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APPLICATION OF SOME SELECTION PROCEDURES FOR IMPROVING OF SOME ECONOMIC CHARACTERS IN COTTON (*G. BARBADENSE* L.)

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ABSTRACT: The main objective of this study was to estimate and compare the genetic gain obtained from Simith-Hazel index model of selection index with direct and indirect selection to enhance selection efficiency of superior promising families in early segregating generations of the cotton cross Giza 86 x Karshenky. The data revealed increase in mean values for all characters with advanced generations' from F_2 to F_4 except micronaire reading which showed lower values (desirable values). This shifting in mean values in desirable direction could largely be attributed to the possible accumulation of favorable alleles as a result of selection procedures adapted in this study. The range was comparatively wider in F_2 generation as compared with the later generationsF_3 and F_4 for all studied characters. The advanced generations (F_3 and F_4 generations) showed reduction in PCV and GCV values as compared with F_2, this may due to reduction in genetic variability and heterozygosity as a result of using different selection procedures which exhausted a major part of variability. Most characters showed high heritability values over 60% over generations indicating high magnitude of genetic variability. Significant desirable correlations between boll weight and each of seed/boll and seed index were existed over the three generations. The significant undesirable association existed between seed cotton yield with most traits in F_2 generation were broken up and converted to desirable relation in later generations. Principal component analysis grouped estimates variables into six main components. In the first PC_1 yield characters (lint yield followed by (x_1) and seed cotton yield/plant showed negative loading and more contributed than the other fiber characters which gave negative loadings. The PC_2 was great influenced by seed index followed by lint/seed and boll weight which had positive loadings, in same time micronaire reading and fiber strength showed negative loadings. Ten 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 generation for lint yield/plant was observed when selecting for lint yield/plant with bolls/plant (IW_1) followed by (I_{12}) selecting for boll/plant with seed/boll and selection index in involving selection index involving lint yield/plant, bolls/plant, seeds/boll and lint/seed. The highest actual genetic gains from F_3 generation for lint yield/plant occurred when selecting directly for lint yield/plant followed by selecting for boll/plant. However the indices IW_{12} (selection index involving lint yield/plant, bolls/plant and seeds/boll) followed by IW_{13} (selection index involving lint yield/plant, bolls/plant and lint/seed) and IW_3 (selection index involving lint yield/plant and lint/seed) were superior to all selection procedures in amount of actual gain. Most indices showed high discrepancy between predicted and actual genetic gain as lint yield/plant, this was due to non-additive gene effect and large effect of environmental factor. However maximum actual genetic advance from F_4 generation for lint yield/plant were achieved when selecting for lint yield/plant, seeds/boll and lint/seed followed by selection indices containing lint yield/plant, boll/plant, seed/boll. The direct selection for lint yield and pedigree selection for boll/plant followed by selection for lint/ seed gave

desirable actual values and surpassed most indices. selection index involving lint yield/plant and boll/plant surpassed all selection procedures for predicted gain followed by Selection index involving lint yield/plant, bolls/plant, seeds/boll and lint/seed. However direct selection for lint yield followed by pedigree selection for boll/plant appeared to be most effective for the improvement lint yield and gives reasonable actual gains. The predicted and actual advances determine from F_3 generation were higher than F_4 generation for most selection procedures. On the basis of various selection procedures, six selected families were isolated from F_4 generation by superiority of these families from better parents, F_3 families and point start of F_2 plants mean. The breeder may utilize such selected families in breeding programs aiming to improve yield and quality.

Key words: ***Genetic advance, Selection procedures, Cotton, Selection index.***

INTRODUCTION

Cotton breading programs aimed to obtain cultivars that associate high yielding capacity with acceptable lint characters. Therefore the success of any breeding program depends directly on the ability of the breeder to Carry on the segregating population and to select progenies genetically superior for multiple traits simultaneously (EL Mansy, 2015). Most of Egyptian cotton breeder's emphasis pedigree selection in F_2 population derived from crosses among elite inbred lines. They desire the isolate sergeants hat have a combination of the favorable characteristics of both parents. Since selection with local material has been going on for a long time, the genetic variability have been exhausted, thus enhance of favorable recombination are limited. (Abdel Salam et al., 2014).

Cotton breeders are continually seeking to improve the selection methods in order to develop superior cotton varieties with high yielding and favorable lint and to clearance to biotic and a biotic stresses (El-lawendey et al., 2008 and El- Mansy, 2009). Direct selection based on yield only is mainly difficult practiced in cotton breeding so yield is complex trait and highly affected by environmental conditions however, the presence of genotype x environment interactions reduces the efficiency of using yield as the sole selection criterion and, thus, complicates the efforts of selection (Fellahi et al., 2018) in addition to the environmental effects, other factors such as polygenic nature, low heritability ,linkage and non-additive gene action may make selection less efficient mainly in early segregation generations (Ramadan et al., 2014) . in order to overcome these difficulties the breeders are focusing on other traits that can be used in parallel or independently of yield in a multi traits approach (Habib et al., 2007). The simultaneous selection of traits, set of economic importance increases the chance of success of breeding program (Sayd et al., 2019).For this purpose selection index which is multiple regression of genotypic values on phenotypic values of several traits, and are generally used to discriminate among selection units by taking into account both of the genetic and statistical structure of the population from which the genotype originated as well as the economic importance of the traits. Thus, when evaluating only those individuals it is predicted to have progeny of superior economic value to be reproduced (Jesus et al., 2006). The use of selection index is superior in improving complex traits. Furthermore, selection index aimed to determine the most valuable genotypes as well as the most suitable combination of traits with the extension of indirectly the yield in different plants (El-Lawendey et al., 2011). Reviewing literature indicated that

most studies of plant selection frequently have focused on single trait or multiple-trait selection without considering the interrelationship, heritability and the weight of traits and less effort has been devoted to index based selection. Some comparisons of the indices with direct selection allow the conclusion that the use of indices as selection criteria achieved relatively superior results. Several researchers confirmed the efficacy of selection index for improving yield and its components in cotton (El-Lawendey et al., 2008; El-Mansy, 2009, El-Lawendey and El-Dahan, 2012; El-Mansy, 2015 and Abd El Aty et al., 2017).

Despite of the usefulness of selection in plant breeding, there are very few reports of the use of selection index in Egyptian cotton. Therefore the aim of this study was to estimate and compare the genetic gain obtained from Simith-Hazel index model of selection index with direct and indirect selection to enhance selection efficiency of superior families and to estimate correlated response to selection.

MATERIALS AND METHODS

The field experiment was carried out at Sakha Agriculture Research Station during three seasons of 2017, 2018 and 2019. Three generations F_2, F_3 and F_4 of the interspecific cross (Giza 86 x Karashenky) were used in this study. The F_2 generation with the original parents was grown in no replicated row with 4.0 m length, 70 cm width and 40 cm hill space in 2017 season. One plant was left per hill at thinning time and self-pollination was practiced for all F_2 plants. At the end of season selfed as well as open pollinated bolls were gained from 200 selected F_2 guarded plants separately. Observations were recorded on yield and its components and fiber quality characters; boll weight in gm. (BW), seed cotton yield/plant in gm. (SCY), lint yield/plant (LY) (xw), lint percentage (LP%), bolls/plant (b/p) (x_1), seeds/boll(s/b) (x_2), seed index (SI), lint/seed (L/s) (x_3), micronaire reading (Mic), fiber strength as Pressely index (Fs) , fiber length (FL) and uniformity index (UI).

