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Correlations and Correlated Responses in Upland Cotton (*Gossypium hirsutum* L.)

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Summary

Plant breeders must be concerned with the total array of economic characters in their efforts to develop a crop variety acceptable to farmers. Their selection endeavours must therefore take into consideration how changes in one trait affect, simultaneously, changes in other economic attributes. The importance of correlations and correlated responses is therefore self evident in plant breeding endeavours. In this study F_3 progenies from a cross between two cotton lines SAMCOT-9 x Y422 were evaluated for two years and performance data were used to obtain correlations between nine agronomic and fibre quality traits in upland cotton. The results indicated that plant height was significantly and positively correlated with seed cotton yield, number of sympodial and monopodial branches, seed index, fibre length and micronaire index. Positive and significant correlations were also obtained between: seed cotton yield, lint percent and fibre strength and fibre length. Significant negative correlations were obtained between: plant height and lint percent; number of monopodial branches, sympodial branches and lint percent; fibre length, fibre strength and micronaire index. The correlated responses in the other eight traits when selection was practiced for seed cotton yield in the present study shows that it might be more profitable to practice direct selection for seed cotton yield compared to selecting for seed cotton yield through any of the other traits.

Résumé

Corrélations entre caractères et réponses corrélées du cotonnier (*Gossypium hirsutum* L.)

Les améliorateurs des plantes cultivées doivent prendre en compte une grande gamme de caractères dans leurs efforts de développer un nouveau cultivar qui répond aux besoins des agriculteurs. Leurs efforts de sélection doivent en conséquence prendre en considération comment un changement au niveau d'un caractère peut affecter simultanément les autres principaux caractères retenus dans leur travail de sélection. L'importance de la corrélation entre caractères et de la réponse corrélée est donc très grande dans un programme de sélection. Dans la présente étude, la descendance F_3 d'un croisement réalisé entre les lignées de cotonnier SAMCOT-9 et Y422 a été évaluée pendant deux années consécutives et des corrélations ont été calculées entre les valeurs observées pour neuf paramètres concernant la morphologie et la productivité des plantes ainsi que la technologie de la fibre. Les résultats obtenus indiquent que la hauteur de la plante est corrélée significativement et positivement avec le rendement en coton-graine, le nombre de branches sympodiales, le seed index, la longueur des fibres et l'indice micronaire. Des corrélations positives et significatives ont également été obtenues entre: le rendement en coton-graine, le rendement à l'égrenage ainsi que la résistance et la longueur des fibres. Des corrélations négatives et significatives ont également été obtenues entre: la hauteur de la plante et le rendement à l'égrenage; le nombre de branches monopodiales, le nombre de branches sympodiales et le rendement à l'égrenage; la longueur, la résistance et l'indice micronaire des fibres. Les huit caractères considérés ont montré une faible réponse corrélée aux modifications du rendement en coton-graine. Cette constatation laisse supposer que chez le cotonnier, il est plus recommandable de réaliser une sélection directe pour le rendement que de réaliser une sélection indirecte en utilisant un de ces huit caractères.

Introduction

Correlation, measured by a correlation coefficient is important in plant breeding because it measures the degree of association, genetic or non-genetic between two or more characters. If genetic association exists, selection for one trait will cause changes in other traits. This is called correlated response (4). Since plant breeders must be concerned with the total array of economic characteristics and not just one trait, the importance of knowing how changes in one character by selection may cause simultaneous changes in other

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economic traits is self-evident. In their continuous efforts to improve both yield and fibre quality attributes, cotton breeders have realized the presence of either favorable or unfavorable associations between such major attributes. The magnitude and type of these associations depend mainly on which yield components and quality attributes were taken into consideration and the kind of population under study. In the present study, phenotypic and genotypic correlations and the associated genetic changes were determined among nine quantitative characters using data obtained from a segregating generation of a cross between two cotton lines.

