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ECONOMIC VALUES EFFECTS ON GENETIC GAINS OF LINT COTTON YIELD AND ITS COMPONENTS USING SELECTION INDICES

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ABSTRACT: *Ten selection indices were investigated to improve cotton yield and yield components based upon different combinations of four traits (lint yield/plant, bolls/plant, seeds/boll and lint/seed) through two applications of relative economic values - according to Walker's (WEV) and equally important (UEV). This study was carried out in early segregating generations F_2 and F_3 of the cotton cross Giza 86 x Russian variety 6022. The results showed that means and the minimum values of F_3 were higher than those of F_2 generation for most lint yield and lint components. This attributed to the efficiency of selection indices application in this study. The coefficient of genotypic correlations revealed that bolls/plant (in both generations) , seeds/boll and boll weight (in F_2) had positive and significant correlation with lint yield. The prediction gains in lint yield of WEV were highest than those of UEV for all selection indices except index I_{23} (seeds/boll with lint/seed). Because the economic values of inserted traits (WEV) were assigned to be weights for each trait, while the UEV considered equally one. Thus, the index weights (b's) for traits considered in WEV were higher than those in UEV. However, predictions of genetic gain based on UEV showed relatively association with realized genetic gain for lint yield. The index involving lint yield and seeds/boll (I_{w2}) may be better buffered and have much to offer in improving lint yield and stabilizing gains of both predicted and realized in the WEV and UEV applications. The lowest predicted and realized advances from WEV and UEV for lint yield were achieved when selecting for seeds/boll with lint/seed (I_{23}). Because the correlation between seeds/boll and lint/seed was not significant, whilst lint yield had negative association with them in F_3 generation. Generally, Smith-Hazel index with WEV was found to be the most efficient in improving lint/seed, boll weight, lint percentage, seed index and micronaire reading. On the other hand, UEV index proved to be relatively more efficient as compared to WEV in improving lint yield, seeds/boll, pressley index and fiber length.*

Key words: *Economic values, Genetic gains, Selection indices, Cotton.*

INTRODUCTION

Yield in cotton crop has a very complex control mechanism and direct selection is not much effective on it. Therefore, the most desirable approach to improve characteristics such as lint yield is simultaneous selection based on related traits (Bos and Caligari, 2007). Index selection is one of three fundamental methods of selecting to improve more than one trait (the other techniques being independent culling levels and tandem selection). Taking advantage of selection indices was first proposed by Smith (1936) in order to improve the plants. Hazel (1943) extended the index procedure for the selection of individuals in animal population. Construction of the S_{MITH} - H_{AZEL} index involves economic weightings of each trait along with genotypic and phenotypic variances and covariances between each pair of traits ; and coefficients of phenotypic weights (b's).

Vast information on the genetic variation and genotypic correlation between different plant characters is available in literature. The studies of Khan (2003) showed that the yield was found positively correlated with bolls/plant and boll weight. Further studies in this respect also indicated that 99% of both genotypic and phenotypic variation in lint yield could be explained by the three component traits. These results suggested that selection for these three component traits could be effective in improving lint yield. Indeed, it has been recommended that bolls/plant be used as the primary selection trait, followed by boll weight and lint percentage (Huang *et al.*, 2003 ; Li *et al.*, 2009). However, bolls/plant is negatively correlated with boll weight , a balanced selection for bolls/plant and boll weight might be needed (Li *et al.*, 2009).

The net genetic improvement which can be brought about by selection indices is the sum of the gains made for the several traits which have economic importance (Hazel, 1943). It is ,therefore, logical to weigh the gain made for each trait by the relative economic importance of that trait. Selection indices have been used in numerous studies in order to determine the most valuable genotypes as well as the most suitable combination of traits with the intention of indirectly improving the yield in cotton (Kamalanathan, 1967; El-Okkia, 1979; Mahdy, 1983; Al-Rawi and Ahmed, 1984; Hassaballa *et al.*,1987; Mahdy *et al.*, 1987; Younis, 1999; El-Lawendey, 2003 ; El-Lawendey *et al.*, 2008 ; Kassem *et al.*, 2008 ; Soliman and El-Lawendey, 2008; El-Mansy,2009).

The objectives of this study were to: (i) explore the effects of two different economic values (WEV and UEV) for the component traits on genetic gain in lint yield. (ii) determine the correlated response between selected and unselected traits in both WEV and UEV. (iii) investigate how heritability , genotypic correlation and selection parameters influence the outcomes of index selection in both WEV and UEV. (iv) evaluate the correlation coefficients among predicted and realized gains resulting from selection indices for yield and its components in both WEV and UEV.

MATERIALS AND METHODS

Genetic materials and selection procedures

The present investigation was carried out at Sakha Agricultural Research Station Kafr El-Sheikh Governorate. F_2 generation of the cotton cross Giza 86 x Russian variety 6022 with original parents were grown in no replicated rows 6.0 meter long with 40 cm hill space, while row to row width was 70 cm apart in 2009 season. One plant was left per hill at thinning time. Self pollination was practiced for all F_2 plants. Selfed as well as open pollinated bolls/plant of 354 F_2 guarded plants were picked up separately. Observations were recorded on lint cotton yield (g)/plant (x_w) , bolls/plant (x_1) , seeds/boll (x_2) , lint (g)/seed (x_3) , boll weight (BW) , lint percentage (L%) and seed index (SI).

Ten selection indices (I_{w12} , I_{w13} , I_{w23} , I_{123} , I_{w1} , I_{w2} , I_{w3} , I_{12} , I_{13} and I_{23}) on basis of Walker's (WEV) and unit (UEV) economic values were applied. These gave a total of 46 F_3 selected progenies by using 5% selection intensity the plants having the highest performance in each selection index (seventeen superior progenies of each index selection).

In 2010 season, selfed seeds of 46 selected progenies were evaluated with the two parents and a random sample of bulked seed of F_3 generation in a randomized complete blocks design with three replicates. Experimental plot was of a single row as carried in 2009. Recommended agronomic practices and need based plant protection measures were followed.

Data were recorded on F_3 guarded plants for the following characters: lint yield (g)/plant (LCY/P) , bolls/plant (B/P) , seeds/boll (S/B) , lint (g)/seed (L/S) , boll weight (BW) , lint percentage (L%) and seed index (SI) , micronaire reading (MR) , pressley index (PI) and fiber length at 2.5% span length (2.5%SL).

