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Efficiency of some Selection procedures to improve economic traits in cotton

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This study was carried out at the Agronomy Department, Faculty of Agriculture, Kafrelsheikh University and the Experimental Farm of Cotton Maintenance Research Department, Sakha Agricultural Research Station, Agriculture Research Center, Egypt, during 2018, 2019 and 2020 growing seasons. Parents were crossed to produce the followings four Populations, biparental progenies (Giza 45 x Giza 94), (Giza 70 x TNB1) and Pedigree selection (Giza 96 x Karsheneski-2.) and (Giza 93 x suvn).

This study is divided into two parts, and each part includes two populations of cotton.

1- The first part includes the study of biparental progenies, which self-pollinated them for 3 years in order to study the efficiency of cross-breeding within segregating generations in improving the economic traits of cotton.

2- The second part is the application of the pedigree selection of the two populations of cotton for the possibility of improvement in the economic traits and a comparison of what was obtained by using BIP to improve the economic traits.

Biparental progenies

Biparental populations BIP derived from inter population mating in BIP1, BIP2 and BIP_3 generation which evaluated with their original parents for the two populations(Giza 45 x Giza 94), (Giza 70 x TNB1). Two individual field trials were conducted to evaluate the biparental progenies with their original parents for the two populations, in a randomized complete block design experiment with three replications.

Pedigree selection

The genetic materials used in this study included the two populations (Giza 96 x Kar.), and (Giza 93x Suven) belonging to (*Gossypium barbadense* L.), from the cotton Research Institute (CRI), which devoted to establish the experimental material for this investigation.

The main objective of this investigation was studying the efficiency of biparental progenies and pedigree selection procedure which possess high yield and good quality of fiber for four Egyptian cotton populations

1- Improvement the seed cotton yield and correlated traits by using biparental progenies
2- Using Pedigree selection method to improve some cotton traits; such as yield, earliness and good quality fiber.

The studied traits were:-

1. **Growth habits and earliness characters:-**Position of first fruiting node (FFN), Days to first flower (DFF, days), Boll maturation period (BMP, days), and Earline index (EI, %).

2. Yield and yield component traits:-

Boll weight (BW, g), Seed cotton yield / plant (SCY/P), Lint yield / plant (LY/ P), Lint percentage (LP %), Seed index (SI), and Lint index (LI).

3. Fiber quality characters:-

Fiber Length (FL, mm), Uniformity Ratio (UR %), Fiber Strength as perisly index (FS), and Fiber fineness as Micronaire reading (MIC).

The important results could be summarized as follows:

1- Using biparental progenies.

Estimation of some genetic parameters

Results exhibited that for population I (Giza 45 x Giza 94) the mean values of biparental selfed pollinated(BIPs3) traits were 61.52, 39.12 and 4.06 for days to first flowering, lint percentage and fiber fineness traits, these mean values were higher than the mean values of the same traits obtained in selfed pollinated ($BIPs_1$).Also, the mean values for some traits, of biparental selfed pollinated($BIPs_3$) were higher than the mean vales of the same traits obtained in selfed pollinated ($BIPs_2$), respectively. They were 61.52, 72.99, 3.47, 38.46, 48.45 and 4.06 for days to first flowering, earliness index, boll weight, lint percentage, fiber strength and fiber fineness traits, respectively.

Regarding to the mean values of biparental selfed pollinated($BIPs_2$) traits for population I were 6.68, 67.09, 80.29, 30.33, 37.75, 88.72, and 4.28 for position of first fruiting node, days to first flowering, seed cotton yield, lint yield, lint percentage, uniformity Ratio and fiber fineness traits, respectively. These mean values were higher than the mean values of the same traits obtained in selfed pollinated ($BIPs_1$), respectively.

