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Response to Selection Using Two Selection Methods in Two Populations of Egyptian Cotton *(Gossypium barbadense L.)*

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Abstract:

Two populations of Egyptian cotton (*Gossypium barbadense L.*) derived from the crosses Giza90 x Giza85 (population I) and Giza90x Giza80 (population II) were subjected selection by two methods, i.e. pedigree selection (PSM) and bulk selection (BSM). The selection criteria were seed cotton yield per plant, number of bolls per plant and earliness index. Results indicated that analysis of variance revealed highly significant differences among families of $F_3$and F_4 generations in the two populations except earliness index in popII. Under F_4 progenies had the highest means for all traits in the two crosses except for earliness index in popII compared to F_3 progenies. The mean values for seed cotton yield per plant, lint yield per plant, lint percentage, number of bolls per plant, boll weight, seed index, earliness index and days to first flower in population I and II were higher by PSM than BSM except for earliness index in popII. Therefore, PSM was more effectives method for cotton breeding compared with other method. Correlation values for F_4 indicated that seed cotton yield/plant was positively correlated with lint cotton yield / plant, bolls per plant and boll weight.

Introduction

Cotton as a commercial crop has played an important role in boosting national economy of several countries and provides fiber and oil for people as well as live stock (Ahmad *et al.* 2005). Increasing of yield per unit area of the crop is a prime concern of breeding programmers and cotton breeders all over the world. They have been utilizing genetic resources to modify the cultivars to meet the ever changing requirements of their society. Plant breeders are continuously searching for a more effective and efficient selection method to achieve their trait several selection methods were used for improving several traits in cotton, pedigree selection method has become the most popular of plant breeding procedures. Mahdy (1983-a) noted that after two cycles of pedigree line selection, for lint yield / plant the corresponding increase was 8.4 and 6.3% for two populations. Mahdy *et al*. (2001-b) reported that after two cycles of pedigree the selection were employed to improve seed cotton yield in F_4 population of Giza-83 x Dandara and Giza-83 x Giza-45. Selection was practice at early and late plantings and the selected families of the second cycle were evaluated at early and late plantings. In the base populations (F_4) seed cotton yield / plant ranged from 20.94 to 128.20 and from 15.84 to 183.88 g / plant in early planting in the two crosses, respectively. The retained genetic variability after pedi-

gree selection was larger than that after selection and intermitting. In general, selection was better than pedigree selection. The two methods of selection for seed cotton yield /plant delayed first flowering and increased the other correlated traits; lint yield /plant, seed index and number of bolls / plant. El-Defrawy and El-Ameen (2004) increased earliness index by 9 and 11% in two Egyptian cotton populations after two cycles of pedigree selection.

Materials and Methods

The present study was carried out at the Experimental Farm of Faculty of Agriculture, Al-Azhar University, Assiut branch during three successive summer seasons of 2014, 2015 and 2016. The objective of this study was to estimate genetic variability, heritability and genetic advance in segregating generations of two Egyptian cotton populations (*Gossypium barbadense* L.) under two methods of selection. The breeding materials which used in this experiment were the F2, F3 and F4 generations of the two crosses Giza90 x Giza85 and Giza90 x Giza 80.

Season 2014, F_2 , generation:

The present work started in 2014; season F_2 of the two aforementioned populations, their parents and check (Giza 95) were sown on March 15th in spaced plants, 1800 plants from each F_2 populations were grown. The spacing between rows was 60 cm and plant to plant was 25 cm. One plant per hill was maintained. All agricultural practices were carried out as the followed for the cotton over the experiment. At the harvest, 10 % from each population were selected according to seed cotton yield /plant, number of bolls / plant and earliness index.

Season 2015, F_3- generation:

180 families from each population beside bulk plot and local check (Giza 95) were sown on 15th of March, for pedigree selection for seed cotton yield / plant, number of bolls/plant and earliness index in two separate experiments(one for each population). Randomized complete block design of three replications was used for each population. The plot size was one row, 4m long, 60 cm apart and 30 cm between hills within the row. After the end of emergence, seedlings were thinned to one plant per hill. The recommended cultural practices were done through the growing season. The best 45 families (selection intensity=25%) for three selection of 15 families for each trait criteria (seed cotton yield / plant, number of bolls / plant and earliness index) were determined, and the best plant from each family was saved selection cycle. 45 plants from each population were selected and subjected to the two breeding methods.

In the bulk method, few seeds (five seeds) from each selected F_2 plants from each population were bulk harvested to form the population for seed bulk for each population. A random sample of bulked seed of each population was space-planted in a 5 rows 4 m long, 60 cm. apart and 30 cm. between hills within row as F_3 generation, during 2016 season under normal dates.

Season 2016, F_4- generation:

After F_3 growing where the second cycle of selection was practiced to raise the F4 generation using PSM

the best three plants in s.c.y /p (selved seeds) were planted to represent the F4 family, while using BS the best 3 plants from each row were mixed and grown as population by bulk method in F_4 generation.

The following characters were recorded on each individual plant:

1-Seed cotton yield/plant in grams (S.C.Y/P), (L.Y/P), Lint percentage (L %), Boll weight in grams (B.W), Number of harvested bolls / plant, Seed index in grams (S.I), earliness index (E.I) and DFF.

Statistical analysis:

Table 1. The analysis of variance and expected mean squares:-

Source of variance	D.F	M.S	Expected mean square	
			Variance	Covariance
Replications	r–1	M_3	$\sigma^2e + g\sigma^2r$	
Genotypes	g-1	M_2	$\sigma^2e + r\sigma^2g$	Cov.e + r Cov.g
Error	(r-1)(g-1)	M_1	σ^2e	Cov.e

Where: r and g are number of replications and genotypes, respectively.

