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GENETIC STUDIES OF SOME ECONOMIC CHARACTERS IN THE *GOSSYPIUM BARBADENSE* L. CROSS GIZA 77 x PIMA S_6

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Abstract

The inheritance of some economic cotton characters of the parents, F_1 and F_2 for the cross (Giza 77 x Pima S_6) showed that the potence ratio estimates were in the range of partial dominance for lint percent and fiber strength. Whereas, over dominance was reported for boll weight and fiber fineness. Highly significant positive M.P. heterosis for boll weight and significant for fiber fineness were found. Moreover, highly significant positive B.P. heterosis was reported for boll weight and fiber fineness also, while lint percent showed highly significant negative heterosis for "B.P." and insignificant for "M.P".

Highly significant inbreeding depression was found for boll weight, fiber fineness and fiber strength only, while lint percent showed only significant value for inbreeding depression.

Reliable moderate heritability estimates were found for fiber fineness, boll weight and lint percent and low heritability estimate for boll weight.

The expected genetic advance upon selection ranged from 1.84% for fiber strength to 13.03% for fiber fineness.

These results led to the conclusion that, an effective breeding method wihtin this material for improving those economic cotton characters would lead towards the production of varieties rather than hybrids. Moreover, the heritability estimates indicated that, such hybrid should be evaluated in several environments before any clear breeding decisions could be made.

INTRODUCTION

Estimating the amount of heterosis, inbreeding depression, potence ratio and partitioning the genotypic variation into its main components in cotton has been studied by many workers, but their results have not been entirely consistent. Heterosis effects, inbreeding depression, potence ratio, genetic advance and heretability in cotton crosses were studied by Miller *et.al.* (1958), Al-Rawi and Kohel (1969), Abo El-Zahab *et al.* (1972), Abou-Alam (1975), Sallam *et al.* (1981), Khattab *et al.* (1984), Sallam *et al.* (1985), Al-Enani *et al.* (1986) and Al-Hashash (1987).

The present investigation was carried out to study the effect of heterosis, inbreeding depression, potence ratio, heritability and genetic advance governing some economic characters in cotton cross of (*G. barbadense* L.) to help the cotton breeder in planning the suitable breeding program for this cross.

MATERIALS AND METHODS

A cross between the two cultivars Giza 77 (P_1) and Pima S_6 (P_2) was carried out in 1990 season. The first parent, Giza 77 was relatively long and carrying a high number of big bolls. The second parent Pima S6 had the highest lint percent, earlier and high yield.

In 1991 season, the hybrid seeds were grown and the F_1 plants were self fertilized to obtain F_2 seeds. In 1992 season, four populations, i.e., the two parents (P_1 & P_2), F_1 and F_2 were planted in a complete randomized blocks design with four replications at Sakha Experimental Station, Agricultural Research Center. Each replicate included two rows for each of the parents and F_1 and ten rows for the F_2 Plants were grown in rows 7.0 meter long and 60 cm wide. Each row had ten hills 75 cm apart. After 40 days all hills were thinned to single plant per hill. All the conventional agricultural practices were carried out. A representative random sample of the F_2 and other populations, respectively, were screened for the following characters: boll weight as the average weight in grams of five sound opened bolls picked

at random from each plant lint percentage as the amount of lint in seed cotton (expressed in percentage), fiber fineness and maturity as measured by the micronaire apparatus in micronaire units and fiber strength in pressley units at zero gauge.

Statistical procedures:

1. Potence ratio:

Potence ratio (P) was calculated from the formula given by Smith (1953):

$$P = \frac{F_1\text{-}MP}{1/2\ (P_2\text{-}P_1)}$$

where,

F_1 = first generation mean.

P_1 = the mean of Giza 77 parent.

P_2 = the mean of Pima S6 parent.

MP = mid parent value = $1/2\ (P_1+P_2)$.

$P = \pm 1.0$ indicates complete dominance.

$P < \pm 1.0$ indicates partial dominance.

$P = 0.0$ indicates absence of dominance.

2. Heterosis:

Heterosis was expressed as percentage increase of F_1 above the mean of the better parent (BP) or the mean of the two parents (MP). To test the significance of heterosis, the variance of heterosis deviation was calculated as follows:

Heterosis deviation = $F_1 - 1/2\ (P_1+P_2)$

$$\text{Percent of heterosis} = \frac{F_1\text{-}1/2\ (P_1+P_2)}{1/2\ (P_2+P_1)} \times 100$$

Variance of heterosis deviation = $VF1 + 1/4\ VP_1 + 1/4\ VP_2$

$VF_1 = VF_1/^n(F_1)$ $VP_1 = VP_1/^n(P_1)$ $VP_2 = VP_2/^n(P_2)$

$$t = \frac{\text{heterosis deviation} - 0}{\sqrt{\text{variance of heterosis}}}$$

The calculated t was compared with tabulated t at degrees of freedom of infinity.

