Original Research Article

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Association and Path Analysis of Yield and its Components in Aerobic Rice (Oryza sativa L.)

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ABSTRACT

A critical analysis of both character association and path analysis indicated that among several yield components in rice, number of filled grains per panicle are playing key role for better yields under aerobic situation. The studies indicated that grain yield is primarily contributed by filled grains per panicle and 1000 seed weight. As a highly significant correlation was noticed between panicle length and plant height and also between panicle length and grains per panicle, stature of plant is very important under aerobic condition. Hence medium stature plant with long panicle, sturdy culms and more grains per panicle would be highly advantageous for this situation. Other important traits for simultaneous consideration for yield enhancement are spikelet fertility and 1000 seed weight.

Keywords
Correlation, Path analysis and aerobic rice.

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Introduction

In Telangana state rice is the principal food crop grown in 16.0 L. ha under irrigated ecosystem with an average productivity of 3.24 t/ha (Milled rice). More than 50% of the water resources from wells, tanks and project canals are diverted for this crop at the cost of other crops and requirements. In addition to this, labour scarcity is becoming a major threat to rice cultivation and in coming 5-10 years total rice cultivation has to be mechanized. At this juncture, innovative technologies are required to use the water most economically without yield sacrifice. This system of rice cultivation would be more successful in the state, provided location specific high yield potential hybrids with acceptable cooking quality are developed and it is need of the day too. The association of different component characters among themselves and with yield is quite important for planning an efficient selection criterion for yield under aerobic cultivation. The total
correlation between yield and component characters may be some times misleading, as it might be an over estimate or under estimate because of its association with other characters. Hence, indirect selection by correlated response may not be some times fruitful. When many characters are affecting a given character, splitting the total correlation into direct and indirect effects of cause as devised by Wright (1921) would give more meaningful interpretation to the cause of association between the dependent variable like yield and independent variables like yield components.

This kind of information in aerobic situation is studied in rice. On account of this, statistical analysis was carried out to estimate the correlation, direct and indirect effect to facilitate selection of better hybrids. This study was conducted to determine the nature of relationship between grain yield and yield components, direct and indirect contribution of these parameters towards paddy yield and to identify better combination as selection criteria for developing high yielding rice genotypes under aerobic condition.

**Materials and Methods**

A total of 32 hybrids along with eight restorers, four ‘B’ lines of corresponding male sterile lines and 3 checks (MTU-1010, CRdhan-201 and MAS-946) were sown under aerobic situation at Rice Research Centre, Rajendranagar, Hyderabad.

Crossed seeds of hybrids were treated with Carbendazim solution (0.1%) and got them germinated in petridishes. Sprouted seeds were sown under aerobic situation and irrigated immediately.

A completely randomized block design with three replications was followed. Top dressing was given with urea and need based plant protection measures were undertaken for raising healthy seedlings. Five plants were selected at random from each entry in each replication. Observations were recorded (on 32 hybrids, 12 parents and 3 checks) for yield and yield attributing traits viz., days to 50% flowering, plant height, panicle length, number of effective tillers per plant, total number of filled grains per panicle, spikelet fertility %, 1000 seed weight. Observations were recorded and the data was subjected to statistical analysis. Statistical analyses for the above characters were done following Singh and Chaudhary (1995) for correlation coefficient and Dewey and Lu (1959) for path analysis.

**Results and Discussion**

Correlation coefficients were estimated involving 47 genotypes (32 hybrids, 12 parents and 3 checks) were presented in table 1. The grain yield per plant had significant positive association with plant height, 1000 seed weight. Hence, desired height with sturdiness could be considered as criteria for raising yield ceiling in aerobic condition.

Similar kinds of results were reported by Adithya et al., (2013), Khare et al., (2014), Jambhulkar et al., (2014) and Pavan Shankar et al., (2016) for the traits plant height, 1000 seed weight. Hence, desired height with sturdiness could be considered as criteria for raising yield ceiling in aerobic condition.

The character days to 50% flowering expressed significant positive association with plant height while it showed negative significant association with spikelet fertility as was reported by Chandan kumar et al., (2014) and Venkanna et al., (2014).

Panicle length showed significant positive correlation with number of grains per panicle, filled grains per panicle and grain yield per plant. Earlier researchers, Rajamadhan et al., (2011), Adithya et al., (2013), Singh et al.,
(2013), Patel et al., (2014), Khare et al., (2014), Fantie et al., (2014) and Pavan Shankar et al., (2016) reported similar results. The trait number of filled grains per panicle is considered as an important component for realizing high yield, because it exhibited significant and positive association with plant height, panicle length and total number of grains per panicle while it registered negative relationship with 1000 grain weight (Nandan et al., 2010).