Statistical and genetic analysis

Heritability in broad sense was calculated according to the following expressions.

$$h_b^2 \text{ (in } F_2 \text{ generation)} = \frac{VF_2 - (VP_1 + VP_2)/2}{VF_2} \times 100$$

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

Where:

VF_2 = The phenotypic variance of the F_2 generation.
VP_1 = The variance of the first parent (Giza 86).
VP_2 = The variance of the second parent (Russian variety 6022).
$\sigma^2 g$ = The genotypic variance of the F_3 generation.
$\sigma^2 p$ = The phenotypic variance of the F_3 generation.

The phenotypic and genotypic coefficients of variation were estimated using the formula developed by Burton (1952).

Genotypic correlation coefficients between studied characters in F_2 and F_3 generations were estimated as outlined by Miller *et al.*, (1958) and Dewey and Lu (1959).

With each selection index score (I) was calculated the formula (Smith, 1936 ; Hazel, 1943):

$$I = b_1X_1 + b_2X_2 + ...+b_nX_n$$

The appropriate index weights (b's) were calculated from the following postulated by Smith (1936) and Hazel (1943) :

$$(b) = (P)^{-1} . (G) . (WEV) ....Application (I)$$

$$(b) = (P)^{-1} . (G) . (UEV) ....Application (II)$$

Where:

(b) =Vector of relative index coefficients,

$(P)^{-1}$ = Inverse phenotypic variance-covariance matrix,

(G) = Genotypic variance-covariance matrix,

(WEV) =Vector of relative economic values according to Walker (1960)

where :

$(WEV)_w$ (lint yield/plant)= $\bar{x}_1. \bar{x}_2. \bar{x}_3$

$(WEV)_1$ (bolls/plant) = $\bar{x}_2. \bar{x}_3$

$(WEV)_2$ (seeds/boll) = $\bar{x}_1. \bar{x}_3$

$(WEV)_3$ (lint/seed)= $\bar{x}_1. \bar{x}_2$

(UEV) =Vector of relative economic values on the basis of equally important, i.e., $(UEV)_w = (UEV)_1 = (UEV)_2 = (UEV)_3 = 1$

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

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

Where:

SD denotes selection differential in standard units.
b_i denotes index weights for characters considered in an index.
σg_{iw} denotes genotypic covariances of the characters with yield.

Also, the predicted response in any selected and unselected character was calculated as suggested by Robinson *et al.*, (1951) and Walker (1960).

The realized gains in F_3 was calculated as deviation of F_3 mean for each character from index mean of that character.

RESULTS AND DISCUSSION

Genetic variation

The development of an effective plant breeding program and the efficiency of selection largely depend upon the magnitude of variability, heritability and correlation coefficients in the segregating generations under study. Table (1) shows the different traits of the parental genotypes, indicating that the two parents are closely-related. Hence, for many varieties, yield improvements have come from mating of closely-related parents. Van Esbroeck and Bowman (1998) observed that parental genetic diversity, as estimated by coefficient of parentage, was not imperative for cotton improvement. Successful cultivars were most frequently developed from closely-related parents, with a level of diversity similar to the average genetic relationship among regionally-adapted cultivars. These indicated that there was sufficient variability or mechanisms to create variability, to make breeding progress in a narrow germplasm base.

Table 1. Characteristics of the cotton parental genotypes under this study.

Variety	LCY/P (x_w)	B/P (x_1)	S/B (x_2)	L/S (x_3)	BW (g)	L%	SI (g)	MR	PI	2.5% SL
Giza 86	27.45	18.44	20.04	0.074	3.81	38.99	11.60	4.90	10.50	34.5
Russian variety 6022	20.17	15.92	20.04	0.063	3.45	36.67	10.90	4.60	10.90	31.6

The phenotypic and genotypic coefficients of variation , means , ranges , heritability in broad sense in both F_2 and F_3 generations for the studied characters are shown in Table (2).

The PCV was generally higher than the GCV for all the characters. High PCV and GCV values were observed for lint yield and yield components except lint percentage and seed index in both F_2 and F_3 generations. This suggested sufficient amount of variation among the accessions selected traits under this investigation. This agrees with the report of Meena *et al.*, (2001) and El-Lawendey *et al.*, (2008). However, the fiber traits indicated low PCV and GCV in F_3 generation. The PCV in F_3 generation was lower than those of F_2 generation for lint and its components. Also, with an exception for lint percentage and seed index, estimates of GCV in F_3 for lint and its components were lower than those of F_2 generation. It was due to reduction in heterozygosity as compared to F_2 generation. Similar result has been reported by Preetha and Raveendren (2008).

Table 2. Phenotypic (PCV%) and genotypic (GCV%) coefficients of variation, means, standard errors($S\bar{x}$), ranges and heritability in broad sense (h_b^2) for the traits studied in both F_2 and F_3 generations.

Character	Generation	PCV%	GCV%	Mean ± $S\bar{x}$	Range	h_b^2
Lint yield (g)/plant (X_w)	F_2 F_3	39.57 17.23	26.49 10.51	23.73 ± 0.50 25.43 ±3.47	6.40 – 67.30 18.77 – 35.00	55.19 37.21
Bolls/plant (x_1)	F_2 F_3	38.32 23.74	26.11 18.67	20.62 ± 0.42 21.22 ± 3.11	6.58 – 53.13 14.70 – 33.43	53.56 61.85
Seeds/boll (x_2)	F_2 F_3	11.05 7.80	8.28 6.17	18.55 ± 0.11 19.49 ± 0.93	9.78 – 23.81 15.40 – 23.65	43.83 62.58
Lint (g)/seed (x_3)	F_2 F_3	9.83 9.23	5.04 8.72	0.063 ± 0.0003 0.064 ± 0.0019	0.038 – 0.080 0.049 – 0.078	73.67 89.11
Boll weight (g)	F_2 F_3	10.68 8.83	9.41 7.55	3.06 ± 0.02 3.28 ± 0.15	1.64 – 4.00 2.62 – 4.01	22.22 73.02
Lint percentage	F_2 F_3	4.42 3.55	2.22 3.29	37.68 ± 0.09 37.63 ± 0.50	30.61 – 41.72 34.83 – 40.40	74.79 85.84
Seed index (g)	F_2 F_3	6.57 5.51	3.24 5.09	10.31 ± 0.04 10.50 ± 0.22	7.56 – 12.30 9.21 – 12.30	75.72 85.58
Micronaire reading	F_3	2.73	1.98	4.92 ± 0.09	4.48 – 5.15	52.50
Pressley index	F_3	4.77	4.37	10.21 ± 0.20	9.30 – 11.07	83.86
Fiber length at 2.5% span length	F_3	2.47	1.89	34.31 ± 0.54	32.60 – 36.00	58.78

Comparing means and the minimum of F_3 generation with those F_2, it is apparent that the means and the minimum of F_3 were higher than those of F_2 generation for most lint yield and lint components (Fig.1 for lint yield). This attributed to the efficiency of selection indices application in this study. The same trend was obtained by Meena *et al.,* (1991) and El-Lawendey *et al.,* (2008).

