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GENETIC ANALYSIS OF CHARACTER ASSOCIATION FOR POLYGENIC TRAITS IN SOME RECOMBINANT INBRED LINES (RIL'S) OF RICE (*Oryza sativa L.*)

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Abstract. Fourteen recombinant inbred lines (RIL's) obtained from IR 30 and Basmati 370 were evaluated along with two popular varieties viz. Khitish (IET4094) and Minikit (IET 4786) for 14 biometrical characters during summer 2012 at Regional Research Station, New alluvial Zone, Chakadaha, Nadia, Bidhan Chandra KrishiVishwavidyalaya, Mohanpur, West Bengal, India., in Randomized Block Design with two replications. Except number of primary branches per panicle, grain breadth and kernel breadth all the characters studied showed significant differences among the genotypes. Four lines (S_7, S_{10}, S_{13} and S_{14}) possessed significantly higher grain yield than superior check variety. The high estimates of GCV and PCV were obtained for number of panicle per plant, grain yield per plant, floret number per panicle, number of grains per panicle and panicle weight. High heritability was observed for number of panicle per plant, kernel L/B ratio, kernel length, 1000 grain weight and grain L/B ratio. High genetic advance was observed for number of grain per panicle, floret number per panicle, grain yield per plant, number of secondary branches per panicle and 1000 grain weight respectively while lowest genetic advance was observed in kernel breadth. Genetic advance as percentage of mean was highest for number of panicle per plant followed by grain yield per plant, florets number per panicle and Kernel L/B ratio while lowest was recorded for kernel breadth. High heritability coupled with high genetic advance was obtained for number of grains per panicle, 1000 grain weight, kernel length and grain yield per plant. It indicated the predominance of additive gene action for controlling these characters. Therefore, these characters can be improved simply through selection. High heritability associated with low genetic advance was observed for panicle weight, grain length, grain L/B ratio and kernel L/B ratio. It suggested non–additive gene action for the expressions of these characters. The magnitude of genotypic correlation coefficient was in general higher than that of the corresponding phenotypic ones. Grain yield per plant was significantly positively correlated with number of panicles per plant, floret number per panicle and number of grain per panicle. The kernel length imparted the highest positive direct effect on grain yield per plant followed by number of grain per panicle, number of panicle per plant and panicle weight.

Keyword: *recombinant inbred lines (RIL's), correlation, genetic advance, heritability and path coefficient*.

Introduction

Worldwide Rice (*Oryza sativa* L.) is the second most important cereal crop after wheat and provides 20 percent of the world's dietary energy supply [FAO, 2004].

Selection of superior RIL's is one of the most important management decisions that are generally based upon agronomic traits and yield potential.

Selection of superior RIL's of rice with wider adaptability over diverse farming environments is important, prior to varietals recommendation in order to achieve a high rate of varietals adoption.

Analysis of correlation is used frequently in to quantify the degree of association between a response variable, and some explanatory variable [ALADAG *et al.,* 2010; Al–MARSHADI, 2011; GAITIN *et al.,* 2013].

Crop yield is said to be correlated with the factors of agronomic traits and variety yield potential [BUTNARIU *et al.,* 2005a; FERENCZ *et al.,* 2012].

In agriculture, path analysis has been used by plant breeders to assist in

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identifying traits that are useful as selection criteria to improve crop yield [MILLIGAN *et al.*, 1990; BUTNARIU *et al.*, 2006].

Use of path analysis permits the partitioning of correlation coefficient into its components, one component being the path coefficient that measures the direct effect of predictor variable upon its response variable [BUTNARIU and SAMFIRA, 2012; BUTU *et al.*, 2014; BUTNARIU and CORNEANU, 2012]; the second component being the indirect effect(s) of a predictor variable on the response variable through another predictor variable [BUTNARIU *et al.*, 2005b; ANDREEA *et al.*, 2012; BUTNARIU *et al.*, 2014].

Path coefficient analysis shows the extent of direct and indirect effects of the causal components on the response component yield is said to be correlated with the factors of agronomic traits and variety yield potential [BUTNARIU *et al.*, 2012; PUTNOKY *et al.*, 2013].