σ^2e and cov.e are error variance and covariance, respectively and σ^2g and cov.g are genetic variance and covariance, respectively.

*** Heritability in broad sense was calculated as follow:

Heritability in F_2 (H) = (VF2-((VP_1+ VP_2) /2)) / VF_2) X 100

Heritability in F_3 and F_4 (H) = (σ^2g / σ^2p) x100

Expected gain from selection (EGS%)

The expected genetic advance (GA) expressed as a percentage of the mean value with an assumed 5% intensity of selection pressure was computed by the formula given by Singh and Chaudhary(1985) as:

$EGS\% = k.\ H\sqrt{\sigma^2 P}$

Where: k = 1.75 and 1.4 constant for 10 and 25% selection intensity (*i.e.* the highest-performing 10 and 25% are selected), respectively.

H = broad-sense heritability and σ^2P = Phenotypic variance of the population.

Realized gain from selection (RGS%):

$$RGS\% = (\overline{X}_0 - \overline{XP}) \times 100 / \overline{XP}$$

Where: RGS% RG the realized advance in one generation of selection, $\overline{X}_0$ is the mean phenotype of the offspring of selected parents, $\overline{XP}$ the phenotype mean of the whole parental generation.

The phenotypic and genotypic coefficients of variation are computed according to Burton (1952).

Where: PCV, GCV are phenotypic and genotypic coefficients of variation, respectively; VP, VG are corresponding variances;

The relative values of these two types of coefficients give an idea about the magnitude of variability presented in a population. Interpretation of variability in terms is given below (Singh and Singh, 1975).

Phenotypic (rp) and genotypic(rg) correlation:

The calculation of phenotypic and genotypic correlation requires estimates of corresponding variances and covariance (Walker, 1960).

Phenotypic correlation rp xy = cov pxy / (σpx. σpy)

Genotypic correlation rg xy = cov gxy / (σgx. σgy)

Results and Discussion

I- Evaluation of the base populations:

A- Analysis of variance, **Range, average and parents:**

The analysis of variance shows a highly significant differences among families in all characters in the two populations (Table 2) indicating that selection in base populations would be effective.

The characteristics of the two base populations (Table 2) indicated sufficient coefficient of variability in the F_2 pop.I (53.35) and in pop.II (33.97) in the criterion of selection; seed cotton yield per plant. The results reported sufficient coefficient of variability in the F_2 pop.I (19.22) and in pop.II (25.08) in the criterion of selection; number of bolls per plant. The coefficient of variability (CV) of the other traits ranged from 9.54 to 58.77% in pop. I, and from 10.62 t0 50.88% in pop. II for lint percentage and lint yield per plant; respectively. Otherwise, the CV of all traits of the three parents were very low indicating to, the high purity of the parents. Broad sense heritability estimates were very high for all traits in two populations.

Table 2. The range and mean values in the F2 population and parents for all studied traits in two Egyptian cotton populations; Season 2014:

Families		Seed cotton yield /plant, g.	No. of bolls /plant	Days to first flower
Pop1	Rang	9-115	14.24-41.02	69-86
	mean	42.51	17.88	78.1
	var	514.30**	50.02**	194.56**
	Cv%	53.35	39.63	17.86
	Hb	96.01	83.24	93.89
Giza90	mean	63.48	17.95	67.53
Giza85	mean	40.47	16.80	76.86
Pop11	Rang	30-155	13.5-37.70	69-93
	mean	40.47	17.84	76.1
	var	248.72**	49.09**	157.09**
	Cv%	38.33	39.17	16.47
	Hb	91	78.32	54.87
Giza80	mean	42.51	19.11	72

The analysis of variance indicates that highly significant among families for all studied traits in population1. While, the selected families from popII showed highly significant for seed cotton yield / plant and number of bolls / plant and the other cor-

related traits except earliness index in Table 3.

Mean performance:

Means of the F3 and F4 generations of two populations for seed cotton yield/plant, number of bolls/plant and earliness index in F_3 and F_4 generation of the two populations are shown in Table 3.

These results indicate that the means increased by different degrees generations after generation, the means of selected families for seed cotton yield/plant, number of bolls/plant and earliness index were higher compared to in F_4 generation in two populations.

The average seed cotton yield/plant for selected families in F_3 generation for population 1 was 62.11 gm with a range from 18.92 to 92.74 gm. On the other hand, average seed cotton yield/ plant for population 2 was 56.11 gm. It could be noticed that the differences among families in the two populations were large enough, and selection for seed cotton yield/plant could be feasible.

PCV% and GCV% for seed cotton yield/plant in the F_3 selected families in population 1 and 2 are presented in Table 3. Under selection for seed cotton yield/plant, the pcv% was 34.00 in population 1. On the other hand, pcv% was 26.68% in population 2. gcv% in population 1 were 32.37% and 24.54 in population 2. Estimates of pcv% and gcv% indicated the presence of variability for seed cotton yield/plant. This variability suggests that selection among the F_3 families may produce change in seed cotton yield/plant. In general, pcv% was relatively higher than gcv%. Similar results were found by Mahrous (2012), El-Hashash (2004), Abdellatif and Soliman (2013) and Yehia and Hassan (2015).

Heritability (H^2) estimated from the expected mean squares was high for 90.65% in population 1. While in population 2 it was 84.62%. In general, high estimates of (H) indicated that the environmental effects were low compared to the genetic effects. These results are in according with those of Younis (1998-b), El-Dahan *et al* (2006) and An *et al* (2008). On the other hand Pole *et al* (2007) and Ali *et al* (2009) reported low heritability for boll weight, seed cotton yield / plant and earliness index.

