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GENETIC IMPROVEMENT OF SOME FIBER QUALITY AND YIELD COMPONENTS IN TWO EXTRA LONG COTTON CROSSES

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ABSTRACT

Grosses between varieties, germplasm introduction and breeding lines are made to create new gene combinations. Superior gene combinations are selected and fixed in the homozygous state by means of self fertilization and selection. These selections are tested extensively with the goal of releasing them for cultivation.

Inheritance of some economic cotton characters was studied on the selected plants from the F_2, F_3 and F_4 generations of the two extra long cotton crosses Suvin x Giza 45 (Population I) and [(Giza 67 x Pima S_6) x (Giza 84 x(Giza 74 x Giza 68))] (population II).

The results showed that the means of F_2 were lower than F_3 and F_4, generations for all studied traits except fiber fineness trait .The phenotypic and genotypic coefficients of variability were larger in F_2 generation than those of succeeding generations for all the studied traits in the two populations. However, high estimates of heritability in broad sense were observed for all studied trait. It's usually traits with high heritability are quick and easy to concentrated when using pedigree selection method.

The estimates of predicted genetic advance of generation mean were obviously higher in F_4 than those in F_3 generation for most studied traits except for fiber fineness and boll weight in population I as well as fiber strength and boll weight in population II. The same trend was observed for actual gains and also, the selection advance (S.A. %) in population I was high compared with population II.

These results led to the conclusion that, the effective breeding method for improving those economic cotton characters and obtained super four families in the two populations could be through applied another cycle of selection in later generation through breeding the continuous breeding programme after induced these super four in another cycle of selection

INTRODUCTION

The Egyptian cotton is a peculiar type of cotton that is characterized by high quality and gained a world-wide reputation for more than a century and half, as being of the highest lint quality among world cotton. However, it still needs effective efforts to increase its yielding capacity and through fiber quality successful breeding programme as follow in cotton institute the number of generation of single plants and line selection as well as selection intensities can be varied in practice according to crop and variability existence all recent Egyptian commercial cultivars are resulted by inter-varietals crossing using pure line methods which may be defined as selection with maximum inbreeding, which must be enforced in cotton by artificial self pollination. Thus hybridization followed by pedigree selection was and still the breeding procedure that yielded all Egyptian cotton varieties grown commercially (Salama et al., 1992). Fahmy *et al.* (1994) on genetic studies for the cross (Giza 77 x Pima S6) showed reliable moderate heritability estimates for fiber fineness, boll weight and lint percent and low heritability estimate for fiber strength. The expected, genetic advance from selection ranged from 1.84% for fiber strength to 13.03% for fiber fineness.

El-Lawendey (2003) indicated that the direct phenotypic selection procedure for lint yield only (lxw) was superior to the other selection procedures in F_4 generation. The highest predicted responses to selection for lint percentage in F_4 generation in the other study, Abd El-Salam (2005) used pedigree selection in three populations and he found that the means of F_2 were lower than F_4 for lint percentage and halo length. The phenotypic and genotypic coefficients of variation in F_2 were higher than those of F_3 and F_4, except for halo length and lint percentage in population II, while the coefficient of variations in F_4 were higher than F_3 generation. Heritability ratios were high for lint percentage and halo length for the three populations in different generations. Also, Gooda (2006) studied improvement in two populations, found that, P.C.V. and G.C.V. were decreased from F_2 to F_3 generations for all studied traits and heritability estimates in broad sense increased from F_2 to F_3 generation for the same studies traits. Improvement of halo length, fiber length at 2.5%, Pressley index and Micronaire value were achieved by using direct phenotypic selection for seed cotton yield, lint yield, boll weight, seed index and lint index.