Except lint yield/plant, estimates of heritability for lint components exceeded from F_2 to F_3 generation. High to moderate broad sense heritability estimates were observed for most studied characters. These estimates show that genetic variance justifies a great amount from phenotypic variation. It should be noticed that in both F_2 and F_3 generations carried out in individual year and genotype x environment may lead to over-estimation of heritability for some aforementioned traits.

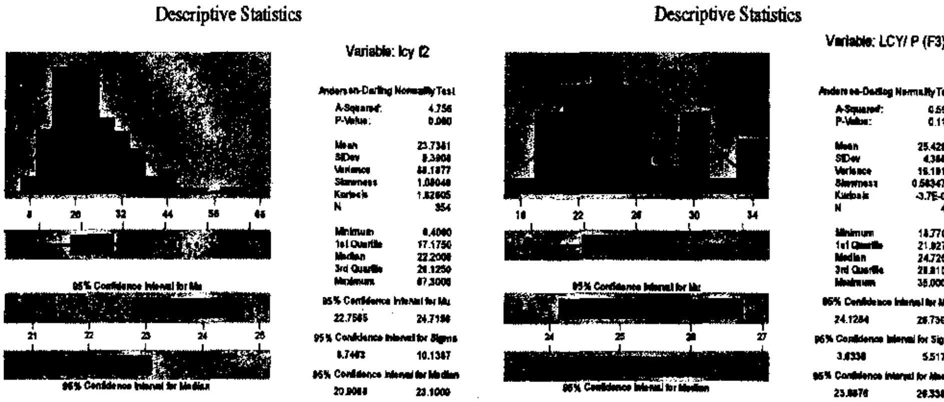

Fig.1. frequency distribution curves of lint yield in F_2 and F_3 generations.

Genotypic correlation

A strong correlation and heritability of economically-important traits are highly desirable in breeding and interpretation selection work. The genetic variability of most characteristics is correlated with changes in other characteristics. Coefficient of genotypic correlations among different character combinations are given in Table (3). The coefficient of genotypic correlations revealed that bolls/plant (in both generations) , seeds/boll and boll weight (in F_2) had positive and significant correlation with lint yield. Also, boll weight exhibited positive association with seeds/boll, lint/seed and seed index in both F_2 and F_3 generations. The same nature of association occurred between lint/seed and both lint percentage and seed index. Similar results were obtained by Khan and Azhar (2000).

The stability relationships from F_2 to F_3 generations between some traits e.i. lint yield with each of bolls/plant , lint percentage ; bolls/plant with each of lint/seed , lint percentage and seed index ; seeds/boll with boll weight ; lint/seed with each of boll weight , lint percentage and seed index ; and boll weight with seed index may have been governed by linkage , where the selection indices can not to break these associations, but it could be cause gene frequency changes. However, the high discrepancy of r_g between F_2 and F_3 generation appeared for both lint yield and bolls/plant with seeds/boll and boll weight. This discrepancy may be due to crossing-over and reduced size of F_3 generation.

The r_g revealed that micronaire reading had positive and significant correlation with both lint yield and bolls/plant ,but it showed negative relationship with seeds/boll , lint/seed , boll weight , lint percentage and fiber length. Pressley index was positively and significantly correlated with fiber length. These results are in agreement with those obtained by Desalegn *et al.*, (2009).

Table 3. Estimates of genotypic correlation coefficients (r_g) in both F_2 and F_3 generations between all pairs of studied traits.

Character	LCY/P (x_w)	B/P (x_1)	S/B (x_2)	L/S (x_3)	BW	L%	SI	MR	PI
B/P (x_1)	0.94** 0.91**								
S/B (x_2)	0.30** -0.59**	0.04 -0.60**							
L/S (x_3)	-0.03 -0.32*	-0.20** -0.59**	0.07 -0.16						
BW	0.24** -0.61**	-0.08 -0.85**	0.93** 0.63**	0.31** 0.64**					
L%	-0.16** -0.51**	-0.31** -0.74**	-0.05 0.14	0.55** 0.85**	0.10 0.65**				
SI	-0.07 -0.01	-0.23** -0.25	0.02 -0.39**	0.48** 0.84**	0.36** 0.44**	-0.001 0.43**			
MR	0.77**	0.78**	-0.54**	-0.32*	-0.63**	-0.46**	-0.09		
PI	-0.02	-0.07	0.14	-0.01	0.11	0.01	-0.01	0.08	
2.5%SL	0.13	0.02	0.37*	-0.12	0.23	-0.10	-0.07	-0.44**	0.67**

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

Relative efficiency of the different selection indices in WEV and UEV for lint yield

In current study, ten selection indices were investigated based upon different combination of four traits (x_w , x_1 , x_2 and x_3) and their economic values through the two applications of WEV and UEV. Table (4) and Fig. (2) show predicted and realized gains according to WEV and UEV for improving lint yield (g) /plant in F_2 and F_3 generations. The prediction gains of WEV were highest than those of UEV for all selection indices except index I_{23}. Because the economic values of inserted traits (WEV) were assigned to be weights for each trait, while the UEV considered equally one. Thus, the index weights (b's) for traits considered in WEV were higher than those in UEV. However, predictions of genetic gain based on UEV showed relatively association with realized genetic gain for lint yield (Table 7).

The lowest predicted and realized advances from WEV and UEV for lint yield were achieved when selecting for seeds/boll with lint/seed (I_{23}). Because the correlation between seeds/boll and lint/seed was not

significant, whilst lint yield had negative association with them in F_3 generation. The index I_{w12} gave the highest predicted efficiencies (240.4%) relative to index selection I_{123} in WEV. This may be attributed to coefficient of genetic correlations that showed strongly and positively correlated for yield with bolls/plant and seeds/boll in F_2 generation. Abouzaid *et al.*, (1997) , Khan *et al.*, (2009) and Makhdoom *et al.*, (2010) reported variable bolls/plant is the key independent yield component and play prime role in managing yield. The maximum of both predicted and realized efficiencies from WEV were fluctuated. However, index selection I_{w2} may be better buffered and have much to offer in improving lint yield and stabilizing gains of both predicted and realized in the WEV and UEV applications (Fig.2)

Deviations (D) of the realized advance from the predicted of lint yield (Table 4) were positive for 7 selection indices in WEV and for 2 in UEV. The close agreement between predicted and realized responses to I_{w2} in both WEV and UEV and I_{w3} in WEV may be due to the non additive effects which were relatively of minor importance and the additive genetic effects would appear to be predominant for seeds/boll (x_2) and lint/seed (x_3).

