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HETEROSIS FOR GRAIN YIELD AND ITS RELATED CHARACTERS IN RICE USING CMS SYSTEM

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ABSTRACTS

Heterosis is a valuable expression that often results from genetic recombination has been frequently utilized for development and isolation of promising hybrids for future exploitation. Adaptation and success of hybrid rice technology will depend largely on practical seed production technology, economical seed yield from female rice plants. Heterosis were estimated for 8 characters through 24 hybrids which were developed by one CMS line namely, IR58025A with 24 genotypes, Sarjoo 52 was used as check variety. The hybrids IR 58025A x IR 69992-AC-2, IR58025A x CSR-93-IR-3 and IR 58025A x NDRK 5024 manifested maximum heterobeltiosis and standard heterosis for yield and its components.

Key words : *Heterosis, grain yield, characters, CMS system, rice.*

Rice (*Oryza sativa* L.) is an important staple food for mankind. It is grown almost all over the world under various agro-climatic conditions. Exploiting heterosis has been one of the most effective measures to furthered raise rice productivity. Heterosis refers to the superiority of F_1 hybrid in one or more characters over its better parents/standard variety. The exploitation of heterosis, an effective measures, has been fully established to raise the rice productivity in China (1). The genetic tools, like male sterile (seed parent) and restorer lines (by which nuclear gene that suppress male sterility cytoplasm and produce normal male gamete) are essential to develop hybrid rice.

MATERIALS AND METHODS

Twenty four F_1s, involving CMS *viz*., IR 58025A as a seed parent and 24 genotypes as pollen parent, with Sarjoo-52 included as check variety were evaluated in Randomized Block Design with three replications. The experiments were conducted under two environments in normal soil (pH=8.2, Ec=6ds m) and saline/sodic soil

Table-1: Bartlett's test of homogeneity of variances of two environments

Characters	X^2 Value	
	Calculated value	Table value
Days to 50% flowering	9.752*	3.841
Plant height (cm)	36.150*	
Panicle bearing tillers per plant	0.449	
Number of grains per panicle	2.694	
Harvest index (%)	24.699	
1000 seed weight (g)	29.189*	
Grain yield per plant(g)	4.715*	

* Significant and heterogeneous variance

Table-2 : Analysis of variance for parents and hybrids for different characters in rice.

Sources of variations	d.f.	Days to 50% flowering	Plant height (cm)	Panicle bearing tillers per plant	Number of grains per panicle	Harvest index (%)	1000 seed weight (g)	Grain yield per plant (g)
Replications	2	0.078	0.178	0.005	0.352	0.196	0.030	0.902
Treatments	49	131.898**	275.240**	32.243**	2859.019**	209.736**	50.155**	270.261**
Parents	24	145.846	421.323*	36.955	3759.264**	251.524*	88.649	211.670
Hybrids	23	89.822	146.211	29.00	1995.362**	184.342	13.029	301.090*
Parents vs hybrids	1	888.231**	4.943*	4.379*	3395.272**	0.121	30.344**	917.653**
Error	98	0.667	3.40	1.126	1.588	1.479	0.377	1.313

*,** Significant at 5% and 1% probability levels, respectively.

Table-3 : Extent of heterosis over better parent (BP) and standard variety (SV) 24 rice hybrids of yield and yield components.

