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STUDY OF HETEROTIC POTENTIAL IN CROSSES INVOLVING LEAF FOLDER (*Cnaphalocrocis medinalis* Gn.) RESISTANT RICE ACCESSIONS

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Hybridization programme involving seven resistant sources of leaf folder and seven popular strains was launched at the Paddy Breeding Station, Coimbatore and crossed seeds were obtained. Twenty three hybrid combinations and their respective parents were raised in randomised block design replicated twice. Six economic traits were studied in randomly selected twenty hybrids and parents. Heterosis, heterobeltiosis and standard heterosis were computed and significance was worked out for heterosis. The study revealed that three crosses viz., IR. 36 x W 1263, IR 20 x IR 4707-106-3-2 and IR 20 x Muthumanickam manifested heterosis for the six characters studied. The manifestation of heterosis in all the 23 cross combinations might be due to additive gene effects and the negative heterosis observed might be due to the disharmony of the gene combinations present in different parents.

In recent years, increased attention is focused to evolve rice strains to withstand chemical and biological stresses occuring in nature. The leaf folder (LF) has assumed an important role to play among the biological stresses. In order to develop leaf folder resistant rice varieties, hybridisation programme involving resistant sources and popular strains was undertaken at the Paddy Breeding Station, Coimbatore.

MATERIALS AND METHODS

Seven high yielding rice varieties viz., IR 20, IR 28, IR 36, CO 44, CO 41, Bhavani and Vaigai and seven leaf folder resitant donor parents viz., W 1263, IET 5741, T 2005, IR 4707-106-3-2, Muthumanickam, ARC 10550 and BKNBR 1088-83 were sown in the nursery beds thrice with 15 days intervals to synchronise the flowering time during September-October, 1980. Planting was taken up with a spacing of 30 cm between rows and 20 cm between plants in the row. Crossing was effected with "wet cloth" method during December 1980 and January 1981. Crossed seeds were collected in 23 cross combinations, dried and again sown in the nursery beds along with their respective parents. Single seedling of F_1s was transplanted in the mainfield along with their respective parents on both sides with a spacing of 30 cm between rows and 30 cm between seedlings in the row. One row of 5.00 meter length in each cross combination was adopted with randomised block design replicated twice. Observations were recorded in randomly selected 20 hybrids and 20 plants in each parent for yield components viz., plant height,

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number of productive tillers, panicle length, spikelet numbers per panicle, 100 grains weight and grain yield per plant during May-June 1981. Mean values, heterosis, heterobeltiosis and standard heterosis were computed and significance was worked out for heterosis (Table 1 and 2).

RESULTS AND DISCUSSION

Plant height: Highly significant heterosis over mid-parent (di) for plant height ranged from +18.12 (IR 36 x IR 4707-106-3-2) to —19.08 per cent (Vaigai x ARC 10550). Eleven cross combinations recorded highly significant heterosis over mid-parent (di) of which four were found to be negative as reported by Khaleque *et al.* (1977) and Mallick *et al.* (1978) and seven were in positive side as obtained by Singh *et al.* (1980.) Heterobeltiosis (dii) ranged from + 13 43 (IR 28 x IR 4707-106-3-2) to -35 67 per cent (Vaigai x ARC 10550). as recorded by Karunakaran (1968) and Sivasubramanian (1970). Among 23 crosses, five crosses recorded both heterosis (di) and heterobltiosis (dii) for plant, height.

Productive tillers: Heterosis was manifested for productive tillers which ranged from +147.12 (Bhavani x ARC 10550) to +424.39 per cent (Co 41 x Muthumanickam). This result is in corroboration with the finding of Parmasivan (1975) and Singh and Singh (1979). Twenty crosses showed highly significant heterosis over mid parent. All the twenty three crosses exhibited heterosis (di), heterobeltiosis (dii) and standard heterosis (diii) for number of productive tillers.

Panicle length: Heterosis manifested for panicle length ranged from + 10.02 (IR 36 x T 2005) to -25.16 per cent (Vaigai x ARC 10550) over mid-parent (di). This finding is in accordance with the work of Saini *et al.* (1974). Three crosses expressed significant heterosis over mid-parent (di) of which two were in positive and one in negative side. Two crosses namely CO 41 x Muthumanickam and IR 20 x IR 4707-106-3-2 exhibited heterosis over mid - parent (di) and heterobltiosis over better parent (dii) for panicle length. This result is confirmed with the findings of Singh *et al* (1980).

