Madras Agric. J., 83(9): 548-551 September 1996
https://doi.org/10.29321/MAJ.10.A01049

HETEROSIS IN EARLY LINES OF INDICA RICE

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ABSTRACT

Nine parents and twenty hybrids of rice (*Oryza sativa*L.) were evaluated for heterosis for days to flowering, plant height, number of productive tillers, panicle length, number of grains per panicle, 100 grain weight and grain yield. Hybrids showing negative heterosis for flowering duration recorded positive heterosis for yield components. Significant standard heterosis for other traits was also observed. We can expect to develop hybrids from the parental lines possessing earliness for higher yield components.

KEY WORDS : Heterosis, Earliness, Yield Components

Increased vegetative growth seen in F_1 hybrids is a common feature in many crop plants. This is due to heterosis, the phenomenon in which the hybrids of two genetically dissimilar parents shown increased vigour over the parents. This phenomenon was first reported by Jones (1926). Positive heterosis, heterobeltiosis and standard heterosis for grain yield in rice *Oryza sativa*L. have been reported by several workers. The objective of the present study was to assess the heterosis for earliness in flowering and other economic components in early cultures of rice.

MATERIALS AND METHODS

Four lines IR 50, CO 37, ADT 36, ASD 16 and five testers CO 39, ASD 8, ASD 17, Heera and Kalyani II were selected and 20 crosses were attempted in line x tester model. All hybrids and their parents were evaluated in a field trail during *kharif*, 1991 at the Paddy Breeding Station, Coimbatore. Randomised block design with three replications was followed adopting a spacing of 20 x 10 cm. Single seedling was planted per hill. At harvest, data were collected on yield and other biometrical traits *viz.*, plant height, number of productive tillers per plant, panicle length, 100 grain weight and number of grains per primary ear. Heterosis, heterobeltiosis and standard heterosis were calculated for all biometrical traits. The test of significance was carried out by adopting 't' test (Wynne *et al.*, 1970)

RESULTS AND DISCUSSION

The performance of 20 hybrids with respect to heterosis (diii) for the seven traits observed is presented in Tables 1-4.

Among the hybrids, relative heterosis ranged from -12.56 (ADT 36/CO 39) to 13.85 (IR 50/ASD 8) per cent for days to flowering. Twelve hybrids recorded negative heterosis. Negative heterosis for days to flowering is desirable as it enables the hybrids to mature earlier thereby increasing their productivity per day per unit area. Compared to the parents, heterosis of early x early crosses might involve recessive x recessive interaction and probably result in early hybrid. Hybrids involving Kalyani II showed high negative heterosis for earliness irrespective of the female parent. The high heterotic performance of the hybrids involving Kalyani II and CO 39 indicated the potentiality of these parents. The relative heterosis for plant height among the hybrids ranged from -1.24 (ASD 16/ASD 8) to 45.34 (ASD 16/Heera) per cent. All the hybrids showed significant positive heterobeltiosis and standard heterosis. Positive and negative heterosis for plant height were reported by Sharma and Mani (1990) and Shailaja Hittalmani *et al.*, (1991). The hybrids ADT 36/CO 39, IR 50/Kalyani II and IR 50/CO 39 had lower heterosis over mid parent, better parent and check variety (IR 50) as well as lower mean plant height. In these three crosses the parents were also dwarf. Thus dwarf x dwarf crosses have resulted in dwarf hybrids. Positive heterosis for number of productive tillers was observed in thirteen hybrids. Similar results were observed earlier by Shanmugasundaram and Sivasubramanian (1985). Out of 20 hybrids, 16 recorded significant positive check variety IR 50 for panicle

