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Heterosis studies for oil content, seed cotton yield and other economic traits in cotton *(Gossypium hirsutum* L.)

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Abstract : An investigation was carried out to assess the nature and extent of heterosis for oil content and other economic traits in cotton *(Gossypium hirsutum* L.) through line x tester analysis. Among 40 hybrids analyzed, ten hybrids were expressed significantly positive heterosis for plant height, 15 hybrids for number of sympodia per plant, 16 hybrids for number of bolls per plant, 11 hybrids for number of seeds per boll, twenty hybrids for seed cotton yield and 14 hybrids for oil content over better parent. Four hybrids showed significantly negative heterosis over better parent for days to 50 per cent flowering which indicated earliness of flowering. The overall study of heterosis indicated that hybrid combinations *viz.*, Sahana x LRA 5166 and L 604 x MCU 7 exhibited significantly positive heterosis for all the traits including oil content and seed cotton yield. Two hybrids namely Surabhi x LRA 5166 and CNH 36 x MCU 7 expressed significantly positive heterosis for all the characters included in the study except for days to 50 per cent flowering.

Key words: Cotton, heterosis, seed cotton yield, oil content.

Introduction

Cotton is one of the most important commercial and industrial crop of many countries. The commercial exploitation of heterosis started in India with the release and large scale cultivation of an intra-*hirsutum* long staple hybrid, H 4 during 1971. On global level, India is the first country to make pioneering efforts to exploit the phenomenon of heterosis in cotton available both in inter-specific and intra-specific hybrids on commercial scale. Cotton seed contains considerable amount of edible oil and contributes about 72 per cent to the total oil obtained from oil and non-oil crops produced in Pakistan (Khan *et al.* 1995).

In cotton, heterosis studies for seed cotton yield and other fiber properties are many. But to know the nature and extent of heterosis for oil content with seed cotton yield and other economic characters is limited. Such studies are very limited in intra specific crosses of cotton genotypes. Considering the above mentioned facts, the present investigation was undertaken to estimate nature and extent of heterosis for oil content, seed cotton yield and other economic characters in cotton hybrids through line x tester analysis.

Materials and Methods

The experimental materials consisted of eight lines *viz.*, TCH 1218 (L_1), Sahana (L_2), Anjali (L_3), Surabhi (L_4), CWROK 165 (L_5), DBD 1071 (L_6), CNH 36 (L_7) and L 604 (L_8) and five testers *viz.*, LRA 5166 (T_1, MCU 5 (T_2), MCU 7 (T_3), MCU 9 (T_4) and SVPR 2 (T_5). Crosses were effected in a line x tester mating design (Kempthorne, 1957). Forty F_1 hybrids of the resultant crosses along with their parents were raised in a randomized block design (RBD) with two replications at Agricultural College and Research

Table 1. Heterosis per cent for oil content, seed cotton yield and other economic traits