The objectives of the present study is to describe character association and contribution of various yield influencing traits to establish appropriate plant attributes for selection to improve the grain yield in the developed RIL's.

Material and methods

The experiment was conducted during summer 2012 at Regional Research Station, New alluvial Zone, Chakadaha, Nadia, Bidhan Chandra KrishiVishwavidyalaya, Mohanpur, West Bengal, India. The experiment was laid out in Randomized Block Design with two replications.

The experimental material comprised 14 recombinant inbred lines (RIL's) obtained from IR 30 and Basmati 370 and two check varieties viz., Khitish (IET4094) and Minikit (IET 4786).

Single seedling per hill was transplanted at a spacing of 20 cm ×15 cm in 5 m×3 m plot accommodating 500 hills in each of the 15 m^2 plots.

The fertilizer dose followed was 80:40:40 N:P:K Kg/ha out of which 40:40:40 N:P:K Kg/ha applied as basal dose and remaining 40 Kg N were applied in two split dose one at tillering stage and another at panicle initiation stage.

The observation on 14 characters viz., panicle weight (g), number of panicle per plant, panicle length (cm), number of primary branch per panicle, number of secondary branch per panicle, number of grain per panicle, floret number per panicle, fertility percentage, 1000 grain weight (g), grain length (mm), grain breadth (mm), grain L/B ratio, kernel length (mm), kernel breadth (mm), kernel L/B ratio and grain yield per plant (g) were recorded on five randomly selected plants from each entry.

The mean data were used for statistical analysis following appropriate computer based statistical programme.

Results and discussion

The estimated mean performances for different traits of RIL are developed from IR 30 and Basmati 370 along with checks varieties are presented in Table 1.

The number of panicle per plant ranged from 6.00 to 12.00.

The maximum number of panicle per plant were recorded for S_7 (12.00) followed by Minikit, S_{10} (10.00), S_{13} (9.00) and S_1 (8.50) respectively while it was minimum for S_4 (6.00).

The panicle weight was varied from 2.00g and 3.46 g of which S_6 was the best performer (3.46) followed by S_{13} (3.24), S_{14} (3.10), S_4 (3.08) and S_9 (3.04) respectively and Khitish was poorest in this regard.

The minimum value for panicle length was observed for S_{10} (24.62 cm) while Minikit (29.55) recorded longest panicle followed by S_{11} (29.00), S_4 (28.50), S_2 (28.00), S_{13} (27.87) and S_{14} (27.62).

The maximum number of primary branches per panicle was observed for S_{14} and Khitish (11.00) followed by S_1, S_3, S_8, and S_{13} (10.50), S_2 and Minikit (10.00) and S_{11} (9.50) respectively while the lowest value was observed for S_4, S_5, S_9 and S_{12}. S_9 (27.50) scored minimum value for number of secondary branches per panicle and S_{14} (37.50) had maximum value followed by S_6 (37.00), S_2 (36.00), S_{13} (33.50), Khitish (33.25), S_1 (31.50) and S_5 (31.50) respectively.

The maximum number of floret per panicle were recorded for S_{14} (241.00)

followed by S_{13} (231.25), S_{10} (226.50) and S_{12} (197.50) while S_9 (129.00) possessed lowest value in this regard.

S_{13} (200.50) registered maximum number of grains per panicle followed by S_{14} (200.00), S_{10} (181.00) and S_{12} (166.00) respectively while S_9 (110.00) registered minimum value for the same.

Table 1.