Table 1. Magnitude of heterosis for days to flowering and plant height

Hybrids	Days to flowering			Plant height		
	di	dii	diii	di	dii	diii
IR 50/CO 39	-9.04**	-2.04	14.37**	8.27	18.34**	18.34**
IR 50/ASD 8	13.85**	31.40**	35.32**	12.12**	51.27**	51.27**
IR 50/ASD 17	-4.06**	3.60**	20.35**	10.52*	26.68**	26.77**
IR 50/Heera	8.82**	25.59**	29.33**	32.35**	44.55**	22.04**
IR 50/Kalyani II	-1.02	16.17**	16.17**	15.34**	17.67**	17.67**
CO 37/CO 39	5.81**	26.15**	47.30**	10.98*	12.54*	33.48**
CO 37/ASD 8	9.96**	41.29**	45.50**	34.21**	60.57**	95.81**
CO 37/ASD 17	-5.18**	13.39**	31.72**	14.12**	17.61**	43.42**
CO 37/Heera	1.81	30.82**	34.72**	26.17**	54.21**	30.19**
CO 37/Kalyani II	-12.13**	14.96**	14.96**	22.47**	33.00**	38.38**
ADT 36/CO 39	-12.56**	0.00	16.76**	5.32	15.69**	14.65**
ADT 36/ASD 8	5.91**	30.25**	34.13**	-0.33	35.25**	34.03**
ADT 36/ASD 17	-3.33**	10.30**	28.13**	22.06**	40.89**	39.46**
ADT 36/Heera	2.60	26.16**	29.93**	37.70**	49.67**	26.36**
ADT 36/Kalyani II	-7.18**	16.17**	16.17**	39.11**	42.58**	41.30**
ASD 16/CO 39	-10.80	-0.51	16.17**	21.74**	22.93**	45.81**
ASD 16/ASD 8	-4.86**	13.95**	17.35**	-1.24	18.72**	43.59**
ASD 16/ASD 17	-3.23**	8.24**	25.74**	17.47**	21.58**	47.06**
ASD 16/Heera	11.16**	33.14**	37.11**	45.34**	76.78**	49.25**
ASD 16/Kalyani II	-5.65**	14.96**	14.96**	23.63**	33.68**	39.07**

* Significant at 5 per cent level; ** Significant at 1 per cent level

Table 2. Magnitude of heterosis for number of productive tillers per plant and panicle length

Hybrids	Number of productive tillers per plant			Panicle length		
	di	dii	diii	di	dii	diii
IR 50/CO 39	63.71**	58.67**	58.67**	-10.23*	-22.10**	-0.69**
IR 50/ASD 8	42.57**	38.20**	38.20**	-10.16*	-17.68**	4.95**
IR 50/ASD 17	88.47**	81.11**	81.09**	-2.69	-12.25**	11.86**
IR 50/Heera	55.76**	22.56*	22.56*	-7.28	-24.47**	-3.71**
IR 50/Kalyani II	36.23**	22.56*	22.56*	-3.55	-24.29**	-3.48**
CO 37/CO 39	9.22	3.46	-6.52	10.65	7.13	0.46**
CO 37/ASD 8	80.75**	68.19**	57.89**	16.67**	6.60	13.15**
CO 37/ASD 17	47.70**	38.61**	27.77*	17.99**	9.57	12.23**
CO 37/Heera	63.58**	39.84**	13.04	33.42**	27.65**	12.09**
CO 37/Kalyani II	27.01	26.29*	2.09	29.20**	18.05**	3.66**
ADT 36/CO 39	-3.27	-10.25	-18.90	15.41**	14.85**	8.75**
ADT 36/ASD 8	99.70**	82.08**	70.93**	13.28*	7.16	13.74*
ADT 36/ASD 17	72.62**	58.70**	46.28**	13.87*	9.57	12.23**
ADT 36/Heera	40.95**	22.77	-5.08	19.33**	10.21	4.35**
ADT 36/Kalyani II	35.49*	33.28*	6.52	15.41*	1.98	-3.44**
ASD 16/CO 39	18.54	0.58	-19.13	13.69**	5.33	15.80*
ASD 16/ASD 8	19.20	-0.42	-6.52	1.12	-0.63	9.25**
ASD 16/ASD 17	6.39	-10.47	-17.47	9.62	5.88	16.40*
ASD 16/Heera	51.68**	44.93*	-8.74	27.86**	10.54*	21.53
ASD 16/Kalyani II	8.03	-3.43	-22.82*	15.45**	-4.12	5.40**