Using 5% selection intensity with eleven selection indices and four direct selection procedures, 45 F_2 plants were selected on the bases of their performance; the plants having the highest performance in each procedure were saved. Selection procedures were as follows:

No.	Indices		Indicate that involving characters
1	I_{w123}	=	Selection index involving lint yield/plant, bolls/plant, seeds/boll and lint/seed.
2	I_{w12}	=	Selection index involving lint yield/plant, bolls/plant and seeds/boll.
3	I_{w13}	=	Selection index involving lint yield/plant, bolls/plant and lint/seed.
4	I_{w23}	=	Selection index involving lint yield/plant, seeds/boll and lint/seed.
5	I_{123}	=	Selection index involving bolls/plant, seeds/boll and lint/seed.
6	I_{w1}	=	Selection index involving lint yield/plant and bolls/plant.
7	I_{w2}	=	Selection index involving lint yield/plant and seeds/boll.
8	I_{w3}	=	Selection index involving lint yield/plant and lint/seed.
9	I_{12}	=	Selection index involving bolls/plant and seeds/boll.
10	I_{13}	=	Selection index involving bolls/plant and lint/seed.
11	I_{23}	=	Selection index involving seeds/boll and lint/seed.
12	$I_{.xw}$	=	Selection for lint yield/plant.

13	I_{x1}	=	Selection for bolls/plant.
14	I_{x2}	=	Selection for seeds/ boll.
15	I_{x3}	=	Selection for lint/ seed.

In 2018 season, the 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 5% selection intensity. This gave a total of 20 selected families.

In 2019 season, selfed seeds of 20 selected families were evaluated with the original parents as same like in 2018. The ordinary practices of cotton cultivation were applied. Data were recorded on 5 guarded plants basis for each entry in F_3 and F_4 families for lint yield/plant, seed cotton yield/plant, boll weight, lint percentage, lint/seed, seed index, bolls/plant, seeds/boll, micronaire reading, fiber strength and fiber length.

Statistical procedure:

The phenotypic (PCV) and genotypic (GCV) coefficients of variation were estimated according to Kearsy and Pooni (1996). Also, heritability in broad sense was calculated as follows,

$$h_b^2 \text{ (in } F_2 \text{ generation)} = \frac{VF_2 - (VP1 + VP_2)/2}{VF_2} \times 100$$

$$h_b^2 \text{ (in } F_3 \text{ and } F_4 \text{ generation)} = \frac{\sigma^2 g}{\sigma^2 p} \times 100$$ (Walker 1960)

Where:

VF_2= the phenotypic variance of the F_2 generation.

VP_1, VP_2= the variance of the first and second parents.

g = the genotypic variance of the F_3 and F_4 generations.

p = the phenotypic variance of the F_3 and F_4 generations.

Genotypic correlation coefficients between studied traits were also computed in three generations according to Falconer and Mackey (1996).

The expected gain through direct (SGx) and indirect selection (SGy(x)) were calculated as follow:

$SGx = i\ .\sigma g_x\ .h_b x$

$SGY(x) = i\ .\sigma g_y\ .h_b x\ .rg\ (yx)$ (Bos and Caligari, 1995)

Where: I is selected intensity obtained considering a selection of 5% among progenies. x = Standard deviation of the genotypic variance of trait x.y = Standard deviation of the genotypic variance of trait y.h.$_{b.x}$ = Square root of heritability in broad sense.r.g (xy)= is the genotypic correlation between trait x and trait y.

Classical selection index (Smith-Hazel) was calculated according to Smith (1936) and Hazel (1943). $(b) = (P)^{-1}.(G).(a)$

Where:

b = vector of relative index coefficients.

(P^{-1}) = inverse of the phenotypic variance – covariance matrix.

(G) = Genotypic variance – covariance matrix.

(a) = vector of relative economic values on the bais of equally important = 1 for all traits.

Predicted improvement in lint yield on the basis of an index was estimated according to the following expression:

Selection advance (SA)= $SD\ (\sum b_i.g_{iw})^{1/2}$ (Walker 1960)

Where: SD denotes selection differential in standard units.

Bidenotes index weights for characters considered in an index.

g_{iw} denotes genotypic covariance's of the characters with yield.

Predicted genetic advance in lint yield

based on pedigree selection was estimated from the following expression: (G_w) due to selection for $X_i=K.g_{wi}/p_i$ (Miller and Rawlings 1967).

The predicted response in any selected and unselected characters was also computed according to Falconar, (1989) as follows: $GS_k = i.\ \sigma g_{ki}/(\sigma i)^{0.5}$

Where,;

i = is the selection differential in standard units.

σg_{ki} = is the genotypic covariance of k trait and the index.

σi = is the variance of the index.

The actual gains were calculated as deviation of generation mean for each trait from procedure mean of the trait.

Principal components analysis was used for data analysis in F_3 generation according to Hair *et al.,* (1987). All these computation performed by using SPSS (1995) and Minitab Computer Procedures.

RESULTS AND DISCUSSION

The cotton breeder strives to isolate the superior genotypes in crop and quality characteristics. To achieve this purpose, different selection methods were used and the choice of selection procedures for genetic improvement of cotton is largely conditioned by the type and relative amount of genetic variance in the population, while the gain from selection in a population depends on genetic variability within a population for given trait, heritability and selection intensity (Falconar; 1989).

Segregating populations with high mean performance were relatively effective in identifying the superior recombinants. A comparison of mean performance for different characters among the three generations F_2, F_3 and F_4 (Table 1). The data revealed increase in mean values for all characters with advanced generations' fromF_2 to F_4except micronaire reading which showed lower values (desirable values). This shifting in mean values in desirable direction could largely be attributed to the predominance of additive and additive x additive type of gene action and also due to the possible accumulation of favorable alleles as a result of selection procedures adapted in this study. Similar results were reported by EL-Mansy (2015) and Al Hibbiny *et al.*, (2019).

The range, an index of variability, was comparatively wider inF_2 generation as compared with the later generationsF_3 and F_4 for all studied characters.

On the other side, most characters showed reduced in variability in F_4 generation. On the same time the lower limits of range were lower in F_2 generation for all studied characters leading to wider spectrum of variability. However, in advanced generations (F_3 and F_4) the lower limits of range were relatively high and the upper limits were also relatively high, this due to shifting invariability and increased of desirable alleles as a result of selection procedures. The same trend was obtained by, Ramdan et al., (2014) and mahmoud (2020).