Mean performance of 14 RIL'S along with check varieties for different characters

Entry/ Genotype	No. of panicle/ plant	Panicle weight (g)	Panicle length (cm)	No. of primary branches	No. of secondary branches	Florets No./ panicle	No. of grains/ panicle	Fertility %
1. S_1	8.50	2.42	25.50	10.50	31.50	181.50	145.00	79.70
2. S_2	7.00	2.81	28.00	10.00	36.00	179.00	155.50	86.81
3. S_3	7.50	2.84	25.00	10.50	31.00	179.75	152.00	84.34
4. S_4	6.00	3.08	28.50	8.50	29.50	150.00	137.50	91.64
5. S_5	6.50	2.95	26.50	8.50	31.50	141.00	115.50	81.78
6. S_6	6.50	3.46	29.55	9.00	37.00	177.50	144.50	81.04
7. S_7	12.00	2.51	27.00	9.00	31.00	177.00	157.00	88.36
8. S_8	7.00	2.94	27.50	10.50	28.50	191.50	162.50	84.72
9. S_9	7.50	3.04	25.90	8.50	27.50	129.00	110.00	84.87
10. S_{10}	10.00	2.79	24.62	9.00	33.00	226.50	181.00	79.89
11. S_{11}	8.00	2.78	29.00	9.50	29.50	153.00	137.00	89.38
12. S_{12}	7.00	2.48	25.37	8.50	28.00	197.50	166.00	84.0
13. S_{13}	9.00	3.24	27.87	10.50	33.50	231.25	200.50	86.55
14. S_{14}	8.00	3.10	27.62	11.00	37.50	241.50	200.00	83.26
15. Khitish	7.00	2.00	26.12	11.00	33.25	161.75	135.00	83.67
16. Minikit	10.00	2.22	24.62	10.00	30.50	187.50	160.50	85.47
Mean	**7.96**	**2.79**	**26.79**	**9.65**	**31.79**	**181.57**	**153.71**	**84.72**
LSD(0.05)	1.22	0.43	2.35	1.94	4.23	49.78	41.72	5.93

Entry/ Genotype	1000 grain weight (g)	Grain length (mm)	Grain breadth (mm)	Grain L/B ratio	Kernel length (mm)	Kernel breadth (mm)	Kernel L/B ratio	Grain yield/ plant (g)
1. S_1	18.30	9.25	2.35	3.93	7.00	2.00	3.50	17.44
2. S_2	21.76	10.75	2.55	4.21	7.50	2.00	3.75	16.70
3. S_3	17.78	10.00	2.45	4.07	7.55	2.15	3.50	17.96
4. S_4	19.11	11.25	2.45	4.59	9.00	1.90	4.75	15.77
5. S_5	21.03	10.75	2.45	4.38	8.75	1.95	4.49	16.31
6. S_6	22.56	11.35	2.45	4.63	9.00	1.95	4.61	18.77
7. S_7	18.69	10.75	2.45	4.38	8.10	2.00	4.05	25.69
8. S_8	19.70	10.00	2.50	4.00	7.35	2.00	3.67	17.74
9. S_9	23.36	11.50	2.50	4.60	9.00	2.00	4.50	19.44
10. S_{10}	17.52	9.75	2.45	3.97	7.25	2.00	3.62	23.75
11. S_{11}	23.92	11.00	2.45	4.49	8.75	2.05	4.27	19.08
12. S_{12}	19.10	9.50	2.50	3.80	6.50	2.05	3.17	15.08
13. S_{13}	20.96	9.85	2.45	4.01	7.25	2.10	3.45	24.88
14. S_{14}	15.65	9.60	2.40	3.99	7.10	2.00	3.67	21.23
15. Khitish	20.68	9.25	2.40	3.85	7.00	2.00	3.45	11.91
16. Minikit	17.40	9.50	2.45	3.87	7.25	2.00	3.62	19.11
Mean	**19.84**	**10.25**	**2.45**	**4.17**	**7.77**	**2.00**	**3.88**	**18.81**
LSD(0.05)	2.04	0.92	0.11	0.30	0.65	0.14	0.41	3.93

A wide range of variation was observed for fertility percentage 79.70% (S_1) to 91.64 % (S_4). S_4 was the top scorer (91.64 %) followed by S_7 (88.36), S_{11} (89.38), S_2 (86.81) and S_{13} (86.55). S_{14} (15.65) had lowest value for 1000 grain weight 17.47 g while S_{11} (23.92) had highest followed by S_9 (23.36), S_6 (22.56) and S_2 (21.76) respectively.

The minimum grain length was observed for S_1 (9.25mm) while maximum value 11.50 mm for S_9 followed by S_6 (11.35), S_4 (11.25) and S_{11} (11.00) respectively.

The range for grain breadth was observed from S_1 (2.35 mm) to S_2 (2.55 mm).