SPIKELET NUMBER PER PANICLE

Heterosis expressed for spikelet number per panicle ranged from +31.62 (IR 36 x T 2005) to -26.04 per cent (CO 41 x IR 4707-106-3-2) over mid-parent (di). This finding is in agreement with the work of Srivastava and Seshu (1982). Twenty crosses showed highly significant heterosis of which eleven were in negative and nine were in positive side. Four crosses viz., IR 36 x T 2005, Vaigai x Muthumanickam, Vaigai X BKNBR 1088-83 and Vaigai x ARC 10550 exhibited heterosis over mid-parent (di) and over better parent (dii). Another set of four crosses viz., IET 5741 x CO 44, IR 20 x IR 4707-106 -3-2, IR 36 x Muthumanickam and IR 20 x Muthumanickam expressed heterosis for number of spikelets for panicle over mid-parent (di), over better parent (dii) and over the superior parent (diii).

Table 1. Mean Values of Parents

S. No	Parents	Plant height (cm)	Productive tiller No.	Panicle length (cm)	Spikelet No per panicle	100 grain weight (g)	Grain yield per plant (g)
1.	IR 36	77.10	12.40	22.20	107.25	2.040	21.50
2.	W 1263	135.30	7.00	24.20	117.10	2.320	29.20
3.	IET 5741	123.80	7.20	25.30	160.40	2.160	42.35
4.	CO 44	102.30	7.40	26.10	128.00	1.840	27.78
5.	Bhavani	128.60	10.20	25.30	150.30	2.060	30.25
6.	T 2005	148.80	6.40	25.60	112.60	1.840	11.70
7.	IR 4707-106-3-2	84.20	8.60	24.50	147.90	1.680	40.10
8.	IR 28	88.60	7.40	25.70	100.80	2.260	28.30
9.	CO 41	105.50	8.20	23.00	112.00	1.680	30.10
10.	Muthumanickam	118.50	8.20	23.17	151.50	1.200	41.10
11.	Vaigai	90.80	8.00	22.90	145.50	2.080	47.40
12.	IR 20	99.20	9.40	26.40	146.30	1.900	30.80
13.	ARC 10550	153.90	7.20	28.36	139.20	2.840	12.50
14.	BKNBR 1088-83	121.00	6.70	28.36	118.40	2.440	28.20

100 grain weight: Heterosis manifested for 100 grain weight ranged from +37.80 (Vaigai x Muthumanickam) to -29.12 per cent (CO 41 X BKNBR 1088-83) over mid-parent (di). This is confirmed with the work of Davis and Rutger (1976). Six crosses showed highly significant heterosis of which five crosses expressed positive heterosis and one negative heterosis over mid-parent (di). Three crosses viz., CO 41 x IR 4707-106-3-2, CO 41 x Muthumanickam and Vaigai x Muthumanickam exhibited heterosis over mid parent (di) and over better parent (dii) as stated by Singh *et al.,* (1980).

Grain yield per plant: The manifested heterosis ranged from -21.79 (IR 28 x Muthumanickam) to +203.61 per cent (IR 36 x T 2005) over mid-parent (di) as observed by Murayama (1974) for grain yield per plant. Twenty two crosses expressed highly significant heterosis over mid-parent (di) of which 20 crosses were in positive side as reported by Srivastava and Seshu (1982) and two were in negative side. Eight crosses showed heterosis over mid parent (di) and over better parent (dii) as found out by Singh and Singh (1979) for grain yield per plant. Another eight crosses expressed heterosis for grain yield per plant for the three parameters viz., heterosis (di = over mid parent), heterobeltiosis (dii = over better parent) and standard heterosis (diii = over the best parent).

Table 2. Mean values and percentage of heterosis over mid parent, better parent and superior parent in economic traits of rice hybrids.

Sl. No.	Hybrids	Plant height (cm) Mean	di	dii	diii	Productive tiller No. Mean	di	dii	diii	Panicle length (cm) Mean	di	dii	diii
1.	IR 36 x W 1263	107.12	+ 0.86	−20.82	−29.93	30.87**	+218.24	+148.95	+148.95	23.50*	+ 9.91	− 2.89	−17.10
2.	IET 5741 x Co 44	129.66**	+14.69	+ 4.73	−15.51	32.66**	+347.39	+341.35	+163.39	24.60	− 4.28	− 9.91	−13.23
3.	Bhavani x T 2005	136.66	− 1.47	− 8.15	−11.03	31.00**	+273.49	+203.92	+150.00	24.20	− 4.91	− 3.90	−14.64
4.	IR 36 x T 2005	95.71**	−15.26	−35.63	−37.24	30.57**	+225.21	+146.53	+146.53	24.70**	+10.02	− 3.51	−12.88
5.	IR 36 x IR 4707-106-3-2	95.28**	+18.14	+13.15	−37.51	35.14	+234.66	+102.74	+183.39	24.50	+ 9.13	0.00	−13.58
6.	IR 28 x W 1263	113.20**	+ 1.12	−16.33	−26.04	36.80**	+411.11	+397.29	+196.77	23.70	− 5.01	− 8.43	−16.40
7.	IR 28 x IR 4707-106-3-2	100.50**	+16.31	+13.43	−53.40	36.66**	+358.25	+362.28	+195.65	24.80	− 1.19	− 3.50	−12.53
8.	Co 41 x IR 4707-106-3-2	104.71**	+10.39	− 0.74	−38.48	32.71**	+289.40	+280.35	+163.70	23.20	− 2.36	− 5.30	−18.16
9.	Co 41 x Muthumanickam	119.33**	+ 6.54	+ 0.70	−22.12	43.00**	+424.39	+424.39	+246.77	23.60	+ 2.20	+ 1.85	−16.54
10.	IR 28 x Muthumanickam	96.33	− 6.97	−18.70	−36.84	38.33**	+391.41	+367.44	+209.11	23.10	− 5.48	−10.11	−18.51
11.	Vaigai x Muthumanickam	102.00	− 2.53	−13.92	−31.21	31.62**	+290.37	+285.61	+155.00	21.60	− 8.24	+ 6.77	+23.79

