
**Application of some selection procedures for
improving some economic traits in two
population of cotton**

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CONTENTS

	Page
1. INTRODUCTION	1
2. REVIEW OF LITERATURE	4
2.1-Biparental mating studies for creating variability in populations.....	4
2.2. Genetic behavior and gene action for quantitative characters in cotton.....	9
2.3. Genetic association among various traits.....	28
2.5. Selection procedure for improvement some economic characteristics.....	36
3. MATERIALS AND METHODS	43
3.1 Genetic materials.....	43
3.2. Experimental design and laboratory procedures.....	44
3.3. Collection of data and recording of observations.....	45
3.4. Statistical and genetically analysis.....	46
3.4.1. Biparental mating system design I.....	50
3.4.2 Second experiment.....	51
4. RESULTS AND DISCUSSION.....	57
4.1. Compare the performance of biparental progenies with the selfed generation in releasing genetic variability.....	57
4.1.1. Analysis of variance among biparental population.....	58
4.1.2. Compare the performance of biparental progenies with the selfed generation in releasing genetic variability.....	61
4.2. Estimation components of variance and heritability.....	67
4.2.1. Partitioning of genetic variances... ..	58
4.2.2. Heritability.....	773
4.3. The nature and magnitude of associations among different traits.....	76

4-3-1. Correlation analysis.....	79
4.3.2. Impact of biparental mating on the genotypic association among traits.....	83
4.4. Construction of some selection procedures to improve lint yield.....	83
5. SUMMARY.....	98
7. REFERENCES	106
8. ARABIC SUMMARY	

5. Summary

The present study was done in the Agronomy Department, Faculty of Agriculture, Kafr EL-Sheikh University. The investigation was carried out at Sakha Agric. Res. Stat. Kafr EL-Sheikh, Agric. Res. Center Egypt, during 2017, 2018 and 2019 growing seasons.

The purpose of this investigation was to study the nature and magnitude of variability generated for different quantitative traits in the biparental progenies (obtained by attempting crosses in F_2 generations) and F_3 selfed populations. The study was also aimed to estimate the variance components for yield, yield components traits and fiber properties in both biparental progenies and F_3 populations. Study the impact of intermating population on nature and magnitude of association for the studied characters. The study was extended to estimate and compare the genetic gain obtained from index model of selection index with direct and indirect selection to enhance selection efficiency of superior families and to estimate correlated response to selection.

Experimental design and laboratory procedures:-

The two cotton parents were crossed to produce two crosses as follow

Cross I	(Sea x Giza 75) x C.B
Cross II	Giza 86 x Aust.

First experiment: Biparental mating (North Carolina Design- I) and F_3 generations:

Biparental populations BIPs derived from inter population mating in F_2 generation were evaluated with the F_3 families' selfed. Two individual field trials were conducted to evaluate the

biparental progenies and F_3 with their original parents for the two crosses, in a randomized complete block with four replications.

Second experiment:

The material used in this part includes three generations F_2 , F_3 and F_4 of the intra specific cotton (*Gossypium barbadense* L.) cross (Giza 86 x Australy2)

In the first season 2017 F_2 generation consisted of 250 single plants with the original parents were grown in non-replicate ridges 5.0 meters long and 0.70 meter width with 0.30 cm hill space. One plant was left/hill at thinning time; self-pollination was practiced for all F_2 plants. Selfed as well as open pollinated bolls/plant were picked up separately and the total seed cotton yield were ginned to obtain lint yield/plant and bolls/plant, ,boll weight seed/boll, lint/seed, seed index and lint percentage were also determined. Fiber quality properties were also determined

Using 10% selection intensity with eleven selection indices and four direct selection procedures, 55 F_2 plants were selected on the bases of their performance; the plants having the highest performance in each procedure were saved.

