Indian J. Genet., **65**(4): 290-292 (2005)

Short Communication

Combining ability studies for grain yield and its component characters in rice (*Oryza sativa* L.)

P. R. Sharma, P. Khoyumthem, N. B. Singh and K. Noren Singh

Department of Plant Breeding and Genetics, College of Agriculture, Central Agril. University, Imphal 795 004

(Received: March 2005; Revised: October 2005; Accepted: October 2005)

The present study was done to understand the genetic architecture of rice lines and search for the possible scope of improvement. Seeds of 13 rice genotypes possessing different morphological and productive attributes were obtained from the Department of Plant Breeding and Genetics, College of Agriculture, Central Agricultural University, Imphal. The 13 genotypes i.e., 10 lines (popular in Manipur) namely, Sanaphou, KD-1-1-38-72, RCM-9, CAU-R-1, KD-6-7-1, Punshi, CAU-R-2, KD-2-6-3, RCM-5 and KD-2-7-6-2 and 3 testers (National) namely Satary, Neela and WR-2-3-2 were grown in 1999 to generate 30 F_1 cross combinations using line × tester mating design.

The 30 F_1s and 13 parents were grown in R.B.D. in 2000 following normal cultivation practices. The materials were evaluated for characters namely seedling height, plant height, days to 50% flowering, days to 80% maturity, tillers plant^{-1}, ear bearing tillers plant^{-1}, panicle length, spikelets panicle^{-1}, filled grains panicle^{-1}, grain length, grain breadth, grain length and breadth ratio, 1000-grain weight, grain yield plant^{-1}, biological yield plant^{-1} and harvest index. The combining ability analysis was carried out as per Kempthorne [1].

Analysis of variance revealed highly significant differences for lines, testers and line × tester for all the characters studied except for tillers plant^{-1}, indicating that the material chosen were desirable and there were diversity among the genotypes.

Both additive and non-additive gene action appeared to play a significant role in controlling the expression of the traits in the present study (Table 2). The major role of non-additive component was evident for plant height, days to 50% flowering, days to 80% maturity, panicle length, 1000-grain weight, grain breadth, filled grains panicle^{-1}, grain yield plant^{-1}, biological yield plant^{-1} and harvest index.

The present finding regarding grain yield plant^{-1} is in conformity with those of earlier workers [2-5] but contrary to the findings of [6-9], where additivity was reported to be of equal or even of greater value.

The parents Punshi, KD-6-7-1 among lines and Neela and Satary among testers were proved to be good combiners for grain yield plant^{-1} (Table 1). The best combiner Punshi for grain yield plant^{-1} also proved to be the best combiner for biological yield plant^{-1} and second best combiner for filled grains panicle^{-1}, spikelets panicle^{-1} and days to 80% maturity. The second best combiner, KD-6-7-1 for grain yield plant^{-1} also proved to be the best combiner for days to 50% flowering and ear bearing tillers plant^{-1}.

The best combiner tester for grain yield plant^{-1}, Neela also proved to be the best combiner for seedling height, days to 50% flowering, 1000-grain weight, grain breadth and harvest index and second best combiner for tillers plant^{-1}, ear bearing tillers plant^{-1} and biological yield plant^{-1}.

The perusal of *per se* performance and *gca* effects also indicated that the genotypes with high *per se* performance of a character are in general, the good general combiner of the particular character. The present findings are in general agreement with that of [4, 6].

Out the 30 crosses, 11 crosses exhibited positive significant *sca* effects for grain yield plant^{-1}. The best *sca* effect was observed in the cross, CAU-R-1 × Neela (14.93) which also showed best *sca* effect for filled grains panicle^{-1} (22.93), tillers plant^{-1} (1.78) and ear bearing tillers plant^{-1} (2.06).