Hybrid	Days to 50% flowering		Plant Height		No.of sympodia/ plant	
	d_i	d_{ii}	d_i	d_{ii}	d_i	d_{ii}
TCH 1218 xLRA 5166	1.71	3.48*	-1.09	-9.13*	35.24*	27.12*
TCH 1218 x MCU 5	-1.68	-1.68	9.26*	0.21	22.80*	16.01*
TCH 1218 x MCU 7	-1.29	0.88	5.05*	-6.08*	-6.63	-15.38*
TCH 1218 x MCU 9	-4.24*	-3.42*	-3.15	12.18*	-10.04*	-14.90*
TCH 1218 x SVPR 2	-2.50	-1.68	1.25	-0.76	13.74*	9.23*
Sahana xLRA 5166	3.48*	3.68*	23.68*	20.75*	32.39*	31.12*
Sahana x MCU 5	0.00	1.74	-0.50	-2.66	-3.98	-5.41
Sahana x MCU 7	0.44	0.00	15.98*	15.26*	37.73*	33.70*
Sahana x MCU 9	0.00	0.87	1.82	0.85	-.16	-7.68
Sahana x SVPR 2	0.85	3.68*	-2.04	1.46	26.68*	22.72*
CWROK 165xLRA5166	-1.74	-1.74	8.98*	-1.08	-0.78	-4.64
CWROK 165 x MCU 5	1.71	3.68*	9.43*	-0.50	-8.75	-12.76*
CWROK 165 x MCU 7	-2.18*	-1-.75	30.40*	21.70*	39.16*	39.05*
CWROK 165 x MCU 9	0.00	0.87	2.93	-5.34	-3.35	-7.71
CWROK 165 x SVPR 2	0.85	3.68*	7.33*	-8.18*	10.48*	3.92
Anjali xLRA 5166	-1.75	-0.88	-4.92	-19.98*	-0.29	-6.56
Anjali x MCU 5	0.85	3.36	-5.88	-20.66*	-11.30*	-17.30*
Anjali x MCU 7	1.32	1.77	-6.76*	-19.53*	-11.25*	-13.62*
Anjali x MCU 9	-1.74	0.00	-19.35*	-31.31*	-19.42	-24.96*
Anjali x SVPR 2	1.71	1.77	-10.49*	28.59*	23.93*	16.58*
Surabhi xLRA 5166	0.85	-3.48*	10.54*	6.51*	36.30*	33.88*
Surabhi x MCU 5	-1.67	-0.84	11.22*	7.37*	-3.73	-5.73
Surabhi x MCU 7	1.26	4.39*	-3.46	-4.16	-1.01	-3.01
Surabhi x MCU 9	0.00	1.71	-15.52*	-17.44*	2.81	-0.27
Surabhi x SVPR 2	0.00	0.00	-1.01	-10.49*	22.83*	18.02*
CNH36xLRA5166	1.74	1.74	7.67*	1.55	3.66	2.87
CNH 36 x MCU 5	-1.74	-3.36*	17.27*	10.80*	-2.96	-3.23
CNH 36 x MCU 7	-0.44	0.00	30.72*	26.92*	35.21*	29.03*
CNH 36 x MCU 9	0.00	0.87	-3.30	-7.53*	-5.79	-5.91
CNH 36 x SVPR 2	0.85	3.87*	1.85	-9.73*	27.15*	25.33*
DPD 1071 xLRA5166	0.86	1.74	-1.62	-5.47	2.87	-2.19
DPD1071xMCU5	-2.54*	-1.74	-14.10*	-17.31*	25.71*	18.92*
DPD 1071xMCU7	-0.43	0.88	7.90*	-8.84*	-12.43*	-13.56*
DPD1071xMCU9	-0.85	-0.85	-11.70*	-13.95*	1.51	-4.10
DPD 1071xSVPR2	-0.84	0.85	10.61*	19.32*	52.88*	42.30*
L 604 xLRA 5166	0.43	1.73	0.91	-0.60	1.24	0.55
L 604 x MCU 5	-4.64*	-5.04*	3.67	2.32	-3.69	-4.86
L 604 x MCU 7	0.86	2.63*	18.83*	17.04*	34.48*	30.19*
L 604 x MCU 9	-2.13	-1.74	-12.45*	-12.50*	-19.67*	-20.75*
L 604 x SVPR 2	2.09*	3.39*	2.82	-5.10	34.41*	30.56*
S. E.	0.58	0.67	2.32	2.62	0.90	1.04

di - Relative heterosis ; dii - Heterobeltiosis * Significant at P = 5 per cent level

Table 1. Contd...

