HETEROSIS AND INBREEDING DEPRESSION IN EGYPTIAN COTTON (G. barbadense, L.)

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ABSTRACT

Ten agronomic and fiber properties were studied for heterosis and inbreeding depression in six cotton parents and their hybrids. Two parents Giza 45 and Giza 70 belong to the extra-long group. The other four, viz, "Giza 66, Giza, 67, Giza 69 and Giza 75" are long-staple cultivars. In 1983 the six parents, their F_1's and F_2's were grown in a randomized complete block design with six replications at Sakha Experimental Station. Results showed significant MP heterosis for seedcotton yield, hair weight and mean length. However, useful heterosis was significant for seedcotton only. Positive but insignificant useful heterosis was detected for hair weight and mean length. Whilst, the remaining traits showed no useful heterotic effects. Although, most of the hybrids showed heterotic effects over their mid-parent (MP), few only exhibited useful heterosis. As for seedcotton yield hybrids reflecting useful heterosis were those having either Giza 67 or Giza 70 in their pedigrees. Inbreeding depression was trivial for most of the traits. Exception from that was the mean length character which showed highly significant inbreeding depression.

INTRODUCTION

Heterosis in intervarietal crosses of Egyptian cotton was reported by several investigators, (1, 2 and 3). Heterosis estimated as percent increase over mid-parent (MP) was detected for seedcotton yield and lint index and seed index (2, 5, 6 and 7). Boll weight and lint percent traits were reported to be variable either showing no heterosis, negative hetrosis or positive heterosis depending apparently upon the parental lines involved in the cross (2 and 5). Insignificant heterosis was reported for halo length, micronaire and fiber strength (8). Useful heterosis, or heterosis above the better parent (BP) was also detected for seedcotton yield (6, 7 and 9).

Inbreeding depression was also reported for seedcotton yield, and seed index (5, 8, 10, 13 and 14). Insignificant

inbreeding depression was reported for seedcotton yield per plant, and lint percent (5 and 11). Nonsignificnat inbreeding depression was reported for micronaire and pressley. Therefore, it was generally concluded that traits showing highest heterotic effects were those also associated with highest inbreeding depression (12 and 14). Here, our aim is to investigate the possibilty of retreiving some hybrids that combine the high yielding capacity of longstaple cultivars and good quality fibers of extra-long cultivars. In addition, to evaluate the amount of heterosis retreived from the economic point of view.

MATERIALS AND METHODS

Six parents and 15 F_1 and their receprocals. 15 F_2 hybrid combinations were planted on 21st of April (1983) at Sakha Experimetal Station. Parents included th two extra-long cultivars Giza 45 and Giza 70 and the four long-staple cultivars; Giza 66, Giza 67, Giza 69 and Giza 75. The whole set was grown in a randomized complete block design with six replications. Plots were two rows each and rows were 7.50 m long and 60 cm. wide. There were ten hills per row spaced 75 cm. apart. 40 days from planting, hills were thinned to a single plants. All experimental units received the same treatments throughout the experimental season. At harvest, a random sample of ten guarded plants from each plot were used to determine seedcotton yield/plant, boll weight (g.), lint per cent, seed index and lint index. Fiber properties taken, included; hair weight in millitex, half fall and mean length in 1/32" and yarn strength. The previous fiber properties were determined at the Agricultural Research Center Laboratory of Cotton Research Institute at Giza.

Heterosis and Inbreeding esimation:

The two parameters were estimated according to the formulas given below:

1- For heterosis:

$$\frac{F_1 - \text{Mid-parent}}{\text{Mid-parent}} \times 100$$

$$\frac{F_1 - \text{Better parent}}{\text{Better parent}} \times 100$$

2- **For inbreeding depression:**

$$\frac{F_1 - F_2}{F_1} \times 100$$

A test of singificant for the F_1 cross mean from the mid-parent value was conducted by the appropriate 't' value as suggested by Wynne et al. (1980).

