STUDIES ON PERFORMANCE OF SOME EGYPTIAN COTTON (*GOSSYPIUM BARBADENSE* L.) CROSSES

By

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APPROVAL SHEET

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SUPERVISION SHEET

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ABSTRACT

This study was carried out during three successive growing seasons (2006, 2007 and 2008).Thirty triallel crosses were developed among five cotton parental cultivars of *Gossypium barbadense* L. The triallel crosses and the commercial check cultivar Giza-80 were evaluated at the Experimental Station, Faculty of Agriculture, Cairo University, Giza, Egypt to estimate general and specific combining abilities for yield, yield components and some fiber quality traits. The nature of gene action that controls the inheritance of the studied characters was also estimated. The results indicate that partitioning the mean squares due to the three-way crosses into their components predicted the significant contribution of additive, dominance and epistatic variances to the genetic expression of studied traits.Giza-70 (P_1) was the best general combiner among this group of cultivars for all studied traits, except for seed index (S I), lint percentage (L%), lint index (L I), pressely index (P I) and uniformity ratio (U R.%). Cultivar Giza-89 (P_2) was the best for lint cotton yield per plant (L C Y /P), cultivar Giza-90 (P_3) was the best for boll weight (B W) and the cultivar Giza-88 (P_5) was the best for fiber length (F L). These cultivars were good combiners when used as the third parent in the three-way crosses. The crosses $P_1xP_4xP_5$, $P_2xP_3xP_5$, $P_1xP_3xP_5$, $P_2xP_4xP_5$ and $P_2xP_5xP_4$ appeared to be the most promising three-way crosses for breeding toward improving most studied yield and fiber traits. The results also showed that the magnitude of additive (σ^2_A) was positive and larger than that of dominance genetic variance (σ^2_D), with respect to all the studied traits. The results indicated that the additive by dominance (σ^2_{AD}) type of epistasis variance played a secondary role in controlling the inheritance of studied characters of the triallel crosses. Estimates of broad-sense heritability (h^2_b %) varied from 93.38% for L% to 99.11% for F L and estimates of narrow-sense heritability (h^2_n %) varied from 3.59 % for U R% to 45.11% for S I. It was concluded that yield and its components and the studied fiber properties were mainly controlled by additive gene effects in addition to additive by dominance epistatic interactions, suggesting that selection practiced in the advanced generations of superior three-way crosses in this study may be effective for improving these traits. Highest estimates of relative precision were detected for simple lattices, while the lowest ones were detected for partially balanced lattices. Path – coefficient analysis showed that N O B/ P had the greatest direct effect on S C Y/ P while N F B/P had the greatest indirect effect on S C Y/ P via N O B/ P.

Key words: Triallel analysis, Gene action, Fiber traits, Heritability ,*Gossypium barbadense*

DEDICATION

I dedicate this work and express my immense gratitude to my Family for all the support they lovely offered along the period of my post graduation

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CONTENTS

INTRODUCTION

Cotton is a warm climate crop grown in approximately 60 countries worldwide. It is cultivated from 45^{o} North latitude to 32^{o} South latitude by over 20 million Farmers. Over 90 percent of cotton grown in the world is upland cotton *Gossypium hisutum* L., while about ten percent of cotton area in the world belong to the sea island species *G. barabadense* L.(Esmail, 2007).

In Egypt, cotton used to be one of the most important economic crops with a vital role in agricultural and industrial development. In recent years, the total cultivated area began to decline, which requires working to increase the production per unit area in order to compensate for the shortage in the cultivated area. Cotton breeders have to continue developing new varieties with higher productivity and lint quality. The true knowledge of the gene action for various cotton traits is useful in making decisions with regard choice of appropriate breeding programs. It is important to study the genetic diversity among Egyptian cotton varieties, which are used for the development of new cotton genotypes. Knowledge of genetic diversity and relationships among breeding materials is essential to cotton breeders for choosing proper parents of the breeding programme. Generation mean analysis as a quantitative genetic method is able to estimate additive, dominance and epistatic gene effects. Genetic analysis using generation means has been used in cotton breeding to estimate the type of gene action controlling quantitative traits. On the other hand, heterosis breeding is used for improving many desirable quantitative and qualitative traits (Abd El-Haleem *et al.*,2010).