B-1-2 number of bolls per plant:

Mean bolls /plant of the families ranged from 7.04 to 31.05 with an average of 20.36 and from 7.66 to 30.66 with an average of 18.05 % (Table 3) in populations I and II, respectively. It could be noticed that the differences among families in the two populations were large enough, and selection for lint percentage.

Phenotypic (PCV) and genotypic (GCV) coefficients of variability:

PCV and GCV coefficients of variability were estimated from the analysis of variance of the F_3 and F_4 and showed in Table (3).

The results clearly indicated small different between PCV and GCV for all studied characters which means low environmental influence on the expression of yhe studied characters.

According to selection of bolls /plant in the F_3 families selected when use in population 1 and 2 are presented in Tables 3. Under selec-

tion for bolls /plant, the pcv% was 30.44 in population 1. While pcv% was 26.62 gcv% in population 1 and in population 2. were 22.89 and 18.32 in population 2, respectively. Estimates of pcv% and gcv% indicated the presence of variability of number of bolls/plant. These variability suggest that selection among the F_3 families may produce change for number of boll / plant in population I. In general, pcv% was slightly higher than gcv%. El-Hashash (2004) and Yehia and Hassan (2015) found that Phenotypic and genotypic coefficient of variability values were highly for number of bolls/plant and seed cotton yield/plant in the two cotton crosses.

Heritability (H^2) was moderate it's was 58.13% in population 1and 47.37 in population 2. These results are in according with those of Pole *et al* (2007), Ali *et al* (2009) and Desalegn *et al* (2009) who showed low heritability for boll weight, seed cotton yield /plant and earliness index. Meanwhile, Younis (1998-b) reported high heritability estimates for earliness index, number of bolls/ plant and lint percentage.

B-1-3 earliness index

In population I, mean earliness index of the families ranged from 35.43 to 73 with an average of 51.53%. For, the same trend was obtained in population II, in which earliness index ranged from 35.10 to 77.75 with an average of 52.51%. The pcv%, gcv% and (H) for earliness index in the F_3 families selected for earliness index in population 1 and 2 are presented in Tables 3. Under selection for earliness index, the pcv% was 27.77 in population 1. On the other hand, pcv% was 18.26% in population 2. gcv% in population 1 were 26.36% and 7.28, respectively. Estimates of pcv% and gcv% indicated that and most of variability were duo to gcv % and suggested that selection among the F_3 families. High heritability estimated 90.10% from the expected mean squares was high for 90.10 % in population 1. While in population 2 it was 15.90 %. Abdellatif and Soliman (2013) found that the value of pcv% was higher than gcv% for days to first flower, boll weight, seed cotton yield per plant, lint yield per plant, lint percentage and seed index. High broad sense heritability estimated was detected for earliness. On the other hand Younis (1998-b) reported that high heritability estimates were found for earliness index, number of bolls/ plant and lint percentage.

C- Pedigree selection for seed cotton yield/plant

C-1-F_4generation:

Cycle (2) of pedigree selection were completed in two Egyptian cotton populations using 45 F_4 families. Direct pedigree selections for seed cotton yield/plant, no. of bolls /plant and earliness index were applied.

C-2-1- Means, range, variance (pcv%), (gcv%) and heritability:

Means of parents, means of the selected families, ranges, analysis of variance, pcv%, gcv% and (H^2) of the studied traits in the F_4 families for populations 1 and 2 with selection for seed cotton yield/plant are presented in Tables (3).

C-2-1seed cotton yield/plant:

The average seed cotton yield/plant for selected families in F_4 generation for population 1 was 84.46

gm with a range from 34.16 to 134.31 gm. While, average seed cotton yield/ plant yield for population 2 was 71.17 gm with a range from 32.22 to 119.14 gm. It could be noticed that the differences between families in the two populations were large enough, and selection population 1 would be effective.

PCV % and GCV% for seed cotton yield/plant in the F_4 selected families for seed cotton yield/plant in population 1 and 2 in Table 4. Selection for seed cotton yield/plant, the pcv% was 24.46 in for seed cotton yield/plant. While, the pcv% was 19.86% for seed cotton yield / plant in population 2. The gcv% were 23.85% and 19.28% in population 1 and in population 2, respectively. This variability suggests that selection among the F_4 families well be effective in this trait for seed cotton yield/plant. In general, pcv% was relatively higher than gcv%. Similar results were found by Mahrous (2012), El-Hashash (2004) and Abdellatif and Soliman (2013).

High (H^2) estimate 95.07 for seed cotton yield/ plant who found in population 1, while in population 2 it was 94.25%. The high estimates of (H) indicated low environmental effects as compared to the genetic effects. Similar results were found by Esmail (2007). On the other hand Pole *et al* (2007), Ali *et al* (2009) and Desalegn *et al* (2009) showed that low heritability for boll weight, seed cotton yield / plant and earliness index.

PCV% and GCV% for seed cotton yield/plant in the F_4 families selected for seed cotton yield/plant in population (1 and 2) are presented in Tables. Under selection for No. bolls/plant, the pcv% was 26.17 in population 1. While it was 24.87 % in population 2. The gcv% were 25.96% in population 1 and 24.17% in population 2. Estimates of pcv% and gcv% indicated that selection among the F_4 families well be effective in this trait for seed cotton yield/plant. In general, pcv% was relatively higher than gcv%. El-Hashash (2004) found that pcv and gcv % of variability values were highly for number of bolls / plant and seed cotton yield / plant characters in the two crosses.

High broad sense (H^2) 98.46% for seed cotton yield / plant was found in population 1,while in population 2 it was 94.47%. The, high estimates of (H) indicated that the environmental effects were low and compared to the genetic effects. Similar results were found by El-Okkia *et al* (1990) and Esmail (2007).