The estimates of genetic variation make the task of breeder easy, so as to make effective selection. The data in Table (1) showed that the PCV and GCV were generally larger in magnitude for all studied characters in F_2 generation as compared with advanced generations F_3 and F_4 indicating the magnitude of the genetic variability persisting in this material was sufficient for providing rather substantial amount of improvement through selection of superior progenies. On the same time, the PCV were generally higher than the GCV for all studied characters and in most case, the values of PCV and GCV differed only slightly in three generations, which reflected high genetic affected. These results indicated to feasibility of selection for these traits. Similar results were obtained by

Hassaballa et al., (2012), Ramadan et al., (2014), EL-Mansy (2015) and Abdel Aty et al., (2017). The advanced generation (F_3 and F_4 generations) showed reduction in PCV and GCV values, this may due to reduction in genetic variability and heterozygosity as a result of using different selection procedures which exhausted a major part of variability. These results are in agreement with EL Mansy (2009) EL-Lawendy et al., (2011) and Vinodhana et al., (2013).

Table (1). Means, standard errors (SE), phenotypic (PCV) and genotypic (GCV) coefficients of variation and broad sense heritability (h^2_b) for the studied characters in F_2, F_3 and F_4 generations.

ar.	GEN.	Means	$\pm$ Sx	Range min.	-	max.	Variances σ^2ph	σ^2g	σ^2e	H^2b.%	P.C.V.%	G.C.V.%
SCY/P	F_2	49.19	1.16	28.80	-	117.50	267.63	197.22	70.41	73.69	33.26	28.55
	F_3	83.22	3.44	54.30	-	116.80	217.53	205.73	11.80	94.58	17.72	17.24
	F_4	94.62	2.15	70.50	-	118.20	234.57	229.94	4.630	98.03	16.19	16.03
LY/P	F_2	18.69	0.47	10.91	-	46.99	43.60	27.61	15.98	63.34	35.33	28.11
	F_3	32.22	1.35	20.20	-	47.89	39.74	37.91	1.83	95.40	19.57	19.11
	F_4	37.17	0.88	27.35	-	48.22	43.90	43.13	0.77	98.25	17.82	17.67
LP%	F_2	37.89	0.13	28.53	-	43.91	3.36	2.48	0.87	73.94	4.84	4.16
	F_3	38.63	0.39	32.88	-	41.00	2.49	2.34	0.15	93.91	4.09	3.96
	F_4	39.20	0.31	37.00	-	41.00	0.94	0.85	0.10	89.65	2.48	2.35
BW	F_2	3.12	0.02	2.46	-	3.98	0.10	0.08	0.02	79.93	10.07	9.00
	F_3	3.44	0.12	3.00	-	4.44	0.07	0.05	0.01	78.95	7.50	6.67
	F_4	3.44	0.13	3.00	-	4.30	0.07	0.05	0.02	77.01	7.80	6.84
B/P	F_2	15.62	0.48	5.76	-	38.98	45.97	40.46	5.51	88.02	43.40	40.72
	F_3	24.33	1.25	15.05	-	34.82	21.13	19.57	1.56	92.62	18.89	18.18
	F_4	27.65	1.27	20.47	-	37.74	21.02	19.42	1.60	92.39	16.58	15.94
SI	F_2	10.03	0.05	8.40	-	11.60	0.38	0.28	0.10	74.42	6.17	5.32
	F_3	11.13	0.23	9.80	-	12.64	0.46	0.40	0.05	88.47	6.06	5.70
	F_4	11.44	0.25	10.20	-	12.50	0.39	0.33	0.06	84.00	5.45	5.00
S/B	F_2	18.24	0.13	13.78	-	23.45	3.25	2.35	0.90	72.37	9.88	8.40
	F_3	19.14	0.34	16.45	-	22.14	3.11	3.00	0.11	96.40	9.21	9.05
	F_4	19.99	0.37	18.00	-	22.40	1.56	1.42	0.14	91.08	6.25	5.96
L/S	F_2	0.06	0.00	0.04	-	0.08	0.00003	0.00002	0.00001	66.67	8.94	7.30
	F_3	0.07	0.002	0.06	-	0.08	0.00004	0.00003	0.000004	89.68	8.65	8.19
	F_4	0.07	0.002	0.06	-	0.09	0.00	0.00	0.000	86.97	7.32	6.82
Mic	F_2	4.30	0.05	3.00	-	5.00	0.55	0.34	0.21	61.60	17.32	13.59
	F_3	4.26	0.15	3.00	-	5.00	0.13	0.11	0.02	82.22	8.44	7.65
	F_4	4.36	0.14	3.50	-	4.90	0.121	0.10	0.02	84.52	7.97	7.33
FS	F_2	9.57	0.03	9.00	-	10.70	0.14	0.09	0.05	63.56	3.91	3.12
	F_3	10.06	0.26	9.10	-	10.90	0.18	0.11	0.07	61.40	4.20	3.29
	F_4	10.36	0.24	9.70	-	11.20	0.11	0.06	0.06	51.23	3.28	2.35
UI	F_2	83.66	0.09	80.10	-	87.20	1.65	1.13	0.51	68.75	1.53	1.27
	F_3	85.90	1.02	81.70	-	88.70	1.88	0.83	1.05	44.05	1.59	1.06

	F_4	87.69	0.90	85.80	-	87.00	2.06	1.25	0.81	60.78	1.64	1.27
FL	F_2	32.18	0.09	28.80	-	35.20	1.65	1.43	0.22	86.53	4.00	3.72
	F_3	33.04	0.44	30.80	-	35.40	1.20	1.01	0.19	83.87	3.32	3.04
	F_4	33.55	0.37	31.00	-	35.00	1.08	0.95	0.14	87.27	3.10	2.90

BW= Boll weight, SCY/P= Seed cotton yield/plant, LCY/P= Lint cotton yield/plant, LP= Lint percentage, SI= Seed index, L/S= Lint/seed, S/B= Seeds/boll, B/P= Bolls/plant, FL= Fiber length, FS= Fiber strength, MIC= Micronaire reading and UI= uniformity index

Heritability plays a productive role in breeding expressing the reliability of phenotype as a guide to its breeding value. Heritability values are useful in predicting the expected progress to be achieved through the process of selection. While genetic coefficient of variation a long with heritability estimates provide a reliable estimate of the amount of genetic advance to be expected through phenotypic selection (Erande *et al.,* 2014). Data illustrated in Table (1) revealed that there was a wide range of genotypic and phenotypic variances among the characters. High heritability values over 50% for most studied traits over generations indicating high magnitude of genetic variability and gave possible success in selection in early generations. On the other side, some character recoded low heritability value due to reduction in genetic variation; hence, the reduction in heritability observed could be due to complex nature of characters and the influence of genotypic by environment interaction (Ahmed *et al*., 2006). A great part of traits showed change on heritability towards higher values inF$_3$ and F$_4$ generations this due to increased portion of genetic variance to total phenotypic variance, which due to cryptic genetic changes that have been brought about two cycles of selection. Improvement of heritability values for these characters is of particular interest for breeder as it enhances the scope for improved selection response for such traits. However traits showed decreased in heritability values in broad sense from advanced generations (F$_4$), this probably due to application of several selection procedures which exhausted genetic variability especially the portion of non-additive and lead to more homogeneity in the population. Similar findings were agreement with those of Abou EL-Yazied *et al.,* (2014) and EL Mansy (2015).