Table 4. Predicted and realized gains from the different selection indices according to WEV and UEV for improving lint yield (g)/plant (x_w) in F_2 and F_3 generations.

Selection indices	WEV							UEV						
	Predicted gain F_2			Realized gain F_3			D	Predicted gain F_2			Realized gain F_3			D
	i	ii%	iii%	i	ii%	iii%		i	ii%	iii%	i	ii%	iii%	
I_{w12}	5.12	21.6	240.4	0.94	3.9	23.4	4.18	2.62	11.0	127.2	0.94	3.9	29.4	1.68
I_{w13}	5.03	21.2	236.2	0.74	3.1	18.5	4.29	2.57	10.8	124.8	0.74	3.1	23.1	1.83
I_{w23}	5.03	21.2	236.2	4.32	18.1	107.7	0.71	2.28	9.6	110.7	3.49	14.6	109.1	-1.21
I_{123}	2.13	9.0	100.0	4.01	16.8	100.0	-1.88	2.06	8.9	100.0	3.20	13.4	100.0	-1.14
I_{w1}	5.08	21.4	238.5	4.16	17.5	103.7	0.92	2.60	11.0	126.2	3.58	15.0	111.9	-0.98
I_{w2}	5.01	21.1	235.2	4.51	18.9	112.5	0.50	4.13	17.4	200.5	4.66	19.6	145.6	-0.53
I_{w3}	5.01	21.1	235.2	4.56	19.1	113.7	0.45	2.27	9.6	110.2	4.46	18.7	139.4	-2.19
I_{12}	2.13	9.0	100.0	4.16	17.5	103.7	-2.03	2.05	8.6	99.5	4.16	17.5	130.0	-2.11
I_{13}	2.12	8.9	99.5	4.56	19.1	113.7	-2.44	2.03	8.6	98.5	3.20	13.4	100.0	-1.17
I_{23}	0.91	3.8	42.7	-1.35	-5.7	-33.7	2.26	1.03	4.3	50.0	-2.09	-8.8	-65.3	3.12

$\bar{F}_2$ =23.73 $\bar{F}_3$ =25.43 **Check mean (F_3) = 23.83**

(i) Predicted and realized gains as lint (g)/plant.
(ii%) Predicted and realized gains percentage as estimated from generation mean and check means, respectively.
(iii%) Predicted and realized gains as a percentage of the response to truncation index selection I_{123} .
(D) Deviations of realized gains from predicted gains are given as lint (g)/plant.
Simple correlation coefficient between WEV and UEV deviations = 0.767**

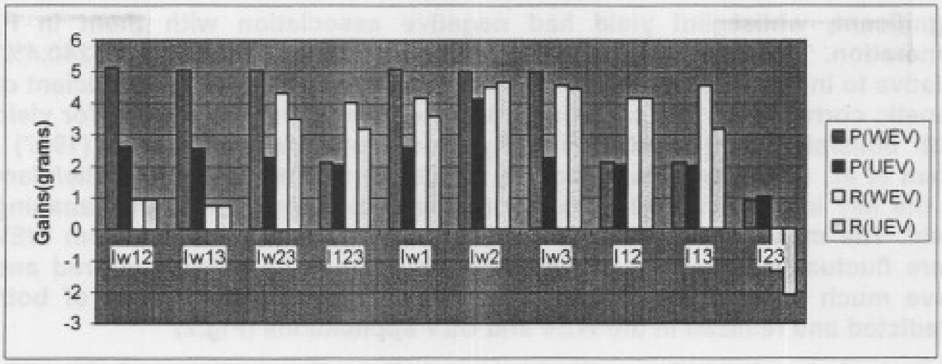

Fig.2. Predicted and realized gins for lint yield from F_2 and F_3, respectively in both WEV and UEV.

Gain from selection in WEV and UEV for selected bolls/plant, seeds/boll and lint/seed

Predicted and realized to selection by using 10 indices in WEV and UEV for selected bolls/plant, seeds/boll and lint/seed are given in Table 5. Index selection I_{w1} had stabilizing and satisfactory of genetic gains in both WEV and UEV for bolls/plant. The index involving seeds /boll and lint/seed (I_{23}) showed the lowest predicted and realized responses from F_2 and F_3 generations, respectively in both WEV and UEV for bolls/plant. These agreements suggest that selection for decreased lint yield will result in a decrease in the bolls/plant. On the contrary, this index (I_{23}) gave high values of predicted and realized responses in both WEV and UEV for seeds/boll and lint/seed. The large discrepancy in behavior I_{23} may be due to negative correlations of each seeds/boll and lint/seed with bolls/plant. Deviations of the realized advance from the predicted were negative in most indices in both WEV and UEV for bolls/plant, while seeds/boll and lint/seed were positive in most selection indices. These results are in agreement with those obtained by El-Lawendey *et al.,* (2008).

Gain from selection in WEV and UEV for unselected boll weight , lint percentage and seed index

Predicted gains exceeded realized gains from most indices for boll weight , lint percentage and seed index in both WEV and UEV (Table 6). The gains from I_{23} in WEV for boll weight, lint percentage and seed index were similar, where these were surprising in view of the fact that the genotypic correlation between them and lint/seed (x_3) were positive and significant in F_3 generation. The highest realized advances for boll weight , lint percentage and seed index in UEV were obtained by using I_{23} , I_{w13} and I_{w13}, respectively. Similar results were obtained by Culp and Harrell (1975).

Table 5. Predicted and realized responses to selection by using different selection indices which estimated from F_2 and F_3 means for selected bolls/plant , seeds/boll and lint/seed.

