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Research Application Summary

Combining ability among interspecific (*G. hirsutum x G. barbadense*) and mutation derived lines of cotton in fiber quality and agronomic traits

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Abstract

Zambia's cotton has had a very good reputation on the international market for a long time. In order to maintain this reputation, the cotton Development Trust of Zambia continues to evaluate germplasm for suitable parents. In this study, the combining ability of crosses between cotton mutants and interspecific lines was evaluated. Crosses influenced all cotton quality traits significantly (P<0.01). Both additive and non-additive gene action were important in controlling all fibre quality traits except yield and earliness. Narrow sense heritability was low, implying that selection must be made in later generations of breeding. Line MFKF-20Kr was the best combiner and should be considered as a parental source for most quality traits in Zambia's cotton.

Key words: Cotton mutants, fibre traits, gene action, heritability, line by tester analysis

Résumé

Le coton Zambien a eu une réputation excellente sur le marché international pendant une longue période. Afin de maintenir cette réputation, la firme fiduciaire de développement de coton de la Zambie continue à évaluer le support génétique pour les parents appropriés. Dans cette étude, la capacité de combinaison des croix entre les mutants de coton et les lignées interspécifiques a été évaluée. Les croix ont influencé de manière significative (P<0.01) tous les traits de qualité du coton. L'action additive et l'action non-additive de gène étaient importantes dans la surveillance de tous les traits de qualité de fibre excepté le rendement et la précocité. L'héritabilité étroite de sens était basse, impliquant que le choix doit être fait dans les générations postérieures de la reproduction. La lignée MFKF-20Kr était le meilleur combinateur et devrait être considérée comme source parentale pour la plupart des traits de qualité du coton Zambien.

Mots clés: Mutants du coton, traits de fibre, action de gène, héritabilité, lignée par analyse du testeur

Background

It is estimated that about 10% of Zambia's population is either directly or indirectly deriving benefits from cotton production, which is the most common cash crop among rural households. The cash generated from cotton production enables farmers to access food and other services such as education for children. Most of the cotton grown in Zambia is exported and has a favourable standing on the international market is due to its high quality cotton lint. The continued good reputation of Zambia's cotton depends on continuous improvement in the yield and fiber quality attributes of cotton varieties grown in the country. This is only possible if suitable parental sources of economically important traits are known. Interspecific hybridization and mutagenesis are useful tools in increasing genetic diversity among elite germplasm lines in upland cotton for both agronomic and fibre traits (Auld *et al.*, 2000; Gutierrez *et al.*, 2002). Estimation of genetic parameters of a population is useful in the plant breeding process in deciding the appropriate breeding strategy that will utilize the genetic variance present (Dudley and Moll, 1969). A study with the objective of assessing the combining ability of cotton mutants and interspecific lines in agronomic and fiber traits was carried out.

Study Description

Five interspecific lines were crossed with five mutants and three parents of mutants in a line by tester mating design during the 2007/08 season at Magoye. Forty F_1 progeny and thirteen parents were evaluated in a Randomized Complete Block Design during 2008/09 season. Collected data included boll count, days to flowering, days to maturity, boll weight, yield per plant, ginning outturn, earliness index, fibre length and fibre strength. Line by tester analysis was used to ascertain the breeding value of parental genotypes and the mode of inheritance of agronomic and fiber traits in the population generated.

Research Application

Analysis of variance revealed that there was significant variation ($p<0.01$) in traits such as boll count, days to flowering, days to maturity, boll weight, yield per plant, ginning outturn, earliness index, fiber length and fiber strength (Table 1). Line by tester analysis revealed that both additive and non-additive gene action were important in the genetic control of all the traits investigated except yield per plant and earliness index in which there was a preponderance of additive gene action. Although both additive and non-additive genetic effects were significant in days to flowering, days to maturity, boll weight, ginning outturn, fibre length and fiber strength, non-additive gene action was more important in the inheritance of these traits. Additive and non-

Table 1. General combining ability effects of lines and testers for agronomic and fibre traits.

Parents	Fibre length	Fibre strength	Boll count	Days to Flowering	Days to maturity	Boll weight	Yield/ plant	Got (%)	Earliness ratio
Lines									
MFKF-20Kr	0.420*	-0.80*	3.82**	-0.132	-1.142**	0.147	13.21**	0.21*	1.441**
MF-20Kr	-0.14	-1.00**	-1.64**	0.288*	-0.810*	0.02	-7.31**	-0.01	4.119**
MCZA20Kr	-0.08	0.84*	3.48**	-0.412*	-0.342*	-0.013	22.79**	-0.59*	-4.455**
MG-15Kr	0.06	-0.18	-0.69*	-0.252*	-2.338**	-0.046	-0.35*	1.39**	6.149**
MCF-30Kr	0.04	0.52*	-2.39**	0.002	0.126	-0.023	-6.87**	-0.65*	0.463*
F 135	-0.08	0.40*	-0.64*	0.288*	1.458**	-0.113	-4.17**	-0.11*	-3.499**
Chureza	0.08	-0.02	-0.37*	-0.012	0.658*	-0.06	-1.51*	-0.75*	-0.409*
G 319-16	-0.300*	0.2	-1.58**	0.228*	2.392**	0.087	-15.79**	0.51*	-3.807**
S.E	0.34	0.12	1.22	0.26	0.909	0.135	6.08	0.242	2.19
Testers									
INTSC-A	0.275*	-0.14*	-0.61*	0.0958	-0.593*	0.1592*	-7.00**	0.655*	1.229**
INTSC-B	0.038	-0.42*	0.44*	0.3083*	0.785*	-0.1575*	1.313*	-0.133	0.534*
INTSC-C	-0.212*	-0.91*	-1.29**	0.0958	0.325*	0.132*	-1.85*	0.0175	-0.089
INTSC-D	-0.263*	0.19*	0.27*	-0.2083*	0.576*	-0.099	0.263*	-0.0075	-0.629*
INTSC-E	0.163*	1.28*	1.20**	-0.2917*	-1.092*	-0.035	7.28**	-0.532*	-1.045**
S.E	0.201	0.11	0.96	0.208	0.71	0.106	4.81	0.191	1.73

additive gene effects were of equal importance in the inheritance of the boll count trait. Narrow sense heritability estimates were low (2.07-19.7%) for the traits studied. In order for selection to be effective for most traits (except yield per plant and earliness index) in this population, it must be delayed until later generations of inbreeding such as F_7 and F_8.

Recommendation

The mutation derived line MFKF-20Kr was the best general combiner as it had favorable GCA effects for most traits studied. It should be considered as a parent source of important economic traits in cotton breeding programmes.

References

Auld, D., Lowery, C., Bechere, E., Wright, R., Hequet, E., Abidi, N. and Smith, W.C. 2007. Use of chemical mutagenesis in improving upland Cotton. Proceedings of the World Cotton Research Conference-4, Lubbock, Texas, USA.

Dudley, J.W. and Moll, R.H. 1969. Interpretation and use of estimates of heritability and genetic variances in plant breeding. *Crop Science*19 (3):257-262

Gutierrez, O.A., Basu, S., Saha, S., Jenkins, J.N., Shoemaker D.B., Cheatham, C.L. and McCarty Jr., J.C. 2002. Genetic distance among selected cotton genotypes and its relationship with F_2 performance. *Crop Science* 42:1841-1847.