Since plant breeders must be concerned with the total array of economic characters. Thus the knowledge of these correlation allows measuring the magnitude of the relationship among several characters and determines the character on which the selection can be based, to improve yield and other characters.. Results of genotypic correlation coefficients among the characters through the three generations are presented in Table (2). Significant desirable correlations between boll weight and each of seed /boll and seed indexwere existed over the three generations. Makhdoom *et al.,* (2010) reported that boll weight is the key independent yield components and play prime role in managing seed cotton yield. On the same trend seed cotton yield/plant showed significant positive correlation coefficients with lint yield and boll/plant (x2) over the three generations. Strong association for such characters with high heritability showed possibility of simultaneous improvement of these characters using different selection procedures. These results are in agreement with those obtained by Ahmed *et al.*, (2006) Desalegn *et al.,* (2009), Farooq *et al.* (2014) and EL-Mansy (2015).On the other side the significant undesirable association existed between

seed cotton yield with most traits in F_2 generation were broken up and converted to desirable relation. Boll/plant recorded significant negative association with boll weight over three generations, on the same time the latest trait showed negative correlation with boll components. Thus, the cotton breeder deals with intensive selection for within boll to improve yield in cotton. Some relations were changed from negative to positive (desirable direction) over generations. This was due to selection procedures which lead to change in gene frequency and increase additive genes (El-Lawenedey *et al.,* 2011 and El-Mansy 2015).

Table (2). Estimates of genotypic correlation coefficients in F_2, F_3 and F_4 generations between all pairs of studied traits.

Gen.	Char.	SCY/P	LY/P	LP%	BW	B/P	SI	S/B	L/S	Mic	FS	UR
F_2		0.99*										
F_3	LY/P	0.98*										
F_4		0.99*										
F_2		-0.34*	0.43*									
F_3	LP%	0.33*	0.52*									
F_4		0.62*	0.70*									
F_2		-0.09	-0.15	-0.37*								
F_3	BW	-0.02	-0.05	-0.17								
F_4		0.16	0.13	-0.18								
F_2		0.96*	0.99*	-0.11	-0.26*							
F_3	B/P	0.94*	0.93*	0.36*	-0.35*							
F_4		0.92*	0.93*	0.66*	-0.22							
F_2		-0.22	-0.31	-0.55*	0.30*	-0.22						
F_3	SI	0.12	0.09	-0.10	0.42*	-0.02						
F_4		0.36*	0.36	0.16	0.55*	0.13						
F_2		0.37*	0.44*	0.40*	0.85*	0.01	-0.04					
F_3	S/B	-0.24	-0.24	-0.14	0.52*	-0.41*	-0.33					
F_4		0.10	0.09	0.01	0.52*	-0.09	0.01					
F_2		-0.46*	-0.52*	-0.51*	-0.14	-0.25	0.59*	0.35*				
F_3	L/S	0.35*	0.48*	0.72*	0.15	0.28	0.62*	- 0.35*				
F_4		0.63*	0.67*	0.69*	0.30	0.48*	0.83*	0.01				
F_2		-0.55*	-0.72*	-0.34*	-0.03	-0.39*	-0.19	0.63*	-0.14			
F_3	Mic	0.04	0.01	-0.11	-0.03	0.02	-0.08	0.04	-0.14			
F_4		-0.09	-0.09	-0.09	-0.24	0.01	-0.02	0.21	-0.06			
F_2		-0.45*	-0.59*	-0.96*	-0.07	-0.29*	-0.23	0.54*	0.12	0.22		
F_3	FS	0.10	0.09	-0.02	-0.07	0.11	-0.20	0.05	-0.16	0.60*		
F_4		-0.04	-0.05	-0.14	-0.31	0.09	-0.05	0.19	-0.11	0.66*		
F_2		-0.49*	-0.64*	-0.94*	-0.02	-0.37*	-0.05	0.38*	-0.22	-0.57*	-0.30*	
F_3	UI	-0.18	-0.18	-0.05	0.04	-0.18	-0.12	0.19	-0.13	0.01	0.28	
F_4		-0.21	-0.19	0.04	-0.25	-0.12	-0.17	-0.16	-0.10	-0.03	-0.10	
F_2	FL	-0.15	-0.17	-0.11	0.07	-0.11	-0.04	0.13	-0.14	-0.09	0.35*	0.49*
F_3		-0.03	-0.04	-0.01	0.22	-0.08	0.12	-0.01	0.06	-0.07	0.10	0.24

F_4		-0.09	-0.15	-0.51*	0.27	-0.17	-0.20	0.20	-0.43	-0.10	-0.12	-0.16

Principal components analysis was applied on F_3 data (Table 3) to know which combination type of agronomic characters of the cotton families would attain high lint yield. The six principal components whose Eigen value was significant and accounted for about 90.4 % of the total variation of the original variables. The principal component analysis grouped the estimates variables into six main components. The first PC1 explained about 30.9% with the highest Eigen value 3.7% (explained variance with the variables), the second PC_2 axis 17.2%, the third PC_3 13.5% , the fourth explained 10.40% and the five and six axis explained 8.0% of the total variation (Table 3). Chahal and Gosal (2002) reported that characters having the highest absolute values closer to one within the given PC can influence the clustering or grouping the genotypes more than variables having lower absolute value closer to zero. In the first PC1 yield characters (lint yield (xw) followed by (x_1) and seed cotton yield/p showed negative loading and more contributed than the other fiber characters which gave negative loadings (Fig. 1). The PC_2 was great influenced by seed index followed by lint /seed and boll weight which had positive loadings, in same time micronaire reading and fiber strength showed negative loadings. The third PC_3 had positive loading with boll weight followed by strength and length. While the forth axis had positive loading with seeds /boll (x_2) and negative with seed index, lint/seed (x_3), micronaire and fiber strength. The fifth and six axes deal with fiber length and length uniformity. Thus the cotton breeder gave greet emphasis with the first two PC axis which contributed most variability in the studied characters in F_3 generation. Since lint yield/plant was the primary source of variation on the first PC axis and showed positive correlation with other yield contributed characters, thus breeder could improve in lint yield/plant by selection the other combination of yield contributed characters. Similar results were obtained by El-Lawendey *et al.,* (2008), Arauja *et al.,* (2012), El- Mansy (2015) and Abdel Aty et al., (2017).

Table (3): Principal components analysis of the contributed characters in F_3families of cotton cross G.86 × Kari.

