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 (S7, S10, S13 and S14) 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
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 m² 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 S7 (12.00) followed by Minikit, S10 (10.00), S13 (9.00) and S1 (8.50) respectively while it was minimum for S4 (6.00).

The panicle weight was varied from 2.00g and 3.46 g of which S6 was the best performer (3.46) followed by S13 (3.24), S14 (3.10), S4 (3.08) and S9 (3.04) respectively and Khitish was poorest in this regard.

The minimum value for panicle length was observed for S10 (24.62 cm) while Minikit (29.55) recorded longest panicle followed by S11 (29.00), S4 (28.50), S2 (28.00), S13 (27.87) and S14 (27.62).

The maximum number of primary branches per panicle was observed for S14 and Khitish (11.00) followed by S1, S3, S6 and S13 (10.50), S2 and Minikit (10.00) and S11 (9.50) respectively while the lowest value was observed for S6, S5, S9 and S12 S9 (7.50) scored minimum value for number of secondary branches per panicle and S14 (37.50) had maximum value followed by S6 (37.00), S2 (36.00), S13 (33.50), Khitish (33.25), S1 (31.50) and S5 (31.50) respectively.

The maximum number of floret per panicle were recorded for S14 (241.00)
followed by $S_{13}$ (231.25), $S_{10}$ (226.50) and $S_{9}$ (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.

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 $S_3$, $S_4$, $S_5$, $S_7$, $S_9$, $S_{11}$, $S_{13}$ 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 $S_5$ (4.63) followed by $S_4$ (4.59), $S_{11}$ (4.49), $S_7$ and $S_5$ (4.38)
respectively while the lowest value was observed for S₁₂ (3.80). The highest value for kernel length was found to be S₆, S₄ and S₈ (9.00 mm) followed by S₉ (8.75), S₁₁ (8.75) and S₇ (8.10) respectively while it was lowest for S₁₂ (6.50 mm).

S₃ (2.15) showed maximum kernel breadth followed by S₁₃ (2.10), S₁₁ and S₁₂ (2.05) and the minimum kernel breadth was observed in S₄ (1.90).

Four lines (S₇, S₁₀, S₁₃ and S₁₄) 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**

<table>
<thead>
<tr>
<th>Characters</th>
<th>Mean</th>
<th>Range</th>
<th>Variance</th>
<th>Phenotypic</th>
<th>Genotypic</th>
<th>Environmental</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of panicle/plant</td>
<td>7.96</td>
<td>6.00–12.00</td>
<td>2.715</td>
<td>2.383</td>
<td>0.331</td>
<td></td>
</tr>
<tr>
<td>Panicle weight (g)</td>
<td>2.79</td>
<td>2.00–3.46</td>
<td>0.168</td>
<td>0.126</td>
<td>0.042</td>
<td></td>
</tr>
<tr>
<td>Panicle length (cm)</td>
<td>26.79</td>
<td>24.62–29.55</td>
<td>3.071</td>
<td>1.846</td>
<td>1.255</td>
<td></td>
</tr>
<tr>
<td>No. of primary branches</td>
<td>9.65</td>
<td>8.50–11.00</td>
<td>1.306</td>
<td>0.475</td>
<td>0.831</td>
<td></td>
</tr>
<tr>
<td>No. of secondary branches</td>
<td>31.79</td>
<td>27.5–37.50</td>
<td>11.381</td>
<td>7.440</td>
<td>3.941</td>
<td></td>
</tr>
<tr>
<td>Floret No./panicle</td>
<td>181.57</td>
<td>128.00–241.00</td>
<td>1281.333</td>
<td>735.808</td>
<td>545.525</td>
<td></td>
</tr>
<tr>
<td>No. of grains/panicle</td>
<td>153.72</td>
<td>110.00–200.50</td>
<td>844.390</td>
<td>461.144</td>
<td>383.246</td>
<td></td>
</tr>
<tr>
<td>Fertility %</td>
<td>84.72</td>
<td>79.70–91.64</td>
<td>14.915</td>
<td>7.192</td>
<td>3.746</td>
<td></td>
</tr>
<tr>
<td>1000 grains weight (g)</td>
<td>19.85</td>
<td>15.65–23.91</td>
<td>5.884</td>
<td>4.964</td>
<td>0.921</td>
<td></td>
</tr>
<tr>
<td>Grain length (mm)</td>
<td>10.25</td>
<td>9.25–11.50</td>
<td>0.704</td>
<td>0.518</td>
<td>0.186</td>
<td></td>
</tr>
<tr>
<td>Grain breadth (mm)</td>
<td>2.45</td>
<td>2.35–2.55</td>
<td>0.003</td>
<td>0.001</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>Grain L/B ratio</td>
<td>4.17</td>
<td>3.80–4.63</td>
<td>0.095</td>
<td>0.076</td>
<td>0.020</td>
<td></td>
</tr>
<tr>
<td>Kernel length (mm)</td>
<td>7.77</td>
<td>6.50–9.00</td>
<td>0.776</td>
<td>0.681</td>
<td>0.095</td>
<td></td>
</tr>
<tr>
<td>Kernel breadth (mm)</td>
<td>2.00</td>
<td>1.90–2.15</td>
<td>0.006</td>
<td>0.001</td>
<td>0.004</td>
<td></td>
</tr>
<tr>
<td>kernel L/B ratio</td>
<td>3.88</td>
<td>3.17–4.75</td>
<td>0.260</td>
<td>0.223</td>
<td>0.037</td>
<td></td>
</tr>
<tr>
<td>Grain yield/plant (g)</td>
<td>18.81</td>
<td>11.91–25.69</td>
<td>15.049</td>
<td>11.646</td>
<td>3.403</td>
<td></td>
</tr>
</tbody>
</table>