* Significant at 5 per cent level; ** Significant at 1 per cent level

Table 3. Magnitude of heterosis for grains per primary panicle and 100 grains weight

Hybrids	Grains per primary panicle			100 grains weight		
	di	dii	diii	di	dii	diii
IR 50/CO 39	24.65**	0.26	64.72**	-13.38**	-16.82**	-9.64*
IR 50/ASD 8	71.70**	57.63**	57.63**	8.12*	-0.43	18.27**
IR 50/ASD 17	19.87**	3.03	43.29**	7.35	3.79	11.17**
IR 50/Heera	23.76*	14.93	14.93	19.10**	6.85*	34.51**
IR 50/Kalyani II	26.61**	20.81*	32.99**	6.04	-5.20	20.30**
CO 37/CO 39	5.44	-8.18	50.85**	-5.65	-11.79**	10.15*
CO 37/ASD 8	54.87**	30.57**	59.11**	7.50*	4.88	30.96**
CO 37/ASD 17	8.28	1.58	41.27**	4.16	-3.25	20.81**
CO 37/Heera	52.22**	29.65**	57.99**	-0.40	-0.81	24.87**
CO 37/Kalyani II	15.95	10.34	34.46**	-11.29**	-12.0**	11.68**
ADT 36/CO 39	-3.91	-17.30**	35.86*	-39.63**	-40.45**	-33.50**
ADT 36/ASD 8	52.19**	29.79**	53.79**	-0.88	-3.85	14.21**
ADT 36/ASD 17	34.87**	24.89**	73.69**	7.66*	5.45	17.77**
ADT 36/Heera	14.74	-1.13	17.16	2.14	-3.63	21.32**
ADT 36/Kalyani II	18.76*	14.54	35.72**	-2.55	-8.40**	16.24**
ASD 16/CO 39	25.98**	13.25*	86.06**	7.55*	5.38	19.29**
ASD 16/ASD 8	39.34**	14.11	49.59**	8.53**	5.98	25.89**
ASD 16/ASD 17	58.09**	53.56**	113.56**	8.29*	5.38	19.29**
ASD 16/Heera	93.02**	59.61**	109.25**	-4.88	-9.68**	13.71**
ASD 16/Kalyani II	10.88	2.00	33.72**	3.59	-2.00	24.37**

* Significant at 5 per cent level; ** Significant at 1 per cent level

Table 4. Magnitude of heterosis for grain yield

Hybrids	di	dii	diii
IR 50/CO 39	13.93	8.25	8.25
IR 50/ASD 8	52.92**	29.24**	29.24**
IR 50/ASD 17	29.86**	21.33**	39.69**
IR 50/Heera	14.76	-9.65	-9.65
IR 50/Kalyani II	3.53	-14.81	-14.81
CO 37/CO 39	-21.86**	-29.21**	-21.51**
CO 37/ASD 8	71.97**	39.52**	54.69**
CO 37/ASD 17	-0.68	-2.52	12.23
CO 37/Heera	28.06**	-2.79	7.78
CO 37/Kalyani II	-0.64	-21.39**	-12.84
ADT 36/CO 39	-49.11**	-51.44**	-51.87**
ADT 36/ASD 8	55.46**	31.87**	30.69**
ADT 36/ASD 17	-16.97*	-22.75**	-11.06
ADT 36/Heera	-3.98	-24.16**	-24.84**
ADT 36/Kalyani II	6.73	-11.87	-12.65
ASD 16/CO 39	31.14**	14.11	2.72
ASD 16/ASD 8	22.14	20.03	-17.15*
ASD 16/ASD 17	13.02	-10.79	2.72
ASD 16/Heera	56.72**	45.92**	-2.76
ASD 16/Kalyani II	-5.07	-6.54	-37.72**

