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Research Article

Genetic variability and combining ability for quality characters in two line hybrids in rice

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Abstract
Studies on genetic variability and combining ability for 10 grain quality characters in a set of crosses involving four TGMS lines and five testers of indica rice revealed that none of parental line was found excellent for all the 10 quality characters. Among the four lines,GD 98014 and GD 98049 showed good general combining ability effect for maximum main quality charaters. Among the testers, IR 72, CO 47 and TKM 12 expressed good gca effects for maximum quality characters. Among the crosses, GD 99017 x CO 47 and GD 98014 x TKM 12 showed high specific combining ability effects. GD 98049 x IR 72 and GD 98049 x CO 43 were good specific combiner for different characters. These crosses can be used for development of rice hybrid in future.

Key words: Genetic variability, combining ability, two line hybrids

Introduction

Rice, the predominant cereal crop is consumed as a whole grain and therefore, physical, cooking and nutritional qualities are very important for the consumers. In Tamil Nadu, rice grain with medium slender grain type, intermediate amylose content, intermediate gelatinization temperature, medium gel consistency are preferred by consumers. Hence varieties with these qualities fetch high price in the market. In a rice breeding programme for evolving good quality rice, selection of parents with best grain quality characteristics is important. Knowledge about variability, general combining ability of parents for quality traits helps the breeder in choosing suitable parents for hybridization. Therefore, the present investigation was undertaken to study the different genetic parameters and the general combining ability of parents and specific combining ability of hybrids for different quality parameters.

Materials and Methods

Four elite TGMS lines (GD 98014, GD 99017, GD 98029 and GD 98049) were crossed with five diverse male parents (IR 10198 - 66 – 2, IR 72, CO 43, CO 47, TKM 12) at Paddy Breeding Station, TNAU, Coimbatore. The resultant 20 hybrids were evaluated along with their parents and a standard check ADTRH 1 in a randomized block design, replicated twice. A standard package of practices was followed for raising the crop. Data were recorded on brown rice length, brown rice breadth, length to breadth ratio, kernel length after elongation, kernel breadth after cooking, linear elongation ratio, breadthwise elongation ratio, alkali spreading value, amylose content, gel consistency and kernel length after cooking on five plants per each replication per each entry. Observations were recorded for quality traits related to cooking quality. The statistical analysis was done as per procedure given by Kempthorne (1957).

Results and Discussion

The analysis revealed significant differences among the parents and F1s for all the characters (Table 1). Variance due to females (lines) was significant for all the quality characters except brown rice breadth. Variance due to male (tester) was significant for all the quality characters. Variance due to hybrids was also significant for all the quality traits.

Analysis of variance for combining ability revealed that the lines showed significant variability for most of the quality characters such as linear elongation ratio, alkali spreading value, amylose content, gel consistency and kernel length after cooking while testers showed significant variability for all the quality characters. The magnitude of general combining ability variance/ specific combining ability variance reveals the predominance of non-additive genetic variance for most of the quality characters (shivani, *et al.*, 2009). General combining ability of an inbred is its average performance across the series of hybrid combinations and it is primarily due to additive effects of genes. Therefore, the information about the gca effects of each parent is of atmost importance for identification of good parental lines.

In the present experiment, results indicated that none of the parents was found excellent for all the 10 qualitative characters. Among the four lines, GD 98014 was found to be a good general combiner for amylose content, alkali spreading value and kernel length after cooking. The line GD 99017 was found to be good general combiner for linear elongation ratio, alkali spreading value and gel consistency. Line GD 98029 has good gca for length to breadth ratio, linear elongation ratio, alkali spreading value, amylose content and gel consistency and the line GD 98049 has good gca for linear elongation ratio, alkali spreading value, gel consistency and kernel length after cooking (Table 2).

Among the five testers, IR 72 was a good general combiner for brown rice length, length to breadth ratio, alkali spreading value, amylose content, gel consistency and kernel length after cooking and the tester, TKM 12 had good gca for brown rice length, length to breadth ratio, alkali spreading value, amylose content, gel consistency and kernel length after cooking. The tester CO 43 had good gca for brown rice length, length to breadth ratio, linear elongation ratio, amylose content and gel consistency and the tester CO 47 was a good combiner for alkali spreading value, amylose content, gel consistency and kernel length after cooking.