Triallel analysis is potent enough to provide information on epistatic components of genetic variance, in addition to additive and dominance variances. Triallel analysis also gives information on the order of parents in three-way cross combinations for predicting the potential of disovering superior trasgressive segregants in their segregating generations (Ponnuswamy *et al*., 1974 and Singh and Narayanan, 2000). A three-way cross symbolized by (AB) C has been defined as a cross between line C and the unrelated F_1 hybrid (AB), lines A and B being called grand parental lines and line C as full parental or immediate parental line (Rawlings and Cockerham, 1962).

The present study was designed to realize the following objectives.

1. Identifying the type of gene action controlling the inheritance of traits related to yield and some fiber properties in cotton by using triallel analysis.
2. Estimating general and specific combining abilities for such traits.
3. Estimating the relative precision of partially and partially balanced lattice designs in evaluating cotton plant characteristics as compared to randomized complete blocks design (RCBD).
4. Determining the relative importance of character contribution to seed cotton yield /plant *via* path analysis.

REVIEW OF LITRATURE

1. Combining ability and gene action for yield and its components

Combining ability analysis and the genetic components of variance for any breeding materials provide useful information to cotton breeders, on the proper choice of parents for improving performance of superior hybrids and determine the most effective breeding methods. In this respect, several authors studied gene action for lint yield and fiber characters (Abd El Bary (1999); Kosba *et al.,* 1999; Sorour *et al.,* 2000b; Awad, 2001; Iftikhar *et al.,* 2001; Kumar and Raveendran, 2001; El-Helw *et al.,* 2002 and Zeina, 2002).

Carvalho *et al.* (1995) studied gene action in *G. hirsutum* L in a complete diallel set of crosses among six parental varieties. They found that both dominance and additive gene effects were significant for yield and boll weight.

Echekwu and Alabi (1995) repated that GCA mean squares were highly significant for lint yield, lint percentage, boll size and seed index, while SCA mean squares were significant for lint percentage and boll size.

El-Tabbakh and El-Nakhlawy (1995) reported significant general combining ability variance for boll weight, and signficant specific combining ability for lint percentage, but both GCA and SCA variances were significant for seed cotton yield/plant and seed index.

Gomaa and Shaheen (1995) studied two crosses among intra-barbadense cotton (Family 8/87 × S6037) and (Giza 80 × S 6037). They indicated that both dominance and additive-by-additive gene effects were involved in the inheritance of seed cotton yield and its components in the two studied crosses.

Kerrio *et al.* (1995) indicated that both GCA and SCA variances were significant for lint yield and seed cotton yield and significant for ginning percentage. Additive gene action was more important than non-additive gene action for lint yield and seed cotton yield and ginning percentage. Highly significant GCA effects for all traits were estimated for lines S_{12} and for line CRIS7A for seed cotton yield and lint yield.

Kosba *et al.* (1995) reported that the dominance effects were relatively larger than additive effects for all crosses except for few traits under study. Seed cotton yield/plant in all crosses showed larger estimates of additive × additive, additive × dominance and dominance × dominance gene effects. In general, dominance gene effects were larger than the other components of genetic variance for most yield and its component traits.

Soomro *et al.* (1995) In a line × tester analysis found that GCA variance for line and SCA variances for crosses were highly significant for seed cotton yield per plant, suggesting the importance of both additive and non-additive type of gene action for these traits.

Tomar and Singh (1996) found that estimates of GCA and SCA variances indicated a predominant role for the additive type of gene action in the inheritance of seed cotton yield, lint yield and ginning (%), while non-additive genetic effects were predominant in the inheritance of seed and lint index.

Ahmad *et al.* (1997) observed additive gene action with partial dominance for boll weight, seed cotton yield and seed index in diallel trial.

Gomaa (1997) reported that additive gene action was the major component of genetic variance for seed cotton yield/plant, boll weight and lint percentage.

Hassan and Awaad (1997) found that both additive and dominance gene effects were significantly involved in the inheritance of boll weight and seed index. They also showed that dominance gene effects were larger in magnitude than the corresponding values of additive gene effects.

