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Heterotic Effects for Lint Yield in Double Cross Hybrids on Cotton**

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ABSTRACT

Double-crosses, compared to the single-crosses, have wider genetic diversity hence possess ecologically wider spans and are more adaptable to environmental conditions as mixture of genotypes have better chances of success to cope up with varied environmental conditions. This study was carried out in order to determine the heterotic effects of investigated traits in the population comprising F1 generation from 45 double crosses developed through double cross breeding method, in Diyarbakır ecological conditions in 2010. The trials were conducted using complete block design (RCBD) with three replications. In the study lint yield was determined. Eight hybrid cotton combinations had positive and high values for heterosis and heterobeltiosis in terms of lint yield (kg ha-1) . These were identified as promising for future studies that need to be taken into consideration in these hybrid combinations.

Keywords: cotton, double cross, lint yield, heterosis, heterobeltiosis.

Introduction

Hybrid vigor or heterosis is the converse of the deterioration that accompanies inbreeding. Turner (1953), Marani (1968), and Khan *et al.* (1981) reported varying degree of heterosis which was attributed to cotton fiber yield.

A double cross hybrid results from the cross between two single crosses that are themselves the result of crosses between two selected inbred lines. For successful double cross hybrid development, heterotic effects have to be maximized and the best results are expected when four unrelated or diverse inbred lines are used (Stoskopf, *et al.,* 1993).

Heterosis is the superiority of F_1 over the mean of the parents or over the better parent or over the standard check with respect to agriculturally useful traits. To maximize heterosis, there is a need for utilizing breeding programs aimed at constantly creating variability and increasing genetic diversity between populations that can further be exploited through selection for combining ability between such diverse populations (Kumar, 2008).

In this research, five *Gossypium hirsutum* L. and one *Gossypium barbadense* L., a total of six genotypes of the types , were used to develop 45 F_1 populations following double cross breeding method of hybridization in order to improve the populations for various traits, heterotic effects (heterosis, heterobeltiosis) and to identify best hybrids for future work in breeding elite cotton genotypes.

Material and methods

The research was carried out at the GAP International Agricultural Research and Training Center Research Areas in 2010. This study was carried out in order to determine the heterotic effects of investigated traits in the F_1 generation populations created through 45 double crosses, using the double cross breeding method. The trials were conducted using complete block design (RCBD) with three replications. Each plot consisted of two rows of 12 m length and harvesting was done from the inner 10 m of the rows. The distance between rows and plants was 70cm and 15 cm, respectively. Sowing was done with combine cotton drilling machine on 15th May 2010; all plots received 120 kg ha^{-1} N and 60 kg ha^{-1} P_2O_5. Half of the N and all P_2O_5 were applied at sowing time and the remaining N was given at the square stage in the form of ammonium nitrate.

Fantom (*G. hirsutum* L.), Paum 15 (*G. hirsutum* L.), Stoneville 468 (*G. hirsutum* L.), Giza 75 (*G. barbadense* L.), Delcerro (*G. hirsutum* L.), and Nazilli-84 S (*G. hirsutum* L.) varieties were used as genetic material.

Six parents were crossed to create 15 F_1 hybrids according to hybridization technique suggested by Poehlman (1959) and Griffing (1956). Forty-five double cross progenies were obtained from 15 single cross F_1 hybrids generation following the half diallel method of Singh and Chaudhary (1985). Statistical analysis was made according to Snedecor and Cochran, (1967). Heterosis of all F_1 hybrids was computed according to Fehr (1987) as follows:

$$Ht(\%) = \frac{\bar{F}_1 - \frac{\bar{P}_1 + \bar{P}_2}{2}}{\frac{\bar{P}_1 + \bar{P}_2}{2}} \text{ x } 100 \qquad Hb(\%) = \frac{\bar{F}_1 - \overline{BP}}{\overline{BP}} \text{ x } 100$$

Where: *Ht:* heterosis; P_1: parent 1; *Hb:* heterobeltiosis; P_2: parent 2; F_1: first generation; *BP:* better parent

The observation was recorded for average lint yield (kg. ha^{-1}) on five randomly selected plants per replicate from each population. The data of all the genotypes were pooled and heterosis (Ht) and heterobeltiosis (Hb) was calculated for average lint yield (Hallauer and Miranda, 1982; Chaing and Smith1967; Fonseca and Patterson, 1968).

