PHYSIOLOGICAL GENETIC STUDIES ON SOME EGYPTIAN CULTIVARS OF COTTON *(Gossypium barbadense L.)*

BY

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B.Sc. Agric. Sci. (Genetics), Ain Shams Univ., 1993

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ABSTRACT

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The present study aimed to studying some yield-related traits and determines some molecular markers linked with some fiber characters, i.e. lint length, fineness and strength; to assist selection in Egyptian cotton (*Gossypium barbadense* L.). From eighteen cultivars, two were chosen to represent the contrasting genotypes for fiber length, fineness and strength where Giza 45 represented the highest cultivar while Dendera represented the lowest one. They were evaluated along with their Fl and F2 for their fiber length, strength and fineness. Bulked segregant analysis developed five RAPD markers with five primers i.e. B11, A11, B06, E08 and E06 which were considered as markers for fiber length. Two RAPD markers were developed with one primer B10 which was characteristic for fiber strength, while two markers were exhibited for fiber fineness using primer A11.

Key words: *Gossypium barbadence* L. fiber length, fineness, strength and quality, PCR, RAPD, bulked segregant analysis (BSA) and Marker-assisted selection (MAS).

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I. INTRODUCTION

Cotton, the most important fiber crop in the world, represents one of the major cash crops in Egypt. Egyptian cotton (*Gossypium barbadense* L.) is distinguished by its extra fine quality of lint, and about 50% of the world long staple cotton is produced in Egypt.

Since the production of Ashmouni, the oldest variety till the early 1920's, the local varieties were off-type selected by the keen eyes of the cotton growers and merchants. The variability in the mixed local populations of cotton at that time, helped greatly in producing several commercial varieties. After the first world war, the Cotton Research Board at Giza was established to investigate cotton problems concerning yield and quality. Individual plant selection was the first method to be used in improving Egyptian cotton. Later on, intervarietal hybridization was practiced in 1921 to produce new improved varieties. At the present time, one of the most important methods of developing new Egyptian cotton varieties is hybridization to create genetic variability, especially after the Egyptian cotton varieties have reached a very high degree of homozygosity, and thus became less amenable to selection methods.

Cotton textile industry has experienced increasing competition with synthetic fibers. To meet the continuous and increasing competition with synthetic fibers, cotton breeders have attempted to develop high yielding varieties with superior fiber properties. Several attributes of cotton lint are known to affect fiber quality as well as yarn characteristics. It is generally agreed that strength, fineness and length of fiber are among the most important characteristics of cotton lint.

The objectives of the present study were:

1. To assess the performance of some Egyptian cotton varieties for some of yield components and the major fiber qualities and, i.e. (earliness, seed index, lint percent, lint length, and fineness and strength).

2. To develop molecular markers (i.e. RAPD) linked with these traits by the use of bulked segregant analysis. This will provide a fast reliable, and cost-effective screening method to assist in molecular breeding for the most promising genotypes.

II. REVIEW OF LITERATURE

2.1. Yield related traits:

Hutchinson (1959) reported that early maturing prolific, annual forms which distinguished modern agricultural varieties from their wild or primitive ancestors, were attributed to the loss or elimination of the short day photoperiodic response and the reduction in the number of main stem nodes that occur between the cotyledonary scores and the point of initiation of first fruiting branch.

Richmond and Radwan (1962) studied several methods of estimating earliness in four experimental stocks of the American Upland cotton (*G. hirsutum*) and four hybrids between them. Three crosses showed complete dominance for early flowering measured as days to first flower, while one cross showed complete dominance for late flowering. For the first boll opening date, three crosses showed partial dominance of the early parent, while the remaining cross showed overdominance of the late parent. The phenotypic correlation coefficients between days to first flower and days to first open boll were positive and highly significant in all studied crosses. The F1 showed overdominance of larger earliness index in two crosses, while partial dominance of early maturity index was manifested in the other two crosses. The phenotypic correlation coefficient between earliness index, days to first flower and days to first boll opening were negative and highly significant in the four crosses. They concluded that all the estimates for earliness studied were significantly correlated to one another.

Gutierrez and El-Zik (1992) evaluated four Spanish and nine American cotton cultivars for yield and fiber properties. Significant differences were observed among cultivars, locations and years, with highest variance for location, year and location X year interaction. Genotype X environment interaction for yield, earliness, and fiber length, strength and micronaire was only significant when cv. Acala SJ2 was included at Ecija. Differences between cultivars for seed cotton yield, earliness and fiber traits were significant. There was less variability for yield than fiber traits, but more for first harvest than total yield. Fiber properties showed greater stability over environments than yield.

Tomar *et al.* (1992) studied coefficients of variation, heritability and genetic advance on ten yield components in 20 female and three male desi cotton parents and their 60 F1 hybrids grown during autumn 1986 at Bulandshahr, Modipuram and Nagina, Uttar Pradesh, India. Moderate to high estimates of genetic variation, heritability and genetic advance were revealed for bolls/plant, seed cotton, seed and lint yields/plant, and lint index, whereas plant height and seed index showed high estimates only for heritability.

