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Evaluation of Hybrids for Cotton Production at Commercial Level

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Abstract: Hybrids in cotton are considered a way out to improve lint quantity and quality by exploiting broad genetic base offered in this technique. The study was carried out to find the cross combinations exhibiting heterosis for the desirable plant characters under CLCuV resistance and insect non-preference genetic background. Fourteen crosses were tested against two high yielding, CLCuV resistant commercial varieties. The analysis of variance for six plant traits revealed significant differences within treatments for plant height, boll number and yield / plant while non-significant for boll weight, staple length and G.O.T. %. A range of positive heterosis was found in all crosses for plant height, boll number and yield. For boll weight, staple length and G.O.T.% heterotic values ranging from negative to positive were observed. Crosses FH-634 x HRVO, FH-634 x Krishna, CIM-448 x HRVO and CIM-448 x NIAB-78 exhibited maximum values of heterosis for more than one character. Among CLCuV resistance and insect non-preference combinations, crosses FH-634 x Krishna, FH-634 x SL7-9, CIM-448 x HRVO and CIM-448 x SL7-9 performed better than essential hybrid vigour for seed cotton yield per plant, hence, recommended for use as commercial cotton hybrids.

Key words: Hybrid, heterosis, CLCuV, host plant resistance, cotton (*G.hirsutum*)

Introduction

Cotton is world's most important cultivated fibre crop and second important edible oil source. Now days it has gained the status of an industry rather than a mere crop. The economy of countries like Pakistan is trapped in improved yield, quality and production of cotton. So the base of a breeding programme is these objectives and the most practiced approach is either by increasing area under cultivation or obtaining highest possible yield potential. In case of cotton both the approaches were used successfully in Pakistan till 1991-92 (Anonymous, 1992) when Cotton Leaf Curl Virus (CLCuV) menace shattered the whole cotton setup. Now area is static and per acre yield is on steep slope. This trend is more or less an international feature except India where the graph is towards increase (Basu, 1989) and major attribute to this is release of hybrid cotton for general cultivation (Directorate of Cotton Development, 1973; Basu, 1994).

Hybrid vigour/heterosis has been exploited in many crops (Paterson *et al.*, 1997 and Carver *et al.*, 1987) and it inspired breeders to explore the benefits of heterosis in cotton (Singh *et al.*, 1980; Davis, 1978). It is well documented that F_1 cotton hybrids are a way to achieve quantum jump in quality and quantity characters. Yield increase by using hybrid vigour has been reported by many researchers (Patel, 1971; Meredith and Bridges, 1972; Davis, 1978, Sheetz and Quisenberry, 1986; USDA, 1988). Thompson, 1971, observed 6-31% increase in yield over the highest yielding cultivar used as a check. Gadagi *et al.* (1990) reported remarkable seed cotton yield of cotton hybrid DCH-32 under Dharwar conditions. No cotton variety exhibited high yield comparable to this hybrid. The cotton hybrid DCH-32 is also claimed to be highly adaptable to varying climates as it was successfully grown under rainfed situations without deterioration of quality of fibre (Joshie, 1997). For fibre quality enhancement in intrahirsutum crosses satisfactory results are obtained if both the parents are satisfactory for all fibre traits (Davis, 1978). Serious cotton production losses due to CLCuV and insects, especially whitefly and American bollworm can be recovered through exploitation of hybrid vigour. These are the most desirable features with special reference to Pakistan as they are considered major constraints in yield improvement now days. Therefore, the objective of the present study was to assess the performance of cotton hybrids having built in CLCuV resistance and insect – non-preference.

Materials and Methods

The study was carried out in the research area of Cotton Research Institute, Faisalabad, during 1998 crop season. The experimental material comprised of fourteen F_1 hybrids and two commercial standards Viz. CIM-448 (CLCuV resistant) and NIAB-78 a long time established standard variety (CLCuV susceptible).

All the 14 hybrids have essentially one CLCuV resistance or insect non-preference parent.