* Significant at 5 per cent level; ** Significant at 1 per cent level

length. Hybrids CO 37/Heera and CO 37/Kalyani II recorded higher values of heterosis over mid and better parents. For 100 grain weight, seven hybrids recorded positive relative heterosis. IR 50/Heera recorded positive heterosis over better parent. Eighteen hybrids recorded high significant positive standard heterosis.

Grafius (1959) suggested that there would be no separate gene system for yield *per se* and that the yield is an end product of the multiplicative interaction between the yield components. The hybrids ADT 36/ASD 8 and CO 37/ASD 8 recorded high heterosis over mid, better parent and standard variety (IR 50) for grain yield. Similar reports was also observed by Sharma and Mani (1990) and Wilfred Manuel and Prasad (1992). Hence, it is obvious that increase in yield in F_1 hybrids is the result of increase in value of yield components. These results suggest that one can expect to develop hybrids from the parents possessing early maturity, semi dwarf height with higher yield.

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(Received:June 1993 Revised: August 1996)

Madras Agric. J 83(9): 551-554 September 1996

GENETIC ARCHITECTURE OF SOME QUANTITATIVE CHARACTERS IN COMMON WHEAT

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ABSTRACT

Five generations involving P_1, P_2, F_1, F_2 and F_3 were studied for six quantitative characters, *viz.*, tillers/plant, ear length, grains/ear, yield/ear, yield/plant and 100-grain weight in five common wheat crosses namely, CAPAN 1962 x CC 493, CAPAN 1961 x MUW 27, CPAN 1933 x HW 517, CPAN 1959 x HUW 1 and WH 147 x CPAN 1874. Both scales (C and D) were significant in all the crosses for majority of the characters therefore, non-allelic interaction (i) and (l) type existed; (d) and (i) were more important.

KEY WORDS : Wheat, Genetic Architecture, Quantitative Characters

Genetic improvement of wheat (*Triticum aestivum*L.) is essential for sustained productivity throughout the country. For that, generation mean analysis becomes an important tool so as to have knowledge on breedings startegy under the specific situation. This has extensively been used to study the inheritance of important yield traits of common wheat. Nevertheless, there remains some sort of unconfirmity in crops like wheat. An attempt, therefore, was made to study the genetics of yield traits by using five parameter model in wheat.

MATERIALS AND METHODS

The exprimental material comprised of five crosses *viz.*, CPAN 1962 x CC 493, CPAN 1961 x MUW 27, CPAN 1933 x HW 517, CPAN 1959 x HUM 1 and WH 147 x CPAN 1874 of common wheat The parents, F_1 s and F_2s of five crosses were obtained from the Department of Agricultural Botany, Meerut University, Meerut. All the five during *rabi* 1989-90 in a randomized block design with three replications at the Experimental Research Farm, Meerut University, Meerut. The distance between and within rows were kept as 20 and 10 cm, respectively. Non-segregating generations (p_1, P_2, and F_1) were raised in a three m long single row, whereas the segregating F_2 and F_3 generations were grown in 9 rows, each 3m long. Usual agronomic practices were adopted to raise the crop.

The data on number of tillers/plant, ear length (cm), number of grains/ear, yiled/ear (g), yield/plant (g) and 100 grain weight (g) were recorded on five randomly selected plants from P_1, P_2 and F_1 generations in each replication, whereas 50 plants in each replication in respect of F_2 and F_3 generations. The mean values were first subjected to scaling tests of scales C and D, (Mather, 1949) and to the five parameter model (Hayman and Mather, 1955) to detect the non-allelic interactions.