The present investigation was directed to study the possibility of selection with early generations. This is done by early identification of superior populations which have desirable high quality and yielding traits compared to check cultivar

MATERIALS AND METHODS

The materials of this investigation contain two populations belonging to *Gossypium barbadense* L. taken from extra long breeding programme. The first population I was derived from the cross between Suvin and Giza 45. The Suvin is a variety of Indian cotton. It's a long staple variety and characterized by earliness, high yield, high boll weight and low of leaf area and plant height compared with second variety Giza 45, the Egyptian extra long staple which characterized by high fiber quality and late maturity. The second population II was derived from the cross between (Giza 67 x Pima S6) and the promising hybrid (Giza 84 x (Giza 74 x Giza 68)) which characterized by earliness, high yield, high fiber strength and low plant height. The parental lines were crossed in

In 2004 F_2 plants of both populations were sown as well as original parents in wide spaced rows 7.0 m., 0.65 m. wide and selection of plants with new of gene combination and pedigree selection or follow 0.70 m. between hills with one plant/hill to facilitate self pollinated. Recommended cultural practices for cotton were followed. Selection was carried out on F_2 plants to obtain the desirable individual plants in the field for plant type, fruiting forms maturity earliness, boll opening and productivity which were 360 and 365 in the two populations, respectively. Where segregation is at maximum (discardation).

In laboratory testing for fiber quality; fiber length in mm, fiber fineness in Micronaire reading and fiber strength in Pressley index as well as, yield components; lint percentage and boll weight in grams to select finally 40 and 36 single plants from the two populations, respectively.

In 2005 season 40 and 36 selfed seeds of each F_3 single plant are planted wide spaced in four rows every two rows as one replicate (two replicates), all single plants were selfed. Natural seeds of F_3 are planted narrow spaced in three rows, 4.0 m. in length and 0.65 m. width and contain 20 hills with two plants were left per hill at thinning time, each is regarded as a family, Selection was be done between families (natural) and within families (single plants) to select best plants inter best families according to later traits. In 2006 season the parental line and selected plants were evaluated in F_4 generation for the five later traits.

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

Phenotypic coefficient of variance (PCV) = $\frac{\sigma p}{\overline{X}} \times 100$

Genotypic coefficient of variance (GCV) = $\frac{\sigma g}{\overline{X}} \times 100$

Where: σ p and σ g are the standard deviation of phenotypic and genotypic families.

$\overline{X}$ is families mean of a character.

The estimates of broad sense heritability (h^2b %) were estimated according to the following equation:

$\sigma^2 g = \sigma^2 P - \sigma^2 E$

$\sigma^2 E = (V P_1 + V P_2)/2$

$h^2 b \% = \sigma^2 g / \sigma^2 p \times 100$

Where:, V P_1 and V P_2 the phenotypic variance of, first and second parent variance . $\sigma^2 P$ and $\sigma^2 g$ the phenotypic and genotypic, environment variance.

The predicted genetic advance in any traits based on one variable alone was estimated from the following expressions as suggested by Walker (1960) and Miller and Rawlings (1967).

Δg in fiber length (Δg_w) due to selection for fiber length itself (x_w) = $K. \sigma^2 g_w / \sigma p_w$.

The analyses were made according to Cockerham (1963). The significance between any two different means were tested using the least significant differences values in F_4 (L.S.D.) at both 5% and 1% levels which can be obtained as follows:

L.S.D. = $t_{0.05}\ E_{df} \times S^{-}_{d}$. L.S.D. = $t_{0.01}\ E_{df} \times S^{-}_{d}$. $S^{-}_{d} = \sqrt{\frac{S_1^2}{n1} + \frac{S_2^2}{n2}}$

Where: n_1 ands n_2 were number of single plant.

RESULTS AND DISCUSSION

The choice of selection and breeding procedures for the genetic improvement of cotton is largely conditioned by the type and relative amounts of genetic variance components in the population. The selection response is determined by the genetic and non genetic variance hence, coefficient of variation is very useful for the study of variation and heritability is the heritable portion of phenotypic variance. It is a good index of the transmission of characters from parents to their offspring (Falconer, 1981), the estimates of heritability help breeder in selection of superior genotypes from diverse genetic population.

Means, ranges, phenotypic and genotypic coefficients of variation, heritability, genetic advances and selection advances estimates in Tables (1 and 2) showed that the means of F_2 were undesirable higher than means of F_3 and F_4 generation for Micronaire reading of the two populations. While the means of fiber length, fiber strength, lint percentage and boll weight for F_2 were lower than F_3 and F_4 generations of the two population. Similarly wide ranges of fiber length and lint percentage while narrow ranges in the remain studied traits in the two populations. Similar results were obtained by El-Lawendy (2003) and Gooda (2006).