Parent	Salient features
CIM-448	CLCuV resistant
FH-634	CLCuV resistant
NIAB-Karishma (KMA)	CLCuV tolerant, nectariless
HRVO	CLCuV susceptible, dense hairy, okra leaf
NIAB-78	CLCuV susceptible, high yielding
Krishna (KNA)	CLCuV susceptible, early maturing
SL7- 9	CLCuV susceptible, red plant colour

All the material was planted in a Randomized Complete Block Design with three replications. Inter-row and intra-row distances were 75 and 30 cm, respectively. At maturity, data for plant height (cm), number of bolls per plant, boll weight (g), yield per plant, staple length (mm) and G.O.T. (%) were recorded from five randomly selected plants per repeat. The data were subjected to analysis of variance following Steel and Torrie (1984). As heterosis calculated on the basis of % increase/decrease over mid parent or better parent is of no value in commercial hybrid production, therefore, heterosis was calculated as % increase/decrease over both standard varieties, separately.

Results and Discussion

The analysis of variance for the plant height executed for F_1 hybrids and two varieties (Table 1) shows significant differences within treatments. A perusal of Table 2, shows that hybrids exhibited positive heterosis over both standards, ranging from 8.13 to 47.0% over NIAB-78 and 15.48 to 56.99 % over CIM-448. The crosses FH-634 x HRVO and FH-634 x SL7-9 were first two in ranking (Table 3). Study of simple correlation (Table 4) between plant height and seed cotton yield per plant revealed positive association, hence, depicting the importance of taller hybrids. For number of bolls the analysis of variance revealed non-significant differences within treatments. Percent heterosis ranged from 6.0 to 74.02 as compared to NIAB-78 while 8.14 to

Table 1: Analysis of variance for traits under study.

	SOV			
	Treatment	Replications	Error	Total
Df	15.00	2.00	30.00	47
Plant Height MS	574.8	864.8	129.8	
F Value	4.43	6.66		
Boll # MS	164.9	1600.00	157.9	
F Value	1.04	10.14		
Boll weight MS	0.49	0.34	0.35	
F Value	1.41	0.97		
Staple Length MS	1.68	1.69	1.22	
F Value	1.38	1.39		
G.O.T.% MS	12.04	5.70	6.67	
F Value	1.81	0.85		
Yield/ Plant MS	6573.00	5488.00	2264.00	
F Value	02.9	2.4		

Table 2: Estimates of Heterosis as compared to commercial standards for yield & other economic traits

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
120.7	27.92	110.3	126.7	138.7	128.3	116.3	134.7	106.3	102.0	124.0	109.0	122.3	116.7	94.3	88.3
27.92	18.73	16.96	34.28	47.0	36.04	23.32	42.76	12.72	8.13	31.45	15.55	29.68	23.68	--	--
36.61	26.79	24.91	43.41	56.99	45.28	31.7	52.46	20.38	15.48	40.38	23.4	38.49	32.08	--	--
51.67	39.67	37.0	51.0	38.33	58.0	45.67	48.67	39.33	35.33	41.33	44.67	45.0	50.0	33.33	32.67
55.03	19.02	11.01	53.02	15.0	74.02	37.02	46.02	18.0	6.0	24.0	34.02	35.01	50.0	--	--
58.16	21.43	13.25	56.11	17.32	77.53	39.79	48.97	20.39	8.14	26.51	36.73	37.74	53.05	--	--
4.41	3.77	3.82	4.11	4.58	4.21	3.78	4.25	4.06	3.31	3.44	3.57	3.55	3.82	3.58	3.15
23.16	5.30	6.70	14.80	27.93	17.60	5.59	18.17	13.41	7.54	3.91	0.28	0.84	0.70	--	--
40.0	19.68	21.27	30.48	45.39	33.65	20.0	34.92	28.99	5.08	9.21	13.33	12.70	21.27	--	--
27.03	27.37	28.07	27.03	27.4	26.3	25.37	26.8	27.13	27.03	25.63	25.03	26.8	27.8		
0.86	2.13	4.73	0.86	1.98	0.86	2.24	-1.87	-5.34	00.00	1.23	0.86	-4.37	-3.62	--	--
-2.77	-1.55	0.97	-1.69	2.77	-1.69	-1.44	-5.39	-8.74	-3.6	-2.41	-2.77	-7.81	-7.09	--	--
39.47	37.13	42.5	37.67	38.3	39.97	37.87	33.73	41.03	37.67	36.5	38.93	37.8	36.3	39.27	38.93
0.51	-5.45	8.23	-4.07	-2.47	-5.86	14.1	4.48	-4.07	-7.05	-0.87	-3.74	-7.56	--		--
1.39	4.62	9.17	-3.24	-1.62	5.03	-2.72	-13.4	5.39	-3.24	-6.24	00.00	-2.90	-6.76	--	--
229.00	149.00	141.00	211.00	171.00	243.00	169.00	210.00	166.00	108.00	139.00	153.00	163.00	234.00	134.00	101.00
70.90	11.19	5.22	57.46	27.61	81.34	26.12	56.72	23.88	2.99	3.73	14.18	21.64	74.63	--	--
126.7	47.52	39.6	108.9	69.3	140.6	67.3	107.9	64.4	36.6	37.62	51.5	61.4	16.7	--	--