Variable / characters	PC_1	PC_2	PC_3	PC_4	PC_5	PC_6	communality
SCY/P	-0.89	-0.17	0.20	0.17	-0.23	-0.25	0.99
LY/P	-0.94	-0.13	0.18	0.22	-0.11	-0.10	0.997
LP%	-0.62	0.09	0.01	0.27	0.47	0.54	0.97
BW	0.21	0.53	0.65	0.26	-0.37	0.01	0.95
B/P	-0.90	-0.32	-0.04	0.08	-0.08	-0.26	0.99
SI	-0.23	0.72	0.26	-0.50	-0.21	-0.06	0.93
S/B	0.50	-0.05	0.36	0.69	-0.21	0.18	0.94
L/S	-0.66	0.57	0.17	-0.13	0.22	0.39	0.99

Mic	0.04	-0.55	0.43	-0.44	-0.27	0.34	0.86
FS	0.00	-0.65	0.56	-0.28	0.08	0.14	0.84
UI	0.27	-0.16	0.41	0.09	0.60	-0.16	0.67
FL	0.07	0.20	0.48	-0.08	0.50	-0.49	0.72
Eigen value	3.71	2.07	1.62	1.24	1.20	1.01	10.85
Var %	30.90	17.2	13.5	10.4	10.0	8.00	0.90
commutative	30.90	48.10	61.60	72.00	82.00	90.40	-

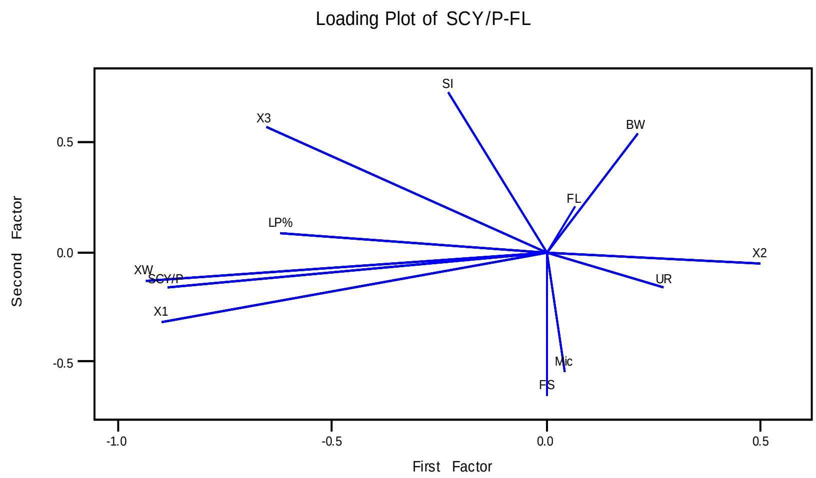

Fig. I. Plot of the first tow PCs as showing relation among variance characters in F_3 generation

The F_2 and F_3 for a population (G.86 X Karshenky) were evaluated for yield and fiber characters to the classical selection index according to Smith (1936) and Hazel (1943). Eleven selection indices containing two or more traits simultaneously were constructed in F_2 population besides direct selection for lint yield and other component only (four pedigree selections). Predicted and realized genetic advances from different selection procedures are presented in Table (4). The data revealed that ten 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 generation for lint yield/plant was observed when selecting for lint yield/plant with bolls/plant (IW_1) followed by (I_{12}) selecting for boll/plant with seed/boll and selection index in involving selection index involving lint yield/plant, bolls/plant, seeds/boll and lint/seed. These indices give values with high relative efficiency over selection based on lint yield. This was true since lint yield showed positive correlation with the other yield contributing characters. On contrast the lowest predicted genetic advance for lint yield/plant in F_2 were observed when selecting for lint/ seed followed by selection for seeds/boll such characters showed negative loading with lint yield. Similar results are obtained by EL-Mansy (2009), EL-Lawendey and EL-Dahan (2012) and Al Hibbiny *et al.*, (2019).

The highest actual genetic gains from F_3 generation for lint yield/plant occurred

when selecting directly for lint yield/plant followed by selecting directly for boll/plant. However, the indices IW_{12} (Selection index involving lint yield/plant, bolls/plant and seeds/boll) followed by IW_{13} (Selection index involving lint yield/plant, bolls/plant and lint/seed) and IW_3 (Selection index involving lint yield/plant and lint/seed) were superior to all selection procedures in amount of actual gain. Most indices showed high discrepancy between predicted and actual genetic gain as lint yield/plant, this was due to non-additive gene effect and large effect of environmental factor. On the other side, some indices showed close agreement between predicted and actual response to selection since the deviation of actual advance from predicted advance were positive and low values. This may due to the non-additive effect which were relatively low or minor importance and the additive effects would appear to be predominant similar results are obtained by EL-Lawendey and EL-Dahan (2012) , EL-Mansy (2015) and Mahmoud (2020).

Table (4): Predicted and actual gain from the different selection procedures for improving lint yield/plant in F_2 and F_3 generations.

Selection procedures	Predicted F_2			Actual F_3		
	i	ii	iii	i	ii	D
	Pred F_2	SA%		ACT		
I.W123	*26.61*	*142.34*	*308.83*	*17.90*	*95.76*	*8.71*
I.W12	*26.45*	*141.50*	*307.02*	*19.82*	*106.02*	*6.63*
I.W13	*24.84*	*132.91*	*288.38*	*19.82*	*106.02*	*5.03*
I.W23	*24.37*	*130.39*	*282.91*	*16.18*	*86.56*	*8.19*
I.123	*26.09*	*139.60*	*302.89*	*17.74*	*94.89*	*8.36*
I.W1	*34.31*	*183.57*	*398.30*	*11.70*	*62.61*	*22.61*
I.W2	*23.45*	*125.47*	*272.23*	*14.65*	*78.35*	*8.81*
I.W3	*18.68*	*99.92*	*216.79*	*19.43*	*103.95*	*-0.75*
I.12	*29.47*	*157.68*	*342.11*	*15.40*	*82.41*	*14.07*
I.13	*21.72*	*116.21*	*252.14*	*18.27*	*97.72*	*3.46*
I.23	*8.62*	*46.14*	*100.10*	*10.28*	*54.99*	*-1.66*
W	*8.62*	*46.09*	*100.00*	*20.89*	*111.77*	*-12.28*
X1	*10.03*	*53.63*	*116.36*	*20.60*	*110.18*	*-10.57*
X2	*4.03*	*21.55*	*46.75*	*11.34*	*60.66*	*-7.31*
X3	*-4.58*	*-24.52*	*-53.20*	*16.07*	*85.96*	*-20.65*

i Predicted and actual gains as lint yield (g)/plant.
i i Predicted and actual gains percentage as estimated from generation mean.
i i i Predicted and actual gains as percentage of the response of pedegree selection.

Table (4): Cont.