Results and discussion

The heterosis and heterobeltiosis for average lint yields are given in Table 1. Heterosis of average lint yield ranged from 24.60% (1x2) x (4x5) {(Paum15 x STV468) x (Fantom x Delcerro)} to -9.79% (3x4) x (5x6) {(Nazilli 84S x Fantom) x (Delcerro x Giza75)}. The double cross combinations (1x2) x (3x4), (1x2) x(3x5), (1x2)x(3x6), (1x2) x (4x5), (1x2) x (4x6), (1x2) x (5x6), (1x3) x (2x5), (1x3) x (2x6), (1x3) x (4x5), (1x3) x (4x6), (1x3) x (5x6), (1x4) x (2x3), (1x4) x (2x5), (1x5) x (2x3), (1x5) x (3x4), (1x5) x (3x6), (1x5) x (4x6), (2x3) x (4x5), (2x3) x (4x6), (2x3) x (5x6) exhibited significant positive heterosis among all the combinations (Figure 1). Turner (1953), Marani (1968), and Khan *et al.* (1981) reported similar results and found varying degree of heterosis which was attributed to cotton fiber yield.

Heterobeltiosis of average lint yield ranged from 11.69% (1x2)x(4x5) {(Paum15xSTV468) x (Fantom x Delcerro)} to -18.81% (1x3) x (5 x 6) {(Paum 15 x Nazilli 84S) x (Delcerro x Giza75)}. The double cross combinations (1x2)x(3x4), (1x2)x(3x5), (1x2) x(3x6), (1x2)x(4x5) exhibited significant positive heterobeltiosis among all the combinations (Figure 1) Stoskopf, *et al.*, (1993) reported similar results and suggested that heterotic effects have to be maximized and the best results are expected when four unrelated or diverse inbred lines are used.

It can be concluded that lint yield is main components for productivity. Therefore, selection for lint yield might results in the improvement of production and the promising double crosses like (1x2)x(3x4), (1x2)x(3x5), (1x2)x(3x6), (1x2)x(4x5) (Ht>10 and Hb>5%) may be further tested on large plots over different locations and seasons before recommending them for commercial utilization.

Table 1. Heterosis (%) and heterobeltiosis (%) of double cross combinations for average lint yield

