RESEARCH PAPER | Asian Journal of Bio Science, Volume **8** | Issue 1 | April, 2013 | 82-85
Received : 15.01.2013; **Revised :** 28.02.2013; **Accepted :** 30.03.2013

Studies on heterosis in cotton (*Gossypium hirsutum* L.) for seed cotton yield and its components

H.M. RANGANATHA[1], SHREEKANTH S. PATIL[2], S.M. MANJULA[2] **AND** B.C. PATIL[2]

[1]Department of Genetics and Plant Breeding, Agricultural College, University of Agricultural Sciences, DHARWAD (KARNATAKA) INDIA
[2]Agricultural Research Station (U.A.S-D), HEBBALLI (KARNATAKA) INDIA
Email: rangauasd1@gmail.com

Present study was undertaken to assess the extent of heterosis for seed cotton yield and its attributing traits in 54 inter plant type hybrids of cotton developed by crossing 9 lines with 6 testers in line × tester mating design during *Kharif* 2009 at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad. The mean sum of squares of parent's vs hybrids was significant for all the characters except reproductive points and boll harvest index, indicating presence of heterosis for these traits. None of the crosses were superior for all the traits studied. However, the cross L_5 x T_5 was the best as it had highest mean performance for economically important characters. Majority of the crosses exhibited positive significant mid parent, better parent heterosis for all important yield contributing characters except for inter boll distance and inter branch distance where they showed significant negative heterosis, indicating predominance of non-additive gene action in the genetic control of these traits. Most of the hybrids expressed significant standard heterosis for all the characters over the checks.

Key words : Cotton, Heterosis, Seed cotton yield

How to cite this paper : Ranganatha, H.M., Patil, Shreekanth S., Manjula, S.M. and Patil, B.C. (2013). Studies on heterosis in Cotton (*Gossypium hirsutum* L.) for seed cotton yield and its components. *Asian J. Bio. Sci.,* 8 (1) : 82-55.

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is a crop of prosperity having a profound influence on men, and matter. It is an industrial commodity of worldwide importance. Cotton is one of the few often cross pollinated crop which is accessible to development of homozygous genotypes as varieties and at the same time amenable for commercial exploitation of heterosis by exploitation of additive as well as non-additive genetic variance. India holds the distinction of being pioneer in the world in developing hybrids by conventional hand emasculation and pollination, and commercial cultivation of hybrids. The development and release of world's first commercial intra-hirsutum hybrid H-4 and first inter specific hybrid, Varalaxmi during the seventies, respectively was an important milestone in the history of cotton improvement not only in India but also in the world.

Heterosis is the superiority of the hybrid over the mid or better parent or over standard check and is the result of allelic or non-allelic interactions of genes under influence of particular environment. To develop potential hybrids in cotton it is necessary to exploit genetic diversity available in the form of visible differences in plant type traits and a cross between robust types and compact types can lead to improvement in higher productivity as a result of superimposition of the desirable features of these contrasting plant types in the F_1 hybrids (Anuradha, 1998). In the present study efforts are made to evaluate the selected diversified parental material for exploiting the hybrid vigour for seed cotton yield and its attributing traits.

RESEARCH METHODOLOGY

The experimental material used in the present investigation was selected based on the plant type traits to exploit the hybrid vigour. Material consisted of 54 crosses derived by crossing 9 robust lines with 6 compact testers (breeding lines) through line × tester mating design. These 54 hybrids and their 15 parents were grown in Randomized Block Design with two replications during *Kharif* 2009 at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad. Each entry was grown in two rows of 1.8

m length following the recommended spacing of 90cm × 60cm. In each entry, three competitive plants were randomly tagged and observations were recorded on seed cotton yield (q/ha), boll number, boll weight (g) and other important yield contributing characters. The mean values of these three plants were computed for each entry for all the characters and were subjected to analysis of variance following the methods of (Panse and Sukathme, 1967). The per cent heterosis of all F_1 crosses over their mid parent (MP), better parent (BP) and standard checks (SC) were computed as per the method suggested by Turner (1953) and Hayes *et al*. (1955).

RESEARCH FINDINGS AND ANALYSIS

Analysis of variance indicated significant differences among the entries for all the characters. Parents exhibited significant differences in respect of all the characters, hybrids exhibited significant differences in respect of all the characters studied except for plant height, reproductive points inter branch distance and inter boll distance. The mean sum of squares of parents vs hybrids was significant for all the characters except reproductive points and boll harvest index, indicating presence of heterosis for these traits (Table 1).

Among 54 hybrids evaluated, none of the crosses were superior for all the traits studied. However, the hybrid 'L_5 x T_5' was superior for seed cotton yield, boll number, boll weight, number of sympodia per plant, reproductive points and inter branch distance. Another hybrid 'L_9 x T_2' was superior for boll weight and lint index. The hybrids, 'L_1 x T_2' seed cotton yield and reproductive points, 'L_2 x T_2' seed cotton yield and bolls per plant. (Table 2). The cross 'L_5 x T_5' was the best since, it had highest mean performance for seed cotton yield and other economically important characters.