In 2018 season, the 55 selected F_3 progenies were evaluated with the original parents in a randomized complete blocks design with three replicates. Experimental plot consisted of one row as carried out in 2017. The different selection procedures include pedigree selection for each selected traits and classical selection index involved all studied traits were applied. Superior progeny of each selection procedure was selected using 10% selection intensity. This gave a total of 28 selected families.

The following observations were recorded on sex individual guarded plants in all the BIPs and F_3 selfed families for each cross.

A- Yield and yield components characters :

- 1- Boll weight (gm).
- 2- Seed cotton yield / plant (gm).
- 3- Lint yield / plant (gm).
- 4- Lint percentage %.
- 5- Seed index (gm).
- 6- Lint index (gm).

B-Fiber quality characters :

- 1- Fiber fineness as micronaire reading.
- 2- Fiber strength (pressly index)
- 3- Fiber length(mm)
- 4- Uniformity ratio.

Different parameters such as analysis of variance , means , range , genotypic and phenotypic coefficients of variability , components of genetic variance , phenotypic variance , heritability in broad and narrow senses , degree of association between different traits and prediction of superior recombination's were worked out for all the progenies separately by using Minitab and SPSS computer programs.

The salient feature of the present invistigation is summarized as follows:

- Analysis of variance revealed significant or highly significant mean squares among biparental families for all traits studied in the two populations indicating the presence of high segregations in F_2 , reflected that the parents involved in these crosses were diverse and this diversity could be transmitted to their progenies.
- The mean squares due to males were highly significant for all traits studied and large in magnitude than female / male mean squares. These results revealed over all differences between F_2 male plants in the two

populations. The variations between plants in biparental progenies were relatively high as compared with F₃ selfed families.

- Female / male mean squares were also significant for all traits studied except for seed index and uniformity ratio in the second population, suggesting the presence of dominance or epistatic genetic variance.
- The results indicated that the average values of BIP progenies were higher than those of F₃ selfed families for most of the traits studied. This shift of mean values in desired direction is clearly illustrated in yield and fiber traits. Desirable mean values of the BIP could largely be attributed to the predominance of additive and additive × additive type of gene action of the characters in the intermated populations.
- The lower limit of range was higher in BIPs for most characters. At the same time the upper limit was higher compared to that of F₃ progenies for most of traits, suggesting that intermating has helped in releasing more variability than selfing. The higher variability in the BIP populations could have resulted due to additional opportunity provided for genetic recombination to occur.
- Biparental mating populations showed higher GCV and PCV values than the F₃ selfed families for most of characters. It may be due to breakage of undesirable linkages and appearance of superior gene combinations. However, some characters such as boll weight, seed cotton yield, lint yield and fiber finenesses showed reduced variability in BIP than F₃ selfed, this would be due to the presence of gene controlling these characters in coupling phase
- The results revealed that, in biparental mating, the contribution of additive variance to the total phenotypic variance is higher for boll weight, seed cotton yield, lint yield, micronaire reading and uniformity ratio in the first Bip. However higher non-additive genetic variance

were noticed for the rest characters in BIPs populations compared with F_3 selfed populations, which confirmed by high degree of dominance than unity. This may be due breakage of repulsion phase linkage and that may lead to some cryptic genetic chances.

- The reverse trend were obtained with F_3 selfed generations, since most yield and and fiber quality traits were mainly controlled by additive genetic components.
- Heritability estimates in broad sense improved considerably for most studied characters in biparental. Most characters showed high $H^2_b\%$ values over 50% in both BIP and F_3 selfed populations. Environmental variation played relatively limited role for most studied characters except for relative growth rate of boll at third interval which affected by great role of environmental conditions.
- High narrow sense heritability was noticed in F_3 selfed generation compared with biparental progenies, for most characters. This was due to a great role of additive portion of genetic variance in selfed series. Among biparental populations, the crosses varied in narrow sense heritability with different characters. The characters like, lint percentage, lint index and most fiber characters showed high narrow sense heritability in both PIB and F_3 selfed populations. Therefore, selection will be effective for such characters based on phenotypic observation.
- Generally, the results from correlation between yield and fiber quality indicated that selection for increased seed cotton and lint yield might result in a simultaneous reduction in fiber length and strength. But lead to increase in micronaire reading (fineness) for inferior value. This association has been attributed to linkage or pleiotrophy.