Table 1: Means, range, phenotypic (PCV) and genotypic (GCV) coefficients of variation and broad sense heritability (h^2b), genetic advances (Δg) and selection advances (SA %) in F_2, F_3 and F_4 generations of population I

Traits	Gene.	Mean	Range	PCV%	GCV%	h^2_b %	Δg		SA%	Check
							Pre	Act		
Fiber length	F_2	35.1	30.0-39.5	5.1	4.4	98.8	1.5	0.5	1.4	34.1
	F_3	35.1	33.4-37.6	4.3	3.4	82.8	1.5	1.5	4.4	33.8
	F_4	35.2	33.5-38.2	3.9	3.7	85.8	2.4	1.1	3.2	34.0
Fiber strength	F_2	11.0	9.5-12.8	8.5	8.0	86.7	1.7	0.8	7.9	10.2
	F_3	11.1	10.5-11.7	6.3	5.8	85.2	1.2	0.8	7.6	10.5
	F_4	11.2	10.6-12.5	6.4	5.9	84.9	1.3	1.3	12.1	10.7
Mic. reading	F_2	3.6	3.0-4.3	7.3	6.7	85.3	1.7	-0.2	5.3	3.8
	F_3	3.6	3.0-3.7	6.5	5.6	73.4	0.4	-0.3	7.7	3.9
	F_4	3.5	3.4-3.7	6.7	5.6	70.1	0.3	-0.1	2.8	3.6
Lint %	F_2	34.5	23.6-40.1	6.6	6.2	88.9	2.0	0.6	1.8	33.9
	F_3	34.7	31.6-36.2	5.4	4.3	64.6	2.4	0.3	0.8	34.4
	F_4	35.8	34.0-38.4	6.1	5.2	74.2	3.2	2.1	6.2	33.7
Boll weight	F_2	3.1	2.3-4.1	10.6	8.8	68.9	1.4	0.1	3.3	3.0
	F_3	3.2	2.9-3.6	9.7	8.2	82.1	0.5	0.3	10.3	2.9
	F_4	3.1	3.0-3.2	6.5	5.7	77.2	0.3	0.1	3.3	3.0

Check = unselection generation mean

The results showed phenotypic and genotypic coefficients of variability that was larger in F_2 generation than those of succeeding generations for all the studied traits in the two populations. However, high estimates of heritability in broad sense were observed for all studied traits in the two populations. These results revealing that the magnitude of the genetic variability persisted in this material was sufficient for providing substantial amount of improvement through the selection of superior progenies. Burton (1952) further suggested that a genetic coefficient of variation together with heritability could give the best indication of the amount of genetic variance to be expected from selection. Similar results were obtained by El-Lawendy (2003), Abd El-Salam (2005) and Gooda (2006).

The data in Tables (1 and 2) showed the heritabilities values were high for all studied traits. These results suggested that traits with high heritability values are quick and easy to concentrate when using this method of selection.

Table 2: Means, range, phenotypic (PCV) and genotypic (GCV) coefficients of variation and broad sense heritability (h^2b), genetic advances (Δg) and selection advances (SA %) in F_2, F_3 and F_4 generations of population II

Traits	Gene	Mean	Range	PCV%	GCV%	h2b %	Δg		SA%	Check
							Pre	Act		
Fiber length	F_2	35.1	30.6-40.4	4.5	4.0	98.7	1.4	0.4	1.2	34.5
	F_3	35.2	34.2-37.1	2.3	2.0	83.9	1.3	0.9	2.6	34.3
	F_4	35.4	34.8-37.8	2.5	2.4	93.0	1.7	1.2	3.5	34.2
Fiber strength	F_2	10.9	9.6-12.5	8.6	8.0	86.6	1.8	0.2	1.9	10.7
	F_3	11.1	10.3-11.9	5.8	5.2	80.1	1.1	0.3	2.8	10.8
	F_4	11.4	10.7-12.4	5.3	4.2	64.4	0.8	0.7	6.5	10.7
Mic. reading	F_2	3.6	2.9-4.3	10.1	8.5	70.6	1.5	0.0	0.0	3.6
	F_3	3.5	3.4-3.6	5.0	4.4	74.5	0.3	-0.1	2.8	3.6
	F_4	3.4	3.2-3.5	7.1	6.2	75.1	0.4	-0.1	2.9	3.5
Lint %	F_2	34.7	22.7-39.7	6.9	5.9	62.2	1.3	0.4	1.2	34.3
	F_3	35.4	34.4-36.2	4.5	4.0	81.0	2.6	1.4	4.1	34.0
	F_4	36.8	35.2-38.4	6.3	5.7	82.6	3.9	1.4	4.0	35.4
Boll weight	F_2	2.9	2.4-4.0	8.1	5.8	51.2	1.3	0.1	3.3	3.0
	F_3	3.1	3.0-3.3	7.5	6.8	82.4	0.4	0.1	3.3	3.0
	F_4	3.1	3.0-3.3	6.3	5.5	76.7	0.3	0.1	3.3	3.0