C-2-2-Means of No.bolls/plant:

The average no. bolls/plant in the selected families of the F_4 generation for population 1 was 27.83 which a ranged from 14.00 to 41.33 for family no 89 and family no. 26. On the other hand, average No. bolls/plant yield for population 2 was 27.49 with a range from 11.56 to 43.60 for family no 177 and family no. 69. These families showed significant response for 21families (No. 15,22,23,25,26, 28,59,63, 76, 79, 98,113,117,120,128, 151,155, and 187) from the bulk sample and G.95.

PCV% and GCV% for No.bolls/plant in the F_4 selected families in population 1 and 2 are presented in Table3. Under selection for no. bolls/plant, the pcv% was 23.73 in for no. bolls/plant. While, the

pcv% was 18.04% in population 2. gcv% in population 1 were 18.66 and 16.36% in population 2. Estimates of pcv% and gcv%) indicated the presence of variability for seed cotton yield/plant. This variability suggests that selection among the F_4 families may produce change in seed cotton yield/plant. In general, pcv% was relatively higher than gcv%. Similar results were found by Mahrous (2012), El-Hashash (2004) and Abdellatif and Soliman (2013).

Heritability (H^2) 62.85% number of bolls/plant was found in population 1. While in population 2 it was 82.13%. The, high estimates of (H) indicated that the environmental effects were low and compared to the genetic effects. Similar results were found by Kassem *et al* (1981-b) and Esmail (2007).

B-2-3-earliness index:

The average earliness index for selected families in F_4 generation for population 1 was 57.37 with a range from 38.96 to 77.00 NO.69 and 22 families respectively. On other hand, average earliness index for population 2 was 52.68with a range from 36.24 to 75.34. No.110 and 59 families respectively, it could be noticed that the differences between families in the population I was large enough, and selection for earliness index could be feasible.

According to selection of earliness index in the F_4 selected families when use for earliness index, the pcv% was 16.06 % in population 1. While, the pcv% was 14.71% in population 2, the gcv% in population 1 were 15.39% and 6.35% in population 2. Estimates of pcv% and gcv% indicated that and most of variability were due to gcv and suggested that selection among the F_4 families. The, pcv% was slightly higher than gcv%. Similar results were found by Mahrous (2012) who found that pcv% and gcv% in F_3 families were 25.12 and 24.88 respectively. El-Hashash (2004) found that Phenotypic and genotypic coefficient of variability values were highly for number of bolls / plant and seed cotton yield / plant characters in the two crosses. Abdellatif and Soliman (2013) found that the value of pcv was higher than gcv for days to first flower, boll weight, seed cotton yield per plant, lint yield per plant, lint percentage and seed index. High broad sense heritability estimates was detected for earliness.

High broad sense 91.83% for earliness index was found in population 1. While, in population 2 it was 18.63%. These results are in according with those of Younis (1998-b), El-Dahan *et al* (2006), and Desalegn *et al* (2009). On the other hand Pole *et al* (2007) and Ali *et al* (2009) showed that low heritability for boll weight, seed cotton yield / plant and earliness index.

Table 3. Means squares, PCV, GCV and H_2 estimates for all characters in f_3 and f_4 generations of the two populations.

Treat.	Pop.	Generations	mean	σ^2p	σ^2g	P.C.V.%	G.C.V.%	H %
Selection for seed cotton yield / plant	Pop_1	F_3 Fam.	62.11	445.26**	404.26**	34.00	32.37	90.65
		F_4 Fam.	84.46	427.03**	405.98**	24.46	23.85	95.07
	Pop_2	F_3 Fam.	56.11	225.06**	190.45**	26.68	24.54	84.62
		F_4 Fam.	71.17	205.55**	193.75**	19.86	19.28	94.25
Selection for h No. of bolls / plant	Pop_1	F_3 Fam.	20.36	28.358**	16.484**	30.44	22.89	58.13
		F_4 Fam.	27.83	25.36**	15.69**	23.73	18.66	61.85
	Pop_2	F_3 Fam.	18.05	23.116**	10.95**	26.62	18.32	47.37
		F_4 Fam.	27.49	21.79**	17.89**	18.04	16.35	82.13
Selection for earli-ness index	Pop_1	F_3 Fam.	51.53	173.91**	156.70**	27.77	26.36	90.10
		F_4 Fam.	57.37	83.02**	76.249**	16.06	15.39	91.83
	Pop_2	F_3 Fam.	52.51	74.78	11.89	18.26	7.28	15.90
		F_4 Fam.	52.68	60.118	11.202	14.71	6.35	18.63

Bulk method

Analysis of variance revealed significant and highly significant differences among families in the F_4 generation within bulk (BM) method in pop I and pop II except s.c.y/p and earliness index in pop II in Tables(4 and 5).

The results in showed that the average of seed cotton yield/ plant was (48.51and 56.30), in population (1 and 2) in Tables 6 and 7 and ranged from 33.38 to 72.48 with an average of 48.41gm and parents mean were 63.28 and 58.43 respectively. In population (2) seed cotton yield per plant ranged from 30.8 gm to 100.32 with an average of 56.30gm and parents mean were 63.28 and 48.46gm respectively.

In pop I, number of harvested bolls /plant ranged from 17 to 34.22 with an average of 20.51 and the parents were 17.95 and 16.80 in pop.I. On the other hand, number of bolls per plant for pop.II ranged from13 to 38. The average of 23.51 and the parents showed 17.95 (Giza 90) and 19.11(Giza 80) for bolls / plant in Tables 6 and 7, respectively. Earliness index ranged from47.10 to 79.82 with an average of 62.06 and parents mean were 63.28 and 72.04 in pop.I. Earliness index ranged from 32.07-to 77.56 with an average of 52.78 and parents mean showed 63.28 and 71.00 respectively. Average days to first flower was 74.10 with a range from 73 to 88 and parents were 88.80 and 73.65 in pop.II respectively.