3. Inbreeding depression:

Inbreeding depression was measured as the percentage decrease of F_2 performance from F_1 mean. Mean plant performance in each plot for each trait was used as the basis for statistical analysis for the parents, F_1 and F_2. Standard errors of differences for heterosis and inbreeding depression were calculated and t test were then used to determine significant differences from zero, Mather (1949).

$$\text{Calculated } t = \frac{F_2 - F_1}{\sqrt{(VF_1/n) + (FV_2/n)}}$$

4. Heritability:

Heritability in broad sense was calculated according to Mather (1949) as follows:

$$h_2\ (B.S.) = \frac{(VF_2 - VE)}{VF_2}$$

5. Expected advance upon selection:

Response = Selection differential x heritability (h^2).

where: Selection differential = the difference between the average of selected individuals and the original population mean (K x OP).

RESULTS AND DISCUSSION

The t-test for the differences between the parents showed significant difference for all the characters studied, i.e. boll weight, lint percentage, fiber fineness and fiber strength, (Table 1).

Potence ratio estimates were in the range of partial dominance for the characters lint percentage and fiber strength, whereas the traits, boll weight and fiber fineness showed over dominance, (Table1). Partial dominance for these traits were found by Al-Rawi and Kohel (1969) and Sallam *et al.* (1985), whereas, Khattab *et al.* (1984), reported overdominance for boll weight and fiber fineness.

With regard to heterotic effects, boll weight and fiber fineness showed highly significant positive MP and BP heterosis, while the lint percentage showed only insignificant negative MP heterosis and highly significant negative BP heterosis in this work. Similar results were obtained by Khattab *et al.* (1984).

On the other hand, the F_1 mean for fiber strength gave insignificant MP and BP heterosis.

The inbreeding depression estimates wre positive and highly significant for boll weight, fiber fineness and fiber strength, whereas, th lint percentage character showed only significant value. (Table 3). Positive and signficant inbreeding depression value were reported by Al-Enani and Ismail (1986) for boll weight, lint percentage. Insignificant inbreeding depression values for boll weight and fiber fineness were found by Khattab *et al.* (1984)

The genetic components were obtained from the calculated variance of the populations.

The broad sense, heritability estimates, is tabulated in (Table 2). Moderate heritability values were found for fiber fineness, boll weight and lint percentage which were less than 50%.

The lowest heritability value was for fiber strength. These results were

Table 1. Means of P1, P2 (P1-P2), F1 and F2 of some economic characters in the cross (Giza 77 x Pima S 6).

	Boll weight	Lint percentage	Fiber fineness	Fiber strength
P1	2.30	33.90	3.59	10.73
P2	2.09	36.75	3.22	10.33
P1-P2	0.21**	2.85**	0.37**	0.40**
M.P.	2.20	35.33	3.41	10.53
F1	2.66	35.20	3.72	10.67
F2	2.35	34.85	3.30	10.33
Potence ratio	4.18	-0.09	1.63	0.70
Heterosis%				
Mp	20.91**	-0.37	9.09*	1.33
BP	15.65**	-4.22**	15.53**	-0.56
Calculated t				
MP	9.20	0.72	2.21	1.57
BP	7.20	7.89	3.57	0.67
Tabulated t				
0.05	1.97	1.97	1.97	1.97
0.01	2.59	2.59	2.59	2.59

Table 2. Estimate of inbreeding depression, heritability and genetic advance upon selection for some economic characters in the cross (Giza 77 x Pima S 6).

	Boll weight	Lint percentage	Fiber fineness	Fiber strength
Inbreeding depression%	11.65**	0.99*	11.29**	3.19**
Heritablity%	36.36	34.33	47.37	16.67
Genetic advance				
Value	0.24	0.91	0.43	0.19
Percentage	10.41	2.62	13.03	1.84
Calculated t	6.47	2.50	8.40	4.53
Tabulated t				
0.05	1.97	1.97	1.97	1.97
0.01	2.59	2.59	2.59	2.59

agreed with those found by Abo El-Zahab *et al.* (1972), Sallam *et al.* (1985), Al-Enani and Ismail (1986) and (1987)Al-Hasbash.

The expected genetic advance after selecting five percent of the better performance individual plants of the F_2 ranged from 1.84% for fiber strength to 13.03% for fiber fineness. Miller *et al.* (1958) and Abo-Alam (1975), studied the expected genetic advance under selection and they reported similar results for the character studied.

It could be concluded from the previous results that such hybrid should be evaluated in several environments before any clear breeding decisions to continue or discard this cross could be made.