The cross showing high sca effects involving parents with good general combining ability could be exploited for hybrid development. Crosses with high sca effects involving high x high combiners indicate additive x additive type of interaction (Tyagi *et al.* 2010). The results of the present investigation showed that no cross was good for all the characters but some crosses showed good sca effects for a number of characters (Table 3). Cross between GD 98014 x TKM 12 was found to be good specific combiner for brown rice length, length to breadth ratio, amylose content, linear elongation ratio, alkali spreading value and kernel length after cooking. It was noticed that the cross GD 98049 x IR 72 was good specific combiner for brown rice length, linear elongation ratio, amylose content, alkali spreading value, gel consistency and kernel length after cooking, whereas the cross GD 98049 x CO 43 recorded high sca effects for brown rice length, length to breadth ratio, amylose content and gel consistency and kernel length after cooking. The cross GD 99017 x CO 47 expressed good sca effects for length to breadth ratio, , linear elongation ratio, alkali spreading value, amylose content and gel consistency and kernel length after cooking. Among all the crosses, GD 98014 x TKM 12 and GD 99017 x CO 47 showed high sca effects as well as high heterosis. These crosses can be used for development of hybrids in future. The parents with high gca effects for quality traits can be used in quality breeding programme in rice.

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Table 1. Analysis of variance for various quality characters of two line hybrids in rice

Source of variation	df	Mean Sum of Squares									
		brown rice length (mm)	**brown rice breadth (mm)**	**length to breadth ratio**	**kernel breadth after cooking (mm)**	**linear elongation ratio**	**breadthwise elongation ratio**	**alkali spreading value**	**amylose content (%)**	**gel consistency (mm)**	**kernel length after cooking (mm)**
Replication	1	0.0012	0.0110	0.0003	0.1332	0.0011	0.0080	0.1923	0.0690	5.5862	0.0166
Parents	9	0.5989**	0.0456**	0.1535**	0.0538*	0.0517*	0.0177*	1.5528**	9.8107**	1025.06**	2.6175**
Lines	3	0.7945**	0.0001	0.1437**	0.0583*	0.0081*	0.0117*	2.1998**	21.4933**	327.33**	4.4786**
Testers	4	0.4225**	0.0767**	0.1030**	0.0865**	0.0742**	0.0226*	1.4125**	0.4360*	408.88**	1.6390**
L x T	12	0.4255**	0.0531**	0.1474**	0.0382**	0.0610**	0.0201*	0.9541**	12.6462**	1437.28**	1.8254**
Hybrids	19	0.4749**	0.0428**	0.1757**	0.0465**	0.0564**	0.0189*	1.3801**	9.6642**	1334.54**	1.4508**
Error	28	0.0811	0.0068	0.0066	0.0157	0.0030	0.0014	0.0255	0.3293	1.8934	0.0166

*, ** = significant at 5% and 1% level

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Table 2. Estimates of gca effects of parents for various quality characters of two line hybrids in rice

Parents	brown rice length (mm)	brown rice breadth (mm)	length to breadth ratio	kernel breadth after cooking (mm)	linear elongation ratio	breadthwise elongation ratio	alkali spreading value	amylose content (%)	gel consistency (mm)	kernel length after cooking (mm)
GD 98014	0.04	-0.02	0.04	-0.16**	-0.02	-0.06**	0.33**	-0.93**	-.038	-0.31**
GD 99017	-0.06	-0.05	0.04	0.07	-0.10**	0.06**	-0.097**	0.24	8.43**	0.00
GD 98029	-0.06	0.07**	-0.12**	0.04	0.05**	-0.02	0.18**	0.82**	-6.47**	0.02
GD 98049	0.08	0.00	0.04	0.05	0.06**	0.03	0.45**	-0.14	-1.58**	0.29**
SE	0.0712	0.0234	0.0221	0.0414	0.0207	0.0137	0.0526	0.1381	0.4038	0.0392
IR 10198	-0.18*	-0.01	-0.05*	-0.08	0.11**	-0.02	0.02	-0.02	13.05**	0.13**
IR 72	0.38**	-0.06*	0.23**	0.04	0.02	0.05**	0.36**	-0.57**	-20.58**	0.51**
CO 43	0.33**	-0.01	0.17**	-0.01	-0.05	0.00	0.08	-0.80**	1.80**	-0.02
CO 47	-0.09	-0.01	-0.04	0.02	-0.00	0.01	-0.23**	0.58**	-8.45**	-0.38**
TKM 12	-0.43**	0.09**	-0.30**	0.03	-0.08**	-0.03	-.023**	0.80**	14.18**	-0.24**
SE	0.0796	0.0262	0.0247	0.0463	0.0231	0.0153	0.0588	0.1544	0.4515	0.0438