Turcotte *et al.* (1992) reported that a *Gossypium barbadense* variety (PI560140), released in August 1991, compares favourably with the currently grown Pima S6, having earlier maturity, greater heat tolerance, higher yield potential at low (<450 m) and intermediate (450-750 m) altitudes and increased earliness at high altitudes. It has similar boll size to Pima S6, 0.9% lower lint percentage, slightly longer 2.5% span fibre length, similar uniformity ratio, somewhat longer classer's staple, 6% stronger fibre, slightly finer fibre, 3% more reflectance and 3% less yellowness.

Opondo *et al.* (1993) reported that the *Gossypium hirsutum* multiline variety (PI561672) synthesized from eight strains developed by single plant selection with progeny testing from the variety UKA59/240 yielded 12% more seed cotton and 16.6% more lint than UKA59/240.

Anandakumar and Muthuswamy (1994) reported that released *Gossypium arboreum* variety K10 and 20 improved selections were compared for four yield components. Ginning percentage had significant positive correlation with yield and lint index, which had a positive association with seed index. Ginning percentage and seed index had a negative association. Ginning percentage had a high positive direct effect on cotton yield and the seed index had a negative correlation.

El-Shaarawy *et al.* (1994) evaluated 30 genotypes of cotton for genotype-environment interaction (GE) and genotypic stability parameters over seven locations in 1992. Seven traits, including lint yield and yield components, were studied. The variance for genotypes was significant for all traits. The GE mean square was highly significant for all traits except seed index. The best two strains were F5 514/90 and F6 557/90 which were stable for lint yield and yield components. Three strains (F5 475/90, F6 601/90 and F10 383/88) were stable for lint yield and most yield components, and were highly productive, producing more than 1000 lb lint/acre.

Hanuman *et al.* (1994) compared 21 American cotton (*Gossypium hirsutum* L.) genotypes in four environments for phenotypic stability for four quality traits during autumn 1989 in Haryana. Genotype X environment interaction and heterogeneity were significant for all four traits. The linear component of genotype X environment interaction was more important than the non-linear component. Of the 21 genotypes, 12 were stable for halo length and seed index, 10 for lint index and nine for ginning outturn. Genotype LH511 and its hybrid LH511 X H974 were stable for all four traits.

Keim (1994) reported that DP5409 is an early maturing, premium-fiber Upland cotton (*Gossypium hirsutum*) variety, particularly adapted to the Mid-South and the Rio Grande Valley areas of Texas. In test comparisons to Deltapine 50 across four years, DP5409 gave a similar lint yield, higher lint percentage, higher fiber strength and lower micronaire. DP2156 is a very early, stripper-type variety adapted to the northern growing areas of the Texas High Plains.

Godoy *et al.* (1995) determined the performance of new cotton cultivars planted on *V. dahliae* infested soils. Mexican cultivars Cian Precoz, Cian 95, and Laguna 89 were compared with commercial cv. Deltapine 80. Data were recorded on *V. dahliae* infestation, lint yield, earliness and fiber quality characteristics. Results showed that Deltapine 80 had 43% of diseased plants and this value was significantly higher than the value obtained for the other genotypes. Cian Precoz was the earliest cultivar and Cian 95 had the best fiber characteristics.

Gomaa and Shaheen (1995) estimated heterosis, inbreeding depression, heritability and type of gene action for five earliness characters in interspecific cotton cross between the family 8/87 (*Gossypium barbadense*) and *Tamcot* sp. 21 (*G. hirsutum*). Six populations, P1, P2, F1, F2, BC1 and BC2, for cross were cultivated in an experiment with three replications. Analysis of gene action showed that additive gene action had a greater effect on the earliness characters. On the other hand, the earliness indices were controlled by all types of gene effects except dominance X dominance. Earliness index (% first pick) showed the highest broad and narrow sense heritabilities (71.55 and 71.55%). Medium broad and narrow sense heritabilities were shown for position of the first fruiting node (56.25 and 56.25%).

Kerby *et al.* (1995) observed that early maturing varieties initiate fruiting branches at a lower node, faster, and are more prone to premature cut out if stress conditions exist. Results from 40 locations from North Carolina to Texas with a wide maturity range in Deltapine varieties indicated that management practice influenced earliness far more than the variety selected.

Mustafa *et al.* (1995) compared 41 long staple cotton strains descending from 10 Egyptian cotton [*Gossypium barbadense*] crosses (Trial A) and 28 genotypes descending from nine crosses (Trial B). The control varieties used were Giza 80 for Middle Egypt and Dendera for Upper Egypt. Trial A was carried out at Sids, and Trial B at five locations in Middle and Upper Egypt. The results obtained from Trial A showed that none of the crosses exceeded the control variety Giza 80 in both yield and its contributing variables, while four crosses were promising for yield and its contributing variables in Trial B. These crosses were Giza 83 X Dendera, Giza 83 X (Giza 72 X Dendera), radiated Ashmouni 302 X Giza 83 and Giza 83 X Giza 80. Heritability values and highly significant genotype X location interactions indicated that the studied crosses were affected by the environment, and should be evaluated for several years at different locations.

Siwach and Lather (1995) evaluated 24 *Gossypium hirsutum* genotypes for nine yield-related traits at Hissar over 2 seasons. Only HHH81 and F846 significantly outyielded the standards. Promising genotypes were *Ganganagar Ageti* for plant height, SH131 for total number of fruiting points, F286 for percentage of effective bolls, GC182 for boll weight and seed index, H777 for lint per boll and HHH81 for number of seeds per pod. Percentage of effective bolls per plant was the main contributing character towards increased yields.