The pcv%, (gcv%) and (H_2) for seed cotton yield/plant in the F_4 families selected for seed cotton yield/plant in population (6 and 7), the (pcv%) was 15.17 in population 1. While, the pcv% was 12.86% in population 2 and gcv% in population 1 were 14,98 and 12.38% in population 2. Selection for earliness index, the pcv % was 6.7% in population 1. While, the pcv % was 17.73% in population 2 and gcv% in population 1 was 4.64% and 9.12% in population 2. Estimates of pcv% and gcv% indicated the presence of variability for earliness index. Broad sense heritability estimates were high for S.C.Y/plant except for bolls/ plant and earliness index in tables (6 and 7).

Table 4. Mean squares of bulk genotypes fore earliness index in pop I characters in season 2016.

S.O.V	D.F	M.S		
		SC.Y/P	B/P	E.I
Reps	2	2.047	8.83	45.238
Genotypes	44	162.0139**	10.271*	52.225**
Error	88	3.991	5.678	26.88

.

Table 5. Mean squares of bulk genotypes fore earliness index in pop II characters in season 2016.

S.O.V	D.F	M.S		
		SC.Y/P	B/P	E.I
Reps	**2**	19.420	0.05467	139.623
Family	**44**	140.972	15.765**	262.875
Error	**88**	10.471	1.480	193.234

Table 6. The means, range, pcv, gcv and broad sense heritability for the studied traits in the F4 generation for bulk method (BM) in the population I.

pop	Traits	Range	Mean	pcv	gcv	h_b
Population 1	**Seed cotton yield /plant**	33.38-72.48	48.41	15.17	14.98	97.53
	Bolls/plant	17-34.22	20.51	8.23	5.50	44.71
	Earliness index	47.10-79.82	62.06	6.7	4.64	8.5

Table 7. The means, range, pcv, gcv and broad sense heritability for the studied traits in the F4 generation for bulk method (BM) in the population II.

Pop.	Traits	Range	Mean	pcv	gcv	h_b
Population 2	**Seed cotton yield/plant**	30.80-100.32	56.30	12.86	12.38	92.57
	Bolls/plant	13-38	23.51	9.74	9.28	90.61
	Earliness index	32.07-77.56	52.78	17.73	9.12	26.46

The expected (EGS%) and realized (RGS%) gain from selection in two methods:

The expected (EGS%) and realized (RGS%) gain from selection in cross1 and cross2 are shown in Tables (8 and 9).

The EGS% for seed cotton yield / plant in cross1 and cross2 in F_2 generation were 38.83 and 34.86 and decreased in F_3 generation which amounted 33.69 and 22.34, respectively.

The EGS% for number of bolls/plant in cross1 and cross2, in F_2

generation were 10.53, 6.11 and decreased in F_3 generation which amounted 5.44 and 4.00, respectively. El-Lawendey *et al* (2008) and Sary *et al* (2008) found the highest predicted genetic advance was achieved for lint yield / plant and number of bolls per plant in the three populations.

The EGS% for earliness index in cross1 and cross2, in F_3 generation which a mounted 20.91, and 2.41, respectively. Hassaballa *et al* (2012) reported that after two cycles of pedigree selection for earliness index were achieved in two segregating populations of Egyptian cotton (G. *barbadense L.*). After two cycles of selection the retained genetic coefficient of variability was sufficient for further other cycles of selection

The RGS% for S.C.Y/P in cross1 and cross2, in F_3 generation were 46.10 and 38.89, then decreased in successive generations which amounted 35.98 and 28.39 in F_4 respectively. This result is in harmony with that obtained by Mahdy *et al* (1987), Younis (1993), Kapoor *et al* (2008), Mahdy *et al* (2009-b) and Abd El-Salam *et al* (2013).

The RGS% for bolls/plant in cross1 and cross2, in F_3 generation were 13.78 and 4.54 then decreased in successive generations which amounted 36.68 and 47.39 in F_4 respectively. The realized gain from selection RGS% for earliness index in cross1 and cross2, in F_4 generation were 11.29 and 2.22 respectively.

Bulk method

The EGS% for seed cotton yield per plant in cross1 and cross2 in F_3 generation were 12.54 and 11.10. The EGS% for number of harvested bolls/plant in cross1 and cross2, the values amounted 1.44 and 3.63 and earliness index in cross1 and cross2, reached 6.20, and 4.33, respectively.

The RGS% for S.C.Y/P in cross1 and cross2, the values reached to 30.83 and 22.14**.** The realized gain from selection RGS% for harvested bolls/plant in cross1 and cross2, the values reached 13.11 and 12.56, and earliness index in cross1 and cross2, they a mounted 18.16, and 8.46, respectively.

Table 8. The EGS% and RGS% estimates for all traitsF_2, F_3 and F_4 generations of the two populations.

Treat.		PM			
		population 1		population 2	
		EGS	RGS	EGS	RGS
Selection for seed cotton yield / plant	F_2	38.83	……	34.86	…….
	F_3	33.69	46.1	22.34	38.89
	F_4	……	35.98	……	28.39
Selection for h No. of bolls / plant	F_2	10.53	……	6.11	…….
	F_3	5.44	13.87	4.00	4.54
	F_4	…….	36.68	……	47.39
Selection for earliness index	F_2	…….	……..	……	…….
	F_3	20.91	……..	2.41	……
	F_4	…..	11.29	……..	2.22

Table 9. The EGS% and RGS% estimates for all traits inF_3 and F_4 generations of the two populations.