2. For population II (Giza 70 x TNB1) the results exhibited that the mean values of biparental selfed pollinated($BIPs_3$) were 6.89, 62.15, 49.51, 70.87, 48.36 and 3.92 for position of first fruiting node, days to first flowering, boll maturation period, earliness index, fiber strength and fiber fineness traits these mean values were higher than the mean values of the same traits obtained in selfed pollinated(BIPs1) and selfed pollinated (BIPs2), respectively. Meanwhile, the mean values

of biparental selfed pollinated ($BIPs_2$) were 69.50, 50.01, 70.54, 11.98, 7.22, 36.53, 44.47 and 4.31 for days to first flowering, boll maturation period, earliness index, seed index, lint index, fiber length, fiber strength and fiber fineness traits, respectively. These mean values were higher than the mean values of the same traits obtained in selfed pollinated ($BIPs_1$), respectively.

3- Genotypic and phenotypic variation coefficient

The genotypic variation coefficient (GCV) values of the most families in biparental selfed pollinated ($BIPS_3$) for populations I and II were greater than that in ($BIPS_1$) and ($BIPS_2$) except for seed cotton yield trait in population I and for days to first flowering, seed cotton yield traits in population II. Phenotypic coefficient of variation (PCV) values in ($BIPs_3$) families were higher than the (PCV) values in ($BIPS_1$ and $BIPS_2$) families, except for seed cotton yield per plant trait in population I; and for days to first flowering trait in population II.

4-Comparison of heritability in broad sense (h^2_b%)

Heritability in broad sense for population I and population II. The results showed for in population I and population II, comparison of broad-sense heritability values between the ($BIPS_3$), and ($BIPS_1$) families revealed that heritability estimate increase in ($BIPS_3$). There values were for most traits. There values were was greater than ($BIPS_1$) families for the same traits, except for value lint yield trait. Heritability in broad sense hb^2% population I and population II exhibited that, the values of heritability gave value more than(50- 60 %) for most traits in the two population.

5- Mean performance of genotypes:

The mean performance for population I in biparental selfed pollinated ($BIPs_3$) families, the results reviled that the mean values for earliness index trait, nine families (No. 1, 5, 6, 14, 15, 19, 21, 24 and 25) and one family (No.30) were significantly and highly significantly differed compared to the better parent (69.14).Meanwhile the mean values for boll weight trait of two families (No. 1 and 14) were highly significantly differed compared to the better parent (3.52). Respecting to seed cotton yield trait, six families (No. 3, 9, 21, 22, 24 and 27) and seven families (No.1, 6, 8, 14, 19, 23 and 28) were significantly and highly significantly differed compared to the better parent (56.96).

Regarding to the fiber length trait, the mean values of eight families(No.2, 3, 6,7, 17, 23, 24 and 26) and eight families (No. 11, 12, 13, 14, 15, 18, 21and 30) were significantly and highly significantly differed compared to the better parent (35.05), significantly. According to the results of fiber strength traits, nine families (No. 3, 4, 5, 7, 8, 11, 17, 18 and 21) were highly significantly differed compared to the better parent (47.16). With respect to micronaire reading trait, the mean values of seven families (No. 3, 4, 7, 10, 19, 20 and 22) highly significantly differed compared to the better parent (4.20).

The results in population II in biparental selfed pollinated ($BIPs_3$) and better parent revealed that the mean values of all families for earliness index trait were highly significantly differed compared to the better parent (58.10). Also, the mean values of boll weight trait, of four families (No. 6, 7, 14 and 23) and eight families (No.1, 2, 3, 4, 5, 8, 25 and 27) were significantly and highly significantly differed compared to the better parent(3.30), respectively.

For seed cotton yield trait, the mean values of one family (No. 28) and seven families (NO.3, 4, 5, 6, 7, 27 and 29) were significantly and highly significantly differed compared to the better parent (57g), respectively. Regarding to the fiber length (FL mm) trait, the mean values of seven families (No.1, 2, 3, 4, 5, 6 and 7) were highly significantly differed compared to the better parent (35.1).

