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# ESTIMATE OF SOME GENETIC PARAMETERS IN A COTTON CROSS THROUGH NORTH CAROLINA DESIGN III

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## ABSTRACT

North Carolina designs are very effective in breaking undesirable linkage and lead to creating genetic variability in a population. $F_1$ population was obtained by crossing the two cultivars Giza 88 $P_1$ and Australian $P_2$. Followed crossing between $F_2$ with the original parents, $P_1$ and $P_2$. The analysis of variance was highly significant for all studied traits. While, females sets were highly significant for all studied traits, which exhibit difference between them. Also, the males were significant for boll weight (BW) g /plant, seed cotton yield (SCY) and lint yield g/plant(LY) g/plant, which showed difference between them. The interactions between them were highly significant for boll weight (BW) and seed cotton yield (SCY). That showed variation background. The additive variance was higher than dominance for most studied traits. The contribution of male or female parents was more pronounced in the genetic variation. Additive components of variation were higher than dominance ones for most studied traits reflecting decreased (√D/A) values (less than unity). While the dominance portion of the genetic variation played a role for some traits reflecting higher (√D/A) values than unity for boll weight (BW) and fiber length (FL.2.5%).

**Keywords**: Cotton, North Carolina design III.epistasis.

## INTRODUCTION

The concept of biparental cross or biparental mating was originally developed by Comostock and Robinson, (1948, 1952). This technique provides information about additive and dominance components of genetic variance, which helps breeders in the choice of breeding procedure for genetic improvement of polygenic characters. Also, this technique based on the second order statistics (Singh and Narayanan, 2000). Also, it is very effective in breaking undesirable linkages as well as leading to certain genetic variability in a population by creating heterozygosity. Assessment of the components of genetic variance controlling yield and its components have been studied by several research workers ( Soliman, 2003 and Abd El-Salam, 2005). El-Mansy *et al.*, (2008) indicated that biparental mating was more effective in breaking undesirable linkage.

The objectives of the present study were 1. to evaluate seed cotton yield and its components and fiber properties of F2 hybrids, 2. to obtain genetic information about the additive and dominance genetic variance, heritability in both broad and narrow sences and degree of dominance.

## MATERIALS AND METHODS

The materials used in this study were the selfed seeds of the Egyptian cotton variety Giza 88 and Austurallian one (Australy), which belonging to *G.barbadense, L.* ,to produce F1 and F2 seeds and crossing 16 F2 plants of the cross (Giza 88x Aust.) as males with both original parents P1 and P2 as females. Thus hybrids were developed and sown, using single plant randomization in two separate blocks in the four sets, at Sakha Agricultural Research Station in 2011 growing season. Normal cultural practices were applied as recommended for ordinary cotton growing. Data were recorded on ten random plants for each replicate for boll weight (B.W) g / plant, seed cotton yield (S.C.Y) g / plant lint yield (L.Y) g / plant, lint percent (L%), seed index (S.I), fiber fineness (F.F) , fiber strength (F.S) and fiber length (F.L2.5%).

North Carolina design III, (N.C.DIII), as outlined by (Comostock and Robinson, 1952) was performed to estimate different genetic components. Analysis of variance is presented in Table1.

**Table 1. Analysis of variance and expected mean squares in N.C.D.III.**

| S.O.V. | df | MS | E.M.S |
|---|---|---|---|
| Sets | S-1 | | |
| Reps./ sets | S (r-1) | | |
| Fem./sets | S | | |
| Mal./sets | S(n-1) | M1 | $\sigma^2e+2r\sigma^2m$ |
| Fem x Mal./sets | S(n-1) | M2 | $\sigma^2e+r\sigma^2m.L$ |
| Error | S(2n-1)(r-1) | M3 | $\sigma^2e$ |

**Where: s = sets r = replication m = male in sets**
**$\sigma^2e$ = M3 due to error/r and refer to environmental variance**
**$\sigma^2m.L$ = [MS due to interaction-MS due to error]/r $\sigma^2m.I = 1/2\ \sigma^2D$**
**$\sigma^2D = 2\ \sigma^2m.L$ , Dominance variance, $\sigma^2m$ [MS due to males – MS due to error]/2r**
**$\sigma^2m = 1/4\ \sigma^2D$ $\sigma^2D = 4\ \sigma^2m$ , additive variance.**

Proportional contribution of males, females and their interaction are presented by the magnitude of sum squares of these genotypes relative to sum squares of cross.

## RESULTS AND DISCUSSION

Analyses of variance of biparental mating for the studied traits are shown in Table 2. Partitioning the hybrid mean squares into variation due to male, Female and their interaction (F x M) revealed that highly significant mean squares for ball weight (BW) g /plant, seed cotton yield (S.C.Y) g/ plant, lint yield (L.Y) g/plant and seed index (S.I). Highly significant female in sets mean squares for all the studied traits except, for fiber strength, these results showed that this female parent differed in their performance. On the other hand, mean squares due to males in sets were highly significant for seed cotton yield (S.C.Y) and lint yield (L.Y) and significant for ball weight (BW). These findings showed the variation between F2 male plants. While, the variance due to females was larger than variance due to males for all the studied traits, indicating that the maternal effect play an important role in the inheritance for these traits. These findings were in agreement with Soliman *et al.* (2007) and El-Mansy *et al.* (2008)