Selection indices	Bolls/ plant (x_1)									
	WEV				D	UEV				D
	Predicted response F_2		Realized response F_3			Predicted response F_2		Realized response F_3		
	i	ii%	i	ii%		i	ii%	i	ii%	
I_{w12}	4.48	21.7	1.63	7.6	2.85	2.39	11.6	1.63	7.6	0.76
I_{w13}	4.57	22.2	1.45	6.7	3.12	2.43	11.8	1.45	6.7	0.98
I_{w23}	4.58	22.2	5.48	25.5	-0.90	2.04	9.9	5.27	24.5	-3.23
I_{123}	2.12	10.3	5.51	25.6	-3.39	2.04	9.9	5.16	24.0	-3.12
I_{w1}	4.56	22.1	5.55	25.8	-0.99	2.42	11.7	5.36	24.9	-2.94
I_{w2}	4.54	22.0	5.10	23.7	-0.56	2.59	12.6	4.89	22.7	-2.30
I_{w3}	4.48	21.7	5.32	24.7	-0.84	2.03	9.8	5.46	25.4	-3.43
I_{12}	2.13	10.3	5.55	25.8	-3.42	2.05	9.9	5.55	25.8	-3.50
I_{13}	2.12	10.3	5.37	25.0	-3.25	2.05	9.9	5.16	24.0	-3.11
I_{23}	-0.85	-4.1	-3.33	-15.5	2.48	0.79	3.8	-2.53	-11.8	3.32

$\bar{F}_2$ =20.62 $\bar{F}_3$ =21.22 Check mean (F_3) = 21.52

Simple correlation coefficient between WEV and UEV deviations =0.865**

Table 5. Continued.

Selection indices	Seeds/boll (x_2)									
	WEV				D	UEV				D
	Predicted response F_2		Realized response F_3			Predicted response F_2		Realized response F_3		
	i	ii%	i	ii%		i	ii%	i	ii%	
I_{w12}	0.017	0.1	0.74	3.9	-0.72	0.061	0.3	0.74	3.9	-0.68
I_{w13}	0.031	0.2	-1.40	-7.4	1.43	-0.008	0.0	-1.40	-7.4	1.39
I_{w23}	0.035	0.2	-0.92	-4.8	0.96	0.124	0.7	-0.70	-3.7	0.82
I_{123}	0.008	0.0	-0.91	-4.8	0.92	0.000	0.0	-0.67	-3.5	0.67
I_{w1}	0.088	0.5	-0.83	-4.4	0.92	0.058	0.3	-0.81	-4.3	0.87
I_{w2}	0.062	0.3	-0.93	-4.9	0.99	1.184	6.4	-0.61	-3.2	1.79
I_{w3}	0.079	0.4	-0.78	-4.1	0.86	0.079	0.4	-0.84	-4.4	0.92
I_{12}	0.002	0.0	-0.83	-4.4	0.83	-0.011	-0.1	-0.83	-4.4	0.82
I_{13}	-0.006	0.0	-0.88	-4.6	0.87	-0.055	-0.3	-0.67	-3.5	0.62
I_{23}	0.393	2.1	0.41	2.2	-0.02	2.051	11.1	1.30	6.8	0.75

$\bar{F}_2$ =18.55 $\bar{F}_3$ = 19.49 Check mean (F_3) = 18.99

Simple correlation coefficient between WEV and UEV deviations = 0.814**

Table 5. Continued.

Selection indices	Lint (g)/seed (x_3)									
	WEV				D	UEV				D
	Predicted response F_2		Realized response F_3			Predicted response F_2		Realized response F_3		
	i	ii%	i	ii%		i	ii%	i	ii%	
I_{w12}	0.000001	0.00	-0.0048	-8.1	0.005	-0.000005	-0.01	-0.0048	.1	0.005
I_{w13}	0.000019	0.03	0.0029	4.9	-0.003	0.000008	0.01	0.0029	9	-0.003
I_{w23}	-0.000024	-0.04	-0.0026	-4.4	0.003	-0.000005	-0.01	-0.0045	.6	0.004
I_{123}	0.000036	0.06	-0.0032	-5.4	0.003	0.000012	0.02	-0.0049	.3	0.005
I_{w1}	-0.000006	-0.01	-0.0032	-5.4	0.003	-0.000006	-0.01	-0.0042	.1	0.004
I_{w2}	-0.000012	-0.02	-0.0008	-1.4	0.001	0.000075	0.12	-0.0012	.0	0.001
I_{w3}	0.000027	0.04	-0.0020	-3.4	0.002	0.000025	0.04	-0.0024	.1	0.002
I_{12}	0.000001	0.00	-0.0032	-5.4	0.003	0.000000	0.00	-0.0032	.4	0.003
I_{13}	0.000059	0.10	-0.0018	-3.1	0.002	0.000004	0.01	-0.0049	.3	0.005
I_{23}	0.001221	1.97	0.0055	9.3	-0.004	0.000392	0.63	-0.0018	.1	0.002

$\bar{F}_2 = 0.062$ $\bar{F}_3 = 0.064$ Check mean (F_3) = 0.059

Simple correlation coefficient between WEV and UEV deviations = 0.740*

Table 6. Predicted and realized responses to selection by using different selection indices which estimated from F_2 and F_3 means for unselected boll weight , Lint percentage and seed index.

Selection indices	Boll weight (g)									
	WEV				D	UEV				D
	Predicted response F_2		Realized response F_3			Predicted response F_2		Realized response F_3		
	i	ii%	i	ii%		i	ii%	i	ii%	
I_{w12}	0.005	0.2	-0.04	-1.3	0.05	0.006	0.2	-0.04	-1.3	0.05
I_{w13}	0.009	0.3	-0.11	-3.6	0.12	0.003	0.1	-0.11	-3.6	0.11
I_{w23}	0.004	0.1	-0.23	-7.5	0.23	0.012	0.4	-0.26	-8.5	0.27
I_{123}	0.005	0.2	-0.24	-7.9	0.25	0.004	0.1	-0.26	-8.5	0.26
I_{w1}	0.010	0.3	-0.24	-7.9	0.25	0.006	0.2	-0.27	-8.9	0.28
I_{w2}	0.008	0.3	-0.17	-5.6	0.18	0.170	5.6	-0.14	-4.6	0.31
I_{w3}	0.013	0.4	-0.18	-5.9	0.19	0.013	0.4	-0.21	-6.9	0.22
I_{12}	0.001	0.0	-0.24	-7.9	0.24	0.000	0.0	-0.24	-7.9	0.24
I_{13}	0.004	0.1	-0.19	-6.2	0.19	0.002	0.1	-0.26	-8.5	0.26
I_{23}	0.251	8.2	0.26	8.5	-0.01	0.022	0.7	0.14	4.6	-0.12

$\bar{F}_2 = 3.06$ $\bar{F}_3 = 3.28$ Check mean (F_3) = 3.05

Simple correlation coefficient between WEV and UEV deviations = 0.931**

Table 6. Continued.