Selection procedures	Predicted F_3			Actual F_4			Predicted F_4		
	PRED	S.A. %		F4		Pred F3-	PRED	S.A. %	S.A. %
	i	ii	iii	i	ii	D	i	ii	iii
I.W123	35.12	109.01	283.46	14.46	44.89	20.66	21.73	58.47	162.07
I.W12	35.00	108.63	282.49	14.12	43.83	20.88	21.73	58.47	162.07
I.W13	35.06	108.82	282.97	12.81	39.76	22.25	21.73	58.47	162.07
I.W23	34.92	108.39	281.87	14.89	46.22	20.03	21.73	58.46	162.04

I.123	34.48	107.03	278.32	14.16	43.95	20.32	20.52	55.19	152.99
I.W1	35.23	109.34	284.35	14.57	45.21	20.66	21.74	58.50	162.14
I.W2	34.92	108.38	281.85	12.18	37.82	22.74	21.73	58.46	162.04
I.W3	34.91	108.36	281.78	11.63	36.09	23.28	21.73	58.46	162.04
I.12	33.38	103.60	269.40	12.73	39.50	20.65	19.93	53.62	148.63
I.13	32.62	101.23	263.24	12.31	38.22	20.30	19.40	52.18	144.63
I.23	8.50	26.37	68.59	0.25	0.77	8.25	1.97	5.30	14.68
W	12.39	38.45	99.99	14.46	44.89	-2.08	13.41	36.08	100.00
X1	11.59	35.96	93.51	14.16	43.95	-2.58	11.97	32.20	89.26
X2	-3.05	-9.46	-24.60	3.15	9.78	-6.20	-0.10	3.21	8.89
X3	5.91	18.34	47.70	13.96	43.31	-8.05	8.52	22.92	63.52

Maximum predicted genetic advance from F_3 generation for lint yield/plant were achieved when selecting for lint yield/plant and bolls/plant followed by selection indices containing lint yield/plant, bolls/plant, seeds/boll and selecting for lint yield/plant, bolls/plant and lint/seed. These main attributes of lint yield. On the other side, the lowest predicted s for lint yield/plant were observed when selecting for seeds/boll followed by pedigree selection for lint/seed and selection index involving seeds/boll and lint/seed respectively. However maximum actual genetic advance from F_4 generation for lint yield/plant were achieved when selecting for lint yield/plant, seeds/boll and lint/seed followed by selection indices containing lint yield/plant, bolls/plant, seeds/boll. The direct selection for lint yield and pedigree selection for bolls/plant followed by selection for lint/seed gave desirable actual values and surpassed most indices. This was true since the correlation between lint yield and such components were changes to significant and positive in the later generation.

Deviations of the actual genetic advance from the predicted advance from F_3 and F_4 generations were positive in most cases. These deviations 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. On the other side, the deviation between predicted and actual were negative and small values in all direct selection. These results are in good agreement with those obtained by EL-Mansy (2015) , Abd EL-Aty *et al.,* (2017) and Mahmoud (2020).

Considering the cumulative predicted and actual gains for lint yield /plant over the three generations by applied various selection procedures (Table 5). Selection index involving lint yield/plant and bolls/plant surpassed all selection procedures for predicted gain followed by selection index involving lint yield/plant, bolls/plant, seeds/boll and lint/seed and Selection index involving lint yield/plant, bolls/plant and seeds/boll. However direct selection for lint yield followed by pedigree selection for boll/plant appeared to be most effective for the improvement lint yield and gives reasonable actual gains. The predicted and actual advances determine from F3 generation were higher than F_4 generation for most selection procedures. Similar findings are agreement with those obtained by EL-Lawendey and EL-Dahan (2012) .

The data illustrated in Table (6) indicated that direct selection for lint yield/plant and pedigree selection for bolls/plant followed by selection index

involving lint yield/plant, bolls/plant and seeds/boll and selection index involving lint yield/plant, bolls/plant and lint/seed gave high values of realized advance for selected and unselected characters. There were close agreement between lint yield /plant and selected characters, indicated that advanced generations were. highest in means for three selected characters about F_2 generation and get up response fast in improvement through advanced progeny (F_3). Most indices give high actual advances in F_3 generations in three selected characters.

This trend was changed in F_4 generation (Table 7) since the maximum actual gains were obtained for most yield traits when applied indices involved lint yield/plant and seeds/boll with lint/seed. However, selection index involving lint yield and bolls/plant showed desirable actual values for most selected characters. Generally, the actual advance decrease from F_4 to F_3 generations for selected and unselected characters. Improvements in selected and unselected characters were very high amounts and fasting through advanced generations. The F_4 generation was smaller improvements compared with every F_2 and F_3 generations to reach stability point and homogeneity between different families (AL Hibbiny *et al*., 2019 and Mahmoud, 2020).

Table (5): cumulative predicted and actual genetic gains over three generations.

Selection procedures	*PRE.F_2*	*PRE.F_3*	*PRE.F_4*	*COMU. PRE*	*ACT.F_3 XW*	*ACT. F_4 XW*	*COMU.ACT*
I.W123	*26.61*	*35.12*	*21.73*	*83.46*	*17.90*	*14.46*	*32.36*
I.W12	*26.45*	*35.00*	*21.73*	*83.18*	*19.82*	*14.12*	*33.94*
I.W13	*24.84*	*35.06*	*21.73*	*81.64*	*19.82*	*12.81*	*32.63*
I.W23	*24.37*	*34.92*	*21.73*	*81.03*	*16.18*	*14.89*	*31.07*
I.123	*26.09*	*34.48*	*20.52*	*81.09*	*17.74*	*14.16*	*31.90*
I.W1	*34.31*	*35.23*	*21.74*	*91.29*	*11.70*	*14.57*	*26.27*
I.W2	*23.45*	*34.92*	*21.73*	*80.10*	*14.65*	*12.18*	*26.83*
I.W3	*18.68*	*34.91*	*21.73*	*75.32*	*19.43*	*11.63*	*31.06*
I.12	*29.47*	*33.38*	*19.93*	*82.78*	*15.40*	*12.73*	*28.13*
I.13	*21.72*	*32.62*	*19.40*	*73.73*	*18.27*	*12.31*	*30.58*
I.23	*8.62*	*8.50*	*1.97*	*19.09*	*10.28*	*0.25*	*10.53*
W	*8.62*	*12.39*	*13.41*	*34.41*	*20.89*	*14.46*	*35.36*
X1	*10.03*	*11.59*	*11.97*	*33.58*	*20.60*	*14.16*	*34.76*
X2	*4.03*	*-3.05*	*1.19*	*2.17*	*11.34*	*3.15*	*14.49*
X3	*-4.58*	*5.91*	*8.52*	*9.84*	*16.07*	*13.96*	*30.02*

Table (6): Actual response to selection by using different selection procedures estimated from F3 means for the selected and unselected traits

Indices	*SCY/P*	*LP%*	*BW*	B/P	*SI*	S/B	L/S	*Mic*	*FS*	*UI*	*FL*
I.W123	*44.82*	*0.86*	*0.15*	*12.18*	*0.91*	*0.90*	*0.008*	*0.036*	*0.48*	*2.07*	*0.93*
I.W12	*48.61*	*1.38*	*0.15*	*13.43*	*1.07*	*0.58*	*0.011*	*-0.049*	*0.39*	*1.83*	*0.96*
I.W13	*48.61*	*1.38*	*0.15*	*13.43*	*1.07*	*0.58*	*0.011*	*-0.049*	*0.39*	*1.83*	*0.96*