S1 = Percent increase over NIAB-78 (Standard 1)S2 = Percent increase over CIM-448 (Standard 2)
1 = 448xHRVO 2 = 448xHRVO 3 = 448xN-78 4 = 448xSL7-9 5 = 634xHRVO 6 = 634xKNA 7 = 634xN-78 8 = 634xSL7-9 9 = KMAx448 10 = KMAxHRVO 11 = KMAxKNA
12 = KMAxN-78 13 = KMAxSL7-9 14 = N-78xKNA 15 = NIAB-78 16 = CIM448

Table 3: Performance wise two best crosses for yield and other economic traits

Characters	1st Best Cross	2nd Best Cross
Plant Height	FH -634 x HRVO	FH-634 x SL7-9
Boll #	FH-634 x KNA	CIM 448 x HRVO
Boll Weight	FH-634 x HRVO	CIM 448 x HRVO
Staple Length	CIM-448x NIAB-78	CIM-448 x KNA,FH-634 x NIAB-78
G.O.T. %	CIM-448x NIAB-78	KMA x CIM-448
Yield / Plant	FH-634 x KNA	CIM-448 x HRVO

Table 4: Simple correlation coefficients between yield and other economic traits

Characters	Plant Height	Boll #	Boll Weight	Staple Length	G.O.T. %	Yield/ Pl.
Plant Height	1					
Boll #	0.652253	1				
Boll Weight	0.736107	0.543912	1			
Staple Length	-0.32216	-0.29763	0.060896	1		
G.O.T. %	-0.39129	-0.22598	0.020148	0.51593	1	
Yield/ Plant	0.671527	0.918273	0.745603	-0.13907	-0.18352	1

77.52 for CIM-448. The two crosses displaying highest values of heterosis were FH-634 x Krishna and CIM-448 x HRVO. The negative association of number of bolls per plant with G.O.T (%) and staple length suggested that in hybrids yield increase achieved through increase in number of bolls may deteriorate the quality traits.

The analysis of variance depicted non-significant differences among genotypes for boll weight. The values of % heterosis of the crosses against NIAB-78 and CIM-448 for boll weight ranged from 7.54 to 27.93 and 9.21 to 45.39 respectively. The two outstanding crosses were FH-634 x HRVO and CIM-448 x HRVO. Boll weight was positively correlated with all the traits under study (Table 4). This situation suggested that in hybrids increase in yield due to increased boll weight might improve staple length and G.O.T. %. Significant differences for yield per plant were observed in analysis of variance. Hybrid vigour for yield ranged from 2.99 to 81.34% against NIAB-78 and 36.63 to 140.59% as compared with CIM-448. The crosses, which exhibited highest heterosis were FH-634 x Krishna and CIM-448 x HRVO.

Non-significant differences within treatments were exhibited for staple length in the ANOVA table. The heterotic value ranged from -5.34 to 4.73% (NIAB-78) and -7.81 to 2.77% (CIM-448) whereas, the highest values for the character were observed in crosses CIM-448 x NIAB-78 and CIM-448 x Krishna / FH-634 x NIAB-78.