Double Cross Combinations	Lint Yield (kg. ha^{-1})	Ht (%)	Hb (%)	Double Cross Combinations	Lint Yield (kg. ha^{-1})	Ht (%)	Hb (%)
(1x2)x(3x4)	1999.5	16,58	9,18	(1x5)x(4x6)	1471.1	5,44	-0,28
(1x2)x(3x5)	2027.6	18,82	10,72	(1x6)x(2x3)	1690.4	2,27	-9,37
(1x2)x(3x6)	1891.7	15,69	3,29	(1x6)x(2x4)	1564.2	-4,81	-15,25
(1x2)x(4x5)	2045.4	24,60	11,69	(1x6)x(2x5)	1550.0	-3,8	-13,01
(1x2)x(4x6)	1756.6	11,65	-4,09	(1x6)x(3x4)	1389.3	-8,58	-13,10
(1x2)x(5x6)	1680.3	7,67	-8,25	(1x6)x(3x5)	1394.5	-7,72	-11,82
(1x3)x(2x4)	1791.4	0,70	-2,94	(1x6)x(4x5)	1413.8	-2,25	-2,62
(1x3)x(2x5)	1740.8	-0,36	-2,29	(2x3)x(4x5)	1762.6	6,28	-5,50
(1x3)x(2x6)	1664.7	-3,80	-4,78	(2x3)x(4x6)	1660.5	4,42	-10,97
(1x3)x(4x5)	1575.8	-0,40	-7,98	(2x3)x(5x6)	1638.1	3,84	-12,17
(1x3)x(4x6)	1507.5	-0,42	-11,97	(2x4)x(3x5)	1717.8	0,24	-6,93
(1x3)x(5x6)	1390.4	-7,38	-18,81	(2x4)x(3x6)	1602.0	-2,45	-13,20
(1x4)x(2x3)	1859.5	9,73	-0,30	(2x4)x(5x6)	1517.7	-3,20	-17,77
(1x4)x(2x5)	1711.2	3,52	-3,96	(2x5)x(3x4)	1673.5	-0,99	-6,07
(1x4)x(2x6)	1537.3	-6,05	-12,07	(2x5)x(3x6)	1578.3	-1,98	-11,41
(1x4)x(3x5)	1514.7	-2,46	-4,23	(2x5)x(4x6)	1497.8	-3,27	-15,93
(1x4)x(3x6)	1352.2	-8,72	-11,28	(2x6)x(3x4)	1676.3	0,17	-4,12
(1x4)x(5x6)	1341.8	-4,63	-11,96	(2x6)x(3x5)	1648.8	-0,97	-5,69
(1x5)x(2x3)	1777.0	6,39	-4,72	(2x6)x(4x5)	1500.6	-6,22	-14,17
(1x5)x(2x4)	1650.3	-0,61	-10,59	(3x4)x(5x6)	1302.9	-9,79	-18,50
(1x5)x(2x6)	1617.0	0,32	-7,51	(3x5)x(4x6)	1458.5	0,70	-7,78
(1x5)x(3x4)	1600.1	4,10	0,08	(3x6)x(4x5)	1365.5	-5,52	-5,95
(1x5)x(3x6)	151,71	4,12	2,83				

(**1:** Paum 15; **2:** STV 468; **3:** Nazilli 84S; **4:** Fantom; **5:** Delcerro; **6:** Giza 75)