Material and methods

Using the hand emasculation technique, a cross was made between the cotton lines SAMCOT-9 and Y422 in the 1986 growing season. The resulting F_3 progenies from this cross was analyzed at Samaru (11°11´N, 7° 38´ E) for two years, 1991 and 1992 using randomized complete block design with three replications in each year. Plots consisted of single ridges, 5 m long and 0.91 m apart. Four to six acid delinted seeds were sown in holes spaced at 45 cm along the ridges. The seedlings were thinned to one plant per hole at 4 weeks after planting. Boronated single superphosphate (with 5% borax as source of boron) was applied to the experimental area at the rate of 125 kg per hectare during land preparation. Calcium ammonium nitrate was applied at the rate of 125 kg per hectare after thinning. Weeding started early and was done regularly. Insect pests were controlled by three fortnightly sprays of Cymbush 10EC at the rate of 2.5 litres per hectare starting at 9 weeks after planting. Data were taken from five random plants per plot on the nine traits, plant height, number of sympodial branches, seed cotton yield, lint percent, seed index, fibre length, fibre strength and micronaire index. The data were analyzed separately for each year and then the combined data for the two years were analyzed. Phenotypic and genotypic correlations were estimated following the formulae given by Miller *et al.* (16) as follows:

$$\text{Genotypic correlation } (r_g) = \frac{O^2_g\ X.Y}{(O^2_g\ X)\ (O^2_g\ Y)}$$

Where :

O^2_g X.Y is the genetic covariance between the two traits X & Y

O^2_g X is the genetic variance of trait X

O^2_g Y is the genetic variance of trait Y

$$\text{Phenotypic correlation } (r_{ph}) = \frac{O^2_{ph}\ X.Y}{(O^2_{ph}\ X)\ (O^2_{ph}\ Y)}$$

Where:

O^2_{ph} X.Y is the phenotypic covariance between the two traits X & Y

O^2_{ph} X is the phenotypic variance of trait X

O^2_{ph} Y is the phenotypic variance of trait Y

Correlated responses were computed according to Fakorede and Obilana (2) as follows:

$CR_{Y.X} = i_x.\ h_x.\ h_y.\ r_x\ (X.Y).\ O^2_y$

Where:

$CR_{Y.X}$ is the correlated response in trait

i_x is the selection intensity of trait X

h_x is the heritability of the trait X

h_y is the heritability of the trait Y

r_x (X.Y) is the genotypic correlation between traits X & Y

O^2_y is the standard deviation of trait Y

Results

Correlations

The estimates of genotypic and phenotypic correlations among nine quantitative traits are presented in table 1. As a general observation, in practically all instances, the genotypic correlations were higher in magnitude than the phenotypic correlations. To avoid unnecessary repetition in the presentation of these results reference will mostly be made to the more important genotypic correlations.

Plant height

Positive and significant correlations were observed between plant height and seed cotton yield, number of sympodial and monopodial branches, seed index, fibre length and micronaire index. The coefficients of genotypic correlations were higher with both number of sym-

Table 1
Genotypic (upper right) and phenotypic (lower left) correlations between the nine quantitative traits in upland cotton

Trait	SCY	PH	NSB	NMB	L%	SI	FL	FS	MIC
SCY	1.00	0.28**	-0.09	0.08	0.57**	0.02	0.16*	-0.02	-0.05
PH	0.04	1.0	0.63**	8.62**	-0.28**	0.71*	0.51*	0.71**	0.17*
NSB	-0.01	0.50**	1.00	0.74**	0.36**	0.01	-0.15*	-0.00	0.08
NMB	0.17	0.60**	-0.27**	1.00	-0.30**	0.23**	0.10	0.18*	-0.16
L%	0.53**	0.27**	-0.55**	-0.29*	1.00	0.07	0.69**	0.48**	0.10
SI	-0.07	0.19*	-0.04	0.16*	-0.23*	1.00	0.54**	0.22**	0.12
FL	-0.03	-0.06	-0.15*	0.06	-0.60**	0.44**	1.00	0.38**	0.14*
FS	-0.23**	-0.05	-0.23**	0.12	-0.51**	0.19*	0.41**	1.00	0.28**
MIC	-0.07	-0.22**	-0.19*	-0.15*	0.019*	0.23**	0.16*	0.17*	1.00

* Significant at 5%, ** significant at 1%
SCY= Seed cotton yield; PH= Plant height; NSB= No. of sympodial branches; NMB= No. of monopodial branches; L%= Lint percent; SI= Seed index; FL= Fibre length; FS= Fibre Strength; MIC= Micronaire index.

podial and monopodial branches and fibre length. A significant negative correlation was observed with lint percent.