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, plant growth, number of florets per panicle, number of grains per panicle and panicle weight.

In this regards, Sawant and collab. [SAWANT et al., 1984] reported high GCV and PCV for grains per plant, 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. [Karthykeyan 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;
Anjaneyulu and collab. [ANJANEYULU et al., 2016] 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.

Table 3 revealed that 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 at genotypic and phenotypic level, floret number per panicle at genotypic level and number of grain per panicle at genotypic level. These findings were earlier corroborated by Mamun and collab. [MAMUN et al., 2012].

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Correlation coefficients for grain yield and quality traits in rice

<table>
<thead>
<tr>
<th>Characters</th>
<th>No. of panicles/ plant</th>
<th>Weight (g)</th>
<th>Panicle length (cm)</th>
<th>No. of primary branches</th>
<th>No. of secondary branches</th>
<th>Fertility %</th>
<th>1000 grain length (mm)</th>
<th>Grain L/B ratio</th>
<th>Kernel length (mm)</th>
<th>Kernel L/B ratio</th>
<th>Grain yield/ plant (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of G</td>
<td>1.000</td>
<td>-0.371**</td>
<td>-0.486**</td>
<td>0.082</td>
<td>-0.362</td>
<td>0.406</td>
<td>0.105</td>
<td>-0.262**</td>
<td>-0.369</td>
<td>0.586</td>
<td>-0.335</td>
</tr>
<tr>
<td>Pancle weight (g)</td>
<td>1.000</td>
<td>0.738**</td>
<td>-0.285</td>
<td>0.399</td>
<td>0.351</td>
<td>0.270</td>
<td>0.043</td>
<td>0.264</td>
<td>0.719**</td>
<td>0.567</td>
<td>0.686**</td>
</tr>
<tr>
<td>Pancle length (cm)</td>
<td>1.000</td>
<td>0.516**</td>
<td>-0.222</td>
<td>0.264</td>
<td>0.018</td>
<td>0.036</td>
<td>0.270</td>
<td>0.498**</td>
<td>0.133</td>
<td>0.513</td>
<td>0.351**</td>
</tr>
<tr>
<td>No. of primary branches</td>
<td>1.000</td>
<td>-0.102</td>
<td>-0.180</td>
<td>0.044</td>
<td>0.567**</td>
<td>0.683**</td>
<td>-0.204</td>
<td>0.568**</td>
<td>0.626**</td>
<td>0.415</td>
<td>0.627**</td>
</tr>
<tr>
<td>No. of secondary branches</td>
<td>1.000</td>
<td>0.457</td>
<td>0.407</td>
<td>-0.281</td>
<td>0.036</td>
<td>-0.004</td>
<td>-0.116</td>
<td>-0.027</td>
<td>-0.019</td>
<td>-0.012</td>
<td>0.041</td>
</tr>
<tr>
<td>Fertility %</td>
<td>1.000</td>
<td>0.979**</td>
<td>-0.218</td>
<td>-0.514</td>
<td>-0.406</td>
<td>-0.080</td>
<td>-0.431</td>
<td>-0.578**</td>
<td>0.213</td>
<td>-0.558**</td>
<td>0.376</td>
</tr>
<tr>
<td>1000 grains length (mm)</td>
<td>1.000</td>
<td>-0.716**</td>
<td>-0.344</td>
<td>0.017</td>
<td>-0.536</td>
<td>-0.326</td>