Check = unselection generation mean

The results showed that estimates of predicted genetic advance of generation mean were obviously higher in F_4 than those in F_3 generation for most studied traits in the two populations except for Micronaire reading and boll weight in population I as well as fiber strength and boll weigh in population II.

The high proportion of the predicted genetic advance may be due to the high heritability value for these traits. While, the actual genetic advances for all selected traits were low than predicted advances for the same traits in the two population. This may be due to the unfavorable environmental conditions which inhibitor genes which controlled these quantitative traits. Similar results were obtained by Younis (1993) mentioned that large discrepancies were between predicted and realized gains because genotypic variances and covariance's used to calculate predicted gains were likely biased by certain genotypic x environment interaction and Singh *et al.* (1986) found that the realized genetic advance was negative for bolls/plant but for lint percentage a positive improvement occurred in cycle C_2 over cycle C_1 based on the mean performance.

The actual gains for most selected traits were higher in F_4 generation than F_3 and F_2 generations in the two population except for fiber length and boll weight in population I where the actual gains was high in the F_3 generation. Also, selection advance (SA %) in population I was high if compared with population II and this increasing may be due to wide differences between the two parents Suvin and Giza 45. In the same time, the selection advances in fiber strength and lint percentage in the two populations were higher than other traits. The highest values of selection advances compared with the mean of original parents and unselected families (the check) indicating that selection procedures applied were effective and successful for selecting the best families within the two populations and maintaining the traits on high standard levels as followed in breeding programme.

Generally, the predicted and actual gains obtained from phenotypic selection were nearly similar in both populations. Improvement in fiber quality and yield component could be due to high selection intensity, genotypic coefficient of variance and heritability. These three factors play a major role in genetic advances in the two populations. Similar results were obtained by Fahmy *et al.* (1994), Gooda (2001), El-Lawendy (2003), Abd El-Salama (2005) and Gooda (2006).

The results of mean performance of F_4 selected families for five selected traits using L.S.D. are presented in Table 3 and 4.

Table 3: Mean performance of F_4 selected families for five traits in population I comparative with mean of selected

F_4 selec. Families	Fiber length	Fiber strength	Micronaire reading	Lint percentage	Boll weight
1100	34.6	11.3**	3.4	34.5	3.3**
1104	34.7	11.4**	3.7	35.0	3.0
1116	35.6**	11.2**	3.6	36.6*	3.1
1133	35.8**	11.0**	3.7	34.4	3.0
Mean	35.2*	11.2*	3.6	35.1	3.1
Check	34.0	10.7	3.6	33.7	3.0
L.S.D $_{0.05}$	1.02	0.56	0.26	2.13	0.19
L.S.D $_{0.01}$	1.54	0.84	0.39	3.22	0.29

*,** **Significant and highly significant at 5% and 1% levels, respectively.**

Table 4: Mean performance of F_4 selected families for five traits in population II

F_4 selec. Families	Fiber length	Fiber strength	Fiber fineness	Lint percentage	Boll weight
1138	34.8	11.1	3.2	35.5	3.1
1144	35.3**	10.8	3.4	36.4	3.0
1149	36.2**	10.9	3.5	36.6	3.4**
1154	35.2**	11.4	3.5	38.4**	3.0
Mean	35.4**	11.4	3.4	36.7	3.1
Check	34.2	10.7	3.5	35.4	3.0
L.S.D $_{0.05}$	0.46	0.69	0.24	1.93	0.24
L.S.D $_{0.01}$	0.69	1.04	0.36	2.91	0.37