S_2 possessed the maximum value 2.55 followed by S_3, S_4, S_5, S_6, S_7, S_{10}, S_{11}, S_{13} and Minikit (2.45), S_8, S_9 and S_{12} (2.50) respectively.

The highest value of grain L/B ratio was recorded for S_6 (4.63) followed by S_4 (4.59), S_{11} (4.49), S_7 andS_5 (4.38)

respectively while the lowest value was observed for S_{12} (3.80).

The highest value for kernel length was found to be S_6, S_4 and S_9 (9.00 mm) followed by S_5 (8.75), S_{11} (8.75) and S_7 (8.10) respectively while it was lowest for S_{12} (6.50mm).

S_3 (2.15) showed maximum kernel breadth followed by S_{13} (2.10), S_{11} and S_{12} (2.05) and the minimum kernel breadth was observed in S_4 (1.90).

S_4 (4.75) ranked first for kernel L/B ratio followed by S_6 (4.61), S_9 (4.50) and S_5 (4.49) respectively.

Grain yield per plant ranged from 11.91 g (Khitish) to 25.69 g (S_{14}).

Four lines (S_7, S_{10}, S_{13} and S_{14}) surpassed the check varieties in this regard.

Estimates of different genetic parameters for 16 different characters were presented in Table 2.

Table 2.

Variability and genetic parameters for different quantitative characters

Characters	Mean	Range	Variance		
			Phenotypic	Genotypic	Environmental
No. of panicle/plant	7.96	6.00–12.00	2.715	2.383	0.331
Panicle weight (g)	2.79	2.00–3.46	0.168	0.126	0.042
Panicle length (cm)	26.79	24.62–29.55	3.071	1.846	1.225
No. of primary branches	9.65	8.50–11.00	1.306	0.475	0.831
No. of secondary branches	31.79	27.5–37.50	11.381	7.440	3.941
Floret No./panicle	181.57	129.00–241.00	1281.333	735.808	545.525
No. of grains/panicle	153.72	110.00–200.50	844.390	461.144	383.246
Fertility %	84.72	79.70–91.64	14.915	7.169	7.746
1000 grains weight (g)	19.85	15.65–23.91	5.884	4.964	0.921
Grain length (mm)	10.25	9.25–11.50	0.704	0.518	0.186
Grain breadth (mm)	2.45	2.35–2.55	0.003	0.001	0.003
Grain L/B ratio	4.17	3.80–4.63	0.095	0.076	0.020
Kernel length (mm)	7.77	6.50–9.00	0.776	0.681	0.095
Kernel breadth (mm)	2.00	1.90–2.15	0.006	0.001	0.004
kernel L/B ratio	3.88	3.17–4.75	0.260	0.223	0.037
Grain yield/plant (g)	18.81	11.91–25.69	15.049	11.646	3.403

Characters	C V (%)	G C V (%)	P C V (%)	h^2(BS)	G.A.	G.A. % of mean
No. of panicle/plant	7.22	19.373	20.675	0.87	2.97	37.39
Panicle weight (g)	7.33	12.708	14.672	0.75	0.63	22.67
Panicle length (cm)	4.13	5.070	6.540	0.60	2.17	8.09
No. of primary branches	9.44	7.137	11.836	0.36	0.85	8.86
No. of secondary branches	6.24	8.578	10.609	0.65	4.54	14.28
Floret No./panicle	12.86	14.938	19.713	0.57	25.94	23.32
No. of grains/panicle	12.73	13.969	18.903	0.54	32.69	21.26
Fertility %	3.28	3.160	4.558	0.48	3.82	4.51
1000 grains weight (g)	4.83	11.225	12.222	0.84	4.21	21.23
Grain length (mm)	4.21	7.019	8.185	0.73	1.27	12.40
Grain breadth (mm)	2.23	1.174	2.403	0.23	0.03	1.18
Grain L/B ratio	3.38	6.586	7.401	0.79	0.50	12.07
Kernel length (mm)	3.96	10.618	11.332	0.87	1.59	20.49
Kernel breadth (mm)	3.14	1.758	3.711	0.22	0.03	1.71
kernel L/B ratio	4.95	12.174	13.137	0.85	0.90	23.24
Grain yield/plant (g)	9.81	18.146	20.627	0.77	6.18	32.88

CV: Coefficient of variation, GCV: Genotypic coefficient of variation, PCV: Phenotypic coefficient of variation, GA: Genetic Advance

Except number of primary branches per panicle, grain breadth and kernel breadth all the characters studied showed significant differences, indicating the presence of considerable genetic variability in the tested materials.