12.	Bhavani x IR 4707-106-3-2	117.50**	+10.43	— 8.63	—23.29	35.50**	+277.65	+248.03	+190.90	24.70	— 8.80	— 2.37	—12.88
13.	IR 20 x IR 4707-106-3-2	101.60**	+10.79	+ 2.49	—33.47	32.80**	+264.44	+248.96	+164.52	27.00	+ 6.09	+ 2.27	— 4.78
14.	Bhavani x ARC 10550	141.00**	— 0.17	— 8.38	— 8.25	21.50**	+147.12	+110.78	+ 73.38	27.30	+ 1.86	— 3.73	— 3.73
15.	Co 41 x BKNBR 1088-83	118.20	+ 4.37	— 1.48	—22.84	29.20**	+291.95	+256.09	+135.48	23.90	— 6.93	—15.72	—15.69
16.	Co 41 x W 1263	125.00	+ 3.82	— 7.61	—18.49	31.80**	+318.42	+287.80	+156.45	18.40**	—22.03	—28.09	—24.49
17.	IR 36 x Muthumanickam	92.20	— 5.72	—21.35	—39.48	39.60**	+288.04	+219.35	+219.35	19.30*	—14.90	—16.90	—31.89
18.	Vaigai x T 2005	101.14**	—15.57	—32.02	—33.76	24.42**	+239.16	+205.25	+ 96.94	23.00	— 5.15	— 1.01	—18.86
19.	Vaigai x BKNBR 1088-83	105.72	— 0.16	—12.68	—30.83	33.16	+351.15	+314.50	+167.42	25.40	—15.53	—10.43	—10.41
20.	Vaigai x ARC 10550	99.00**	—19.08	—35.67	—35.13	39.00**	+413.15	+387.50	+214.52	22.90**	—25.16	—19.25	—19.21
21.	Vaigai x IR 4707-106-3-2	89.60	+ 2.40	— 1.32	—41.15	38.60**	+365.06	+348.84	+211.25	24.00	— 1.26	— 2.04	—15.34
22.	IR 20 x Muthumanickam	114.60	+ 5.28	— 3.29	—25.15	30.60**	+251.72	+225.53	+146.77	25.30	+ 2.05	— 4.16	—10.77
23.	IR 20 x ARC 10550	114.70**	— 9.36	—25.47	—25.08	20.60	+134.09	+119.15	+ 66.13	23.10**	—15.53	— 5.26	—18.51

Sl. No.	Hybrids	Spikelet No. per Panicle				100 grain weight (g)				Grain yield per plant (g)			
		Mean	di	dii	diii	Mean	di	dii	diii	Mean	di	dii	diii
1.	IR x 36 x W 1263	113.50	+ 1.17	− 3.07	−29.07	2.220	+ 1.83	− 4.31	−21.83	49.16**	+ 93.92	+ 68.36	+ 3.71
2.	IET 5741 x Co 44	179.30**	+24.24	+11.78	+11.71	1.900	− 3.00	−10.18	−31.68	46.33**	+ 32.10	+ 9.40	− 2.26
3.	Bhavani x T 2005	106.60**	−18.60	−29.07	−33.35	2.033	+ 4.25	−13.10	−28.41	19.37**	− 0.08	− 69.02	−57.87
4.	IR 36 x T 2005	144.70**	+31.62	+28.50	− 9.73	2.040	+ 5.15	0.00	−28.16	50.40**	+203.61	+134.42	+ 6.32
5.	IR 36 x IR 4707-106-3-2	144.20**	+ 3.14	−16.02	−22.44	2.020	+ 8.60	− 9.80	−28.87	60.10**	+ 95.12	+ 49.87	+26.79
6.	IR 28 x W 1263	100.80**	− 7.48	− 5.03	−30.50	2.280	− 0.43	−17.24	−19.71	39.40**	+ 37.04	+ 34.93	−16.88
7.	IR 28 x IR 4707-106-3-2	122.60	− 1.67	−17.10	−23.43	2.160	+ 9.64	− 6.89	−23.94	24.50**	− 0.28	− 38.90	−48.31
8.	Co 41 x IR 4707-106-3-2	96.10**	−26.04	−35.02	−39.86	2.120**	+26.19	+26.19	−23.35	43.56**	+ 24.10	+ 8.63	− 8.10
9.	Co 41 x Muthumanickam	151.50**	+14.99	− 3.84	−12.71	1.833**	+27.29	+ 9.10	−35.45	43.00**	+ 20.78	+ 4.62	− 9.28
10.	IR 28 x Muthumanickam	111.60**	−11.53	−26.33	−30.25	2.133**	+23.29	− 5.61	−2489	27.06**	− 21.79	− 34.16	−42.91
11.	Vaigai x Muthumanickam	154.30**	+ 3.90	+ 1.84	− 3.78	2.260**	+37.80	+ 7.69	−20.42	63.01**	+ 42.40	+ 32.93	+32.93
12.	Bhavani x IR 4707-106-3-2	142.45**	− 4.46	− 5.22	−11.12	2.000	+ 6.95	−29.12	−29.57	70.90**	+101.53	+ 76.81	+49.58