- Fiber strength was significantly positive correlated with fiber length and uniformity ratio in both Bip populations, while showed negative associated with micronaire reading. Fiber fineness was negatively correlated with the other fiber quality characters confirmed a similar direction of improvement for these characteristics, indicating that stronger, longer and fine fibers could be the main target of selection in the cotton variety.
- The study of the correlations showed a negative association between the yield and most yield components with most fiber quality parameters. Such a negative association of yield and fiber quality brought up the question of the relative importance of both parameters or the level of expected yield reduction.
- A comparison of direction and magnitude of association among characters between biparental and F_3 selfed populations indicated that several new associations in terms of direction and magnitude were observed. Many additional correlations become established in PIBs compared with F_3 selfed populations. This may occur due to gene reshuffling and breakage of linkage.
- The reduction or complete disappearance of the negative association in inter-mated progenies compared to F_3 selfed families may be due to the breakage of linkages upon intermating thereby more number of plants having favorable combinations of genes were produced in BIP progenies. These desirable shifts may be attributed to breakage of undesirable linkages between the genes which control these traits, and resulted in newer recombinants which presumably, were due to changes from a coupling to repulsion phase associations'.
- The data revealed increase in mean values for all characters with advanced generations' from F_2 to F_4 This shifting in mean values in

desirable direction could largely be attributed to the progress in selection from F_2 to F_4 generation.

- The advanced generation (F_3 and F_4 generations) showed reduction in PCV and GCV values, a result of using different selection procedures which exhausted a major part of variability.
- The data revealed that eight out eleven selection indices were more efficient than direct selection for improvement of lint yield in F_2 population. The highest predicted genetic gain from F_2 and F_3 generations for lint yield/plant was observed when applied index selection contained lint yield/plant with bolls/plant (IW_1) followed by (Iw_{123}) selecting for lint yield/plant, boll/plant with seed/boll and lint/seed, selection index involving lint yield/plant, bolls/plant and lint/seed (Iw_{13}), index selection Iw_{23} and Iw_2 . These indices give values with high relative efficiency over selection based on lint yield only.
- The highest realized genetic gains from F_3 generation for lint yield/plant occurred when selecting for IW_{12} (Selection index involving lint yield/plant, bolls/plant and seeds/boll) followed by Iw_{123} (Selection index involving lint yield/plant, bolls/plant, seed/boll and lint/seed, followed by Iw_{12} (Selection index involving lint yield/plant, boll/plant and seed/boll indicating that these characters were the most effective yield contributing
- Most indices showed high discrepancy between predicted and actual genetic gain from F_2 and F_3 as lint yield/plant and most showed negative values, this was due to non-additive gene effect and large effect of environmental factor.

- Deviations of the realized advance from the predicted advance from F_3 and F_4 generations were positive in most cases. These deviation were large values for all indices, such large discrepancy between predicted and actual gains did not raise doubt as to the validity of the general theory of selection index and also due to the large effect of genotypic x environment interaction.
- Selection index involving lint yield/plant and boll/plant surpassed all selection procedures for predicted gain. However selection index involving lint yield/plant, bolls/plant, seeds/boll and lint/seed followed by selection index involving lint yield/plant, bolls/plant and lint/seed appeared to be most effective for the improvement lint yield and gives reasonable actual gains.
- All selected families exceeded F_4 means and point start of F_2 means; these families were surpassed F_3 families mean for yield characters as well as fiber quality characters. The breeder may utilize such selected families in breeding programs aiming to improve yield and quality.