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Short Communication

Heterosis and combining ability in rice (*Oryza sativa* L.) hybrids developed for Kerala state

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Substantial increase in rice (*Oryza sativa* L.) production can be achieved only with the use of suitable hybrids. The main objective of this investigation was to identify good general and specific combiners and heterotic cross combinations for yield and its component traits from among the high yielding and widely adapted rice varieties of Kerala. Five genetically diverse and widely adapted rice varieties of Kerala *viz.*, Annapoorna (Ptb 35), Matta Triveni (Ptb 45), Kanchana (Ptb 50), IR36 and Aiswarya (Ptb 52) were crossed with four stable cytoplasmic-genetic male sterile lines *viz.*, IR 62829 A, IR 68890 A, IR68891 A and PMS 10A in a line × tester mating design. The twenty hybrids along with their nine parents were evaluated at Agricultural Research Station, Mannuthy, Kerala. Fifteen plants were selected randomly from each plot for recording observations on panicles per plant, days to flowering, grain yield per plant, grains per panicle and hundred seed weight. Data were subjected to heterosis and combining ability analysis.

Grain yield per plant recorded high *sca* variance suggesting predominance of non-additive genetic variance, which could be exploited through heterosis breeding. Among the female parents IR 68890A recorded high positive *gca* for characters *viz.*, panicles per plant, days to flowering, grain yield per plant and hundred seed weight. This indicates that this particular CMS line can be effectively utilised in the hybrid-breeding programme aimed at production of superior hybrids. Among the testers high *gca* for different characters were expressed by different genotypes. Kanchana (Ptb 50) exhibited high *gca* for panicles per plant and grain yield, whereas Aiswarya recorded high *gca* values for days to flowering, grain yield and hundred seed weight Different varieties exhibiting high *gca* for different characters was reported by other workers also [1].

Among the hybrids evaluated IR 68890 A × Aiswarya was identified as the most superior specific combiner (Table 1). The two parents involved in this hybridisation were having high *gca* effect for almost all the characters under study. Other hybrids having significant *sca* effect for grain yield were IR68891A × IR36, IR62829A × Matta Triveni, IR 62829A × Kanchana and IR 68891 A × Annapoorna. Most of the hybrids expressed negative *sca* effect for number of filled grains per panicle. Only three hybrids *viz.*, IR 62829A × Aiswarya, IR 68890A × Kanchana and IR 68891A × IR 36 expressed positive significant *sca* effect for number of filled grains per panicle. Since hybrid breeding programme in rice involve male sterile lines, combining ability for number of filled grains per panicle assume greater importance.

Magnitude of heterosis expressed by hybrids varied between crosses and both positive as well as negative heterosis were expressed by different hybrids for various characters [1]. In the present study, four hybrids *viz.*, IR62829A × Kanchana, IR68890A × Kanchana, IR68890A × Aiswarya and IR 68891 A × IR36 expressed significant positive standard heterosis for grain yield indicating that these hybrids have the potential to be used in hybrid rice production. Heterosis for grain yield is due to simultaneous heterosis in more than one components of yield. In the present study heterosis for grains per panicle and hundred seed weight were lower or negative in most of the crosses, which in turn can limit heterosis for grain yield. AH the hybrids expressed high positive values of standard heterosis for number of panicles per plant. But only one hybrid combination (IR 68891A × IR 36) recorded significant positive standard heterosis for grains per panicle, thus explaining the low or negative standard heterosis for grain yield expressed by most of the hybrids. Standard heterosis for hundred seed weight was also significant and negative in all the hybrid combinations except IR 68890A × Aiswarya. Hybrids with high level of standard heterosis also exhibited high *sca* for grain yield and other related characters of economic importance suggesting their usefulness in development of rice hybrids for Kerala.