13.	IR 20 x IR 4707-106-3-2	174.00**	+18 28	+17.64	+13 60	1.800	+ 0.55	— 5.26	—36.61	58.70**	+ 65.59	+ 46.38	+23.84
14.	Bhavani x ARC 10550	135 50*	— 7.77	— 9.84	—24.00	2.575	+ 5.10	— 9.33	— 9.33	46.13**	+115.76	+ 52.50	— 2.68
15.	Co 41 x BKNBR 1088-83	100.60	—12.67	—15.03	—59.80	2.000	—29.12	—18.03	—29.57	33.60*	15.26	+ 11.63	—29.11
16.	Co 41 x W 1163	110.20**	— 3.79	— 5.89	—50.20	1.800	—10.00	—22.41	—36.61	36.10**	+ 21.75	+ 19.93	—23.84
17.	IR 36 x Muthumanickam	161.80	+25.05	+ 6.79	+ 0.86	1.880	+16.04	— 7.84	—33.80	67.50	+115.65	+ 64.23	—42.41
18.	Vaigai x T 2005	107.40**	—16.77	+26.18	—32.86	2.200*	—12.24	+ 5.76	—22.53	46.60**	+ 44.16	10.13	—10.13
19.	Vaigai x BKNBR 1088-83	151.80**	+15.08	+ 4.32	— 5.33	2.200	— 2.65	— 9.83	—22.53	50.10**	+ 34.13	+ 6.96	+ 6.96
20.	Vaigai x ARC 10550	159.00**	+11.69	+ 9.27	— 0.86	2.000**	—18.69	—14.08	—29.57	40.40**	+ 34.89	— 14.77	—14.77
21.	Vaigai x IR 4707-106-3-2	134.40	— 8.38	— 9.12	—16.12	1.900	+10.63	— 8.65	—33.09	43.90	+ 0.34	— 7.38	— 7.38
22.	IR 20 x Muthumanickam	161.00**	+ 8.12	+ 6.27	+ 0.37	1.840**	+18.70	—31.57	—35.21	65.72**	+ 82.80	+ 59.90	+38.65
23.	IR 20 x ARC 10550	111.40	—21.96	—23.85	—30.28	2.360	— 4.21	—16.90	—04.80	29.30	+ 35.33	— 4.87	—38.19

Heterosis = (di =increase/decrease over mid-parental value)

Heterobeltiosis (dii =increase/decrease over better parent)

Standard heterosis = (diii=increase/decrease over superior parent)

** Significant at 1% level

* Significant at 5% level

On overall consideration of the expression of heterosis in different cross combinations, three crosses viz., IR 36 x W 1263, IR 20 x IR 4707-106-3-2 and IR 20 x Muthumanickam manifested heterosis over mid-parent (di) for all the six characters studied of which IR 36 x W 1263 expressed significant heterosis for number of productive tillers, panicle length and grain yield per plant; IR 20 x IR 4707-106-3-2 exhibited highly significant heterosis for four traits viz., plant height, number of productive tillers, spikelet number per panicle and grain yield per plant and IR 20 x Muthumanickam expressed highly significant heterosis for four traits viz., number of productive tillers, spikelet number per panicle, 100 grain weight and grain yield per plant.

From this study, it could be observed that manifestation of heterosis might be due to additive gene effects and there is considerable disharmony between gene combinations among different parental lines leading to negative heterosis in most of the cases The study revealed that the three cross combinations mentioned above may be exploited for further improvement programme since they manifested heterosis for all the six yield components studied.

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