<td>0.123</td>
<td>-0.512**</td>
<td>0.512</td>
<td>0.427</td>
<td></td>
</tr>
<tr>
<td>Grain L/B ratio</td>
<td>1.000</td>
<td>0.351</td>
<td>0.286</td>
<td>0.288</td>
<td>0.321</td>
<td>-0.106</td>
<td>-0.306</td>
<td>0.159</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kernel length (mm)</td>
<td>1.000</td>
<td>0.716**</td>
<td>0.635**</td>
<td>0.653**</td>
<td>0.615**</td>
<td>0.206</td>
<td>0.533**</td>
<td>-0.219</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kernel L/B ratio</td>
<td>1.000</td>
<td>0.315</td>
<td>0.560**</td>
<td>0.577**</td>
<td>-0.023</td>
<td>0.469</td>
<td>0.165</td>
<td>0.573**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grain yield/ plant (g)</td>
<td>1.000</td>
<td>0.979**</td>
<td>0.683**</td>
<td>0.653**</td>
<td>0.839**</td>
<td>0.758**</td>
<td>0.742</td>
<td>0.712**</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Characters</th>
<th>No. of panicle/plant</th>
<th>Panicle weight (g)</th>
<th>Panicle length (cm)</th>
<th>No. of primary branches</th>
<th>No. of secondary branches</th>
<th>Floret No./panicle</th>
<th>No. of grains/panicle</th>
<th>Fertility %</th>
<th>1000 grains weight (g)</th>
<th>Grain breadth (mm)</th>
<th>Grain L/B ratio</th>
<th>Kernel length (mm)</th>
<th>Kernel L/B ratio</th>
<th>Yield correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of panicle/plant</td>
<td>1.119</td>
<td>−0.307</td>
<td>−0.013</td>
<td>0.015</td>
<td>−0.000</td>
<td>−0.647</td>
<td>0.599</td>
<td>0.026</td>
<td>0.437</td>
<td>1.109</td>
<td>0.103</td>
<td>0.254</td>
<td>0.140</td>
<td>0.573</td>
</tr>
<tr>
<td>Panicle weight (g)</td>
<td>−0.422</td>
<td>0.812</td>
<td>0.019</td>
<td>−0.045</td>
<td>0.003</td>
<td>−0.361</td>
<td>0.352</td>
<td>−0.011</td>
<td>1.109</td>
<td>0.103</td>
<td>0.254</td>
<td>0.140</td>
<td>0.573</td>
<td>0.573</td>
</tr>
<tr>
<td>Panicle length (cm)</td>
<td>−0.555</td>
<td>0.598</td>
<td>0.026</td>
<td>−0.003</td>
<td>0.004</td>
<td>0.230</td>
<td>−0.058</td>
<td>0.140</td>
<td>−0.361</td>
<td>0.352</td>
<td>0.140</td>
<td>0.573</td>
<td>−0.011</td>
<td>0.573</td>
</tr>
<tr>
<td>No. of primary branches</td>
<td>0.103</td>
<td>−0.232</td>
<td>−0.001</td>
<td>0.158</td>
<td>0.005</td>
<td>−1.146</td>
<td>1.034</td>
<td>0.051</td>
<td>−0.361</td>
<td>0.352</td>
<td>0.140</td>
<td>0.573</td>
<td>−0.011</td>
<td>0.573</td>
</tr>
<tr>
<td>No. of secondary branches</td>
<td>−0.003</td>
<td>0.243</td>
<td>0.011</td>
<td>0.071</td>
<td>0.010</td>
<td>0.741</td>
<td>0.598</td>
<td>0.095</td>
<td>−0.361</td>
<td>0.352</td>
<td>0.140</td>
<td>0.573</td>
<td>−0.011</td>
<td>0.573</td>
</tr>
<tr>
<td>Floret No./panicle</td>
<td>0.503</td>
<td>0.204</td>
<td>−0.004</td>