The maximum range of variation was observed for grain yield per plant followed by number of panicle per plant, number of grain per panicle and floret number per panicle.

In general the phenotypic variances were higher than the corresponding genotypic variances for all the characters.

The highest estimates of phenotypic and genotypic variances were observed for florets number per panicle followed by number of grains per panicle and grain yield per plant.

The environmental influences in expression of some characters like grain yield per plant, 1000 grain weight, number of secondary branches and number of

panicles per plant were less as observed from the lower value of environmental variance the genotypic variance which implies that the environment has played not significant role in expression of these characters.

The highest coefficient of variation was observed for florets number per panicle followed by number of grains per panicle, grain yield per plant, number of primary branches per panicle, panicle weight and number of panicles per plant where as it was lowest for kernel breadth.

The magnitude of PCV was higher than the corresponding GCV for all the characters indicating the influence of environment in the expression of these characters [DUTTA *et al.*, 2013; KUMAR and SENAPATI, 2013]. The high estimates of GCV and PCV were obtained for number of panicle per plant, grain yield per plant, floret number per panicle, number of grains per panicle and panicle weight.

In this regards, Sawant and collab. [SAWANT *et al.*, 1994] reported high GCV and PCV for grains per panicle, plant height, 1000 grain weight and grain yield per plant; Singh and Choudhary [SINGH and CHOUDHARY 1996] for number of panicles per plant, number of grains per panicle, grain yield per plant and 1000 grain weight; Nayak and collab. [NAYAK *et al.*, 2002] for number of panicles per plant, number of spikelets per panicle, number of grains per panicle and grain yield per plant; Sarkar and collab. [SARKAR *et al.*, 2005] for number of panicles per plant, number of tillers per plant and grain yield per plant; Panwar and collab. [PANWAR *et al.*, 2007] for straw yield per plant, grain yield per plant, total biological yield per plant, number of fertile florets per plant and number of branches per panicle; Raut and collab. [RAUT *et al.*, 2009] for seed yield per plant, 1000 grain weight, grains per panicle and effective tillers per plant; Karthikeyan and collab. [Karthikeyan *et al.*, 2009] for straw yield per plant, grain yield per plant, total biological yield per plant, number of fertile florets per panicle and number of branches per panicle and Anjaneyulu and collab. [Anjaneyulu *et al.*, 2010] for number of grain per panicle, fertility percentage and grain yield per plant.

High heritability was observed for number of panicle per plant, kernel L/B ratio, kernel length, 1000 grain weight and grain L/B ratio.

These findings were in accordance with the reports made by other authors [YADAV *et al.*, 1992; BIHARI *et al.*, 2004; PANWAR *et al.*, 2007; KARTHIKEYAN *et al.*, 2009] for different characters.

The lowest heritability was observed for kernel breadth. Number of grain per panicle recorded highest genetic advance followed by floret number per panicle, grain yield per plant, number of secondary branches per panicle and 1000 grain weight respectively while lowest genetic advance was observed in kernel breadth.

Genetic advance as percentage of mean was highest for number of panicle per plant followed by grain yield per plant, florets number per panicle and Kernel L/B ratio while lowest was recorded for kernel breadth.

These findings were corroborated by Karthikeyan and collab. [KARTHIKEYAN *et al.*, 2009] for number of branches per panicle, straw yield per plant, total biological yield per plant and grain yield per plant; Sarma and collab. [SARMA *et al.*, 1996] for effective tillers per m row length followed by panicle weight; Chaubey and Singh [CHAUBEY and SINGH 1994] for grain yield per plant followed by panicle weight and total number of spikelets.

The lowest GA as percentage of mean was observed for kernel breadth. High heritability coupled with high genetic advance was obtained for number of grains per panicle, 1000 grain weight, kernel length and grain yield per plant.