Hybrid	No.of bolls/ plant		No.of seeds/ boll		Seed cotton yield/plant		Oil content	
	d_i	d_{ii}	d_i	d_{ii}	d_i	d_{ii}	d_i	d_{ii}
TCH 1218 xLRA 5166	41.59*	29.03*	7.76*	2.46	36.96*	35.60*	3.81	3.74
TCH 1218 x MCU 5	21.61*	9.84	7.30*	2.46	26.16*	14.82*	-5.48*	-7.81*
TCH 1218 x MCU 7	4.22	-8.39	-4.35	-9.84*	-1.73	-6.57*	-0.94	-2.00
TCH 1218 x MCU 9	-18.91*	-28.06*	-8.55*	-12.55*	-5.40*	-0.93	1.88	0.67
TCH 1218 x SVPR 2	14.36*	6.98	-2.54	-5.74*	4.59	4.26	-3.75	-7.67*
Sahana xLRA 5166	37.10*	34.42*	14.81*	12.73*	48.48*	36.55*	11.06*	7.67*
Sahana x MCU 5	-17.37*	-18.20*	-0.46	-2.70	13.63*	13.46*	-0.50	-0.97
Sahana x MCU 7	40.62*	37.76*	9.35*	8.33*	38.31*	32.25*	-2.21	-6.04*
Sahana x MCU 9	6.80	5.75	5.55*	2.68	12.62*	6.49*	-4.39*	-8.24*
Sahana x SVPR 2	32.04*	25.93*	3.64	0.00	26.32*	15.44*	-1.62	-8.26
CWROK165xLRA5166	17.30*	6.67	-.5.45*	-5.45*	1.61	-7.60*	7.06*	6.88*
CWROK165xMCU5	12.45*	3.20	-3.17	-3.60	7.97*	6.81*	0.04	-2.20
CWROK165xMCU7	62.24*	53.19*	14.68*	13.64*	33.45*	26.12*	1.15	-0.16
CWROK 165 x MCU 9	11.20*	3.95	1.80	0.89	4.37	-2.45	-5.87*	-7.19*
CWROK165xSVPR2	34.10*	18.89*	7.14*	5.26*	31.37*	18.73*	-1.51	-5.71*
Anjali xLRA 5166	-9.39	-12.94*	6.78*	5.32*	-16.32*	-26.38*	11.82*	11.49*
Anjali x MCU 5	-1.71	4.40	1.78	0.88	3.54	-1.23	5.51*	2.59
Anjali x MCU 7	8.43	8.51	-1.35	-3.54	17.67*	7.42*	6.53*	5.73*
Anjali x MCU 9	-9.21	-10.15	-2.33	-2.67	-9.62*	-18.37*	7.86*	6.93*
Anjali x SVPR 2	-18.65*	-24.81*	-2.20	-2.67	-9.93*	-21.22*	12.08*	7.86*
Surabhi xLRA 5166	21.70*	17.27*	6.38*	6.34*	36.29*	25.51*	10.58*	6.64*
Surabhi x MCU 5	-1.71	-6.18	6.78*	6.32*	21.71*	21.34*	-12.58*	-13.65*
Surabhi x MCU 7	-13.73*	-20.00*	2.75	1.82	11.89*	7.14*	-6.37*	10.87*
Surabhi x MCU 9	-8.74	-14.55*	1.80	0.89	-6.19*	-11.17*	-1.23	-5.88*
Surabhi x SVPR 2	19.27*	18.18*	0.00	-0.89	15.63*	6.82*	-2.83	-4.78*
CNH36xLRA5166	-6.55	-12.88*	-0.90	-1.79	-1.43	-9.65*	7.15*	6.07*
CNH 36 x MCU 5	0.97	-6.78	-0.45	-0.89	12.57*	12.33*	-0.34	-3.70
CNH 36 x MCU 7	28.32*	15.34*	7.27*	5.36*	31.96*	25.74*	6.08*	5.96*
CNH 36 x MCU 9	6.54	-3.39	-0.67	0.89	3.01	-2.94	7.08*	6.84*
CNH 36 x SVPR 2	20.35*	15.35*	5.36*	3.51	12.28*	2.28	1.86	-1.38
DPD 1071 XLRA5166	5.38	-3.34	1.87	0.97	-7.10*	-13.96*	5.85*	5.28*
DPD1071xMCU5	39.13*	28.00*	11.42*	9.91*	28.17*	25.11*	4.13*	1.09
DPD 1071xMCU7	1.12	-4.52	1.85	1.85	2.38	-1.40	-0.37	-0.95
DPD 1071xMCU9	-16.13*	8.88	3.64	1.79	-0.53	-5.29	8.49*	7.72*
DPD 1071xSVPR2	47.92*	31.48*	2.70	0.00	28.53*	19.19*	5.60*	1.77
L 604 xLRA 5166	7.00	4.90	-0.45	-0.97	-8.69*	-14.73*	6.59*	1.08
L 604 x MCU 5	-2.83	-3.80	-2.70	-2.70	-5.96*	-7.63*	7.14*	-0.71
L 604 x MCU 7	41.87*	38.98*	9.58*	8.11*	27.33*	23.71*	14.15*	9.43*
L 604 x MCU 9	-18.25*	-19.08*	-4.45*	-4.78*	-8.54*	-12.15*	13.08*	8.52*
L 604 x SVPR 2	35.15*	28.89*	10.22*	8.77*	27.54*	18.34*	0.09	-1.21
S.E.	1.41	1.62	0.55	0.64	2.29	2.65	0.45	0.52