I.W23	*40.36*	*0.89*	*0.17*	*10.95*	*0.91*	*1.14*	*0.008*	*0.013*	*0.56*	*2.62*	*0.90*
I.123	*43.70*	*1.20*	*0.26*	*11.34*	*0.97*	*1.71*	*0.009*	*0.156*	*0.72*	*2.82*	*1.19*
I.W1	*31.43*	*-0.20*	*0.06*	*8.53*	*1.06*	*0.12*	*0.006*	*0.090*	*0.60*	*2.40*	*0.93*
I.W2	*38.11*	*0.23*	*0.15*	*10.75*	*1.03*	*0.41*	*0.007*	*-0.012*	*0.61*	*2.59*	*1.05*
I.W3	*47.28*	*1.55*	*0.17*	*12.77*	*1.09*	*0.88*	*0.011*	*-0.118*	*0.54*	*2.69*	*0.92*
I.12	*38.60*	*0.78*	*0.26*	*9.30*	*0.94*	*2.46*	*0.008*	*0.110*	*0.58*	*2.34*	*0.74*
I.13	*45.29*	*1.14*	*0.16*	*12.50*	*1.08*	*0.32*	*0.010*	*-0.040*	*0.47*	*2.33*	*0.93*
I.23	*27.06*	*0.09*	*0.18*	*5.57*	*0.84*	*3.19*	*0.005*	*-0.057*	*0.49*	*2.42*	*0.89*
W	*50.41*	*1.85*	*0.21*	*13.74*	*1.12*	*0.30*	*0.012*	*-0.053*	*0.49*	*1.96*	*0.62*
X1	*50.00*	*1.70*	*0.15*	*13.98*	*1.06*	*0.06*	*0.012*	*-0.023*	*0.51*	*1.83*	*0.82*
X2	*29.10*	*0.35*	*0.24*	*6.29*	*0.84*	*3.01*	*0.006*	*-0.030*	*0.46*	*2.38*	*0.58*
X3	*38.30*	*1.74*	*0.14*	*9.39*	*1.56*	*0.35*	*0.015*	*-0.109*	*0.36*	*2.03*	*0.99*

Table (7): Actual response to selection by using different selection procedures estimated from F4 means for the selected and unselected traits.

Indices	*SCY/P*	*LP%*	*BW*	B/P	*SI*	S/B	L/S	*Mic*	*FS*	*UI*	*FL*
I.W123	**32.713**	**1.639**	**0.121**	**8.267**	**0.749**	**1.376**	**0.010**	**0.055**	**0.278**	**1.756**	**0.289**
I.W12	**32.673**	**1.359**	**0.069**	**8.777**	**0.593**	**1.086**	**0.008**	**0.038**	**0.258**	**1.657**	**0.469**
I.W13	**29.270**	**1.401**	**0.024**	**8.188**	**0.595**	**0.936**	**0.008**	**0.009**	**0.297**	**1.431**	**0.242**
I.W23	**33.447**	**1.756**	**0.129**	**8.382**	**1.066**	**1.893**	**0.012**	**0.321**	**0.512**	**1.797**	**-1.094**
I.123	**32.947**	**1.297**	**0.037**	**9.151**	**0.516**	**1.376**	**0.007**	**0.163**	**0.312**	**1.564**	**0.198**
I.W1	**33.097**	**1.597**	**0.104**	**8.520**	**0.799**	**2.160**	**0.010**	**0.288**	**0.437**	**1.856**	**-0.211**
I.W2	**28.324**	**1.078**	**0.201**	**6.575**	**0.910**	**2.349**	**0.009**	**0.316**	**0.484**	**1.814**	**0.012**
I.W3	**26.055**	**1.464**	**-0.004**	**7.406**	**0.533**	**1.443**	**0.008**	**0.255**	**0.395**	**1.831**	**-0.311**
I.12	**29.400**	**1.279**	**0.002**	**8.423**	**0.506**	**0.966**	**0.007**	**0.025**	**0.318**	**1.364**	**0.056**
I.13	**28.472**	**1.239**	**-0.029**	**8.455**	**0.358**	**0.443**	**0.006**	**-0.087**	**0.228**	**1.097**	**0.181**
I.23	**0.121**	**0.281**	**-0.104**	**0.689**	**0.324**	**-0.574**	**0.003**	**0.180**	**0.178**	**2.606**	**0.173**
W	**32.713**	**1.639**	**0.121**	**8.267**	**0.749**	**1.376**	**0.010**	**0.055**	**0.278**	**1.756**	**0.289**
X1	**32.947**	**1.297**	**0.037**	**9.151**	**0.516**	**1.376**	**0.007**	**0.163**	**0.312**	**1.564**	**0.198**
X2	**8.080**	**0.022**	**0.312**	**0.166**	**0.449**	**2.493**	**0.003**	**0.105**	**0.303**	**1.731**	**0.723**
X3	**31.197**	**1.731**	**0.104**	**7.990**	**0.941**	**1.376**	**0.012**	**0.146**	**0.378**	**1.697**	**-0.194**

It is worth to conclude that, selection including single trait is not efficient to bring genetic improvement in cotton yield. This is due to the fact for yield is a

commutative effect of several traits and hence selection for single traits only is not expected to explain fully genotypic variation for yield. However, when two or more traits based indices were merged, the relative efficiency of the result index is better than using each of single traits independently, since the obtained gains are distributed among all evaluated traits and achieved a higher total without a significant loss in the main traits (EL-Mansy, 2015).

The underlying reason for use of selection index is that yield is a commutative effect of two or more correlated and co-heritable with yield components. Thus, the progress to be attained from indirect selection using one or more yield components depends upon the direct and magnitude of genetic correlation between the traits in selection index and yield. Ramadan et al., (2014) reported that when component traits are negatively correlated, the correlated response might be negative for possible combinations of these traits, resulted in reduced gain from the use of selection index. The efficacy of use of selection indices was observed by EL-Lawendey and EL-Dahan (2012), EL-Mansy (2015) and Mahmoud (2020).

Segregating populations could be assessed using means and variability along with their ability to release superior segregates to know the real worth of a population. Breeder really to develop high yielding Breeder really to develop high yielding with acceptable fiber quality lines. Genotypes with high yielding capacity are crossed with the hope of obtaining desired recombinant with better yielding capacity. In the present study the scope of superior segregates were isolated on the basis of various selection procedures, then the six selected families were isolated in F_4 generation by superiority of these families from better parents, F_3 families and point start of F_2 plants mean.

Data illustrated in Table (8) revealed that all selected families exceeded better parent and point start of F_2 means, however some of 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.

Table (8): The best selected families resulted from different selection procedures in F4 generation.