Selection indices	Lint percentage									
	WEV				D	UEV				D
	Predicted response F_2		Realized response F_3			Predicted response F_2		Realized response F_3		
	i	ii%	i	ii%		i	ii%	i	ii%	
I_{w12}	0.02	0.1	-0.94	-2.6	0.96	-0.04	-0.1	-0.94	-2.6	0.90
I_{w13}	-0.06	-0.2	0.19	0.5	-0.25	-0.04	-0.1	0.19	0.5	-0.23
I_{w23}	-0.09	-0.2	-0.64	-1.7	0.55	-0.06	-0.2	-1.05	-2.9	0.99
I_{123}	-0.09	-0.2	-0.78	-2.1	0.69	-0.03	-0.1	-1.16	-3.2	1.13
I_{w1}	-0.05	-0.1	-0.77	-2.1	0.72	-0.03	-0.1	-0.98	-2.7	0.95
I_{w2}	-0.09	-0.2	-0.34	-0.9	0.25	-0.25	-0.7	-0.24	-0.7	-0.01
I_{w3}	-0.07	-0.2	-0.55	-1.5	0.48	-0.08	-0.2	-0.61	-1.7	0.53
I_{12}	0.04	0.1	-0.77	-2.1	0.81	0.01	0.0	-0.77	-2.1	0.78
I_{13}	-0.07	-0.2	-0.52	-1.4	0.45	-0.01	0.0	-1.16	-3.2	1.15
I_{23}	1.79	4.8	1.10	3.0	0.69	0.55	1.5	-0.17	-0.5	0.72

$\bar{F}_2$ = 37.68 $\bar{F}_3$ = 37.63 Check mean (F_3) = 36.63

Simple correlation coefficient between WEV and UEV deviations = 0.786**

Table 6. Continued.

Selection indices	Seed index (g)									
	WEV				D	UEV				D
	Predicted response F_2		Realized response F_3			Predicted response F_2		Realized response F_3		
	i	ii%	i	ii%		i	ii%	i	ii%	
I_{w12}	-0.01	-0.1	-0.38	-3.7	0.37	0.00	0.0	-0.38	-3.7	0.38
I_{w13}	0.00	0.0	0.38	3.7	-0.38	-0.01	-0.1	0.38	3.7	-0.39
I_{w23}	-0.01	-0.1	-0.14	-1.4	0.13	0.00	0.0	-0.28	-2.7	0.28
I_{123}	-0.01	-0.1	-0.17	-1.7	0.16	-0.01	-0.1	-0.30	-2.9	0.29
I_{w1}	0.00	0.0	-0.19	-1.9	0.19	0.00	0.0	-0.26	-2.6	0.26
I_{w2}	-0.01	-0.1	0.01	0.1	-0.02	0.02	0.2	-0.09	-0.9	0.11
I_{w3}	0.00	0.0	-0.08	-0.8	0.08	0.00	0.0	-0.13	-1.3	0.13
I_{12}	-0.01	-0.1	-0.19	-1.9	0.18	0.00	0.0	-0.19	-1.9	0.19
I_{13}	-0.01	-0.1	-0.07	-0.7	0.06	-0.01	-0.1	-0.30	-2.9	0.29
I_{23}	0.34	3.3	0.42	4.1	-0.08	0.17	1.6	-0.22	-2.2	0.39

$\bar{F}_2$ = 10.31 $\bar{F}_3$ = 10.50 Check mean (F_3) = 10.19

Simple correlation coefficient between WEV and UEV deviations = 0.780**

Finally, correlation coefficients between WEV and UEV deviations for lint yield and its components (Tables 4, 5 and 6) were positive and significant, indicating that both WEV and UEV took the same direction in improving lint yield and its components . Furthermore, they gave the trust in index selection.

Means of studied characters in both WEV and UEV scored by each selection index in F_3 generation are shown in Table (7). Performances of WEV application gave the highest value than those of UEV application for lint/seed , boll weight , lint percentage and seed index. Also, the desirable value (low) of micronaire reading was obtained when applying selection index I_{23} in WEV. On the other hand, performances of UEV application were higher than those of WEV for lint yield (I_{w2}) and seeds/boll , pressley index and fiber length (I_{23}). However, both WEV and UEV gave the equal performance for bolls/plant.

Evaluate the correlation coefficients among predicted and realized gains

This study summarized the influence of economic value kinds as important selection indices for improving lint yield. Correlation coefficients among predicted and realized gains resulting from selection indices in both WEV and UEV for yield and its components are presented in Table 8. Predicted gains had positive and significant with realized gains in WEV for lint/seed , boll weight , lint percentage and seed index, but small positive correlations for lint yield , bolls/plant and seeds/boll. Although association of predicted and realized gains in UEV was positive and significant for seeds/boll only, the magnitude was relatively large as compared with the WEV for lint yield and bolls/plant.

Generally, Smith-Hazel index with WEV was found to be the most efficient in improving lint/seed , boll weight , lint percentage , seed index and micronaire reading . UEV index proved to be relatively more efficient as compared to WEV in improving lint yield , seeds/boll, pressley index and fiber length. For handling this deficiency, the use of a recurrent selection that overcomes undesirable linkage through inter-mating and that produces new recombination. Then just like that selection index may be more effective to improve the yield and its components together.

Table 7. Means of traits studied in both WEV and UEV scored by each selection index in F_3 generation.