REFERENCES

1. Abo El-Zahab, A.A. and S.A. Abd-Alla. 1972. Genetic variation and heritability of some agronomic characters in Egyptian cotton *G. barbadense.* Alexandria Journal of Agricultural Research, 20(2): 275-282.
2. Abo-Alam, A.M. 1975. Inheritanceof yield components and other fiber properties in cotton crosses. Ph.D. Thesis, Ein Shams Univ.
3. Al-Enani, Foraisa and F.M. Ismail. 1986. Estimates of gene effect, inbreeding depression and heritability in a cross of Egyptian cotton. Annals of Agric. Sci. Moshtohor, 24(2): 787-793.
4. Al-Hashash, K.A. 1987. Genetic evaluation of some Egyptian cotton varieties. Ph.D. Thesis. Zagazig Univ.
5. Al-Rawi, K.M. and R.L. Kohel. 1969. Diallel analysis of yield and other agronomic characters in *G. hirsutum* L. Crop Sci., 779-783.
6. Khattab, A.M., H.Y. Awad and Y.M. Atta. 1984. Estimation of heterosis, inbreeding depression, potence ratio and gene action in an Egyptian cotton cross. Annals of Agric. Sci., Moshtohor, 21: 93-100.
7. Mather, K. 1949. Biometrical Genetics, the Study of Continuous Variation. Dover Policatims, Inc. London, 158 p.
8. Miller, P.A., J.C. Williams, H.F. Robinson and R.E. Comstock. 1958. Estimates of genotypic and environmental variance and covariance in Upland cotton and their implications in selection. Agron. J. 50: 126-131.
9. Sallam, A.A., A.A. Al-Gohary and M. El-Moghazi. 1981. Breeding potential of some cultivated Egyptian varieties. II. Heterosis and combining ability of lint yield and fiber properties. Agric. Res. Rev., 59(9): 19-31.

10. Sallam, A.A., A.A. El-Gohary and M. El-Taweil. 1985. Gene action in the inheritance of some characters in Egyptian cotton *G. barbadense* L. I. seed cotton yield and some related characters. Assiut J. Agric. Sci., 16(2): 3-21.
11. Smith, H.H. 1953. Fixing transgressive vigour in *Nicotina rustrica.* Heterosis. Iowa State College Press, Ames, Iowa, USA.

دراسات وراثية على بعض الصفات الاقتصادية فى هجين القطن جيزة ٧٧ x بيما س ٦

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يهدف هذا البحث إلى دراسة قوة الهجين وأثر التربية الداخلية وكفاءة التوريث وطبيعة عمل الجينات التى تتحكم فى بعض الصفات الاقتصادية للهجين جيزة ٧٧ x بيما س٦ ، وقد أجريت الدراسة فى الأعوام ١٩٩٠ و ١٩٩١ و ١٩٩٢. تمت زراعة الآباء والجيل الاول والثانى فى تجربة ذات قطاعات كاملة العشوائية فى أربعة مكررات وذلك فى محطة البحوث الزراعية بسخا.

أظهرت النتائج سيادة جزئية لصفة تصافى الحليج ومتانة التيلة فى حين أظهرت صفة وزن اللوزة وصفة نعومة التيلة سيادة متفوقة. وجد أن تأثير قوة الهجين جوهريا وموجبا عن متوسط الأبوين M.P. لصفة وزن اللوزة وصفة نعومة التيلة ، كما وجد أيضا أن تأثير الهجين جوهريا وموجبا لصفة وزن اللوزة ، تصافى الحليج ونعومة التيلة عن الأب الأفضل B.P. بينما صفة تصافى الحليج تأثرت معنويا ولكن سالبا بالنسبة للأب الافضل. أما صفة متانة التيلة فقد كانت غير معنوية عن الأب الأفضل والمتوسط أى لم يظهر فيها قوة الهجين. أظهرت نتائج الانخفاض الراجعة إلى التربية الداخلية فروق جوهرية عالية لصفة وزن اللوزة ، نعومة التيلة ومتانة التيلة وجوهرية فقط لصفة تصافى الحليج. أظهرت كفاءة التوريث بالمعنى العام كفاءة متوسطة لصفات نعومة التيلة ، وزن اللوزة وتصافى الحليج وكانت كفائة التوريث منخفضة بالنسبة لصفة متانة التيلة فقط.

أوضحت هذه الدراسة ان التأثير الوراثى فى هذا الهجين يؤدى إلى احتمال تحسين هذه الصفات باستخدام إحدى طرق التربية التى تؤدى الى إنتاج اصناف وليس إنتاج القطن الهجين كما يجب أن يؤخذ فى الاعتبار إعادة تقييم هذا الهجين فى مناطق مختلفة قبل الحكم على طريقة التربية المناسبة له.