Inbreeding depression estimates were tested for significance by using the formula mentioned by Al-Rawi and Kohel (1969).

RESULTS AND DISCUSSION

A summary of heterotic and inbreeding effects is shown in Table (1). It is apparent that variability exist among parents for various variables covered in this study. A high significant mean heterotic effect was obtained for seedcotton yield. Insignificant heterosis was detected for lint percent, lint index, boll weight and seed index. Briefly, none of the yield components included in this study showed heterosis. Intuitively, then, heterosis obtained for seedcotton yield is resultant from other variables that are left out.

Among the six parents, bone fide heterosis was detected in four hybrids and three reciprocals for seedcotton yield, Table (2).

Nonsignificant inbreeding estimates were obtained for seedcotton yield and its related variables. Because of the low level of heterosis manifested for all variables except seedcotton yield and because of the presence of low and insignificant amount of inbreeding depression, it could be inferred that the major part of the genetic effects in these hybrids is additive in nature.

Heterosis for seedcotton yield showed that several combinations outyielded the better parent (BP). Albeit, these combinations need further evaluation before any breeding decision could be taken. Results on seedcotton and related variables agree in general with those of El-Rassas (1976). The reciprocals of the hybrids that exhibited true heterosis for seedcotton yield showed also heterotic effects however insignificant. This indicate that heterosis obtained is genic and cytoplasmic inheritance is ruled out.

Table (1): Average performance of F_0, F_1 and F_2 population and overall heterosis and inbreeding depression for seedcotton yield, components of yield and fiber properties.

Variables	Population $\bar{x}$			HP/LP	% Heterosis		% Inbréeding depression
	F_0	F_1	F_2		MP	BP	
Seedcoton yield	47.92	56.95	54.42	1.75	19.27**	7.90*	4.42
Boll weight	2.66	2.62	2.51	1.23	----	----	4.20
Lint percent	34.70	35.19	34.79	1.23	1.39	----	1.14
Seed index	9.97	9.73	9.59	1.09	----	----	1.44
Lint index	5.33	5.28	5.14	1.46	0.57	----	2.65
Micronaire	3.85	3.81	3.83	1.35	-1.04	-----	----
Hair weight	178.50	161.17	162..97	1.63	-9.82	-1.96	----
Staple length	44.00	44.40	43.37	1.17	0.90	-----	2.32
Mean length	0.95	0.98	0.97	1.11	0.83**	1.03	1.53*
Yarn strength	2237.00	2299.13	2245.80	1.48	2.87	-----	2.32

*, **: Singificcant at the 5% and 1% level of probability, respectivley.

Table (2): Hybrids with bone fide heterotic effects for seedcotton yield.

Hybrid	% Heterosis	
	MP heterosis	BP heterosis
Giza 70 x Giza 67	36.42**	32.85*
Giza 70 x Giza 75	30.31*	----
Giza 66 x Giza 67	34.30*	----
Giza 67 x Giza 69	44.68**	40.45**
Reciprocals		
Giza 70 x Giza 45	39.66*	----
Giza 69 x Giza 45	38.27*	----
Giza 67 x Giza 45	45.89**	----

*,**: Significant at the 5% and 1% levels of probability. respectively.

Table (3): Hybrids with Bone fide heterotic effects for hair weight and mean length.

Hybrid	% Heterosis	
	Hair weight	Mean length
Giza 45 x Giza 70	14.95**	4.00*
Giza 45 x Giza 66	-17.37**	----
Giza 45 x Giza 67	-19.76**	----
Giza 45 x Giza 69	10.83*	----
Giza 45 x Giza 75	-13.86**	10.54**
Giza 70 x Giza 66	-14.74**	----
Giza 70 x Giza 67	-12.07**	----
Giza 66 x Giza 67	-20.29**	----
Giza 66 x Giza 69	-20.30**	4.30*
Giza 67 x Giza 69	-19.20**	----
Giza 67 x Giza 75	-12.44	13.98**
Giza 69 x Giza 75	----	15.05**

*, **: Significant at the 5% and 1% levels of probability, respectively.