F_2	F_3	F_4	SCY/P	LY/P	LP%	BW	B/P	*SI*	S/B	L/S	Mic	FS	UI	FL
40	8	4	116.33	46.60	40.07	3.57	32.63	12.23	22.20	0.08	4.73	10.73	88.33	3360
41	9	5	115.60	46.32	40.07	3.47	33.36	11.10	20.93	0.07	4.30	10.10	87.30	34.83
65	18	8	114.80	46.19	40.23	3.63	31.61	12.03	19.07	0.08	3.80	10.10	87.93	34.60
159	33	13	93.77	37.32	39.80	3.23	29.02	10.90	20.73	0.07	4.57	10.47	87.63	34.23
193	40	16	117.00	47.62	40.70	3.57	32.80	12.17	19.87	0.08	4.43	10.40	87.07	34.30
197	43	18	109.53	44.29	40.43	3.40	32.25	11.87	20.93	0.08	4.67	10.50	87.07	33.90
MeanF_4			94.62	37.17	39.20	3.44	27.65	11.44	19.99	0.07	4.36	10.36	87.69	33.55

L.S.D.		0.05	21.66	8.82	3.15	1.29	12.73	2.51	3.75	0.02	1.38	2.39	9.04	3.74

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تطبيق بعض طرق الأنتخاب لتحسين بعض الصفات الأقتصادية فى أقطان الباربادنس

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الملخص العربى

يهدف هذا البحث الى تقدير ومقارنة التحسين الوراثى الفعلى والمتوقع باستخدام طريقة الادلة الانتخابية لكل من (سميث وهازل) مع الانتخاب المباشر والغير مباشر وذلك بغرض زيادة كفاءة الانتخاب للعائلات المتفوقة فى الاجيال الانعزالية لهجين من القطن المصرى (جيزة 86 ×كارشنكى).

أظهرت النتائج زيادة فى قيم المتوسطات لكل الصفات مع تقدم الاجيال من الجيل الثانى للجيل الرابع عدا صفة الميكرونير والتى أظهرت انخفاض فى القيم مع التقدم فى الانتخاب من الجيل الثانى للجيل الرابع (قيم مرغوبة) ويرجع هذا التغير فى قيم المتوسطات للقيم الافضل فى المقام الاول لتجمع الأليلات المفيدة او المرغوبة كنتيجة لأجراءات الانتخاب .

كما أظهرت النتائج انخفاض فى قيم معاملات الاختلاف المظهرى والوراثى فى الجيل الثالث والرابع بالمقارنة مع تلك الموجودة فى الجيل الثانى ويرجع ذلك لانخفاض قيم التباين الوراثى وانخفاض الخلط الوراثى كنتيجة لاستخدام مختلف اجراءات الانتخاب والتى تؤدى لاستنفاذ الجزء الاكبر من التباين .

أعطت معظم الصفات قيما عالية لدرجة التوريث فى المعنى الواسع وأكبر من 60% خلال الاجيال ويرجع ذلك لاهمية الجزء من التباين الوراثى كما وجد ارتباط وراثى موجب ومعنوى بين وزن اللوزة وكل من عدد البذور / لوزة ومعامل البذرة خلال الاجيال الثلاثة .

كما أظهرت الدراسة أن الارتباط الغير مرغوب بين محصول القطن الزهر ومعظم الصفات تحت الدراسة فى الجيل الثانى تم كسره وتحوله الى ارتباط مرغوب فى الاجيال المتقدمة .

أظهر تحليل المكونات الاساسية أن الصفات التى تم دراستها تم توزيعها على ستة مكونات كبيرة على المكون الاول أظهرت صفات محصول الشعر يليها محصول القطن الزهر أكبر مساهمة على المحور الاول بالمقارنة بصفات التيلة فى حين وجد ان المحور الثانى كان اكثر تاثرا بصفات معامل البذرة يليها كمية الشعر / بذرة ووزن اللوزة والتى أظهرت علاقة موجبة مع المحور فى نفس الوقت أظهرت صفات التيلة قراءة الميكرونير والمتانة علاقة سالبة أظهرت نتائج الانتخاب أن عشرة أدلة أنتخابية من جملة أحدى عشر دليل انتخاب كانت أكثر مثالية بالمقارنة بالأنتخاب المباشر للتحسين فى كمية القطن الشعر فى عشيرة الجيل الثانى .

وجد أن أعلى التحسينات الوراثية المتوقعة لمحصول القطن الشعر /نبات فى الجيل الثانى عند الأنتخاب لمحصول القطن الشعر مع عدد اللوز /نبات يليها الأنتخاب لعدد اللوز/نبات مع عدد البذور/لوزة والدليل الأنتخابى المتضمن محصول الشعر/نبات وعدداللوز / نبات وعددالبذور/لوزة مع كمية الشعر/بذرة كما وجد أن أعلى التحسينات الوراثية الفعلية المتحصل عليها فى الجيل الثالث لمحصول القطن الشعر تم الحصول عليها عند الأنتخاب المباشر لصفة محصول الشعر /نبات يليها الإنتخاب لعدد اللوز/نبات بينما أعطى الدليل الأنتخابى (محصول الشعر/نبات ،عدداللوز/نبات وكمية الشعر / بذرة) والدليل الأنتخابى محصول الشعر/نبات وكمية الشعر/بذرة قيما متفوقة على جميع أدلة الأنتخاب لكمية التحسين الفعلى .

أظهرت معظم الأدلة الإنتخابية قيما عالية من الأختلاف بين التحسين الفعلى والمتوقع مما يرجع ذلك لوجود الفعل الجينى الغير مضيف مع التاثيرات البيئية لوحظ أن أعلى تحسين وراثى فعلى فى الجيل الرابع تم التحصل عليه عند تطبيق الإنتخاب لمحصول الشعر / نبات وعدد البذور / لوزة وكمية الشعر/ بذرة متبوعة بالدليل الأنتخابى (محصول الشعر / نبات، عدد اللوز/ نبات ، عدد البذور / لوزة) .

أعطى الإنتخاب المباشر لمحصول القطن الشعر وكذلك الإنتخاب لعدد اللوز/نبات متبوعة بالإنتخاب لصفة الشعر/بذرة قيما مرغوبة للتحسين الفعلى فاقت معظم الأدلة ، الدليل الأنتخابى المتضمن محصول الشعر/نبات مع عدد اللوز/نبات أعطى قيما فاقت كل الأدلة فى التحسين المتوقع لمحصول الشعر فى الجيل الرابع يتبعه الدليل الأنتخابى المتضمن محصول الشعر/نبات ،عدد اللوز/نبات والبذرة / لوزة مع الشعر /بذرة كان التحسين الوراثى المتوقع والفعلى المتحصل عليه فى الجيل الثالث أعلى من التحسين المتحصل عليه فى الجيل الرابع لمعظم الأجراءات الأنتخابية تم عزل وأنتخاب ستة عائلات من الجيل الرابع والتى تفوقت عن الأب الأفضل وكذلك متوسط الجيل الرابع وعلى هذا فإن المربى يمكنه استخدام مثل هذه العائلات المتفوقة فى برامج التربية التى تهدف لتحسين المحصول والجودة فى القطن المصرى إما عن طريقة الأستخدام مباشرة كسلالات مبشرة أو إدخالها فى برامج التهجين .

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