Treat.		B.M			
		population 1		population 2	
		EGS%	RGS%	EGS%	RGS%
Selection for seed cotton yield / plant	F_3	12.54	…..	11.1	…..
	F_4	…..	30.83	……	22.14
Selection for h No. of bolls / plant	F_3	1.44	…..	3.63	…..
	F_4	…..	13.11	…..	12.56
Selection for earliness index	F_3	6.2	…..	4.33	…..
	F_4	…..	18.16	…..	8.46

Phenotypic and genotypic correlation coefficients:

Results of phenotypic and genotypic correlation coefficients between seed cotton yield /plant with the other six yield components and also among the characters themselves were worked out and presented in Tables 10 and 11. Seed cotton yield was significant and positively correlated with three traits namely lint yield/plant (0.93 and 0.96), followed by number of bolls/ plant (0.91 and 0.97) and boll weight, (0.55 and 0.51). However, lint percentage recorded negative and positive low correlation with yield (-0.057 and 0.016). However, seed index and days to first flower recorded positive and low correlation with yield. But, seed cotton yield per plant was negatively correlated with earliness index (-0.20 and -0.25). Moreover, boll weight was significant and positively correlated with lint yield per plant (0.532 and 0.524). However, boll weight recorded negative and low correlation with lint percentage (-0.128 and -0.134) in popI. Seed cotton yield was significant and positively correlated with three traits namely lint yield per plant (0.930 and 0.970), followed by number of bolls/ plant (0.665 and 0.741) and lint percentage, (0.294 and 0.490). However, seed index and boll weight recorded positive and low correlation with yield. But, seed cotton yield per plant was negatively correlated with earliness index and days to first flower (-0.20 and -0.25 and -0.006 and -0.032). Moreover, boll weight recorded positive and low correlation with lint percentage, lint yield / plant, seed index and days to first flower in popII. This is in according with the findings of Desalegn *et al* (2009), Khan *et al* (2009, Mahrous *et al* (2012), Baloch *et al* (2014) and Erande *et al* (2014). On the other hand, Ahmed *et al* (2008) reported that there is negatively correlated between B.W with S.C.Y/P. Baloch *et al* (2014-b) the phenotypic correlations revealed that bolls plant and seed in-

dex were highly and positively associated with seed cotton yield.

Population II:

In the pedigree method:

Results of phenotypic and genotypic correlation coefficients between seed cotton yield / plant with the other six yield components and also among the characters themselves were worked out and presented in Tables 12 and 13. Seed cotton yield was significant and positively correlated with three traits namely lint yield per plant (0.930 and 0.970), followed by number of bolls/plant (0.665 and 0.741) and lint percentage, (0.294 and 0.490). However, seed index and boll weight recorded positive and low correlation with yield. But, seed cotton yield per plant was negatively correlated with earliness index and days to first flower (-0.20 and -0.25 and -0.006 and-0.032). Moreover, boll weight recorded positive and low correlation with lint percentage, lint yield /plant, seed index and days to first flower. This is in according with the findings of Desalegn *et al* (2009), Khan *et al* (2009, Mahrous *et al* (2012), Baloch *et al* (2014) and Erande *et al* (2014). On the other hand, Ahmed *et al* (2008) reported that there is negatively correlated between B.W with S.C.Y/P. Baloch *et al* (2014-b) the phenotypic correlations revealed that bolls plant and seed index were highly and positively associated with seed cotton yield.

For number of bolls per plant was significant and positively correlated with lint yield / plant (0.569 and 0.710). However number of bolls/ plant was negative correlated with boll weight (-0.256 and -0.284). However, lint percentage, seed index and days to first flower recorded positive and low correlation with number of bolls per plant. But, number of bolls per plant was negatively correlated with earliness index (-0.020 and -0.024).

For earliness index was positive and low correlation with days to first flower (0.012 and 0.067). However, s.c.y/p, l.y/p, seed index, boll weight, lint percentage and number of bolls per plant recorded negative and low correlation with earliness index. This is in according with the findings of Abou-Zahra *et a*l (1992) and Younis (1998-b). On the other hand, Ismail *et al* (1991) and Younis (1998-b) reported that there is genotypic correlation was positive and highly significant between earliness and date of the first flower.

In the bulk method:

Results of phenotypic and genotypic correlation coefficients between seed cotton yield /plant with the other six yield components and also among the characters them selves were worked out and presented in Tables 14 and 15. Seed cotton yield was significant and positively correlated with two traits namely lint yield per plant (0.449 and 0.631) and boll weight (0.382 and 0.600). However, lint percentage recorded negative low correlation with yield (-0.220 and -0.313). However, days to first flower and earliness index were significant and positive correlation with yield in genotypic correlation coefficients (0.501 and 0.376). Moreover, numbers of bolls per plant and seed index were positively and negative low correlated with seed cotton yield per plant. However, boll weight was sig-

nificant and negative correlation with numbers of bolls per plant (-0.329 and 1.00). Boll weight was significant and positively correlated with days to first flower i. genotypic correlation (0.531). Moreover, lint yield per plant was significant and positively correlated with lint percentage (0.658 and 0.614). This is in according with the findings of Desalegn *et al* (2009), Mahrous *et al* (2012), Baloch *et al* (2014) and Erande *et al* (2014). On the other hand, Ahmed *et al* (2008) reported that there is negatively correlated between B.W with S.C.Y/P. Baloch *et al* (2014-b) the phenotypic correlations revealed that bolls plant and seed index were highly and positively associated with seed cotton yield.