These findings corroborated the reports of Singh and collab. [SINGH *et al.*, 2005] for plant height; Sanker and collab. [SANKER *et al.*, 2006] for days to 50 % flowering, plant height, productive tiller per plant, panicle length, grain per panicle, 1000 seed weight and single plant yield; Singh and collab. [SINGH *et al.*, 2007] for days to 50% flowering, grain per panicle and plant height; Kishore and collab. [KISHORE *et al.*, 2008] for days to 50 % flowering, plant height;

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Anjaneyulu and collab. [ANJANEYULU *et al.*, 2010] for number of grains per panicle, plant height and fertility percentage.

It indicated the predominance of additive gene action for controlling these characters.

Therefore, these characters can be improved simply through selection.

High heritability associated with low genetic advance was observed for panicle weight, grain length, grain L/B ratio and kernel L/B ratio.

It suggested non–additive gene action for the expressions of these characters.

The high heritability was being exhibited due to favourable influence of environment rather than genotype therefore, direct selection for such traits might not be rewarding.

Low heritability coupled with high genetic advance was registered for number of grain per panicle, florets number per panicle and number of secondary branches. It revealed that the character is governed by additive gene effects.

The low heritability was being exhibited due to high environmental effects. Therefore, selection for this character might be effective.

Low heritability coupled with low genetic advance was observed for kernel breadth, grain breadth and number of primary branches per panicle.

It indicated that these characters were highly influenced by environmental effects and controlled by non–additive gene action thus direct selection would be ineffective for these characters.

The genotypic and phenotypic correlation coefficient studies (Table 3) revealed that the magnitude of genotypic correlation coefficient was in general higher than that of the corresponding phenotypic ones.

Table 3.

Correlation coefficients for grain yield and quality traits in rice

Characters		No. of panicle/ plant	Panicle weight (g)	Panicle length (cm)	No. of primary branches	No. of secondary branches	Floret No./ panicle	No. of grains/ Panicle	Fertility %	1000 grains weight (g)	Grain length (mm)	Grain breadth (mm)	Grain L/B ratio	Kernel length (mm)	Kernel breadth (mm)	kernel L/B ratio	Grain yield/ plant (g)
No. of panicle/plant	G	1.000	–0.377	–0.496*	0.092	–0.002	0.450	0.459	–0.105	–0.382	–0.322	–0.445	–0.267	–0.269	0.569*	–0.325	0.776**
	P	1.000	–0.292	–0.240	0.077	–0.013	0.329	0.367	0.101	–0.364	–0.204	–0.103	–0.194	–0.243	0.105	–0.252	0.762*
Panicle weight (g)	G		1.000	0.736**	–0.285	0.299	0.251	0.270	0.043	0.264	0.719**	0.567*	0.668**	0.579*	–0.344	0.600*	0.290
	P		1.000	0.516*	–0.222	0.264	0.018	0.036	0.051	0.270	0.498*	0.133	0.513*	0.488	–0.009	0.461	0.375
Panicle length (cm)	G			1.000	–0.021	0.418	–0.160	–0.044	0.567*	0.644**	0.603*	–0.024	0.656**	0.620*	–0.410	0.627**	–0.051
	P			1.000	–0.059	0.299	–0.074	0.010	0.374	0.417	0.585	0.217	0.578*	0.461	–0.273	0.489	0.113
No. of primary branches	G				1.000	0.448	0.797**	0.792**	–0.209	–0.500*	–1.039	–0.903**	–0.961**	–0.922**	0.890**	–0.936**	–0.090
	P				1.000	0.383	0.321	0.313	–0.121	–0.241	–0.444	–0.244	–0.420	–0.430	0.296	–0.450	–0.014
No. of secondary branches	G					1.000	0.515*	0.458	–0.386	–0.283	–0.226	–0.516*	–0.159	–0.208	–0.343	–0.081	0.167
	P					1.000	0.457	0.407	–0.281	–0.035	–0.004	–0.116	0.027	–0.059	–0.012	–0.041	0.170
Floret No./panicle	G						1.000	0.979**	–0.403	–0.756**	–0.924**	–0.451	–0.906**	–0.843**	0.720**	–0.767**	0.689**
	P						1.000	0.974**	–0.218	–0.514	–0.406	–0.060	–0.431	–0.578**	0.213	–0.558*	0.376
No. of grains/panicle	G							1.000	–0.205	–0.716**	–0.847**	–0.362	–0.838**	–0.813**	0.830**	–0.754**	0.712**
	P							1.000	–0.000	–0.481	–0.344	0.017	–0.386	–0.526**	0.213	–0.512*	0.427
Fertility %	G								1.000	0.351	0.628**	0.547*	0.578*	0.381	0.269	0.297	–0.090
	P								1.000	0.153	0.314	0.288	0.262	0.313	–0.106	0.306	0.139
1000 grains weight (g)	G									1.000	0.716**	0.635**	0.653*	0.615*	–0.206	0.533*	–0.219
	P									1.000	0.599*	0.315	0.563*	0.577**	–0.023	0.469	–0.165
Grain length (mm)	G										1.000	0.470	0.990**	0.025	–0.630**	1.009	0.078
	P										1.000	0.463	0.960**	0.858**	–0.293	0.813**	0.100
Grain breadth (mm)	G											1.000	0.340	0.242	0.202	0.178	–0.123
	P											1.000	0.196	0.143	0.014	0.105	0.019
Grain L/B ratio	G												1.000	0.056	–0.715**	0.050	0.103
	P												1.000	0.904**	–0.328	0.866**	0.106
Kernel length (mm)	G													1.000	–0.822**	0.998**	0.026
	P													1.000	–0.311	0.952**	0.051
Kernel breadth (mm)	G														1.000	–0.856**	0.462
	P														1.000	–0.570*	0.148
kernel L/B ratio	G															1.000	–0.024
	P															1.000	0.017

