http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet

Asian Network for Scientific Information

308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 3 (9): 1412-1413, 2000

Estimation of Heterosis for Yield and Yield Components in Cotton (*Cossypium hirsutum* L.)

Muhammad Shahid Mukhtar[1] and Tariq Manzoor Khan[2]
[1]Plant Biotechnology Division, NIBGE, Faisalabad, Pakistan
[2]Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad, Pakistan

Abstract: Heterotic effects were studied over mid and better parents, for yield and primary yield components in 12 crosses of *Gossypium hirsutum* L. involving four indigenous varieties *viz*., CIM-1 100, CIM-443, VH-57 and CIM-444. Maximum heterotic effects were found in all these traits ranging from 2.05 to 8.83% and all the crosses showed approximately 55% of positive heterotic effects over mid parent values. Positive heterobeltiosis was estimated in plant height and seed index. The crosses showing fair degree of heterotic effects may be used as a selection criteria for further strengthening the cotton breeding programme.

Key words: Mid parents, better parent value, upland cotton, F_1 hybrids

Introduction

The interest of hybrid cotton production is increasing continually among public as well as the private seed companies, but the primary limitation of commercial use of F_1 hybrids is the expense of producing F_1 seed. So information about heterosis and heterobeltiosis among cotton gene pool and population is essential to optimize hybrid development.

Mid parent heterosis of 8 to 24% had been reported in cotton for yield and yield components in selected intra-specific crosses (Meredith, 1990). Tang *et al.* (1992) reported that F_2 hybrids, resulting from crosses between pest resistant germplasm, were not only high yielding and highly stable but also had acceptable fibre traits. Akbar *et al.* (1993) estimated heterotic effects over mid parents as well as better parents for cotton seed yield/plant, staple length, fibre fineness and fibre strength. All the characters showed degree of heterosis over mid parents ranging from 5.59 to 50.04%. Singh *et al*. (1993) reported that seven crosses showed 25% heterosis over the better parents for harvest index and 9 crosses showed 90% heterosis for economic yield characters. Tang *et al.* (1993) also reported 8 to 24% heterosis in cotton for yield and yield components.

Ansari (1994) studied heterosis performance in eight intra-specific hybrids of cotton. The results revealed that the parents and their F_1 hybrids were significantly different. Most of the hybrids showed heterobeltiosis for seed cotton yield/plant, number of balls/plant, boll weight and staple length. Carvalho *et al*. (1994) studied 30 hybrids involving 6 *Gossypium hirsutum* varieties to estimate heterotic effects. Heterosis was associated with boll weight as well as seed index and also observed that heterosis for yield was greater than fibre quality traits. Das and Shunmugavalli (1995) observed heterosis for 5 quantitative traits in each genotype. The magnitude and heterosis depended on cross and trait. Tashkent 3×P216T was the best cross in terms of heterosis for seed cotton yield and its other components. Kowsalya and Raveendran (1996) investigated the expression of heterosis over mid parent, better parent and best parent for 11 characters. Number of bolls/plant, GOT, span length, fibre fineness and fibre strength showed significant values of heterosis.

A-F_2 hybrid population is very heterozygous and has only 50% as much as heterozygosity as an F_1 hybrid. Research has indicated that a potential exist for use of F_2 hybrids as commercial cultivars indicated by Olvey (1986), Meredith (1990) and Tang *et al.* (1993).

These research reported herein was conducted to provide further information on the potential value of heterosis for yield and yield components among a selected groups of genotypes to evolve hybrids from segregating generations.

Materials and Methods

The experiment was conducted in experimental area of department of Plant Breeding and Genetics, University of Agriculture Faisalabad. The experimental material was developed by crossing four cotton varieties *viz.* CIM-1100, CIM-443, VH-57 and CIM-444 in a complete diallel fashion during the year 1997-1998. All necessary precautions were made to avoid the foreign pollen contamination. The seeds of twelve F_1 hybrids along with their parents were field planted in a triplicated randomized complete block design. Each row contained eight guarded plants spaced 30 cm apart within a row and 75 cm apart between the rows. The recommended agronomic practices were constantly employed for all the treatments. At maturity, the data was recorded both in the field and laboratory on individual plant basis for plant height (cm), number of bolls per plant, boll weight (g), yield of the seed cotton per plant (g) and seed index (g).