Concerning number of bolls per plant was significant and negatively correlated with boll weight (-0.329 and 1.00). However, L.Y/P, lint percentage, seed index, earliness index and days to first flower recorded positive and negative and low correlation with number of bolls per plant.

For earliness index was significant and positively correlated genotypic with lint yield per plant in genotypic correlation (0.425. However, L%, seed index and days to first flower recorded positive and negative and low correlation with earliness index.

Table 10. Estimates of phenotypic correlation coefficient (rp) in F_4 generation between all pairs of studied traits in population 1 .

Traits	S.C.Y/P	L.Y/P	L%	B/P	B.W	S.I	E.I	DFF
S.C.Y/P	------	0.939**	-0.057	0.911**	0.559**	0.031	0.201	0.015
L.Y/P		------	0.197	0.862**	0.532**	0.024	-0.199	0.065
L%			------	0.024	-0.128	0.054	-0.014	0.126
B/P				------	0.291	0.000	-0.116	-0.045
B.W					-------	0.129	-0.187	0.142
S.I						-------	0.006	-0.023
E.I							------	0.082

*, ** Significant at 0.05 and 0.01 levels of probability respectively.

Table 11. Estimates of genotypic correlation coefficient (rg) in F_4 generation between all pairs of studied traits in population 1 .

Traits	S.C.Y/P	L.Y/P	L%	B/P	B.W	S.I	E.I	DFF
S.C.Y/P	------	0.964**	0.016	0.971**	0.517**	0.029	-0.257	0.018
L.Y/P		--------	0.242	0.936**	0.524**	0.020	-0.241	0.081
L%			------	0.062	-0.134	0.029	0.057	0.187
B/P				--------	0.431**	0.012	-0.133	-0.033
B.W					-------	0.190	-0.297*	0.189
S.I						-----	0.038	-0.005
E.I							------	0.108

Table 12. Estimates of phenotypic correlation coefficient (rp) in F4 generation between all pairs of studied traits for pedigree methods in population II.

Traits	S.C.Y/P	L.Y/P	L%	B/P	B.W	S.I	E.I	DFF
S.C.Y/P	------	0.930**	0.294*	0.665**	0.174	0.039	-.036	-0.006
L.Y/P		-----	0.521**	0.596**	0.194	0.047	-.039	0.008
L%			-------	0.143	0.140	-0.158	-0.027	0.052
B/P				-------	-0.256	0.023	-0.020	0.111
B.W					---------	0.112	-0.099	0.101
S.I						----------	-0.156	0.061
E.I							-------	0.012

Table 13. Estimates of genotypic correlation coefficient (rp) in F_4 generation between all pairs of studied traits for pedigree method in population II .

Traits	S.C.Y/P	L.Y/P	L%	B/P	B.W	S.I	E.I	DFF
S.C.Y/P	--------	0.970**	0.490**	0.741**	0.195	0.037	-0.054	-0.032
L.Y/P		------	0.669**	0.710**	0.233	0.050	-0.085	0.006
L%			------	0.267	0.247	-0.240	-0.055	-0.008
B/P				--------	-0.284	0.000	-0.024	0.224
B.W	-				------	0.115	-0.131	0.069
S.I						-------	-0.192	0.081
E.I							-------	0.067

Table 14. Estimates of phenotypic correlation coefficient (rp) in F4 generation between all pairs of studied traits for Bulk method (BM) in population I.

Traits	S.C.Y/P	L.Y/P	L%	B/P	B.W	S.I	E.I	DFF
S.C.Y/P	------	0.658**	-0.31**	0.037	0.455**	0.040	0.167	-.071
L.Y/P		------	0.658**	-0.010	0.382**	0.036	0.262	0.206
L%			------	-0.044	0. 033	0.026	0.169	0.083
B/P				------	-0.32**	0.031	0.140	-0.080
B.W					-------	-0.044	0.081	0.096
S.I						------	-0.033	-0.080
E.I							------	-0.071

Table 15. Estimates of genotypic correlation coefficient (rp) in F4 generation between all pairs of studied traits for Bulk method (BM) in population I.

Traits	S.C.Y/P	L.Y/P	L%	B/P	B.W	S.I	E.I	DFF
S.C.Y/P	--------	0.631**	-0.220	-.001	0.779**	-0.018	0.376**	0.501**
L.Y/P		------	0.614**	-0.148	0.600**	0.249	0.425**	0.332**
L%			------	-0.199	-0.040	0.142	0.158	-0.098
B/P				------	-1.00	0.131	0.427**	-0.139
B.W	-				-------	0.015	0.152	0.538**
S.I						-------	-0.021	0.221
E.I							------	0.072

Table 16. Estimates of phenotypic correlation coefficient (rp) in F4 generation between all pairs of studied traits for pedigree methods in population II.

Traits	S.C.Y/P	L.Y/P	L%	B/P	B.W	S.I	E.I	DFF
S.C.Y/P	------	0.930**	0.294*	0.665**	0.174	0.039	-.036	-0.006
L.Y/P		-----	0.521**	0.596**	0.194	0.047	-.039	0.008
L%			-------	0.143	0.140	-0.158	-0.027	0.052
B/P				-------	-0.256	0.023	-0.020	0.111
B.W					--------	0.112	-0.099	0.101
S.I						--------	-0.156	0.061
E.I							-------	0.012

Table 17. Estimates of genotypic correlation coefficient (rp) in F_4 generation between all pairs of studied traits for pedigree method in population II .