Hybrids	Days to 50% flowering		Plant height (cm)		Panicle bearing tillers per plant		Number of grains per panicle		Harvest index (%)		1000-seed weight (g)		Grain yield per plant (g)	
	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV
IR58025A x IR68649-3B-4-2	-11.05**	-12.01**	41.00**	1.28	-19.83**	-13.39**	43.35**	-17.71**	48.95**	10.09**	1.41	5.95**	27.38**	-50.69**
IR58025A x IR68654-3B-20-3	-2.17**	-3.23**	45.47**	4.50**	-12.69**	4.46	66.95**	14.58**	2.70	13.30**	-2.83	13.67**	34.17**	23.04**
IR58025A x IR69992-AC-1	-1.89*	-6.99**	30.78**	-6.06**	-22.31**	-16.07**	-31.71**	-12.27**	45.29**	10.17**	-2.80	-5.66*	-28.34**	-38.25**
IR58025A x IR69992-AC-2	5.98**	4.84**	59.51**	14.59**	-30.58**	-25.00**	24.72**	3.36**	27.13**	24.46**	2.20	16.09**	155.56**	27.19**
IR58025A x IR70865-B-P-6-2	-4.89**	-5.91**	42.27**	2.20	-27.27**	-21.43**	21.55**	-9.26**	25.80**	25.36**	5.04*	2.65	57.02**	-12.44**
IR58025A x IR70865-B-P-19-1	-3.83**	-14.52**	20.18**	-13.67**	0.00	8.04	19.81**	0.81	79.49**	32.76**	11.56**	2.13	91.67**	5.99*
IR58025A x IR70865-B-P-20-3	-3.26**	4.30**	53.13**	10.00**	-24.79**	-18.75**	17.69**	8.56**	7.48**	7.36**	15.73**	9.18**	5.13	-24.42**
IR58025A x IR70868-B-P-8-3	-5.07**	-6.09**	34.87**	-3.12	-18.18**	-11.61*	-7.75**	-14.58**	-9.76**	6.46*	-9.00**	-7.86**	-10.40*	-48.39**
IR58025A x IR70869-B-P-10-2	-4.35**	-5.38**	48.91**	6.97**	-32.23**	-26.79**	36.91**	4.75**	24.34**	10.95**	4.06	5.58*	31.20**	-24.42**
IR58025A x CSR96-IR-2	-1.09**	-2.15**	34.99**	-3.03	-47.11**	-42.86**	-19.47**	-11.92**	-47.20**	-40.97**	-11.39**	10.29**	-43.27**	-45.62**
IR58025A x CRR96-IR-1	6.74**	5.02**	31.42**	-5.60**	-18.18**	-11.61*	27.05**	-20.80**	-44.20**	-30.35**	3.78	14.92**	4.80	-39.63**
IR58025A x NDRK 5050	-1.99**	-3.05**	39.72**	0.37	-36.36**	-31.25**	5.12**	-14.47**	-8.56**	3.47	-8.22**	-14.78*	31.40**	-26.73**
IR58025A x CSR93-IR-3	7.07**	5.91**	45.72**	4.68**	5.79	14.29**	18.51**	6.71**	22.08**	5.00	-8.13**	7.94**	141.49**	4.61
IR58025A x CRR95-IR-2	4.17**	3.05**	36.91**	-1.65	-6.62	13.39**	-6.50**	-6.83**	-27.20**	-13.35**	13.08**	-12.34**	44.37**	-5.53*
IR58025A x NDRK 5063	-1.81*	-2.87**	49.68**	7.52**	-39.67	-34.82**	-15.10**	-8.22**	-24.33**	-11.93**	13.29**	-7.27**	6.60	-47.93**
IR58025A x NDRK 5062	-3.62**	-4.66**	30.91**	-5.96**	-25.62**	-19.64**	29.49**	7.75**	-12.66**	-15.45**	5.65*	-5.14*	19.53**	-29.49**
IR58025A x CSR-13	0.72	-1.79*	42.02**	2.02	13.22**	-6.25	-17.10**	-4.63**	12.91**	28.19**	24.07**	3.38	23.28**	31.80**
IR58025A x NDR 2022	5.39**	-5.38**	37.42**	-1.28**	-23.14**	-16.96**	12.77**	10.42**	-10.27**	9.99**	-1.20	-9.48**	3.03	-37.33**
IR58025A x NDRK 5024	-4.53**	-5.56**	53.51**	-10.28**	4.96	13.39**	55.17**	40.63**	-15.39**	-12.19**	-11.23**	12.64**	69.94**	27.65**
IR58025A x NDRK 5040	-3.68**	-0.75**	58.37**	13.76**	-28.93**	-23.21**	13.98**	-1.85*	11.74**	12.43	-4.72*	5.29*	19.69**	-29.95**
IR58025A x NDRK 5047	20.51**	2.15**	30.65**	-6.15**	-35.54**	-30.36**	-24.14**	-28.36**	-24.00**	-13.86**	-14.68**	-18.59**	-15.97*	-44.24**
IR58025A x NDRK 5049	-7.98**	-13.26**	40.61**	1.01	4.96	13.39**	29.67**	-37.73**	-39.15**	-33.50**	-2.15	6.83**	-22.89**	-41.01**
IR58025A x NDRK 5058	-13.22**	-14.16**	63.86**	17.71**	-26.45**	-20.54**	-27.85**	-15.76**	-13.90**	-14.55**	0.29	1.32	-54.25**	-47.93**
IR58025A x IR 64	-6.19**	-7.71**	33.59**	-4.10*	-28.10**	-22.32**	-41.73**	-43.75**	-45.68**	-43.51**	-5.11*	-0.37	-17.29**	-49.31**