*Significant at 5 % level; **Significant at 1 % level; G: Genotypic correlation coefficient; P: Phenotypic correlation coefficient

These findings were earlier corroborated by Mamun and collab. [MAMUN *et al.*, 2012].

Grain yield per plant was significantly positively correlated with number of panicles per plant at genotypic and phenotypic level, floret number per panicle at genotypic level and number of grain per panicle at genotypic level.

Similar findings were reported earlier by Swain and Reddy [SWAIN and REDDY, 2006] for number of panicle per plant and Senapati and collab. [SENAPATI *et al.*, 2009] for number of panicle per plant and number of grains per panicle.

Therefore, number of panicles per plant, floret number per panicle and

number of grains per panicle were the principal yield determining trait in rice.

Path coefficient analysis (Table 4) revealed that the number of characters, chosen for the study were very much appropriate for yield determination in rice as evident from low value of residual effect (0.12095).

Table 4.

Path coefficient analysis showing direct (Diagonal bold) and indirect effects of component traits on grain yield in rice

Characters	No. of panicle/ plant	Panicle weight (g)	Panicle length (cm)	No. of primary branches	No. of secondary branches	Floret No./ panicle	No. of grains/ panicle	Fertility %
No. of panicle/plant	**1.119**	–0.307	–0.013	0.015	–0.000	–0.647	0.599	0.026
Panicle weight (g)	–0.422	**0.812**	0.019	–0.045	0.003	–0.361	0.352	–0.011
Panicle length (cm)	–0.555	0.598	**0.026**	–0.003	0.004	0.230	–0.058	–0.140
No. of primary branches	0.103	–0.232	–0.001	**0.158**	0.005	–1.146	1.034	0.051
No. of secondary branches	–0.003	0.243	0.011	0.071	**0.010**	–0.741	0.598	0.095
Floret No./panicle	0.503	0.204	–0.004	0.126	0.005	**–1.438**	1.277	0.099
No. of grains/panicle	0.514	0.219	–0.001	0.125	0.005	–1.408	**1.305**	0.051
Fertility %	–0.117	0.035	0.015	–0.033	–0.004	0.580	–0.267	**–0.247**
1000 grains weight (g)	–0.428	0.214	0.017	–0.079	–0.003	0.087	–0.935	–0.087
Grain length (mm)	–0.360	0.584	0.016	–0.164	–0.002	1.330	–1.105	–0.155
Grain breadth(mm)	–0.498	0.460	–0.001	–0.142	–0.005	0.648	–0.472	–0.135
Grain L/B ratio	–0.299	0.542	0.017	–0.151	–0.002	1.303	–1.094	–0.143
Kernel length (mm)	–0.301	0.470	0.016	–0.145	–0.002	1.213	–1.061	–0.094
Kernel breadth (mm)	0.636	–0.279	–0.011	0.140	–0.004	–1.036	1.083	–0.066
Kernel L/B ratio	–0.364	0.487	0.016	–0.148	–0.001	1.103	–0.983	–0.073