Traits	S.C.Y/P	L.Y/P	L%	B/P	B.W	S.I	E.I	DFF
S.C.Y/P	--------	0.970**	0.490**	0.741**	0.195	0.037	-0.054	-0.032
L.Y/P		------	0.669**	0.710**	0.233	0.050	-0.085	0.006
L%			------	0.267	0.247	-0.240	-0.055	-0.008
B/P				--------	-0.284	0.000	-0.024	0.224
B.W	-				------	0.115	-0.131	0.069
S.I						-------	-0.192	0.081
E.I							-------	0.067

In the bulk method:

Results of phenotypic and genotypic correlation coefficients between seed cotton yield / plant with the other six yield components and also among the characters themselves were worked out and presented in Tables 18 and 19. Seed cotton yield was significant and positively correlated with two traits namely lint yield per plant (0.730 and 0.831) and bolls/ plant (0.884 and 1.00). However, lint percentage recorded negative low correlation with yield (-0.201 and -0.201). However, a day to first flower was negative and low correlation with yield (-0.153 and -0.208). Moreover, boll weight, earliness index and seed index were positively and negative low correlated with seed cotton yield per plant. However, boll weight was significant and negative correlation with numbers of bolls per plant in genotypic correlation coefficients (-0.345). Moreover, lint yield per plant was significant and positively correlated with lint percentage (0.511 and 0.360). This is in according with the findings of Desalegn *et al* (2009), Khan *et al* (2009, Mahrous *et al* (2012), Baloch *et al* (2014) and Erande *et al* (2014). On the other hand, Ahmed *et al* (2008) reported that there is negatively correlated between B.W with S.C.Y/P. Baloch *et al* (2014-b) the phenotypic correlations revealed that bolls plant and seed index were highly and positively associated with seed cotton yield.

Concerning number of bolls per plant was significant and negatively

correlated with boll weight in genotypic correlation coefficients (-0.345). However, lint yield per plant was significant and positive correlation with numbers of bolls per plant (0.695 and 0.878). However, lint percentage, seed index, earliness index and days to first flower recorded positive and negative and low correlation with number of bolls per plant.

For earliness index was positively and negative and low correlation for all traits. On the other hand, Ismail *et al* (1991) and Younis (1998-b) reported that there is genotypic correlation was positive and highly significant between earliness and date of the first flower.

Table 18. Estimates of phenotypic correlation coefficient (rp) in F4 generation between all pairs of studied traits for bulk method (BM) in population II.

Traits	S.C.Y/P	L.Y/P	L%	B/P	B.W	S.I	E.I	DFF
S.C.Y/P	-------	0.730**	-0.201	0.884**	0.004	0.032	0.045	-0.009
L.Y/P		--------	0.511**	0.695**	-0.079	-0.055	-0.045	0.056
L%			---------	-0.098	-0.128	-0.086	-0.073	0.049
B/P				--------	-0.102	0.001	0.021	-0.019
B.W					---------	-0.040	-0.027	0.049
S.I						---------	0.265	-0.172
E.I							--------	-0.153

Table 19. Estimates of genotypic correlation coefficient (rp) in F4 generation between all pairs of studied traits for bulk method (BM) in population II.

Traits	S.C.Y/P	L.Y/P	L%	B/P	B.W	S.I	E.I	DFF
S.C.Y/P	-------	0.838**	-0.201	1.00**	0.003	-0.007	0.060	-0.015
L.Y/P		--------	0.360**	0.878**	-0.133	-0.071	-0.076	0.105
L%			---------	-0.155	-0.262	-0.088	-0.189	0.150
B/P				--------	-0.345**	0.019	0.053	-0.009
B.W					---------	0.019	-0.024	0.081
S.I						---------	0.133	-0.218
E.I							----------	-0.208

*, ** Significant at 0.05 and 0.01 levels of probability respectively

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الإستجابة للانتخاب فى عشيرتين من القطن المصري باستخدام طريقتين للانتخاب

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الملخص:

أجرى هذا البحث فى ثلاثة مواسم صيفية من ٢٠١٤-٢٠١٦ فى مزرعة تجارب كلية الزراعة - جامعة الازهر- فرع اسيوط وكانت المواد المستخدمة عبارة عن عشيرتين قاعدتين في الجيل الثاني ناتجة من التهجين بين اصناف القطن المصري وهما العشيرة الأولي (جيزة ٩٠ Xجيزة ٨٥) والعشيرة الثانية (جيزة ٩٠ X جيزة ٨٠). وكان الهدف من هذا البحث : تقدير الإستجابة المباشرة للإنتخاب المنسب والتجميع المحصول وتقدير الارتباط المظهرى والوراثى.

أهم النتائج المتحصل عليها يمكن عرضها كالتالى:

أظهر تحليل التباين وجود إختلافات عالية معنوية بين العائلات المنتخبة لصفة محصول القطن الزهرللنبات (جم) فى كل من العشيرتين مما يدل على ان الانتخاب داخل العشيرتن يكون فعالآ. وفى العشيرة الاولى كان متوسط محصول القطن الزهر لنبات العائلات المنتخبة يتراوح 62.11 و84.46 (جم) للجيل الثالث والرابع فى العشيرة الأولي و يتراوح .56 و72.16 (جم) للجيل الثالث والرابع فى العشيرة الثانية حيث تفوقت العائلات المنتخبة على العشيرة المجمعة قى الجيل الثالث والرابع فى كل من العشيرتين. وكذلك أظهر تقدير الارتباط المظهرى والوراثى بين المحصول و الصفات (عدد اللوز علي النبات وصفة محصول القطن الشعر وصفة وزن اللوزة) انه كان ارتباط موجب معنوي فى العشيرتين لطريقة النسب بينما أظهر تقدير الارتباط المظهرى والوراثى بين المحصول و الصفات(عدد اللوز علي النبات وصفة محصول القطن الشعر).