di - Relative heterosis dii - Heterobeltiosis * Significant at P = 5 % level

Institute, Madurai during summer, 2001. Each genotype was sown in a single row of 4.5 meter length with a spacing of 90 x 45 cm. Recommended cultural practices were followed throughout the crop growth and need based plant protection measures were taken up. Data on ten randomly selected plants in each genotype were collected for days to 50 per cent flowering, plant height (cm), number of sympodia per plant, number of bolls per plant, number of seeds per boll, seed cotton yield(g) per plant and seed oil content (%). The ginned representative samples were delinted with commercial sulphuric acid and used for oil content estimation by employing Nuclear Magnetic Resonance (NMR) technology using Oxford 4000 NMR auto analyzer installed at Department of Biochemistry, Tamil Nadu Agricultural University, Coimbatore. The relative heterosis or average heterosis and heterobeltiosis were estimated for all the characters, in each hybrid combination.

Results and Discussion

The extent of heterosis will have direct effect on breeding methodology in the hybrid / varietal improvement programme. The utilization of hybrids directly for commercial production mainly depends upon the nature and extent of heterosis. Increasing of F_1 hybrid value over the better parent ~~value~~ is more relevant for exploitation of heterosis for commercial purpose (Williams and Gilbert, 1960).

The expression of heterosis was worked out for all the characters over mid-parent and better parent and are presented in Table 1. The relative heterosis for days to 50 per cent flowering ranged from -4.64 (L 604 x MCU 5) to 3.48 per cent (Sahana x LRA 5166). Out of 40 hybrids analyzed, six recorded significant negative heterosis over mid parental value. Heterobeltiosis ranged from -5.04 to (L 604 x MCU 5) to 4.39 per cent (Surabhi x MCU 7). Four hybrids showed significant negative heterosis and ten hybrids showed significant positive heterosis over better parent for this trait. Kumaresan *et al.* (1999) reported negative heterosis for days to 50 per cent flowering.

For plant height, relative heterosis per cent manifested in the hybrids varied from -19.35 (Anjali x MCU 9) to 30.72 (CNH 36 x MCU 7) and from -31.31 (Anjali x MCU 9) to 26.92 (CNH 36 x MCU 7) for heterobeltiosis. Relative heterosis for 10 hybrids and heterobeltiosis for ten hybrids were positive and significant.

Relative heterosis per cent for number of sympodia per plant ranged from -19.67 (L 604 x MCU 9) to 52.88 per cent (DBD 1071 x SVPR 2) and from -20.75 (L 604 x MCU 9) to 42.30 per cent (DBD 1071 x SVPR 2) for heterobeltiosis. Heterosis values were significantly positive in 16 cross combinations for relative heterosis and 15 hybrids were recorded significantly positive values over better parent. This is akin with earlier finding of Koodalingam *et al.* (1991).

