GENETIC PARAMETERS OF SOME AGRONOMIC TRAITS IN COTTON CROSSES UNDER DROUGHT STRESS CONDITIONS

BY

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ABSTRACT

Saleh Hussein AL-Moustafa, Genetic parameters of some agronomic traits in cotton crosses under drought stress conditions, Unpublished of Master thesis, Agronomy Department, Faculty of Agriculure, Ain Shams University, 2005.

A half diallel set of crosses involving eight cotton parental cultivars; six of them belonging to *G. barbadense*, L. namely; Giza 45, Giza 70, Giza 83, Giza 85, Pima S-7 and Sea Island as well as two Upland cultivars (*G. hirsutum*, L.), viz. Tamcot and Deltapine 703, were evaluated for days to the first open flower, days to the first open boll, earliness index, number of open bolls/plant, boll weight, seed cotton yield/plant, lint percentage seed index and lint index under three irrigation intervals, viz. 15, 25 and 35 days. In addition, sodium dodycyl polyacrylamide gel electrophoresis (SDS-PAGE) technique was performed on the water soluble proteins. The results revealed that irrigation regimes mean squares were found to be highly significant for all studied traits. Highly significant differences among genotypes, parents and F_1 crosses were observed for all studied traits under the three irrigation regimes and their combined analysis. The interactions of irrigation regimes with each of genotypes, parents and crosses were found to be highly significant for all studied traits. Heterobeltiosis was generally pronounced and existed for all studied characters except for boll number. Both general and specific combining ability (GCA and SCA) variances were found to be highly significant for all studied traits under the three irrigation regimes and their combined data, suggesting that both additive and non-additive gene effects were operative for these traits. The GCA/SCA ratios indicated that additive and additive by additive types of gene action were of greater importance in the inheritance of all studied traits either under normal irrigation or water stress conditions. The best general combiners under normal irrigation were: Tamcot and Deltapine 703 for earliness, boll weight, seed index and seed cotton yield/plant, Giza 70 for boll number, lint percentage and seed cotton yield, Giza 45 for boll number, Giza 83 and Giza 85 for boll number, lint percentage and seed index and Pima S-7 and Sea Island for

boll number and lint percentage. On the other side, the four exotic varieties Pima S-7, Sea Island, Tamcot and Deltapine 703 were good general combiners for seed cotton yield and some of its components under the relatively water stress conditions. Some cross combinations revealed desirable SCA effects for yield under normal irrigation and water stress conditions. The best cross combinations were Giza 45 x Giza 85, Giza 70 x Sea Island, Giza 83 with both of Pima S-7 and Tamcot and Pima S-7 x Tamcot under normal irrigation condition and the two crosses Giza 45 x Giza 83 and Sea Island x Deltapine 703 under drought condition. Moreover, the four cotton genotypes Giza 85, Pima S-7, Tamcot and Deltapine and three crosses Pima S-7 x Tamcot, Giza 85 x Sea Island and Tamcot x Deltapine showed the lowest drought susceptibility index (most drought tolerance). Heritability percentages in narrow sense were calculated for each environment. The highest heritability values were 89.72%, 94.42% and 82.13% for boll weight under normal irrigation and drought treatments (25 and 35 days), respectively. The highest positive and significant values of correlation were found between seed cotton yield per plant and each of number of open bolls/plant and boll weight. Path coefficient analysis estimates indicated that number of open bolls/plant and boll weight can be considered as the most important sources of seed cotton yield variation. Results suggest that choosing superior parental genotypes Giza 85, Pima S-7, Tamcot and Deltapine 703 as well as the three crosses Pima S-7 x Tamcot, Giza 85 x Sea Island and Tamcot x Deltapine 703 can be utilized for future cotton breeding program and are recommended for the improvement of seed cotton yield under both normal irrigation and water stress conditions. The results also revealed that soluble protein electrophoretic bands could be used as a useful tool for identification and characterization of tolerant cotton genotypes.

KEY WORDS: Cotton, Drought stress, Heterosis, Combining ability, Heritability, Correltion, Path coefficient, Protein electrophoresis.

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INTRODUCTION

Development of cotton cultivars tolerant to drought stress in Egypt becomes a vital objective in many breeding programs especially with the current interest in expanding cotton acreage in newly reclaimed desert lands, which is characterized by low water holding capacity, sandy soils and water scarcity. To achieve such objective the breeder must take an interdisciplinary approach toward the evaluation of cotton germplasm. One discipline is to enter the parental material into a crossing program and progenies are selected using an index based on yield under no stress and stress known as drought susceptibility index (**Fischer and Maurer, 1978**). This index provide a measure of stress tolerance based on minimization of yield loss under stress compared to optimum conditions rather than on yield level under non stress *per se*.

The diallel mating design has been used extensively by many geneticists and breeders to evaluate parental materials before taking any decisions concerning the breeding system to be used. The combining ability analysis is the most widely used as biometrical tool for classifying parental genotypes for their ability to combine in hybrid combinations. The parents having the best potential, as judged by their efficiency to transfer high yielding ability to their progeny, are those exhibiting the highest general combining ability effects. The hybrid combinations which possess the highest specific combining ability effects would be the reflection of the non-additive gene effects. Several researchers have studied the combining ability for different economic traits of cotton (**Hendawy, 1994; El-Gohary *et al*, 1981 and Rady *et al*, 1996**) in both intra- and interspecific crosses. There is continuous need, however, to evaluate the behavior of different varieties in new cross-combinations under stress conditions to provide plant breeders with essential information about their combining ability under such conditions before establishing any breeding program.