*,** **Significant and highly significant at 5% and 1% levels, respectively.**

The best four families in each population were chosen of F_4 generation from five phenotypic selection traits compared with F_4 generation mean for selected traits by using L.S.D., the most super families were showed significant differences for most studied traits, special families numbers 1100 gives highly significant values for fiber strength and boll weight, 1104 showed best fiber strength, 1116 was higher in fiber length, fiber strength and lint percentage and 1133 was highly significant values for fiber length and fiber strength in population I.

The data of mean of best families were achieved as fast response to applied phenotypic selection for fiber length and fiber strength comparing with unselection. The two families of 1116 and 1133 in these four families in population I could constructed promising cross characterize by high quality and yield components.

The family number 1154 from four super families in population II appeared significant difference about generation mean for fiber length fiber strength and lint percentage, while, the family number 1149 as the best family where showed highly significant difference for fiber length and boll weight, the same trend, appeared in family number 1154 was the best lint percentage and fiber strength as well as fiber length.

Finally, the F_4 generation in the two populations contains amounts of genetic variation to get up best results of gains from using phenotypic selection and response of genetic advance in fiber quality and yield components through another cycle of selection in later generation through breeding programme.

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التحسين الوراثي لبعض صفات جودة التيلة ومكونات المحصول في هجينين من القطن الطويل الممتاز

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يجرى التهجين بين الأصناف والمواد الوراثية لإنتاج تراكيب وراثية جديدة. ثم الانتخاب في الأجيال المتعاقبة لانتخاب المتفوق منها وإجراء عملية الإخصاب الذاتي لها لتثبيت العوامل الوراثية في الحالة الأصيلة وراثيا وذلك بهدف استخدامها كأصناف في الزراعة.

ومن خلال الانتخاب في الأجيال الثاني والثالث والرابع بطريقة سجلات النسب لدراسة توارث بعض الصفات الاقتصادية في هجينين من برنامج تربية الأقطان الطويلة الممتازة وهما (سيوفين × جيزة٤٥) (العشيرة الأولى) و (جيزة ٦٧ × بيماس٦) × (جيزة ٨٤ ×(جيزة ٧٤ × جيزة ٦٨)) (العشيرة الثانية) وكانت النتائج كالأتي:

- كان متوسط الجيل الثانى أقل من متوسط كلا من الجيل الثالث والرابع لكل الصفات المدروسة ماعدا صفة نعومة التيلة.
- كان معامل الاختلاف المظهري (PCV)والوراثي (GCV)في الجيل الثاني أكبر من الأجيال المتعاقبة لكل الصفات المدروسة في العشيرتين محل الدراسة. وقد لوحظ ارتفاع قيم درجة التوريث في المدى الواسع لكل الصفات وارتفاع قيم التوريث لهذه الصفات يجعل من السهل انتقالها والتركيز عليها من خلال طريقة سجلات النسب.
- لوحظ ارتفاع قيم التحسين الوراثي المتوقع في الجيل الرابع بالمقارنة بالجيل الثالث لمعظم الصفات ماعدا صفة نعومة التيلة ومتوسط وزن اللوزة في العشيرة الأولى بالإضافة إلى متانة التيلة ومتوسط وزن اللوزة في العشيرة الثانية. وقد لوحظ نفس الشيء بالنسبة للتحسين الوراثي الحقيقي والمكسب الانتخابي (SA%)حيث كان أعلى في العشيرة الأولى بالمقارنة بالعشيرة الثانية.

نستخلص من هذه النتائج فاعلية طريقة التربية هذه بالنسبة لهذه المواد الوراثية لتحسين الصفات الاقتصادية بها وتحقيق استجابة سريعة من تطبيق الانتخاب المظهري والحصول على أربع عائلات متفوقة من كلا العشيرتين يمكن تطبيق دورات انتخاب عليها في الأجيال المتعاقبة من خلال برامج التربية المستمرة.