High specific combining ability (*sca*) results mostly from dominance and interaction effects existing between the hybridizing parents. The *sca* effect in the simplest terms is the average performance of a specific cross combination from the population mean. Also, the two parents, if they carry different genes for the trait in question, will tend to complement each other and would produce hybrids of superior genetic constitution. The

Table 1. General combining ability effects of parents for different characters

Characters/ Parents	Seedling height (cm)	Plant height (cm)	Days to 50% flowering	Days to 80% maturity	Tillers plant^{-1}	Ear bearing tillers plant^{-1}	Panicle length (cm)	1000-grain weight (g)	Grain length (mm)	Grain breadth (mm)	Grain length and breadth ratio	Spikelets plant^{-1}	Filled grains panicle^{-1}	Grain yield plant^{-1} (g)	Biological yield plant^{-1} (g)	Harvest index (%)
Testers																
Satary	−1.90**	5.95**	12.80**	−11.46**	0.80**	0.73**	−0.61**	−1.13**	−0.19**	−0.02	−0.04**	−12.02**	−5.09**	0.09	2.57**	−1.23**
Neela	1.22**	−5.54**	−9.85**	8.38**	0.56**	0.34**	−0.13	0.54**	−0.23**	0.10**	−0.15**	−18.28**	−6.49**	0.87**	−0.97	1.52**
WR-2-3-2	0.68**	-0.40	−2.96**	3.08**	−1.47**	−1.07**	0.74**	0.39**	0.43**	−0.08**	0.18**	30.31**	11.58**	−0.97**	−1.59*	−0.29
Lines																
Sanaphou	0.36	−1.10*	16.57**	−16.45**	0.53	0.31**	0.17	−1.42**	−0.30**	0.11**	−0.10**	−18.15**	−17.08**	−4.27**	−3.73**	−3.99**
KD-1-1-38-72	−0.59**	−5.07**	−2.01**	4.75**	0.07	0.00	0.80**	−0.32*	−0.15**	0.00	−0.04*	−11.10**	4.66**	0.57	1.01	0.12
RCM-9	−1.11**	7.00**	20.06**	−17.83**	0.67	0.20*	1.35**	0.12	0.31**	−0.03	0.11**	−13.85**	−2.08	0.56	3.29*	−0.62
CAU-R1	1.38**	−0.09	23.93**	−24.34**	−0.73**	−0.66**	0.41	2.81**	0.15**	0.00	0.03	−15.79**	−13.58**	−2.17**	−5.68**	−1.40**
KD-6-7-1	−0.23	7.68**	−29.74**	23.71**	−0.38	0.69**	−0.98**	−1.65**	−0.31**	−0.09**	−0.03	5.28	5.83**	2.02**	1.62	1.47**
Punshi	−1.29**	−2.08**	23.09**	−21.00**	−1.87**	0.11	−0.45*	0.06	0.03	−0.07**	0.03	18.15**	15.27**	3.16**	12.44**	−2.04**
CAU-R-2	0.49**	−8.87**	−3.85**	5.82**	0.16	−0.22*	−0.53*	−1.20**	0.33**	0.02	0.06**	−18.10**	−6.28**	−3.90**	10.42**	2.24**
KD-2-6-3	−0.79**	−4.42**	−28.67**	29.57**	0.27	0.22*	−0.07	−0.58**	0.05	−0.01	0.02	14.80**	6.10**	1.94**	−5.19**	5.23**
RCM-5	1.95**	8.33**	3.57**	−5.89**	−0.04	0.05	−0.96**	1.66**	−0.09**	0.17**	−0.16**	−0.83	−6.31**	0.89	−0.56	0.91*
KD-2-7-6-2	−0.17	−1.37*	−22.96**	21.66**	1.47**	−0.71**	0.26	0.54**	−0.02	−0.09**	0.06**	39.57**	31.46**	1.21*	7.22**	−1.90**
SE (testers)	0.09	0.26	0.24	0.04	0.12	0.04	0.11	0.08	0.01	0.01	0.01	1.49	0.73	0.24	0.67	0.21
SE (lines)	0.19	0.55	0.51	0.08	-	0.09	0.22	0.16	0.03	0.02	0.02	3.17	1.55	0.51	1.42	0.44

*Significant at 5% level; ** Significant at 1% level; NB: Effect of lines to the total variance was found non-significant for the character tillers plant^{-1}, therefore *gca* (lines) were not estimated.