<td>0.126</td>
<td>0.005</td>
<td>−1.438</td>
<td>1.277</td>
<td>0.099</td>
<td>−0.361</td>
<td>0.352</td>
<td>0.140</td>
<td>0.573</td>
<td>−0.011</td>
<td>0.573</td>
</tr>
<tr>
<td>No. of grains/panicle</td>
<td>0.514</td>
<td>0.219</td>
<td>−0.001</td>
<td>0.125</td>
<td>0.005</td>
<td>−1.408</td>
<td>1.305</td>
<td>0.051</td>
<td>−0.361</td>
<td>0.352</td>
<td>0.140</td>
<td>0.573</td>
<td>−0.011</td>
<td>0.573</td>
</tr>
<tr>
<td>Fertility %</td>
<td>−0.117</td>
<td>0.035</td>
<td>0.015</td>
<td>−0.033</td>
<td>−0.004</td>
<td>0.267</td>
<td>0.074</td>
<td>−0.087</td>
<td>−0.361</td>
<td>0.352</td>
<td>0.140</td>
<td>0.573</td>
<td>−0.011</td>
<td>0.573</td>
</tr>
<tr>
<td>1000 grains weight (g)</td>
<td>−0.428</td>
<td>0.214</td>
<td>0.017</td>
<td>−0.079</td>
<td>−0.003</td>
<td>0.87</td>
<td>0.095</td>
<td>−0.087</td>
<td>−0.361</td>
<td>0.352</td>
<td>0.140</td>
<td>0.573</td>
<td>−0.011</td>
<td>0.573</td>
</tr>
<tr>
<td>Grain length (mm)</td>
<td>−0.360</td>
<td>0.584</td>
<td>0.016</td>
<td>0.164</td>
<td>−0.002</td>
<td>1.330</td>
<td>−1.105</td>
<td>−0.155</td>
<td>−0.361</td>
<td>0.352</td>
<td>0.140</td>
<td>0.573</td>
<td>−0.011</td>
<td>0.573</td>
</tr>
<tr>
<td>Grain breadth(mm)</td>
<td>−0.498</td>
<td>0.460</td>
<td>−0.001</td>
<td>−0.142</td>
<td>−0.005</td>
<td>0.648</td>
<td>−0.472</td>
<td>−0.135</td>
<td>−0.361</td>
<td>0.352</td>
<td>0.140</td>
<td>0.573</td>
<td>−0.011</td>
<td>0.573</td>
</tr>
<tr>
<td>Grain L/B ratio</td>
<td>−0.299</td>
<td>0.542</td>
<td>0.017</td>
<td>−0.151</td>
<td>−0.002</td>
<td>1.303</td>
<td>−1.094</td>
<td>−0.143</td>
<td>−0.361</td>
<td>0.352</td>
<td>0.140</td>
<td>0.573</td>
<td>−0.011</td>
<td>0.573</td>
</tr>
<tr>
<td>Kernel length (mm)</td>
<td>−0.301</td>
<td>0.470</td>
<td>0.016</td>
<td>−0.145</td>
<td>−0.002</td>
<td>−1.211</td>
<td>−1.061</td>
<td>−0.094</td>
<td>−0.361</td>
<td>0.352</td>
<td>0.140</td>
<td>0.573</td>
<td>−0.011</td>
<td>0.573</td>
</tr>
<tr>
<td>Kernel breadth (mm)</td>
<td>0.636</td>
<td>−0.279</td>
<td>−0.011</td>
<td>0.140</td>
<td>−0.004</td>
<td>−1.036</td>
<td>1.083</td>
<td>0.066</td>
<td>−0.361</td>
<td>0.352</td>
<td>0.140</td>
<td>0.573</td>
<td>−0.011</td>
<td>0.573</td>
</tr>
<tr>
<td>Kernel L/B ratio</td>
<td>−0.364</td>
<td>0.487</td>
<td>0.016</td>
<td>−0.148</td>
<td>−0.001</td>
<td>1.103</td>
<td>−0.983</td>
<td>−0.073</td>
<td>−0.361</td>
<td>0.352</td>
<td>0.140</td>
<td>0.573</td>
<td>−0.011</td>
<td>0.573</td>
</tr>
</tbody>
</table>

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 (S7, S9, S10, S13 and S14) 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.

References
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