In terms of fiber strength trait, the mean values of the most families were highly significantly differed compared to the better parent (45.80). Regarding to micronaire reading the mean values of one family (No.10) were highly significantly differed compared to the better parent (3.60).

6 - Genotypic and phenotypic correlation among different traits.

For population I, biparental selfed pollinated3 ($BIPS_3$) families. The phenotypic and genotypic correlation values between seed cotton yield trait, and lint yield trait were positive and highly significantly (0.989** and 0.987 **), respectively. The genotypic and phenotypic correlation values between seed index trait, with each of lint index and micronaire reading traits were positive and highly significantly (0.834** and 0.598**) and (0.806** and 0.441*), respectively.

For the population II data showed that the genotypic correlation values between earliness index trait with each of boll weight , seed cotton yield ,lint yield traits and uniformity index traits were positive highly significantly (0.527**, 0.962**, 0.948** and 0.549**) ,respectively. Meanwhile, the phenotypic correlation values between earliness index trait with each of seed cotton yield ,lint yield, fiber length and uniformity index traits were positive significantly highly significantly (0.824**, 0.815**, 0.481** and 0.430*), respectively.

Respecting for the association between boll weight trait and both of yield component and fiber quality traits, there were positive highly significant, the genotypic correlation values among boll weight trait with earliness index, seed cotton yield, lint yield, seed index, lint index, fiber length, uniformity index and micronaire reading traits were (0.527**, 0.760**, 0.755**, 0.454**, 0.424*, 0.614**, 0.454** and 0.448*), respectively.

Also, the phenotypic correlation values between boll weight trait with among seed cotton yield, lint yield, seed index and fiber length traits were (0.582**, 0.589**, 0.351* and 0.475**), respectively. Meanwhile, the genotypic and phenotypic correlation value between seed cotton yield trait with each of earliness index, boll weight, lint yield , fiber length and uniformity index traits were positive highly significantly {(0.962**, 760**, 0.986**, 0.603** and 0.530**) and (0.824**, 0.582**, 0.985**, 0.545** and 0.459**)},respectively. For, the genotypic correlation values between lint yield trait, and each of the earliness index, boll weight , seed cotton yield, lint index ,fiber length and uniformity index traits were positive significantly and highly significantly (0.948**, 0.755**, 0.986**, 0.375*, 0.621** and 0.580**),respectively.

7- Observed gain and correlated response for selection

for population I, data showed that; in ($BIPS_3$) the observed gain values of the best five families for seed cotton yield ranged from (14.145* to 25.647**%) and ranged from (-6.367 to 13.160 **%) for earliness index. As well as the best five families which selected based on earliness index were ranged from(13.160 ** to 23.531**%) for earliness index trait and ranged from (-20.702 to 14.145 **%) for seed cotton yield.

for the population II data revealed that, the observed gain values for yield and its component traits of the best five families which selected based on seed cotton yield in ($BIPS_3$) ranged from (26.912** to 52.737**%) and ranged from (28.099** to 35.951**%) for earliness index. the observed gain values of the best five families which selected based on earliness index were ranged from (28.168 ** to 35.634**%) for earliness index trait and ranged from (17.324** to 52.737 **%) for seed cotton yield.

2-Pedigree selection method.

2-1- Estimation of some genetic parameters

The results for population I (Giza 96 x Kar.) exhibited that the mean values of F_4 generation for population I were 3.45 g, 37.37 % , 10.57 g , 6.10 g and 86.32 % for boll weight, lint percentage, seed index, lint index and uniformity ratio traits , respectively. These mean values were higher than the mean values of the same traits which obtained in F_3 generation, respectively.

The results for population II (Giza 93 x Suvn.) exhibited that the mean values of F_4 generation were 6.86 , 3.40 g, 77.51%, 78.63 g, 30.12 g, 38.28 %, 10.40 g, 6.46 g, 86.02% and 3.50 for first fruiting node, boll weight, earliness index, seed cotton yield ,lint yield ,lint percentage, seed index , lint index , uniformity ratio and fiber fineness traits, respectively. These mean values were higher than the mean values of the same traits which obtained in F_3 generation, respectively.