The statistical analysis conducted revealed non-significant differences within treatments for G.O.T. %. When studied it showed negative heterosis for all crosses except three, in case of NIAB-78 it ranged from -7.56 to 8.23 % and for CIM-448 it ranged from -8.17 to 15.71%. Crosses CIM-448 x NIAB-78 and

Karishma x CIM-448 secured first two positions.

Shah *et al.* (1998) revealed that more than 50% hybrid vigour for yield is essential to get economic returns from hybrid cotton production. Five hybrids viz. FH-634 x KNA, NIAB-78 x KNA, CIM-448 x HRVO, CIM-448 x SL7-9 and FH-634 x SL7-9 exhibited heterosis more than essential level for yield/plant. As current requirement is CLCuV resistance and insect non-preference, therefore, four hybrids out of above mentioned five (excluding NIAB-78 x KNA) are suggested for hybrid cotton production.

References

Anonymous, 1992. Agricultural Statistics of Pakistan, Ministry of Food Agriculture & Livestock, Government of Pakistan, Islamabad.

Basu, A.K., 1989. Technologies for increasing cotton production in India. AICCIP Pub., pp : 11.

Basu, A.K., 1994. Hybrid cotton results and prospects. Challenging the future: Proceedings of the World Cotton Research Conference -1, Brisbane Australia, February 14-17, G.A. Constable and N.W. Forrester (Eds), CSIRO, Melbourne, pp: 355-341.

Carver, B.F., E.L. Smith and H.O. England, Jr., 1987. Regression and cluster analysis of environmental responses of hybrid and pure line winter wheat cultivars. Crop Sci., 27: 659-664.

Davis, D.D., 1978. Hybrid cotton: specific problems and potentials. Adv. In Agron., 30: 129-157.

Directorate of Cotton Development, Government of India. Ministry of Agriculture, 1978. Intensive cotton district programme.

Gadagi, D. , A.S.Prabhakar and L.A. Dixit, 1990. Effect of date of sowing and plant population on the Performance of hybrid cotton - Jaylaxmi. Mysore J. Agri. Sci., 24: 13-16.

Joshi, M., 1997. Hybrid cotton scenario in southern transition zone of Karnataka. Pub. : UAS, Banglore., pp : 1-25.

Meredith, W.R., Jr. and R.R. Bridges , 1972. Heterosis and gene action in cotton, *Gossypium hirsutum* L. Crop Sci., 12: 304-310.

Patel, C.T., 1971. Hybrid 4, a new hope towards self-sufficiency in cotton in India. Cotton Dev., 1: 1-6.

Peterson, C.J., J.M. Mofatt and J.R. Erickson, 1997. Yield stability of hybrid Vs Pureline Hard Winter Wheats in regional performance trials. 1947. Crop Sci., 37: 116-120.

Shah, M.K.N.,R.A. Kainth, H:Rehman, I.Ullah and W.S.Khan, 1998. World Cotton Research Conference- 2. "New Frontiers in Cotton Research". Abstract Book. Sept. 6-12, 1998, Athens, Greece., pp: 77.

Sheetz, R.H. and J.E. Quisenberry, 1986. Heterosis and combining ability effects in upland cotton hybrids. p. 94-98. In T.C. Nelson (ed.) Beltwide Cotton Prod. Res. Conf., Las Vegas, NV. 4-9 Jan. 1986. Natl. Cotton Council of Am. Memphis, TN.

Singh, T.H., G.S. Chahal, H.C. Bhardwaj and P. L. Tikku, 1980. Exploitation of heterosis in cotton – a review. J. Ind. Soc. - Cotton. Imp., 5: 46-56.

Thomson, N.J., 1971.Heterosis and combining ability of American and African cotton cultivars in low latitude under high yield conditions. Aust. J. Agric. Res., 22: 759-770.

U.S. Department of Agriculture. Cotton varieties planted in 1988. USDA Agric. Marketing Serv., Cotton Div. Memphis, TN.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics with special reference to Biological Sciences. McGraw Hill Inc., N.Y.