Table (4): Reciprocals with bone fide heterotic effect for hair weight and mean length.

Hybrid	% Heterosis	
	Hair weight	Mean lengt
Giza 66 x Giza 45	-11.38**	----
Giza 67 x Giza 45	-3.38*	-4.17*
Giza 75 x Giza 45	----	4.21*
Giza 66 x Giza 70	----	7.22**
Giza 69 x Giza 70	-9.76**	4.08*
Giza 67 x Giza 66	-23.67**	----
Giza 69 x Giza 66	-17.86**	----
Giza 75 x Giza 66	-17.96**	7.61**
Giza 69 x Giza 67	-22.45**	6.45**
Giza 75 x Giza 67	-10.37*	6.45**
Giza 75 x Giza 69	-10.77*	5.38**

*, **: Significant at the 5% and 1% levels of probability respectively.

Table (5): Hybrids with significant inbreeding depressio for mean length.

Hybrid	% Inbreeding depression	
Giza 70 x Giza 67	-6.32**	P> 0.0

As for fiber properties, significant heterosis was detected for hair weight and fiber mean length. Out of the 15 hybrids, 9 showed significant heterotic effects for lowering hair weight measurement. And two showed heterotic effects toward increasing this measurement. Five hybrids showed true heterosis for mean length (Table 3). Nine reciprocals showed heterosis for hair weight and five reciprocals showed heterosis for mean length. Because some of the hybrids and their respective reciprocals showed hetrosis for hair weight and mean length, this may suggest the presence of cytoplasmic effects in the expression of these two traits.

Inbreeding depression was almost trivial. Mean length character was the only variable for which inbreeding depression was manifested. Of the fifteen hybrids, only Giza 70 x Giza 67 showed significant inbreeding depression.

F_0, F_1 and F_2 means for any one character of fiber are pretty close to each other. This, in addition to the low and insignificant levels of inbreeding depression obtained, suggest that additive and dominance are more important than epistasis in this material. Sallam et al. (1981) reported similar results.

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قوة الهجين والانخفاض الناتج عن التربية الذاتية في القطن المصري

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درست عشرة صفات من الصفات المحصولية وصفات الشعر بالنسبة لظاهرة قوة الهجين والانخفاض الناتج عن التربية الذاتية في ستة أصناف من أصناف القطن المصري والهجين المستنبطة منهم وكانت الأصناف كالآتي :

جـ ٤٥ ،جـ ٧٠ ، الأصناف الفائقة الطول ،جـ ٦٦ ،جـ ٦٧ ،٦٩ من الأصناف الطويلة .

في سنة ١٩٨٣ زرعت الآباء والهجين الأول والهجين الثاني للآباء المختلفة في تجربة نظام القطاعات الكاملة ذات ستة مكررات وقد أظهرت الدراسة مايلي من نتائج :

١ - أظهرت معظم الهجين تميزا في قوة الهجين بالنسبة للأب المتوسط وكانت قوة الهجين أكثر وضوحا بالنسبة لمحصول القطن الزهر / نبات ووزن الشعر ومتوسط الطول فقط .

٢ - كانت قوة الهجين واضحة مقاسة بالنسبة للأب الأفضل في صفات محصول القطن الزهر / نبات ،ووزن الشعر ومتوسط الطول ولم ترق الى مستوى المعنوية الا بالنسبة لصفة محصول القطن الزهر /نبات فقط .

٣ - كان الانخفاض الناتج عن التربية الداخلية واضحا في معظم الصفات ولم يرقى لمستوى المعنوية الا بالنسبة لصفة متوسط الطول حيث سجل هذا الأخير انخفاض معنويا (١ ٠/٠) .