All the fourteen characters studied in the present study exhibited significant mid parent, better parent heterosis in majority of the crosses indicating predominance of non-additive gene action in the genetic control of these traits. This is in accordance with the results reported by Kajjidoni (1982), Kapoor *et al.* (2000), Neelam *et al.* (2002a), Deosarkar *et al.* (2009a), Pole *et al.* (2008), Rajamani *et al.* (2009), Tuteja *et al.* (2004) and Wankhade *et al.* (2009) in Cotton. Most of the hybrids expressed significant standard heterosis for all the characters over the standard checks, whereas some hybrids expressed negative heterosis for inter boll distance which were in agreement with the findings of Anuradha (1990). The results of heterosis also indicated that, no single hybrid was superior in respect of all the traits. However, considering the hybrids with significant heterosis over mid parent, better parent, standard check and *per se* performance, five crosses *viz*., 'L_5 x T_5, L_9 x T_2, L_5 x T_6, L_9 x T_5 and L_2 x T_2' exhibited significant higher standard heterosis over both the standard checks (Table 2). The hybrids, L_1 x T_4 and L_5 x T_6 exhibited significant negative heterosis over both the standard checks for inter boll distance where the reduced inter boll distance helps in increased and better packing of bolls on the sympodial branches. Further, it is noticed that all the superior hybrids for fourteen characters studied had L_5 (among lines) and T_2 (among testers) as one of the parents in their cross combinations. Hence, these parents can be utilized in realizing the superior heterosis for full exploitation of the crop for the economically important traits.

Table 1: Analysis of variance for seed cotton yield and its attributing characters in cotton

Source of variation	D.F.	Seed cotton yield (q/ha)	Bolls per plant	Boll weight (g)	Number of sympodia per plant	Reproductive points	Inter branch distance (cm)	Inter boll distance (cm)
Replication	1	4.73	3.44	0.32	43.09	0.11	0.04	0.07
Genotypes	68	45.84**	179.00**	0.61**	35.55**	0.51*	1.77**	1.71*
Parents	14	17.72**	30.65**	0.43**	11.95**	0.98**	2.46**	2.69**
Hybrids	53	16.77**	46.52**	0.32**	18.32**	0.38	0.83	1.25
Hybrids Vs Parents	1	1980.14**	9277.87**	18.68**	1279.15**	0.69	41.72**	11.95**
Error	68	5.31	17.64	0.06	4.67	0.29	0.93	1.1

Contd….Table 1

Source of variation	D.F.	Plant height (cm)	Number of monopodia per plant	Sympodial length at 50% plant height (cm)	Ginning out turn (%)	Seed index (g)	Lint index (g)	BHI (%)
Replication	1	3.38	0.03	14.11	0.38	0.01	0.06	3.54
Genotypes	68	787.35**	0.56**	65**	2.83**	1.42**	0.90**	5.51**
Parents	14	2040.93**	0.29	140.62**	3.51**	0.75**	0.41**	2.34**
Hybrids	53	271.81	0.20*	36.50**	1.77**	0.76**	0.43**	6.43**
Hybrids Vs Parents	1	10560.47**	23.23**	516.45**	49.41**	45.87**	32.48**	1.64
Error	68	183.95	0.12	16.47	0.57	0.09	0.07	0.43

* and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 2: Superior crosses with *per se* performance and heterosis for seed cotton yield and its attributing characters in cotton