Table 2. Component of genetic variance in intervarietal crosses of rice

S. No.	Characters	$\delta^2 g$	$\delta^2 s$	$\delta^2 g/\delta^2 s$	$\delta^2 A$	$\delta^2 D$
1	Seedling height (cm)	1.84	3.35	0.55	3.69	3.35
2	Plant height (cm)	17.05	104.81	0.16	34.10	104.81
3	Days to 50% flowering	98.17	709.58	0.14	196.35	709.58
4	Days to 80% maturity	77.46	627.36	0.12	154.93	627.36
5	Ear bearing tillers plant^{-1}	0.58	1.05	0.54	1.13	1.05
6	Panicle length (cm)	0.05	2.63	0.02	0.10	2.63
7	1000-grain weight (g)	0.55	4.02	0.13	1.10	4.02
8	Grain length (mm)	0.09	0.10	0.90	0.20	0.10
9	Grain breadth (mm)	0.005	0.02	0.25	0.01	0.02
10	Grain length and breadth ratio	0.02	0.02	1.00	0.04	0.02
11	Spiklets panicle^{-1}	528.7	568.61	0.93	1057.57	568.61
12	Filled grains panicle^{-1}	51.14	339.13	0.15	102.28	339.13
13	Grain yield plant^{-1} (g)	−4.82	44.12	0.11	−9.64	44.12
14	Biological yield plant^{-1} (g)	−35.29	312.12	0.11	−70.59	312.12
15	Harvest Index (%)	−0.51	22.40	0.02	−1.02	22.40

result was also in conformity with other workers [2, 8-10].

Two cross combinations namely CAU-R-1 × Neela and KD-2-7-6-2 × WR-2-3-2 exhibited significant highest and second highest *sca* effects for grain yield plant^{-1}. These hybrids exhibiting high *sca* involved both or one of the parent having high *gca* effects. Such crosses are expected to produce desirable segregants and could be exploited successfully for varietal improvement programme. In the present study such crosses were CAU-R-I × Neela for grain yield plant^{-1}, filled grains panicle^{-1}, ear bearing tillers plant^{-1} and biological yield plant^{-1}; KD-2-7-6-2 × Salary for harvest index, KD-2-6-3 × Neela for spikelets panicle^{-1}, CAUR-2 × Neela for 1000-grain weight and grain length and RCM-5 × WR-2-3-2 for grain breadth.

Both additive and non-additive genes appeared to play a significant role in controlling the expression of the traits in the study (Table 2). Preponderance of additive gene action for seedling height, ear bearing tillers plant^{-1}, grain length, grain length and breadth ratio, spikelets panicle^{-1} and non-additive gene action for other traits were brought out. This suggest that there is scope of improvement for these characters by using selection methods and as well as go for hybrid breeding programme for exploitation of the non-additive gene action. The results were in agreement with other workers [2, 8, 10].

Thus, in rice, both types of gene action appear to be playing a considerable role. The above findings have an important bearing on future breeding strategies. The additive gene action has already been exploited in several countries to develop high yielding rice varieties; the non-additive variance caused by dominance and epistasis remains unutilized. Using these effects, successful hybrids have been developed in maize, sorghum, cotton, bajra and few other crops. Hybrids may be equally suitable for rice under a rainfed rice cultivation system like that of Manipur.

References

1. **Kempthorne O.** 1957. An Introduction to Genetical Statistics. John Wiley & Sons, Inc. New York.
2. **Panwar L. L.** 2005. Line x tester analysis of combining ability in rice (*Oryza sativa* L.). Indian J. Genet., **65**: 51-52.
3. **Satyanarayana P. V., Reddy M. S. S., Ish Kumar and Madhuri J.** 2000. Combining ability studies on yield components in rice. Oryza, **37**: 22-25.
4. **Bidhan Roy and Mandal A. B.** 2001. Combining ability of some quantitative traits in rice. Indian J. Genet., **61**: 162-164.
5. **Yadav L. S., Maurya D. M., Girl S. P. and Singh S. B.** 1999. Combining ability for yield and its components in rice. Oryza, **36**: 208-210.
6. **Reddy J. N.** 2002. Combining ability for grain yield and its components in lowland rice (*Oryza sativa* L.). Indian J. Genet., **62**: 251-252.
7. **Lavanya C.** 2000. Combining ability for yield and its components in hybrid rice. Oryza, **37**: 11-14.
8. **Rita Bisne and Motiramoni N. K.** 2005. Study on gene action and combining ability in rice. Oryza, **42**: 153- 155.
9. **Kalitha U. C. and Upadhya L. P.** 2000. Line x tester analysis of combining ability in rice under irrigated lowland condition. Oryza, **37**: 15-19.
10. **Rosamma C. A. and Vijaykumar N. K.** 2005. Heterosis and combining ability in rice (*Oryza sativa* L.) hybrids developed for Kerala state. Indian J. Genet., **65**: 119-120.