Patel *et al.* (1997) found that the estimates of combining ability indicated a predominance of non-additive genetic variance for seed cotton yield. G.Cot.14 was a good general combiner for seed cotton yield. G67 showed average general combining ability and G.Cot.10 showed poor general combining ability. Out of the 17 testers, PKV072, Trianhpy-3, 0-356 and DP90 showed good combining ability for both characters. They indicated that crosses with high SCA effects did not always involve parents with high general combining ability.

Nadeem *et al.* (1998) observed significant GCA effects for seed cotton yield and seed index, and significant SCA effects for seed cotton yield, boll weight and seed index.

Amer (1998) found that the magnitude of additive genetic variance was larger than of non-additive genetic variances including dominance genetic variance for most studied traits in Egyptian cotton hybrids.

Valarmathi and Jehangier (1998) found that non-additive gene action was predominant for ginning out-turn, while additive gene action was predominant for seed cotton yield per plant and lint index. The line × tester analysis showed the , preponderance of both additive and non-additive gene action for boll weight.

Abd El-Bary (1999) found that dominance variance was of larger magnitude than additive genetic variance for all yield and yield component traits except boll weight.

Kosba *et al.* (1999b) showed that general combining ability was more important than specific combining ability in the inheritance of most studied cotton yield traits, indicating that additive genetic effects played a major role in the expression of these traits.

Rady *et al.* (1999) reported that both GCA and SCA mean squares were highly significant for all studied cotton yield traits. They added that additive and additive-by-additive types of gene action were of greater importance in the inheritance of all studied yield traits except seed index where the non-additive genetic variance (SCA) was of greater importance.

Abd El-Maksoud *et al.* (2000) found that additive variance was of larger magnitude than dominance variance for seed cotton yield/plant, lint cotton yield/plan and lint percentage.

Hamoud (2000) evaluated 36 cotton genotypes and reported that dominance variance was larger than additive variance for all studied yield and yield component traits, except lint percentage.

Khorgade *et al.* (2000) showed that general and specific combining ability were highly significant for number of bolls per plant, boll weight, lint index and seed yield per plant, while SCA for boll weight was not significant, indicating the predominance of the additive component of genetic variance for all traits except lint index.

El-Adl *et al.* (2000) revealed that dominance genetic variance was larger than that of additive genetic variance for all studied traits with the exception of boll weight

Awad (2001) stated that additive genetic effects were significant for all studied traits, while dominance gene effects were significant for lint yield/plant and seed cotton yield/plant. However, additive by additive effects were significant for seed cotton yield/plant.

Iftikhar *et al.* (2001) reported that the additive type of gene action with partial dominance was observed for number of bolls/plant, boll weight and yield of seed cotton. In addition, no epistatic effects were detected in the inheritance of these traits.

Kumar and Raveendran (2001) cleared that both additive and dominance genetic variance components were detected for number of bolls/plant and boll weight in the studied crosses.

Zeina *et al.* (2001) indicated that dominance genetic variance was larger than additive genetic variance for seed cotton yield, lint yield, lint percentage, with both dominance and additive genetic variance having approximately the same role in the inheritance of these traits.

Ramalingam and Sivasamy (2002) estimated the genetic parameters affecting seed cotton yield of upland cotton (*G. hirsutum*, L) using triallel analysis. They reported that the analysis of variance for three-way crosses (triallel analysis) showed significant general line, two line (both first and second kind) and three specific effects, indicating the importance of additive and non-additive gene effects in the expression of this trait. Their results indicated the importance of additive, additive × dominance and dominance × dominance types of non-allelic interaction for seed cotton yield.

Zeina (2002) from a biparental mating system for the cross (Giza 88 x Pima S6) indicated that the proportional contribution of males was higher than that of females and their interaction for studied yield traits. Additive variance accounted for the largest major proportion of the phenotypic variance for all studied traits by using.

Abd El-Maksoud *et al.* (2003a) found that the magnitude of additive genetic variance was positive and larger than that of dominance genetic variance, with respect to all studied yield traits.

Deshpande *et al.* (2003) found that parent PA402, followed by Jla 1993 and PA478 showed good GCA effects for yield and most of yield attributes. Among the hybrids, the best performance for seed cotton yield, lint yield and ginning outturn and SCA effects were noticed for cross (PA402 × PA415), followed by (PA183 × PA 363)