2.2.Genotypic and phenotypic variation coefficient

In population I, the **genotypic and phenotypic variation coefficient** (GCV and PCV) values in F_2 generation for most studied traits were greater than that in F_3 and F_4 families except boll weight,

seed index, lint index, fiber strength and fiber fineness traits. The genotypic and phenotypic variation coefficient (GCV and PCV) values in population II, in F_3 families for all studied traits were greater than GCV and PCV values of F_4 and F_2 except uniformity ratio and fiber strength in F_4

Comparison of heritability in broad sense (h^2_b%) Comparison heritability in broad sense**(h^2_b%)** estimates between F_2, F_3 and F_4 for population I and population II revealed that, heritability estimates in F_4 families for all studied traits were greater than that in F_2 and F_3 families ,except for days to first flowering, lint index days to first flowering, boll maturation period, and fiber length, respectively.

2.3. Selection criteria

The mean values as well as phenotypic and genotypic coefficients of variation for yield, yield components and earliness index characters for the five different selection criteria; I_1 (based on boll weight), I_2 (based on seed cotton yield), I_3 (based on lint percentage), I_4 (based on earliness index), and I_5 (based on seed index), for the two populations (I and II). For population I, the results cleared that the families which surpassed of seed cotton yield and earliness index traits were combining in selection criterion (1_4). They reported that the selection for seed cotton yield adversely affected earliness index. Also, the PCV and GCV values of seed cotton yield in selection criterion I_3 were highest values (15.168 and 14.172 %, respectively) compared to PCV and GCV in the remaining indices (I_1, I_2, I_4 and I_5). Therefore, selection based on lint percentage trait appeared to be more effective for improving this trait and selection the best genotypes which have the highest value of lint percentage. Results for population II, showed that the mean value of seed cotton yield was the highest value

(96.38g/plant) combining by high value of earliness index (81.87%) when selection based on seed cotton yield as a selection criterion (I_2). but it was not the highest value of earliness index (78.27%) in the selection criterion I_4. Regarding to selection criterion I_5, the results showed that selection for the seed index trait was effective to improve boll weight, seed cotton yield, earliness index, and lint percentage traits.

2.4. Mean performance of genotypes:

The results revealed that the mean performance in population I and population II, for F_4 families were highly significance differed for the most studied traits compared to better parent (G.96). Generally, the obtained results indicated that selection for seed cotton yield caused a positive effect of earliness index. Most high seed cotton yield families were more earliness compared to the better parent (G.96).

2.5. - Genotypic and phenotypic correlation among different traits.

The Phenotypic and genotypic correlation among yield, yield component and fiber quality traits for the population I of F_4 families, the genotypic and phenotypic correlation values between boll maturation period trait and lint percentage trait was positive significant (0.426* and 0.348*), respectively. Meanwhile, the genotypic and phenotypic correlation values between boll weight trait and seed cotton yield trait were positive and significant (0.405* and 0.342*), respectively. Respecting for the genotypic and phenotypic correlation values between earliness index trait, with seed cotton yield and lint yield traits was positive and highly significantly (0.901** and 0.926 **) and (0.725** and 0.801**), respectively. With respect to the genotypic and phenotypic correlation values between seed cotton yield trait and lint yield trait were positive and highly significant (0.920** and 0.809**), respectively. The results also showed that the phenotypic and genotypic correlation values

were positive and highly significant between seed cotton yield and each of earliness index, lint yield and boll weight. The same relationship was found between lint yield and each of boll weight and seed cotton yield.

For the genotypic correlation and phenotypic correlation values between of lint percentage and lint index trait was positive and highly significantly (0.531** and 0.555**), respectively.

Meanwhile, the genotypic correlation value between seed index and lint index trait was positive and highly significant (0.788**).

Respecting for the genotypic and phenotypic correlation values between fiber length and uniformity index trait were positive and highly significantly (0.530** and 0.444**), respectively.

