percent.

These correlations indicate that the improvement of these traits may certainly increase the cotton seed yield thus will be useful in a selection programme. The number of bolls positively correlated with boll weight. A similar result was observed by Kyei and Kea (1968).

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Received for publication on January 26 , 2005
Accepted for publication on September 2,1 2005

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