Residual effect = 0.1209522;* Significant at 5 %; ** Significant at 1 %

Characters	1000 grains weight (g)	Grain length (mm)	Grain breadth (mm)	Grain L/B ratio	Kernel length (mm)	Kernel breadth (mm)	kernel L/B ratio	Yield correlation
No. of panicle/plant	0.055	–0.041	–0.058	0.104	–0.485	–0.174	0.583	0.776**
Panicle weight (g)	–0.038	0.092	0.073	–0.260	1.045	0.105	–1.076	0.290
Panicle length (cm)	–0.092	0.077	–0.003	–0.255	1.119	0.125	–1.125	–0.051
No. of primary branches	0.071	–0.133	–0.117	0.374	–1.663	–0.272	1.678	–0.090
No. of secondary branches	0.040	–0.029	–0.067	0.062	–0.375	0.105	0.146	0.167
Floret No./panicle	0.108	–0.118	–0.058	0.353	–1.521	–0.221	1.374	0.689*
No. of grains/panicle	0.102	–0.108	–0.047	0.326	–1.467	–0.254	1.351	0.712*
Fertility %	–0.050	0.080	0.071	–0.225	0.688	–0.082	–0.533	–0.090
1000 grains weight (g)	**–0.143**	0.092	0.082	–0.254	1.109	0.063	–0.955	–0.219
Grain length (mm)	–0.102	**0.128**	0.061	–0.385	1.850	0.193	–1.809	0.078
Grain breadth(mm)	–0.091	0.060	**0.129**	–0.132	0.437	–0.062	–0.320	–0.123
Grain L/B ratio	–0.093	0.127	0.044	**–0.389**	1.905	0.219	–1.882	0.103
Kernel length (mm)	–0.088	0.131	0.031	–0.411	**1.804**	0.252	–1.790	0.026
Kernel breadth (mm)	0.030	–0.081	0.026	0.278	–1.483	**–0.306**	1.535	0.462
Kernel L/B ratio	–0.076	0.129	0.023	–0.409	1.801	0.262	**–1.793**	–0.024

Residual effect = 0.1209522;* Significant at 5 %; ** Significant at 1 %

Nine characters *viz.* number of panicle per plant, panicle weight, panicle length, number of primary branches, number of secondary branches per panicle, number of secondary branches per panicle, florets number per panicle, grain length, grain breadth and kernel length had positive direct effect on grain yield while the remaining six viz. number of grain per panicle, fertility %, 1000 grain weight, grain L/B ratio, kernel breadth and kernel L/B ratio characters imparted negative direct effect on grain yield.

The kernel length imparted the highest positive direct effect on grain yield per plant followed by number of grain per panicle, number of panicle per plant and panicle weight.

Significantly positive correlation of floret number per panicle with grain yield per plant in spite of negative direct effect indicated that indirect effects of kernel L/B ratio, number of grains per panicle, number of panicle per plant, grain L/B ratio and panicle weight would be the cause of such correlation.

Therefore, for yield improvement in rice, the present experiment indicates that the characters like kernel L/B ratio, number of grains per panicle, number of panicle per plant, grain L/B ratio and panicle weight should be taken care of.

Conclusions

Therefore the present investigation highlighted the differential performance of 14 RIL's developed from IR 30 and Basmati 370.

Five lines (S_7, S_9, S_{10}, S_{13} and S_{14}) showed very promising performance that may be useful for development of variety in future for gangatic plains of West Bengal.

Number of panicle per plant, floret number per panicle and number of grains per panicle are the prime yield contributing characters and direct selection would be effective for yield improvement in rice.

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