Journal of Pharmacognosy and Phytochemistry

KR Saravanan
Department of Genetics and
Plant Breeding, Faculty of
Agriculture, Annamalai
University, Annamalainagar,
Tamil Nadu, India

D Yogini
Department of Genetics and
Plant Breeding, Faculty of
Agriculture, Annamalai
University, Annamalainagar,
Tamil Nadu, India

K Vinothkumar
Department of Genetics and
Plant Breeding, Faculty of
Agriculture, Annamalai
University, Annamalainagar,
Tamil Nadu, India

M Prakash
Department of Genetics and
Plant Breeding, Faculty of
Agriculture, Annamalai
University, Annamalainagar,
Tamil Nadu, India

Heterosis and combining ability analysis for yield and quality traits in rice (*Oryza sativa.* L)

KR Saravanan, D Yogini, K Vinothkumar and M Prakash

Abstract
Combining ability analysis for yield and grain quality traits was carried out in rice through line x tester analysis. Thirty two hybrids were evolved by crossing 8 lines with 4 testers. Success of any plant breeding programme depends on the choice of appropriate genotypes as parents in the hybridization programme. Combining ability studies of the parents were effective in identifying better parents and provides information which helps in the selection of better parent for effective breeding programme. Combining ability analysis also provides information on gene action. The analysis of variance for combining ability showed us significant difference among parents, crosses and Line x Tester interaction for six traits of interest. General combining ability effects indicated that line L_3 (K R 09009) as a good general combine for majority of the traits studied *viz.,* 100 grain weight, high kernel length, high kernel L/B ratio and moderate panicle exsertion and kernel breadth. Among the testers, T3 (ASD-19) was adjudged as good general combiner for all the traits *viz.,* panicle exsertion, 100 grains weight, kernel length, kernel breadth, kernel L/B ratio and grain yield per plant. The crosses L_6 x T_3 (RP-4353-MSC-38-43-6-2-4-3 x ASD-19), L_5 x T_1 (CR 2815 - 4-23-7-52-1-1x ADT38 and L_5 x T_3 (CR 2815-4-23-7-5-2-1-1 x ASD-19) were the best specific combiner. The hybrid L_6 x T_3 (RP-4353-MSC-38-43-6-2-4-3 x ASD-19) was the best hybrid based on specific combining effect for yield and quality traits.

Keywords: Combining ability, heterosis, GCA and SCA effects, quality traits

Introduction
Rice (*Oryza sativa* L. 2n = 24) belongs to the family of Poaceae, is the world's most important staple food crop. India is the second largest producer and consumer of rice in the world. More than half of the world's population relies on rice as the major daily source of calories. It contains carbohydrate (78.2%), protein (6.8%), fat (0.5%) and minerals (0.6%). According to FAO in 2013, world production of milled rice reached 436 million tones as compared to 399 million tonnes in 2002. However a considerable quantity of rice will be required to meet future needs. Rice is grown in 463. 10 million hectares in world. More than 90 per cent of this area is in Asia.

Rice is generally considered to be a highly self pollinated crop inspite of varying degree of cross pollination reported. Improvement in this crop so far has been mostly confined to single plant selection. Recombination breeding is commonly followed. Considerable amount of heterosis has been reported in this crop. To exploit heterosis, knowledge on choosing appropriate parent of good genetic potential is very essential.

The parent should possess good combining ability and wide genetic diversity for various economic traits. Among various biometrical techniques, Line x Tester analysis appears to be an ideal method to evaluate parents and crosses. Hence, the present study was undertaken to generate information on combining ability and gene action for grain yield and its quality parameters.

Materials and Methods
Thirty two cross combinations of line x tester mating design, evolved by crossing eight lines with four testers along with thirty two cross combinations were raised in randomized block design with three replications at Experimental field of Department of Genetics and plant breeding farm, Annamalai University, Annamalai nagar, Cuddalore district during kar season (September 2013). Synchronization of flowering was aided by staggered souring of lines and testers in raised nursery bed at ten days interval. Crossing work was carried on more than 10-20 panicles in every cross combination in order to get the required amount of crossed seeds. Thirty two cross combinations along with the parents were raised in three replications of 3m length for each genotypes respectively. Seedling were planted at one per hill with a spacing of 20 x 15cm during pishanam season (February 2013).

Correspondence
KR Saravanan
Department of Genetics and
Plant Breeding, Faculty of
Agriculture, Annamalai
University, Annamalainagar,
Tamil Nadu, India

Standard agronomic practices and need based plant protection measures were followed to raise healthy crop. The observation were recorded on five randomly selected plants in each treatment in all three replications for five character *viz.*, panicle exsertion, 100 grain weight, kernel length, kernel breadth and kernel L/B ratio. Panicle exsertion in (cm), 100 grain weight (gm), kernel length and kernel breadth (mm) from randomly selected five unbroken kernels. The mean values of each genotype used for analyzing combining ability by line x Tester method of analysis.