Characters	Superior crosses	*Per se* performance of crosses	Heterosis over mid parent	Heterosis over better parent	Heterosis over standard check 1	Heterosis over standard check 2
Seed cotton yield (q/ha)	L_5 x T_5	34.73	69.65**	57.74**	35.23**	40.71**
	L_9 x T_2	34.45	74.45**	49.82**	34.12**	39.56**
	L_1 x T_2	32.89	84.03**	70.88**	28.07**	33.26**
	L_5 x T_6	31.38	76.91**	65.74**	22.15*	27.1**
	L_9 x T_5	31.02	37.82**	34.9**	20.77*	25.66**
	L_2 x T_2	30.90	55.86**	33.48**	20.3*	25.18**
Bolls per plant	L_5 x T_3	47.95	154.58**	116.28**	49.14**	51.5**
	L_5 x T_5	47.05	162.59**	112.22**	46.35**	48.66**
	L_2 x T_2	46.55	127.99**	99.49**	44.79**	47.08**
	L_5 x T_4	46.40	82.55**	61.87**	44.32**	46.6**
Boll weight (g)	L_9 x T_2	6.06	67.89**	58.56**	27.95**	22.77**
	L_4 x T_2	5.97	48.79**	29.08**	25.95**	20.85**
	L_5 x T_5	5.84	21.67**	14.51**	23.21**	18.22**
	L_7 x T_2	5.77	47.95**	31.14**	21.73**	16.8**
Number of sympodia per plant	L_5 x T_5	33.75	104.55**	87.5**	52.71**	56.25**
	L_5 x T_2	28.8	88.85**	60**	30.32**	33.33**
	L_7 x T_2	28.65	74.51**	40.89**	29.64**	32.64**
Reproductive points	L_7 x T_1	5.5	26.58*	17.9	44.74**	50.89**
	L_5 x T_5	5.4	35.93**	22.17	42.11**	48.15**
	L_1 x T_2	4.95	24.69*	7.61	30.26*	35.8**
Inter branch distance (cm)	L_8 x T_5	7.50	-3.23	-11.18	-35.90**	-39.27**
	L_9 x T_6	7.75	-6.38	-15.96	-33.76**	-37.25**
	L_5 x T_5	7.80	-9.71	-11.7	-33.33**	-36.84**
Inter boll distance (cm)	L_1 x T_4	8.35	6.35	-8.26	-27.4**	-25.99**
	L_5 x T_6	8.54	-3.34	-17.58	-25.7**	-24.26**
Plant height (cm)	L_6 x T_1	187.45	50.87**	48.97**	0.24	5.01
	L_7 x T_4	182.65	18.22*	-1.27	-2.33	2.32
Number of monopodia per plant	L_6 x T_3	3.05	115.17**	83.18**	41.86*	29.79*
	L_5 x T_2	2.85	106.9*	36.69*	32.56*	21.28
Sympodial length at 50% plant height (cm)	L_7 x T_6	52.9	55.91**	29.47**	25.36**	34.95**
	L_8 x T_4	50.25	38.62**	20.84**	19.08*	28.19**
Ginning out turn (%)	L_7 x T_6	41.69	8.9**	1.95	8.28**	10.14**
	L_4 x T_6	41.42	5.82**	1.28	7.57**	9.42**
	L_4 x T_1	41.11	11.53**	9.97**	6.77**	8.6**
Seed index (g)	L_5 x T_1	9.64	32.12**	30.69**	16.2**	13.34**
	L_8 x T_2	9.54	38.11**	32.32**	14.94**	12.1**
Lint index (g)	L_8 x T_2	6.35	53.96**	46.11**	22.12**	22.46**
	L_4 x T_6	6.27	25.06**	23.58**	20.76**	21.09**
Boll harvest index (%)	L_6 x T_6	78.29	5.2**	4.29**	9.3**	9.03**
	L_3 x T_6	77.89	3.88**	3.76**	8.73**	8.47**

* and ** indicate significance of values at P=0.05 and 0.01, respectively

LITERATURE CITED

Anuradha, B. (1998). Genetic studies in compact cotton genotypes (*Gossypium hirsutum* L.). M.Sc. (Ag.) Thesis, University of Agricultural Sciences, Dharwad, KARNATAKA (INDIA).

Deosarkar, D.B., Jadhav, D.S. and Patil, S.G. (2009a). Heterosis study in cotton (*Gossypium hirsutum* L.) under rainfed conditions. *J. Cotton Res. Dev.,* **23**(1) : 36-40.

Hayes, H.K., Immer, F.R. and Smith, D.C. (1955). *Methods of Plant Breeding*. Mc. Graw Hill Book Co., Inc, NEW YORK (U.S.A.).

Kajjidoni, S.T. (1982). Heterosis, combining ability and gene action for earliness, yield and yield components in 2´10 crosses of *G. arboreum* L. *G. herbaceum* cotton. M.Sc. (Ag.) Thesis, University of Agricultural Sciences, Dharwad, KARNATAKA (INDIA).

Kapoor, C.J., Singh, M. and Maheshwari, R.V. (2002). Heterosis for yield and yield attributing traits in desi cotton. *J. Cotton Res. Dev.,* **16**(2) : 182-183.

Neelam, G.D., Potdukhe, N.R. and Patil, V.T. (2002a). Heterosis for seed cotton yield and other morphological characters in *Gossypium hirsutum* L. *J. Cotton Res. Dev.,* **16**(2) : 165-167.

Panse, V.G. and Sukathme, P.V. (1967). *Statistical Methods for Agricultural Workers*, ICAR, NEW DELHI (INDIA).

Pole, S.P., Sudewad, S.M., Kamble, S.K. and Borgaonkar, S.B. (2008b). Heterosis for seed cotton yield and yield components in upland cotton (*Gossypium hirsutum* L.). *J. Cotton Res. Dev.,* **22**(2) : 139-142.

Rajamani, S., Mallikarjuna, R. and Krishna, N.R. (2009). Heterosis for yield and fibre properties in upland cotton (*Gossypium hirsutum* L.). *J. Cotton Res. Dev.,* **23**(1) : 43-45.

Turner, J.H. (1953). A study of heterosis in upland cotton-I, yield of hybrids compared with varieties. *Agron. J.*, **45**: 487-490.

Tuteja, O.P., Kumar, S., Verma, S.K. and Ahula, S.L. (2004). Estimation of heterosis for seed cotton yield and its component of characters in *Gossypium hirsutum* L. *J. Cotton Res. Dev.,* **18** : 38-41.

Wankhade, S.N., Patil, S.P., Burghate, S.K. and Chikhale, N.J. (2009). Heterosis for seed cotton yield and its quantitative characters of *Gossypium hirsutum* L. *J. Cotton Res. Dev.,* **23**(1) : 27-31.