**Table 2. Analysis of variance for yield, its components and fiber properties in the biparental cross.**

| S.O.V | Mean Squares | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | d.f | B.W | S .C. Y | L. Y | L% | S. I | Mic | F.S | F.L2.5% |
| sets | 3 | 0.119** | 39407.47** | 5763.60** | 0.371 | 0.277** | 0.022 | 72.071 | 0.106 |
| R .sets | 4 | 0.029 | 2064.23 | 691.47 | 0.195 | 0.064 | 0.032 | 62.180 | 0.358 |
| F.sets | 4 | 0.240** | 684512.11** | 146875.16** | 13.450** | 0.765** | 2.315** | 72.817 | 19.751** |
| M.sets | 12 | 0.042* | 6274.34** | 1811.64** | 0.800 | 0.058 | 0.051 | 57.246 | 0.423 |
| F M .sets | 12 | 0.051** | 1978.48** | 495.66 | 0.184 | 0.021 | 0.031 | 54.084 | 0.466 |
| error | 28 | 0.016 | 828.34 | 330.540 | 0.455 | 0.033 | 0.032 | 56.725 | 0.330 |

The interaction between females x males mean squares were highly significant for boll weight (B.W) and (S.C.Y) ,exhibit the difference between females and males , also the variation between males in their genetic background. On the other hand, insignificant mean squares due to this interaction revealed that the male or female had a degree of similarity for these traits.

**Table 3. Proportional contribution as percentage of males, females and their interactions for all studied traits.**

| traits | Sources | | |
|---|---|---|---|
| | Females% | Males% | Males x females interaction % |
| B.W | 46.36 | 24.42 | 29.22 |
| S. C. Y | 96.51 | 2.65 | 0.84 |
| L.Y | 95.50 | 3.53 | 0.97 |
| L% | 82.00 | 14.64 | 3.36 |
| S. I | 76.27 | 17.38 | 6.34 |
| Mic | 90.46 | 5.95 | 3.58 |
| F.S | 17.90 | 42.22 | 39.88 |
| F.L2.5% | 88.10 | 5.67 | 6.23 |

Data in Table 3 showed that the male or female parents appeared to contribute the maximum portion in the genetic variation for most traits . The contribution of female parent was more pronounced in all traits except fiber strength. These results confirm the role of additive genetic effects in controlling these traits. Information about additive and dominance components of genetic variance, heritability and degree of dominance are showed in Table 4.Regarding the relative magnitude of additive (A) and dominance (D) components estimates of additive variance were higher than those of dominance variance for most traits resulting in (√D/A) values less than unity and explaining that, the additive component was the predominant type in the inheritance of such traits. This was confirmed by high narrow sense heritability estimates. This agrees with Abd El Bary (2003) , El-Mansy (2005) and El-Mansy *et al.* (2008) .While, the magnitude of dominance component was larger than corresponding additive ones for B.W and F.L.2.5% reflecting higher (√D/A) values than unity. These findings showed the importance of over dominance gene effects in the control of these traits and indicated that non-fixable genes could be exploited efficiently through hybrid breeding method for improving these traits .This agrees with Soliman

(2003) and El-Mansy *et al.* (2008),which was confirmed by low estimates of narrow sense heritability.

**Table 4. Component of genetic variance**

| Genetic components | Traits | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | B.W | S.C.Y | L.Y | L% | S.I | Mic | F.S | F.L2.5% |
| A | 0.026 | 1150.14 | 1481.095 | 0.345 | 0.025 | 0.019 | 0.521 | 0.093 |
| D | 0.034 | 828.3415 | 165.116 | 0.000 | 0.000 | 0.000 | 0.000 | 0.135 |
| E | 0.0163 | 828.3415 | 330.5402 | 0.455 | 0.0332 | 0.032 | 56.725 | 0.330 |
| broad sense | 78.75 | 70.49 | 83.28 | 43.17 | 42.84 | 36.92 | 0.91 | 40.87 |
| narrow sense | 33.96 | 40.98 | 74.93 | 43.17 | 42.84 | 36.92 | 0.91 | 16.67 |
| √D/A | 1.149 | 0.849 | 0.334 | 0.000 | 0.000 | 0.000 | 0.000 | 1.205 |

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# تقدير بعض المكونات الوراثية فى القطن من خلال النموزج الثالث

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أجرى هذا البحث بغرض تقدير مكونات التباين الوراثى و حساب الارتباط للوراثى المضيف و السيادى باستخدام طريقة التهجين الرجعي لعدد ١٦ من نباتات الجيل الثانى مع الابوين حيث تم الحصول على ٣٢ هجين بالتهجين الرجعى للجيل الثانى مع الابوين للهجين(جيزة ٨٨ × استرالى).

اظهر تحليل التباين لمعظم الصفات وجود قدر كبير من الاختلافات يسمح باجراءالانتخاب كما اظهرت أن المساهمة النسبية لكل من الأباء و الأمهات أكبر من المساهمة النسبية للتفاعل.

كانت مساهمة الفعل الجينى المضيف أكبر من مساهمة الفعل الجينى السيادى لمعظم الصفاتالمدروسة مما انعكس على انخفاض قيم درجة السيادة عن الواحد الصحيح لمعظم الصفات.بينما لعب الفعل الجينى السيادى دور اكبر فى دراسة بعض الصفات مثل وزن اللوزة و طول التيلة مما ادى الى زيادة متوسط درجة السيادة عن الواحد الصحيح.

كان اتجاة السيادة غير معنوى لكل الصفات المدروسة مما يدل على أن السيادة غير موجة أى فى اتجاهين مؤكدا التوزيع غير المتماثل لجينات السيادة للأباء.

قام بتحكيم البحث

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