Results and Discussion

The recorded data on different agronomic parameters were subjected to analysis of variance to confirm the difference among the rice genotypes. Mean squares from analysis of variance of six characters are presented in Table.1. The table depicted highly significant differences among rice genotypes for all the characters studied, mean sum of squares of rice genotypes for these traits were further portioned into parents, cross and parents vs crosses, which depicted the variance due to line x tester were significant for all characters except kernel length. It indicated the importance of line x tester interaction effect and high specific combining ability. The variance due to replication was non-significant for all the characters. It indicates the lesser influence of environment on the on the expression of the characters. Also the GCA/SCA ratio were found to be less than unity for all the traits indicating that the characters of interest were governed by non-additive gene action. The result is in collaboration with the findings of Palaniraja *et al.* (2011) [13]. The variances due to SCA were higher than the corresponding GCA variances for panicle exsertion, 100 grain weight, kernel length, kernel breadth, kernel L x B ratio and grain yield per plant. The ratio of GCA/SCA was also less than unity. The results indicated that the identified traits were predominantly controlled by dominance and epistasis.

Among the lines studied L_6, L_5 and L_3 recorded significantly high *gca* effects for 100 grain weight, kernel length, kernel breadth, kernel L x B ratio and grain yield per plant. Among the testers studied T_3 followed by T_1 recorded the significant and desirable *gca* effects for all the six traits *viz.,* panicle exsertion, 100 grain weight, grain yield per plant, kernel length, kernel breadth and kernel L x B ratio. Among the hybrids, the F_1 hybrids of L_6 x T_3 followed by L_5 x T_1 and L_5 x T_3 showed high per se performance for the traits viz., 100 grain weight, kernel length, kernel breadth, panicle exsertion and Grain yield per plant. The result is in agreement with the findings of Janardhanam *et al.* (2000). The hybrid L_6 x T_3 was the best hybrid based on *sca* effects, since it had desirable performance for all the characters except panicle exsertion. Twenty six hybrids registered significant standard heterosis for grain yield per plant. The hybrids L_6 x T_3, was identified as the best hybrid since it had significant standard heterosis for all the traits. The next best hybrids were L_5 x T_1 and L_5 x T_3 since they possessed desirable standard heterosis for four characters each.

The hybrids based on *per se* performance, sca effects and standard heterosis will be more effective. It may be concluded that based on all the three criteria, the following three hybrids L_6 x T_3, L_5 x T_3 and L_5 x T_1 were identified as the superior hybrids, among the thirty two hybrids evaluated. The hybrid L_6 x T_3 was adjudged as the best hybrid since it possessed desirable performance based on *per se*, *sca* effect and standard heterosis for the yield and quality traits.

References

1. Allard RW. Principles of plant breeding. Joh wiley and Sons. Inc., New York, 1960.
2. Banumathy S, Thiyagarajan K, Vaidyanathan P. Study on magnitude of heterosis of rice hybrids for yield and its components. Crop res. Hisar, 2003; 25(2):287-293.
3. Chaitali sen, Sing RP. Study on heterosis in high yielding rice hybrids. Int. J. PL. Breed and Genet. 2011; 5(2):141-149.
4. Bagheri, Babauan Jelodar. Heterosis and combining ability analysis for yield and related yield traits in hybrids rice. Intl. J. Biology. 2010; 2(2):222-231.
5. Chakrborty R *et al*. Combining ability analysis for yield and yield components on bold grained rice (Oryza sativa L.) of Assam. http://www.redalyc. Org/articulo. Acta Agronomica. 2009; 58:9-13.
6. Dalvi VV, Patel DV. Combining ability analysis for yield in hybrids rice. Oryza. 2009; 46(2):97-102.
7. Deepa sankar P, Subbaraman N, Lakshmi Narayanan S. Heterosis, Combining ability and gene action studies in TGMs based rice hybrids under normal and salt affected environments. Indian J. Agric. Res. 2008; 42(3):177-182.
8. Devaraja C, Shivakumar N, Lohith KS, Patil SS. Combining ability studies on yield and its components rice. (Oryza sativa L.) Res. J. Agric. Sci. 2012; 3(6):1195-1198.
9. Eswaran R. Heterosis breeding in bhendi (Abelmosches esculentes. L.) (Moench) unpublished Ph.D Thesis, Annamalai University. Annamalainagar, India, 2008.
10. Janardhanam V, Nadarajan N, Ganesh SK, Jebaraj S. Studies on heterosis in rice (*Oryza sativa* L.). Madras Agric. J. 2001; 88(10-12):721-723.
11. Nelam Venkateswara Rao. Studies on Line x Tester analysis in rice (*Oryza sativa* L.). M.Sc., (Ag.,) Thesis, Annamalai Univ., Annamalainagar, India, 2006.
12. Sanjeev Kumar, Singh HB, Sharma JK, Salej Sood. Heterosis for morpho-physiological and qualitative traits in rice. Oryza. 2010; 47(1):17-21.
13. Palaniraja K, Vennila S, Anbuselvam Y, Elangaimannan R. Studies on combining ability through line x tester analysis in rice (Oryza sativa L.). In: Extended summary National Seminar on Innovative Crop Improvement Techniques. February 17-18. 2011. Faculty of Agriculture, Annamalai Univ., Annamalainagar, India. 2011, 21.