Indices	LCY/P (x_w)		B/P (x_1)		S/B (x_2)		L/S (x_3)		BW (g)		L%		SI (g)		MR		PI		2.5%SL (mm)	
	WEV	UEV	WEV	UEV	WEV	UEV	WEV	UEV	WEV	UEV	WEV	UEV	WEV	UEV	WEV	UEV	WEV	UEV	WEV	UEV
I_{w12}	26.37	26.37	22.86	22.86	20.23	20.23	0.059	0.059	3.24	3.24	36.69	36.69	10.12	10.12	4.94	4.94	10.22	10.22	34.24	34.24
I_{w13}	26.16	26.16	22.67	22.67	18.09	18.09	0.066	0.066	3.17	3.17	37.82	37.82	10.88	10.88	4.95	4.95	10.20	10.20	34.19	34.19
I_{w23}	29.75	28.92	26.70	26.50	18.57	18.79	0.061	0.059	3.05	3.02	36.99	36.58	10.37	10.22	4.98	5.00	10.12	10.12	34.23	34.30
I_{123}	29.44	28.63	26.73	26.39	18.58	18.82	0.060	0.059	3.03	3.01	36.85	36.47	10.33	10.20	4.99	5.00	10.16	10.19	34.32	34.31
I_{w1}	29.59	29.01	26.78	26.59	18.65	18.68	0.060	0.059	3.04	3.01	36.86	36.65	10.31	10.24	5.00	5.00	10.13	10.11	34.31	34.30
I_{w2}	29.94	30.09	26.33	26.12	18.55	18.88	0.063	0.062	3.11	3.14	37.29	37.39	10.51	10.41	4.97	4.96	10.12	10.14	34.20	34.21
I_{w3}	29.99	29.89	26.54	26.68	18.71	18.64	0.062	0.061	3.10	3.07	37.08	37.02	10.42	10.38	4.98	4.99	10.16	10.12	34.26	34.27
I_{12}	29.59	29.59	26.78	26.78	18.65	18.65	0.060	0.060	3.04	3.04	36.86	36.86	10.31	10.31	5.00	5.00	10.13	10.13	34.31	34.31
I_{13}	29.99	28.63	26.60	26.39	18.61	18.82	0.062	0.059	3.09	3.01	37.11	36.47	10.44	10.20	4.96	5.00	10.14	10.19	34.24	34.31
I_{23}	24.07	23.34	17.90	18.69	19.90	20.79	0.069	0.062	3.53	3.42	38.73	37.46	10.92	10.29	4.88	4.89	10.20	10.28	34.35	34.40
$S\bar{x}$ (F_3)	3.47		3.11		0.93		0.0019		0.15		0.50		0.22		0.09		0.20		0.54	

Table 8. Estimates of simple correlation coefficients between predicted and realized gains resulting from selection indices in both WEV and UEV for yield and yield components.

Character	WEV	UEV
LCY/P (x_w)	0.235	0.553
B/P (x_1)	0.526	0.613
S/B (x_2)	0.499	0.662*
L/S (x_3)	0.764*	0.226
BW	0.909**	0.145
L%	0.840**	0.219
SI	0.653*	-0.082

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

REFERENCES

Abouzaid, A., M.A. Bishr and S.S. El-Tabbakh (1997). Future of Egyptian cotton production in the new desert land of Egypt. 1. Effect of planting dates and cultivars on seed cotton yield and lint quality. *Alexandria. J. Agric. Res.*, 42: 49-62.

Al-Rawi, K.M. and A.A. Ahmed (1984). Evaluation of the relative efficiencies of several selection indices for predicting yield performance in upland cotton (*Gossypium hirsutum* L.). Iraqi J. Agric. Sci. 2(1): 15-27.

Bos, I. and P. Caligari (2007). *Selection Methods in Plant Breeding,* 2nd edition. Springer.

Burton, G.W. (1952). Quantitative inheritance in grasses. Proc. 6th Internat. Grassland Congr. 1: 277-283.

Culp, T.W. and D.C. Harrell (1975). Influence of lint percentage, boll size, and seed size on lint yield of upland cotton with high fiber strength. Crop Sci. 15(6): 741-746.

Desalegn, Z., N. Ratanadilok and R. Kaveeta (2009). Correlation and heritability for yield and fiber quality parameters of Ethiopian cotton (*Gossypium hirsutum* L.) estimated from 15 (diallel) crosses. Kasetsart J. (Nat. Sci.) 43:1-11.

Dewey, D.R. and K.H. Lu (1959). A correlation and path coefficient analysis of components of crested wheat grass seed production. Agron. J. 51(9): 515-518.

El-Lawendey, M.M.A. (2003). Effect of some selection procedures on lint yield and seed characters improvement in cotton. Ph.D. Thesis, Fac. Agric., Moshtohor, Zagazig University, Egypt.

El-Lawendey, M. M., Y. A. Soliman, A. R. Abd El-Bary and Y. M. El-Mansy (2008). Using fourteen selection procedures to evaluate predicted and realized genetic gain in the cotton cross Giza 86 x Suvin. Egypt. J. Plant Breed. 12 (1): 157-175.

El-Mansy, Y. M. (2009). Cluster analysis with selection index for improvement some characters in some cotton genotypes. 1st Nile Delta Conference, Fac. of Agric., Minufia Uni., 135-155.

El-Okkia, A.F.H. (1979). Evaluation of selection indices in Egyptian cotton (*G. barbadense* L.). Ph.D. Thesis, Fac. Agric., Kafr El-Sheikh, Tanta University, Egypt.

Hassaballa, E.A., E.E. Mahdy, M.A. Khalifa and F.G. Younis (1987). Correlation and path-analysis as affected by selection procedures in an inter-specific cotton population. Assiut J. Agric. Sci. 18(3): 85-100.

Hazel, L.N. (1943). The genetic basis for constructing selection indices. Genetics 28: 476-490.

Huang, Z., D. Ji and J. Pan (2003). Genetics and breeding of cotton in China. (ed.: Cotton Research Institute, Chinese Academy of Agricultural Sciences). pp.165, Shandong Science and Technology Press, Jinan, China.

Kamalanathan, S. (1967). A selection index for lint yield in cotton (*Gossypium hirsutum* L.). Madras Agric. J. 54: 612-618.

Kassem, M., G.A. Sary, A.F. El-Okkia and M.M. El-Lawendey (2008). Comparison of the efficiencies of the different selection procedures in three populations of Egyptian cottons (*Gossypium barbadense* L.). Egypt. J. Agric. Res., 86(2):623-629.

Khan, A.I. and F.M. Azhar (2000). Estimates of heritabilities and pattern of association among different characters of *Gossypium hirsutum* L. Pak. J. Agri. Sa. 37 (1-2): 7-10.

Khan, N.U. (2003). Genetic analysis, combining ability and heterotic studies for yield, its components, fibre and oil quality traits in upland cotton (*G. hirsutum*). Ph.D. Dissertation, Sindh Agric. Univ. Tandojam, Pakistan.

Khan, N.U., G. Hassan, K.B. Marwat, S. Batool, K. Makhdoom, I. Khan, I.A. Khan and W. Ahmad (2009). Genetic variability and heritability in upland cotton. *Pak. J. Bot.*, 41(4): 1695-1705.

Li, W., T. Zhang, M. Dieters and G. Ye (2009). The effects of component trait selection on genetic gain of lint yield in upland cotton breeding program investigated using simulation. SABRAO J. Breeding and Genetics. 41(2): 83-100.

Mahdy, E.E. (1983). Selection index in cotton (*G. barbadense* L.). Assiut J. Agric. Sci. 14: 267-282.

Mahdy, E.E., E.A. Hassaballa, M.A. Khalifa and F.G. Younis (1987). Relative efficiency of three selection procedures in improving yield and its components in Egyptian cotton. Assiut J. Agric. Sci. 18(3): 159-175.