Number of sympodial branches
Correlation of number of sympodial branches with plant height has already been described above. Positive and significant correlations were obtained with number of monopodial branches and lint percent. A low but significant negative correlation was however obtained with number of monopodial branches and fibre length.

Number of monopodial branches
The relation between number of monopodial branches, number of sympodial branches and plant height has been analyzed above. Positive and significant correlations were obtained between number of monopodial branches, seed index and fibre strength. A negative and significant correlation was recorded with number of sympods, lint percent and micronaire index.

Seed cotton yield
Seed cotton yield was significantly and positively correlated with lint percent and fibre strength. Very low negative correlation was obtained with the other fibre traits. The relationship between seed cotton yield and other traits have been discussed previously.

Seed index
Correlations of seed index with plant height, number of sympodial and monopodial branches, seed cotton and lint percent have been discussed above. Seed index was also positively correlated with all fibre quality traits. Only correlations with fibre length and strength were however significant.

Fibre length
Fibre length was positively and significantly correlated with fibre strength and micronaire index. Other correlations of fibre length have been described above.

Fibre strength
Fibre strength was positively and significantly correlated with fibre strength and micronaire index. Other interrelationships with fibre strength have been described already.

Micronaire index
Correlations involving fibre fineness as measured by micronaire index were discussed in the respective sections above. To summarize these relations, selecting for increased fibre fineness could cause an increase in plant height, fibre length, fibre strength and a decrease in number of monopodial branches.

Correlated response
The overall association between seed cotton yield and the traits investigated in this study, presented as correlated response in seed cotton yield when selection is practiced for the various traits is given in table 2.

Table 2
Selection for 8 quantitative traits and expected correlated response in seed cotton yield in a segregating generation of an upland cotton cross

Trait	Correlated response in seed cotton yield
Plant height	3.41
No. of sympodial branches	-0.13
No. of monopodial branches	0.13
Lint percent	2.24
Seed index	0.02
Fibre lenght	0.18
Fibre strength	-0.01
Micronaire index	-0.04

Very low correlated responses were obtained in seed cotton yield when selection was practiced for the other eight traits.

Discussion

The results of the present study demonstrated different patterns of association among the nine traits studied. In cotton, the trait of most interest to applied plant breeders is yield (5). Yield is a very complex quantitative trait, highly influenced by environmental fluctuations, hence a direct selection for yield could be misleading. It would have been desirable to have one or more traits in which indirect selection for yield could be practiced. The results of the present study have however shown very low correlated responses in seed cotton yield when selection is practiced for the remaining eight traits. Under this situation it will be profitable to practice direct selection for seed cotton yield, more so, since it has been established to have moderate to high heritability (1, 6, 7, 8). Grafius (3) has also indicated that it is not always desirable to select for components of complex traits because under conditions of low correlated response it may be more profitable to deal directly with the complex trait.

Literature

1. Echekwu C.A., 1983. Inheritance of seed cotton yield and lint traits in cotton (*Gossypium hirsutum* L.). Unpublished M. Sc. Dissertation, Ahmadu Bello University, Zaria, 75 pp.
2. Fakorede M.A.B. & Obilana A.T., 1979. Predicted responses to recurrent selection in maize. Ife Journal of Agric., 1: 36- 44.
3. Grafius J.E., 1964. A geometry for plant breeding. Crop Sci., 4: 241- 246.
4. Hallauer A.R. & Miranda J.B., 1981. Quantitative genetics in maize breeding. Iowa State University Press. Ames.
5. Meredith W.R., 1980. Use of insect resistant germplasm in reducing the cost of production in the 1980's. Proc. Beltwide Cotton Production- Mech. St. Louis, Mo.
6. Miller P.A., Williams Jr. J.O., Robinson H.F. & Comstock R.E., 1958. Estimates of genotypic and environmental variance and covariance in upland cotton and their implications in selection. Agron. J., 50: 126- 131
7. Murray J.C. & Verhalen L.M., 1969. Genetic studies of earliness, yield and fibre properties in cotton (*Gossypium hirsutum* L.). Crop Sci., 9: 725- 755.
8. Younis F.G., Madry E.E. & Kheiralla K.A., 1990. Genetic study of four interspecific crosses of *G. barbadense* L. and G. hirsutum L. J. Agric. Sci., 21: 3-21

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