Water soluble protein electrophoretic analysis was also used by many investigators (**Sammour, 1990; Esmail *et al,* 1999 and Abou-Deif *et al,* 2002**) in attempts to identify and characterize cotton genotypes through protein electrophoretic bands that could be considered as biochemical genetic markers associated with certain traits.

Therefore, the main objectives of the present study were; to evaluate eight cotton genotypes and their 28 F_1 hybrids in half diallel cross for heterosis, combining ability and heritability of agronomic traits and relative contributions of yield components in yield variation under normal and stress conditions to formulate the most efficient breeding procedure to maximize genetic improvement under drought stress conditions as well as to study the possibility of using protein electrophoretic bands as genetic markers associated with drought tolerance.

REVIEW OF LITERATURE

The review of this study will be written herein under two main headings; genetic parameters under normal and drought conditions and protein electrophoresis.

I- Genetic parameters:

Cited studies on genetic parameters (heterosis, combining ability, heritability) and correlation and path coefficient analysis under normal and drought conditions are reviewed for; days to the first flower, days to the first boll, earliness index, plant height, no. of fruiting branches per plant, no. of open bolls, boll weight, seed cotton yield/plant, seed index, lint index and lint percentage.

A - Genetic parameters under normal conditions :

1 – Heterosis estimates:

In interspecific crosses between *G. hirsutum,* L. and *G. barbadense,* L**., Kassem *et al* (1981)** found that heterosis values over mid and better parents were positive and significant for no. of fruiting branches/plant, seed index and seed cotton yield/plant while, these values relatively to better parent were negative and significant for days to the first flower, boll weight, lint percentage and earliness index only.

In a diallel cross among *G. barbadense,* L. varieties **El-Kadi *et al* (1982)** found that no heterotic effect relative to high parent was detected for lint percentage, seed index and lint index. Few crosses showed significant heterotic effect relatively to mid-parent for lint percentage and the majority of crosses showed significant effects for seed index and lint index**.**

In an intra *G. barbadense*, L. cross and *G. hirsutum* × *G. barbadense* cross, **Rady and Gomaa (1983)** found that positive and significant heterotic effects relatively to mid-parent were detected for

boll weight, no. of bolls/plant and seed cotton yield/plant in the first cross and for no. of fruiting branches/plant, plant height, no. of bolls/ plant, seed cotton yield/plant and seed index in the second cross. Negative and significant heterotic effects were detected for boll weight and lint percentage in the interspecific cross. Heterotic effects for earliness index in both crosses were insignificant and the same trend was found for no. of fruiting branches/plant, plant height, lint percentage and seed index in the intraspecific cross.

El-Kilany and El-Mazar (1985) in interspesific crosses between *G. hirsutum,* L. and *G. barbadense,* L. found that mid-parent heterosis values were significant and positive for no. of bolls/plant and lint yield while, it was insignificant and negative for lint index. No useful heterosis relative to the best parent was observed for all characters except no. of bolls/plant which gave highly significant and positive estimate, indicating the presence of non-additive gene effect for this trait.

In six interspecific hybrids between *G. barbadense,* L. and *G. hirsutum,* L. **Al-Enani and Eid (1986)** found that mid- and better parent heterosis values were positive and significant for seed index, indicating the persence of over dominance for this trait.

Ismail *et al* (1998 a and b) found highly significant and positive mid- and better-parent heterosis values for plant height in an intraspecific cross of Egyption cotton. Highly significant and negative better parent heterosis value was found for lint percentage. However, days to first flower, no. of fruiting branches/plant, boll weight, lint index and seed index exhibited insignificant better parent heterotic effects.

El-Helw *et al* (1988 b) in a diallel analysis of Egyptian and Russian cotton varieties found that significant and positive heterosis values relative to the higher parent were manifested for no. of bolls/ plant and seed cotton yield/plant. Insignificant heterosis values above the higher parent were observed for boll weight and lint percentage.

Hanna *et al* (1988) used four hirsutum and three barbadense cotton varieties in a complete diallel cross and found that heterosis effects relatively to mid-parent were significant and positive for no. of bolls/plant, boll weight, seed cotton yield and seed index. While, this value for lint percentage was negative and significant. Heterosis over high parent was negative and significant for boll weight and lint percentage while, these values for seed cotton yield and seed index were positive and significant.

Luckett (1989) found that amount of heterosis in intraspesific crosses of Upland cotton over high parent was large and positive for boll weight, while it was negative for lint percentage .

Rahoumah *et al* (1989) observed that heterosis values over mid- and high parent in interspesific crosses were negative and significant for seed cotton yield/plant, lint percentage and lint index. Heterosis value over mid-parent was negative and significant for boll weight, while these values for seed index and no. of bolls/plant showed positive and insignificant.

In intraspesific crosses of *G. barbadense,* L. **Salama and Hassoub (1992)** found that significant positive heterotic effect relatively to mid-parent was detected for no. of bolls/plant, boll weight, seed cotton yield/plant, lint percentage and lint index while, heterosis value relatively to better parent was positive and significant for seed cotton yield/plant and lint index.

In a half diallel cross among eleven varieties of *G. hirsutum,* L. and *G. barbadense,* L. **Hendawy *et al* (1993 a)** found that heterosis value over better parent was positive and significant for no. of bolls/ plant, boll weight, seed cotton yield/plant, seed index and lint index. No useful heterosis was found for lint percentage.

In a half diallel cross among ten varieties of *G. hirsutum,* L. and *G. barbadense,* L. **Hendawy *et al* (1993 b)** found significant and positive heterosis value over mid- and better parent in most of crosses for no. of open bolls/plant, boll weight, seed index, lint index and seed