The recorded data was subjected to analysis of variance technique for each of the character as reported by Steel and Torrie (1980). The percent increase (+) or decrease (-) of F_1 over mid parents (MP) and better parents (BP) was calculated to observe possible heterotic effects for all the traits following Fonseca and Patterson (1968). The test of significance for mid parent and better parents were applied as given by Wynne *et al.* (1970).

Results and Discussion

The analysis of variance (Table 1) indicated the presence of significant variation among genotypes for yield and yield components. Table 2 reflected the difference between the hybrids and their parents over mid parent and better parent values indicating the possible presence of heterosis in all the traits.

Plant height: Ten out of twelve F_1 hybrids were taller than their respective mid parent. The positive value of heterosis was ranged from 0.92 percent (CIM-444×CIM-443) to 7.67 percent (CIM-444×CIM1100). Highly significant heterosis was recorded in five crosses while three crosses showed significant increase over respective mid parent values. Only one cross

Table 1: Analysis of variance for yield and yield components in cotton

SOV	df	Plant height	Number of balls /plant	Boll weight	Yield of the cotton/plant	Seed index
Replication	2	0.007	2.112**	0.001	52.530* *	0.003
Genotypes	15	372.040**	18.905**	0.211**	592.376**	0.249**
Error	30	1.160	0.373	0.002	6.682	0.007

Table 2: Heterotic effects for yield and yield components in cotton

Genotypes	Percent increase over mid parent (MP) and better parent (BP) values									
	Plant height		Number of balls /plant		Boll weight		Yield of the cotton/plant		Seed index	
	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP
CIM-1100 × CIM-443	2.89*	-9.91	-4.80	-9.16	-1.33	-5.26	-9.67	-17.09	-0.84	-3.68
CIM-1 100 × VH-57	3.24**	-5.64	2.09	-11.85	-0.34	-7.74	1.21	-18.66	3.74*	-3.27
CIM-1100 × CIM-444	4.19**	-2.69	-2.20	-9.73	-0.23	-2.40	7.19	-16.04	-1.85	-2.45
CIM-443 × CIM-1100	5.87**	-7.99	-4.13	-8.52	1.40	-2.63	2.98	-10.93	-2.53	-5.32
CIM-443 × VH-57	1.20	-3.48	-2.63	-19.77	0.55	-10.32	-4.56	-20.05	2.48*	-1.74
CIM-443 × CIM-444	2.97*	-3.95	1.63	-10.12	1.29	-4.77	2.13	-14.38	0.21	-2.06
VH-57 × CIM-1100	2.53*	-6.28	0.00	-14.33	-5.91	-12.90	-7.16	-25.39	-0.65	-7.37
VH-57 × CIM-443	3.72**	-1.08	-12.89	-20.13	-6.45	-16.57	-20.68	-40.15	4.76**	0.43
VH-57 × CIM-444	-3.13	-5.35	-4.65	-12.13	-5.12	-10.33	-9.98	-21.23	8.41**	1.60
CIM-444 × CIM-1100	7.67**	0.54	-2.01	-9.55	1.85	-1.11	-1.16	-10.59	-7.73	-5.32
CIM-444 × CIM-443	0.92	-5.85	2.54	-9.32	-3.30	-9.89	-10.84	-24.59	1.49	-0.82
CIM-444 × VH-57	-5.41	-7.58	7.15*	-1.25	2.05	-3.54	8.83*	-4.74	7.96**	1.24

showed non significant heterobeltiosis. For plant height negative estimates of heterosis are preferred. So the cross showing least value i.e. -5.41% (CIM-444 × VH-57) will be considered for further breeding programme.

Number of boils per plant: Four crosses exhibited positive heterosis over their mid parents ranging from 1.636% (CIM-443 × CIM-444) to 7.150% (CIM-444 × VH-57). None of the cross out yielded their better parents. Only one cross i.e. (CIM-444 × VH-57) indicated significant increase. All the negative estimates of heterosis and heterobeltiosis are not desirable. The results corroborated the findings of Tang *et al.* (1993), Ansari (1994), Das and Shunmugavalli (1995) and Kowsalya and Raveendran (1996).