For population II, in F_4 families the genotypic and phenotypic correlation values between earliness index trait, with each of seed cotton yield and lint yield traits were positive and highly significant (0.851** and 0.810**) and (0.807** and 0.772**) respectively.

Regarding to the genotypic correlation and phenotypic correlation values between boll weight trait, with each of seed cotton yield, lint yield, seed index and lint index traits were positive significant and highly significant (0.430**,0.467**,0.386*and 0.535**) and (0.336*, 0.369*, 337* and 0.464**), respectively. The associations between boll weight and the remaining traits were significant for phenotypic and genotypic correlation levels. Also, the genotypic correlation values among boll weight with seed cotton yield, lint yield, seed index, and micronaire reading traits were positive highly significant (0.764**, 0.744**, 0.915**, and 0.947**), respectively. Meanwhile, the genotypic correlation values between boll weight with each of lint index, fiber

length, and elongation fiber traits were positive significant (0.662 and 0.734*) and negative highly significant (-1.00**), respectively.

The genotypic and phenotypic correlation values between of seed cotton yield and lint yield traits were positive and highly significant (0.983** and 0.956**), respectively. The same relationship was found between lint yield and each of boll weight, seed cotton yield and lint percentage.

Meanwhile, the genotypic and phenotypic correlation values between lint yield and lint index traits were positive and significant (0.410* and 0.371*). Also, the results showed that the genotypic and phenotypic correlation values were positive and highly significant between seed cotton yield and each of earliness index, boll weight and lint yield.

While, the genotypic and phenotypic correlation values between seed cotton yield and the quality fiber traits were negative and insignificantly correlated. Meanwhile, the genotypic and phenotypic correlation values between lint percentage trait with each of lint index and fiber strength traits were positive significant and highly significant (0.462** and 0.423**) and (0.511** and 0.363*), respectively.

Regarding to genotypic and phenotypic correlation values between seed index trait and lint yield trait were positive and highly significant (0.772** and 0.755**), respectively. The genotypic correlation value between uniformity index trait, and boll maturation period trait was positive and highly significantly (0.493**). Also, the genotypic correlation value between micronaire reading and lint index were positive and highly significant (0.424**).

2.6. Observed gain and correlated response to selection

For the population I, data showed that; the observed gain values of the best five selected hybrids based on seed cotton yield ranged from (21.29** to 29.07**%) and from (9.57** to 14.03** %) for seed cotton yield and earliness index, respectively, compared to the better parent. As well as the best five families which selected based on earliness index were ranged from (9.63** to 14.03** %) for earliness index trait and ranged from (21.29** to 29.07 ** %) for seed cotton yield.

Meanwhile, the observed gain values of the best five families which selected based on fiber strength were ranged from (12.50** to 14.46**%), and ranged from (-7.89** to -15.00%)for micronaire reading compared to the better parent, respectively. With respect to the observed gain values of the best five families which selected based on micronaire were ranged from (-9.21** to -15.00 **%). And ranged from (2.72* to 14.46 ** %) for fiber strength compared to the better parent, respectively.

Regarding to the population II data revealed that, the observed gain values of the best five families which selected based on seed cotton yield ranged from (59.43** to 116.93**%) and from (25.80** to 40.01**%) for seed cotton yield and earliness index, respectively, compared to the better parent. As well as the best five families which selected based on earliness index were ranged from (26.32** to 40.01** %) for earliness index trait and ranged from (47.05** to 116.93** %)for seed cotton yield.

Meanwhile, the observed gain values of the best five families which selected based on fiber strength were ranged from (5.50* to 9.17** %). And ranged from (-4.47** to -11.32 %) for micronaire

reading compared to the better parent, respectively. With respect to the observed gain values of the best five families which selected based on micronaire reading were ranged from (-10.53** to -12.37**%) and ranged from (-9.17* to 7.34%)for fiber strength compared to the better parent, respectively.