*, ** = significant at 5% and 1% level

Table 3. Estimates of sca effects of two line hybrids for various quality characters in rice

Crosses	brown rice length (mm)	brown rice breadth (mm)	length to breadth ratio	kernel breadth after cooking (mm)	linear elongation ratio	breadthwise elongation ratio	alkali spreading value	amylose content (%)	gel consistency (mm)	kernel length after cooking (mm)
GD 98014x IR 10198	-0.43*	0.02	-0.23**	-0.13	0.11*	-0.07*	-0.77**	0.66*	31.75**	0.16
GD 98014 x IR 72	0.07	0.08	-0.08	0.05	-0.05	-0.03	-0.11	1.21**	10.38**	0.09
GD 98014 x CO43	-0.16	-0.16**	0.15**	-0.05	-0.08	0.06	0.17	-4.36**	8.0**	-0.59**
GD 98014 x CO47	-0.06	0.03	-0.06	-0.03	-0.16**	-0.01	-0.27*	0.66*	-49.75**	-0.90**
GD 98014x TKM 12	0.59**	0.04	0.21**	0.16	0.18**	0.05	0.98**	1.84**	-0.38	1.24**
GD 99017x IR 10198	0.28	-0.25**	0.47**	-0.01	-0.03	0.15**	-0.72**	1.38**	-31.55**	-0.45**
GD 99017 x IR 72	0.41*	0.09	0.05	0.02	-0.01	-0.05	0.69**	1.53**	6.58**	-0.13
GD 99017x CO43	-0.56**	0.27**	-0.57**	-0.13	0.09	-0.19**	-0.28*	1.46**	5.20**	-1.10**
GD 99017x CO47	0.28	-0.05	0.18**	0.09	0.26**	0.05	0.78**	-1.42**	9.95**	1.46**
GD 99017x TKM 12	-0.42*	-0.06	-0.13*	0.03	-0.31**	0.04	-0.47**	-2.94**	9.82**	0.22*
GD 98029x IR 10198	0.05	0.03	-0.03	0.07	0.09	0.01	1.13**	-1.90**	0.85	0.93**
GD 98029x IR 72	0.29	0.08	0.02	-0.00	-0.14**	-0.05	-0.21	1.65**	-13.52**	-0.15
GD 98029x CO43	0.21	-0.06	0.14**	0.20*	0.05	0.11**	0.07	0.47	-33.40**	0.98**
GD 98029 x CO47	-0.33*	-0.08	-0.04	-0.23*	-0.03	-0.05	-0.62**	-.30	42.35**	-0.56**
GD 98029x TKM 12	-0.22	0.02	-0.09	-0.04	0.03	-0.02	-0.37**	0.07	3.72**	-1.20**
GD 98049x IR 10198	0.10	0.20**	-0.22**	0.06	-0.17**	-0.08*	0.36**	-0.14	-1.05	-0.64**
GD 98049 x IR 72	-0.77**	-0.25**	0.00	-0.06	0.19**	0.12**	-0.38**	-4.39**	-3.42**	0.19*
GD 98049x CO43	0.51**	-0.05	0.27**	-0.01	-0.06	0.01	0.05	2.43**	20.20**	0.71**
GD 98049 x CO47	0.11	0.10	-0.07	0.16	-0.06	0.02	0.11	1.06**	-2.55*	-0.00
GD 98049x TKM 12	0.05	-0.00	0.02	-0.15	0.10*	-0.07*	-0.14	1.04**	-13.18**	-0.26**
S.E.	0.29	0.08	0.08	0.13	0.06	0.04	0.16	0.57	1.38	0.13

*, ** = significant at 5% and 1% level