*,** Significant at 5% and 1% probability levels, respectively.

(pH=9.2, Ec=0.8), at Student's Instructional Farm and Genetics and Plant Breeding Research Farm respectively, N.D. University of Agriculture and Technology, Kumarganj, Faizabad during *Kharif* 2000. Pooled study of the environments according to Bartlett's of homogeneity test of variances of two environments exhibited that major characters showed significant/highly variances. Five competitive plants were selected randomly from each treatment in each replication and observations were recorded on days to 50% flowering, plant height (cm), panicle bearing tillers per plant, number of grains per panicle, harvest index (%), 1000-grain weight (g) and grain yield per plant (g). The statistical analysis was carried out on the data pooled over two environments. The heterosis over the better parent and over standard variety as Sarjoo-52 was estimated. The percentage of heterosis were worked out as follows :

Heterobeltiosis (over better parent)

$$\% = \frac{F_1 - BP}{BP} \times 100$$

Standard heterosis (over check variety)

$$\% = \frac{F_1 - SV}{SV} \times 100$$

RESULTS AND DISCUSSION

The exploitation of hybrid rice has been fully established in China (1). The nature and magnitude of heterosis differs from character to character depending upon the hybrid combination. The analysis of variance due to treatments indicated significant for all the studied characters, interaction between parents vs hybrid was significant for all the characters except for harvest index. Heterosis for days to 50% flowering out of 24 hybrids 16 crosses over better parent (BP) and 19 crosses over standard variety (SV) showed significant for earliness and the best hybrids for earliness were IR58025A x NDRK 5058 over BP-13.39% and IR58025A x IR70865-B-P-19-1 over SV-14.52%. Out of 24 hybrids over BP and 24 over SV, only 9 crosses exhibited significant heterosis for tallness while 6 crosses over SV showed heterosis for dwarfness. The best heterotic cross IR58025A x IR70865-B-P-19-1 for dwarfness over SV,-13.67% . The crosses IR58025A x IR68654-3B-20-3 over BP, 66.95% and SV, 15.58% heterosis and IR58025A x NDRK 5024 over BP, 55.17% and SV, 40.63% showed maximum positive significant heterosis for number of grains per panicle. The crosses IR 58025A x IR 70865-B-P-19-1(over BP 0.0% and over SV 8.04%), IR 58025A x CSR 93-IR-3(over BP 5.79 % and over SV 14.29%), IR 58025A x NDRK 5024(over BP 4.96% and over SV 13.39%) and IR 58025A x NDRK 5049 (over BP 4.96% and over SV13.39%) showed significant positive heterosis for more number of panicle bearing tillers per plant. The best crosses for harvest index, IR58025A x IR70865-B-P-19-1 over BP, 79.49% and SV, 32.76% and IR58025A x IR69662-AC-2 over BP, 27.13% and SV, 24.46% showed maximum positive significant heterosis out of 24 crosses. The crosses for 1000-seed weight, IR58025A x IR70865-B-P-20-3 (over BP, 15.39% and SV, 9.18%) and IR58025A x CSR-13 (over BP, 24.07%) exhibited maximum significant and positive heterosis over all the crosses . The crosses IR58025A x IR69992-AC-2 over BP, 155.56% and SV, 27.19% and IR58025A x NDRK 5024 (over BP, 69.94% and SV, 27.65%) exhibited maximum positive significant heterosis for grain yield per plant. Similar results were worked out by (2, 3, 4).

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