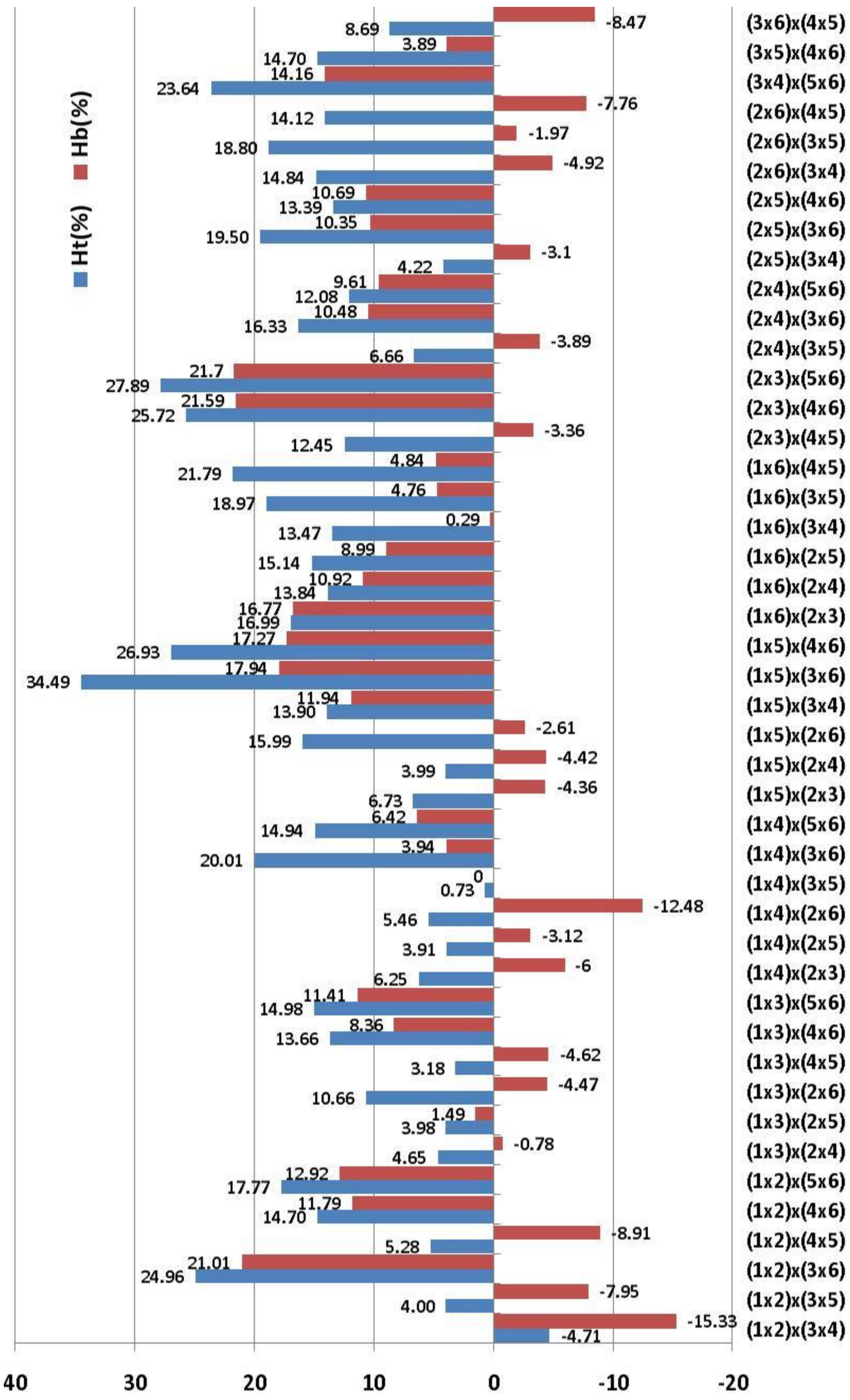

Figure 1. Heterosis (%) and heterobeltiosis (%) of double cross combinations in terms of lint yield

References

Chaing MS and Smith JD (1967). Diallel analysis of inheritance of quantitative characters in grain sorghum. I.Heterosis and inbreeding depression. Canadian Journal Genet. Cyto. **9**:44-51.

Fehr WR (1987). Principles of cultivar development. Theory and techniques. Vol.1. McGrawhill, New York, USA.

Fonseca SM and Patterson FL (1968). Hybrid Vigour in a Seven Parent Diallel Cross in Common Winter Wheat (*T. avestivium* L.) Crop Sci. **8** (1): 85-88.

Griffing LB (1956). Generalized Treatment of the Use of Diallel Crosses in Quantitative Inheritance. Heredity **10**: 31-50.

Hallauer AR and Miranda JB (1982). Quantitative Genetics in Maize Breeding. Iowa State Univ. Pres. Ames. USA.

Khan IA, IF A Khan and M Ahmad (1981). Study of Gene Action and Combining Ability In Various Characters of Cotton (Gossypium hirsutum L.). Cotton and Trop. Fib. Abst.6-9: 1117.

Kumar KJY (2008). Combining ability and heterosis studies in experimental hybrids of cotton (*Gossypium hirsutum* L.). MSc. Thesis, Dept. of Genetics and Plant Breed. College of Agric. Dharwad Univ. of Agr. Sci.,

Marani A (1968) Heterosis and Inheritance of Quantitative Characters in Interspesific Crosses of Cotton. Crop Science: 8: 299-303.

Poehlman MJ (1959). Breeding Field Crops. Holt Rine Hart and Winston, ınc., New York.

Singh RK and Chaudhary BD (1985). Biometrical Methods in Quantitative Genetic Analysis. Published by Mrs. Usha Raj Kumar for Kalyani Publishers, New Delhi. Revised Edition 1985. Page: 140-146.

Snedecor GW and Cochran WG (1967). Statistical Methods. The Iowa State College Press, Ames, IOWA, USA. 161-413.

Stoskopf NS, Tomes DT and Christie BR (1993). Plant Breeding. Theory and Practice. San Francisco: Westview Press Inc.

Turner JM, (1953). A study of heterosis in upland cotton II Combining ability and inbreeding effects. Agron. J. 43: 487-490.