For number of bolls per plant, the highest relative heterosis (62.24%) and heterobeltiosis (53.19%) were observed in the same hybrid CWROK 165 x MCU 7. Whereas, the lowest relative heterosis (-18.91%) and heterobeltiosis (-28.06%) were observed in the same hybrid TCH 1218 x MCU 9. Among 40 hybrids, 19 hybrids expressed significantly positive relative heterosis and 14 hybrids showed significantly positive heterosis values over better parent.

Heterosis for number of seeds per boll ranged from -8.55 (TCH 1218 x MCU 9) to 14.81 per cent (Sahana x LRA 5166) for relative heterosis and from -12.55 (TCH 1218 x MCU 9) to 13.64 per cent (CWROK 165 x MCU 7) for heterobeltiosis. Relative heterosis for 15 hybrids and heterobeltiosis for 11 hybrids were significantly positive for this trait.

For seed cotton yield, the cross Sahana x LRA 5166 showed highest percentage of relative heterosis (48.48%), while the cross Anjali x LRA 5166 recorded the lowest value (-16.32%). Heterobeltiosis per cent for this trait ranged from -26.38 (Anjali x LRA 5166) to 36.55 (Sahana x LRA 5166). Among 40 hybrids, 22 hybrids showed significantly positive heterosis over mid parent and 20 hybrids expressed significantly positive heterosis over better parent. The similar results were already reported by Chaudhari *et al.* (1992) for seed cotton yield.

For oil content, among 40 combinations, 19 crosses were recorded significantly positive heterosis over mid parent and 14 hybrids over better parent. For this trait, minimum and maximum heterosis per cent ranged from -12.58 (Surabhi x MCU 5) to 14.15 (L 604 x MCU 7) over mid parent and from -13.65 (Surabhi x MCU 5) to 11.39 (Anjali x LRA 5166) over better parent. Positive heterosis for cotton seed oil content was reported already by Kashalkar *et al.* (1989).

The overall study of heterosis indicated that the hybrid combinations like Sahana x LRA 5166 and L 604 x MCU 7 exhibited significantly positive heterosis for all the traits included in the study (days to 50 per cent flowering, plant height, number of sympodia per plant, number of bolls per plant, number of seeds per boll, seed cotton yield per plant and oil content). The other two hybrids *viz.*, Surabhi x LRA 5166 and CNH 36 x MCU 7 expressed significantly positive heterosis for all the characters except days to 50 per cent flowering, which indicated earliness of flowering. Hence these hybrids would be effectively utilized for heterosis breeding programme.

References

Chaudhari, P.N., Borole, D.N., Tendulkar, A.V. and Narkhede, B.N. (1992) Heterosis for economic traits in intra-specific crosses of desi cotton. *J. Maharashtra Agric. Univ.*, **17(2):** 273-276.

Kashalkar, P. D., Dani, R. G. and Weginwar, D. G. (1989). Heterosis and maternal effects for seed oil content in upland cotton. *Indian J. Genet. Plant Breed.*, **49(2):** 209-221.

Khan, LA., Qayyum, A. and Manzoor, T. (1995). Analysis of seed oil and protein contents in cotton germplasm. *Sci. Int.*, **7:** 199-200.

Kempthorne, O. (1957). An Introduction to Genetic Statistics. John wiley and Sons. Inc., New York.

Koodalingm, K., Rajasekaran, S. and Ramalingam, A. (1991). Heterosis and inbreeding depression in inter-specific upland cotton. *Ann. Agric. Res.*, **12 :** 288-291.

Kumaresan, D., Ganesan, J., Azhaguvel, P. and Senthilkumar, P (1999). Heterosis for some important quantitative traits in cotton (G. *hirsutum* L.). *Tropical Agric. Res.*, **11 :** 149-153.

Williams, W. and Gilbert, N.E. (l960). Heterosis and inheritance of yield in the tomato. *Hererity*, **15:** 133-150.