Table 1. Specific combining ability and standard heterosis of hybrids for grain yield and related characters in rice

Hybrids	*sca* effects					Standard heterosis				
	Panicles per plant	Days to flowe-ring	Grain yield per plant	Number of filled grains per panicle	100 seed weight	Panicles per plant	Days to flowering	Grain yield per plant	Number of filled grains per panicle	100 seed weight
IR 62829 A/Annapoorna	−0.08	−1.64**	−2.48	−0.19	−0.02	34.4**	−11.7**	−27.1	−5.7	−12.1**
IR 62829 A/Matta Triveni	−2.76**	1.80**	4.82**	−9.19	−0.02	27.5**	−8.2**	12.2	−14.4	−11.3**
IR 62829 A/Kanchana	1.67*	0.11	4.30**	3.94	0.11**	117.2**	−7.3**	33.3*	9.1	−3.8
IR 62829 A/IR36	−0.51	1.55**	−4.32**	−7.06	−0.06*	31.0**	−4.6**	−28.4	8.0	−23.4**
IR 62829 A/Aiswarya	1.67*	1.83**	−2.31	12.50*	−0.02	89.6**	−4.3**	−2.2	17.3	−1.1
IR 68890 A/Annapoorna	0.67	1.66**	0.57	−2.69	0.017**	48.2**	−1.4	14.4	−12.1	−0.7
IR 68890 A/Matta Triveni	2.24**	−1.90**	−5.12**	5.06	−0.01	100.0**	−6.1**	−20.2	−5.4	−6.8**
IR 68890 A/Kanchana	0.42	0.66	1.49	17.69**	−0.18**	103.4**	−2.9**	21.7**	17.6	−10.2**
IR 68890 A/IR36	−1.76*	1.35**	−3.20*	−16.31**	−0.20**	17.2	1.4	1.9	−4.5	−24.5**
IR 68890 A/Aiswarya	−1.58*	1.78**	6.26**	−3.75	0.23**	48.2**	2.1*	70.6**	−1.6	12.8**
IR 68891 A/Annapoorna	−1.43*	0.31	3.57**	−7.09	−0.12**	13.7	−3.2**	20.7	−9.8	−24.5**
IR 68891 A/Matta Triveni	0.89	0.00	−0.64	1.91	−0.03	75.8**	−4.1**	−5.4	−2.1	−20.8**
IR 68891 A/Kanchana	−0.68	0.31	−3.23*	−15.21**	0.10**	82.7**	−0.8	3.7	−6.1	−13.2**
IR 68891 A/IR36	−0.11	−1.00	5.27**	28.79**	0.15**	34.4*	−1.4	39.6**	43.0**	−24.5**
IR 68891 A/Aiswarva	1.32	0.38	−4.96**	−8.40	−0.11**	82.7**	4.4**	−3.9	0.4	−13.2**
PMS 10 A/Annapoorna	0.82	−0.34	−1.65	9.96	−0.03	24.1	−6.1**	16.2	7.6	−21.1**
PMS 10 A/Matta Triveni	−0.36	0.10	0.94	2.21	0.06*	37.9**	−6.1**	−3.8	0.6	−17.0**
PMS 10 A/Kanchana	−1.43*	−1.09**	−2.55	−6.41	−0.04	51.7**	−4.6**	0.3	4.3	−18.1**
PMS 10 A/IR 36	2.39**	−1.90**	2.25	−5.41	0.11**	48.2**	−4.6**	14.9	14.1	−25.7**
PMS 10 A/Aiswarya	−1.43*	3.22**	1.02	−0.35	−0.10**	24.1	5.5**	22.6	10.2	−12.0**

*,**Significant at P = 0.05 and P = 0.01 respectively.

The number of cross combinations generated from parents having different types of *gca* effect (*viz.*, positive significant, negative significant or non significant) and their corresponding *sca* effects were observed. Almost all types of *sca* effects were obtained from any type of parental combinations. Parents with high, medium and low general combining ability produced hybrids with high *sca*. Hybrids with positive and significant *sca* for grain yield were produced by almost all types of parental combinations. The high yield potential in cross combinations (high × low) can be attributed to interaction between positive alleles in the good combiner and negative alleles from poor combiner while heterosis involved in high × high combiners involve interaction between positive × positive alleles. In the present study, low × low combinations also produced hybrids with high *sca* and this can be attributed to over dominance or epistasis [3]. All these results revealed that there is no direct relation between *gca* effects of parents and *sca* effects of hybrid combinations. This can be also be explained from the point of gene action since *gca* is more due to additive gene action whereas *sca* is due to dominance and epistasis.

References

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