Boll weight: The results depicted that five crosses out of twelve showed positive heterotic effects ranging from 0.55% (CIM-443 × VH-57) to 2.05% (CIM-444 × VH-57). Heterosis and heterobeltiosis evaluated in this trait is non significant which is not useful in hybrid cotton breeding programme.

Yield of the seed cotton per plant: The results revealed that three out twelve crosses possessed positive heterosis over their mid parents. The value ranged from 1.21% (CIM-1100 × VH-57) to 8.83% (CIM-444 × VH-57). None of cross reflected positive heterobeltiosis in the manifestation of this character. The results are compatible with the findings of Meredith (1990), Tang *et al.* (1992), Akbar *et al.* (1993), Singh *et al.* (1993), Ansari (1994) and Carvalho *et al.* (1994).

Seed index: Seven F_1 crosses showed increased seed index over mid parent value ranging from 0.21% (CIM-443 × CIM-444) to 8.41% (VH-57 × CIM-444). Three crosses indicated highly significant heterotic effects while two crosses exhibited significant increase over mid parents. Only three crosses showed positive heterobeltiosis, but non significant in the manifestation of this trait. The results are in agreement with the findings of Tang *et al.* (1993) and Das and Shunmugavalli (1995).
On the basis of overall results, the cross CIM-444 × VH-57 was non significant for plant height but exhibited remarkable heterosis for number of bolls/plant, boll weight yield of the seed cotton/plant and seed index. Therefore, it is generally suggested that hybrid may be exploited to enhance the cotton breeding programme.

References

Akbar, M., M.A. Khan and N.I. Khan, 1993. Heterosis and combining ability in diallel crosses of cotton (*Gossypium hirsutum*). J. Agric. Res., 31: 369-377.

Ansari, B.A., 1994. Heterotic performance of intraspecific hybrids of *Gossypium hirsutum* L. Sarhad J. Agric., 10: 681-686.

Carvalho, L.P., C.F.D.E. Moraes and C.D. Cruz, 1994. Combining ability and heterosis in upland cotton, Revista Ceres, 41: 514-527.

Das, L.D.V. and N. Shunmugavalli, 1995. Heterosis in cotton Madras. Agric. J., 82: 672-673.

Fonseca, S. and F.L. Patterson, 1968. Hybrid vigor in a seven-parent diallel cross in common winter wheat (*Triticum aestivum* L.). Crop Sci., 8: 85-88.

Kowsalya, R. and T.S. Raveendran, 1996. Heterosis in intra specific Gossypium hybrids possessing harknessii and hirsutum plasmons. Ann. Plant Physiol., 10: 114-117.

Meredith, W.R.Jr., 1990. Yield and fiber-quality potential for second-generation cotton hybrids. Crop Sci., 6: 1045-1048.

Olvey, J.M., 1986. Performance and potential of F2 hybrids. Proceedings of the Beltwide Cotton Production Research Conferences, (BCPRC'86), National Cotton Council of America, Memphis, TN., pp: 101-101.

Singh, T.H., L.S. Randhawa and G.S. Chahal, 1993. Heterosis and combining ability for harvest Index and economic yield in upland cotton (*Gossypium hirsutum* L.). Crop Improv. Soc. India, 32: 68-69.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics: A Biometrical Approach. 2nd Edn., McGraw Hill Book Co., New York, USA., ISBN-13: 9780070609266, Pages: 633.

Tang, B., J.N. Jenkins and J.C. McCarty Jr., 1992. Genotypic stability of cotton varieties, resistant germplasms and their F_2 hybrids. Proceedings of the Beltwide Cotton Production Research Conference, January 6-10, 1992, Nashville, TN., USA., pp: 583-587.

Tang, B., J.N. Jenkins, J.C. McCarty and C.E. Watson, 1993. F_2 hybrids of host plant germplasm and cotton cultivars: I. Heterosis and combining ability for lint yield and yield components. Crop Sci., 33: 700-705.

Wynne, J.C., D.A. Emery and P.W. Rice, 1970. Combining ability estimates in *Arachis hypogaea* L. II. Field performance of F_1 hybrids. Crop Sci., 10: 713-715.