Makhdoom, K., N.U. Khan, S. Batool, Z. Bibi, Farhatullah, S.Khan, F. Mohammad, D. Hussain, Raziuddin, M. Sajjad and N. Khan (2010). Genetic aptitude and correlation studies in *Gossypium hirsutum* L. Pak. J. Bot., 42(3):2011-2017.

Meena, R.A., M.N. Mishra and R.G. Dani (2001). Genetic variability and correlation for seed-quality parameters in upland cotton (*Gossypium hirsutum*L.). Indian J. Agric. Sci. 71(6): 417-420.

Meena, R.A., P. Singh and R.K. Deshmukh (1991). Potentials for seed setting in Egyptian cotton. J. Cotton Res. & Dev. 5(1): 12-15.

Miller, P.A., J.C. Williams, H.F. Robinson and R.E. Comstock (1958). Estimates of genotypic and environmental variances and covariances in upland cotton and their implications in selection. Agron. J. 50:126-131.

Preetha, S. and T.S. Raveendren (2008). Genetic appraisal of yield and fiber quality traits in cotton using inter-specific F_2 , F_3 and F_4 population. IJIB, 3 (2):136-142.

Robinson, H.F., R.E. Comstock and P.H. Harvey (1951). Genetic and phenotypic correlations in corn and their implications in selection. Agron. J. 43: 283-287.

Smith, H.F. (1936). A discriminant function for plant selection. Ann. Eugenics 7: 240-250.

Soliman, Y.A. and M.M. El-Lawendey (2008). Relative efficacy of selection indices for improving lint yield in two intraspecific cotton crosses. Egypt. J. Agric. Res., 86(1):207-222 .

Van Esbroeck, G. and D. T. Bowman (1998).Cotton germplasm diversity and its importance to cultivar development. The *J. Cotton Science* 2:121-129.

Walker, J.T. (1960). The use of a selection index technique in the analysis of progeny row data. Emp. Cott. Gr. Rev. 37: 81-107.

Younis, F.G. (1999). Predicted and realized responses to selection procedures for improving yield and its components in Egyptian cotton (*G. barbadense* L.). Al-Azhar J. Agric. Res., 30: 17-23.

تأثير القيم الاقتصادية علي التحسين الوراثي لمحصول القطن الشعر ومكوناته باستخدام أدلة الانتخاب

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الملخص العربي

يهدف هذا البحث إلى دراسة تأثير تطبيق طريقتين لحساب القيم الاقتصادية في نموذج دليل الانتخاب (SMITH - HAZEL index) علي التحسين الوراثي لمحصول القطن الشعر، والتجاوب المتلازم لمكونات المحصول، كيفية تأثير درجة التوريث بمعناها العام والارتباط الوراثي علي حصيلة أدلة الانتخاب، دراسة التلازم بين التحسين الوراثي المتوقع والتحسين الوراثي الفعلي لمحصول الشعر ومكوناته في كل من التطبيقين.

ولتحقيق ذلك تم استخدام الجيلين الثاني والثالث لعشيرة من القطن (جيزة ٨٦ x الصنف الروسي ٦٠٢٢) وتم تطبيق طريقتين في نموذج دليل الانتخاب هما طريقة Walker, 1960) حيث أعطت أهميه نسبية لكل صفة (WEV) وطريقة مساواة الأهمية النسبية لكل صفة بالوحدة (UEV). وأظهرت النتائج مايلي:

١- أعطت المتوسطات والحد الادني للمدى قيما اعلي في الجيل الثالث مقارنة بالجيل الثاني لمعظم صفات المحصول ومكوناته. ويرجع ذلك إلي كفاءة تطبيق أدلة الانتخاب في هذه الدراسة.

٢- أظهرت معاملات الارتباط الوراثية معنوية عالية وموجبة بين محصول القطن الشعر/نبات وكل من عدد اللوز/نبات (في الجلين الثاني والثالث) ، عدد البذور/لوزة ووزن اللوزة (في الجيل الثاني).

٣- أظهر تطبيق القيم الاقتصادية WEV قيما اعلي من UEV للتحسين الوراثي المتوقع لمحصول الشعر لكل أدلة الانتخاب عدا الدليل المتضمن عدد البذور/لوزة ووزن الشعر/بذرة (I_{23}). ويرجع ذلك إلي ارتفاع قيم معاملات الانحدار الجزيئية في نموذج

الدليل عند تطبيق WEV بالمقارنة عند تطبيق UEV. ومع ذلك أظهر التطبيق UEV توافقا ما للتحسين الوراثي المتوقع بالانتخاب مع التحسين الوراثي الفعلي لمحصول القطن الشعر.

٤- أظهر دليل الانتخاب المتضمن لصفتي المحصول وعدد البذور/لوزة (I_{w2}) قيم عالية وموثوق بها (به ثبات) لكل من التحسين الوراثي المتوقع بالانتخاب والتحسين الفعلي في كل من التطبيقين WEV و UEV .

٥- أظهر دليل الانتخاب المتضمن عدد البذور/لوزة ووزن الشعر/بذرة (I_{23}) أقل قيم للتحسين في محصول الشعر ويرجع ذلك إلي أن التلازم الوراثي بين عدد البذور/لوزة ووزن الشعر/بذرة كان غير معنوي بينما كانت صفة المحصول مرتبطة ارتباطا سالبا ومعنويا مع كل منهما. كما أوضحت تقديرات معاملات الانحدار الجزئية انه عند حذف صفتي محصول القطن الشعر وعدد اللوز/نبات من أدلة الانتخاب فان صفتي مكونات المحصول الاخري (عدد البذور/لوزة ووزن الشعر/بذرة) لا تستطيع تعويض الفقد الناتج من حذفهما.

٦- أظهرت النتائج أن تطبيق WEV كان أكثر كفاءة من تطبيق UEV في تحسين وزن الشعر/بذرة ، وزن اللوزة ، معدل الحليج ، معامل البذرة وقراءة الميكرونير. بينما تطبيق القيم الاقتصادية المساوية للوحدة (UEV) كان أكثر كفاءة في تحسين محصول الشعر ، عدد البذور/لوزة ، معامل البريسلي وطول التيلة.

٧- لتعظيم الاستفادة من نتائج هذه الدراسة يجب استخدام طريقة الانتخاب الدوري عقب دورة أدلة الانتخاب للتغلب علي التلازمات الغير مرغوبة بين الصفات وإنتاج تراكيب وراثية جديدة تعمل عليها أدلة الانتخاب لتحسين محصول القطن الشعر ومكوناته معا.