The trait, spikelet fertility (%) was found to possess positive and significant association with grain yield per plant (Haider et al., 2012, Singh et al., 2013 and Chandan Kumar et al., 2014). It expressed negative relationship with days to 50% flowering and total number of grains per panicle.

The studies finally indicated that grain yield is primarily contributed by filled grains per panicle and 1000 seed weight. As a highly significant correlation was noticed between panicle length and plant height and also between panicle length and grains per panicle, stature of plant is very important under aerobic condition. Hence medium tall (120-130cm) with sturdy, non-lodging stems having long panicles and more grains per panicle would be highly advantageous. Semi tall statured plants also mostly have extensive root system; they are preferable under water scarce situation.

Data recorded on 47 genotypes (32 hybrids and 12 parents with three check) were subjected to analysis for estimation of correlation coefficients first, than they were further split into direct and indirect effects to know the cause and effect of each trait on yield (Table 2).

Days to 50% flowering had minimum direct effect on grain yield (0.0442). Positive but low level of indirect effects were exhibited on grain yield per plant by this trait via plant height, number of productive tillers per plant and number of filled grains per panicle.

Yadav et al., (2010), Seyoum et al., (2012), Pandey et al., (2012), Yadav and Rajendra Kumar (2012), Haider et al., (2012) and Khare et al., (2014) also reported that plant height had positive direct effect on grain yield, but small extent (0.0127) as in the case of present study. The indirect effects of this trait on grain yield per plant were expressed via days to 50% flowering, panicle length, number of productive tillers per plant and number of filled grains per panicle, spikelet fertility and 1000 seed weight, among these, the effect was high through number of filled grains per panicle.

Number of productive tillers per plant also exhibited positive direct effect (0.256) on grain yield per plant but low, when compare to grains per panicle. Results reported by Patel et al., (2014) and Thirumala Rao et al., (2014) are almost in agreement with the presently observed findings. It is interesting to note that productive tillers had positive indirect effects through all the other yield components except total number of grains per panicle.

Highest level of positive direct effect was exhibited by number of filled grains per panicle on grain yield per plant (0.4021), indicating its greater role in higher yield.

Earlier Pandey et al., (2012), Seyoum et al., (2012), Adithya et al., (2013), Khare et al., (2014), Patel et al., (2014) and Thirumala Rao et al., (2014) also reported that number of filled grains per panicle were very important among yield components. This trait also displayed desirable effects through all the traits studied except total number of grains per panicles and 1000 grain weight.
**Table.1** Simple correlation coefficients for grain yield and yield components

<table>
<thead>
<tr>
<th>Characters</th>
<th>Days to 50% flowering</th>
<th>Plant height</th>
<th>Panicle length</th>
<th>Productive tillers / plant</th>
<th>Total No. of grains/panicle</th>
<th>No. of Filled grains/panicle</th>
<th>Spikelet fertility</th>
<th>1000 seed weight</th>
<th>Seed yield / plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days to 50% flowering</td>
<td>1.0000</td>
<td>0.2983 *</td>
<td>0.0915</td>
<td>0.1900</td>
<td>0.276</td>
<td>0.1968</td>
<td>-0.3016 *</td>
<td>-0.0455</td>
<td>0.1158</td>
</tr>
<tr>
<td>Plant height</td>
<td>1.0000</td>
<td>0.7361 **</td>
<td>0.0966</td>
<td>0.3289 *</td>
<td>0.3581 *</td>
<td>0.0501</td>
<td>0.3157 *</td>
<td>0.5016 **</td>
<td></td>
</tr>
<tr>
<td>Panicle length</td>
<td>1.0000</td>
<td>-0.0290</td>
<td>0.3128*</td>
<td>0.2903*</td>
<td>0.1451</td>
<td>0.3003 *</td>
<td>0.4107 **</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Productive tillers / plant</td>
<td>1.0000</td>
<td>0.1624</td>
<td>0.1294</td>
<td>-0.1179</td>
<td>-0.0151</td>
<td>0.2906*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total No. of grains/panicle</td>
<td>1.0000</td>
<td>0.9281 **</td>
<td>-0.3708 *</td>
<td>-0.3215 *</td>
<td>0.0766</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of Filled grains/panicle</td>
<td>1.0000</td>
<td>-0.0134</td>
<td>-0.2733</td>
<td>0.3239*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spikelet fertility</td>
<td>1.0000</td>
<td>0.224</td>
<td>0.3598 *</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000 seed weight</td>
<td>1.0000</td>
<td>0.3891 **</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seed yield / plant</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at 5% level; **Significant at 1% level

**Table.2** Path coefficient analysis for yield and yield contributing characters

<table>
<thead>
<tr>
<th>Characters</th>
<th>Days to 50% flowering</th>
<th>Plant height</th>
<th>Panicle length</th>
<th>Productive tillers / plant</th>
<th>Total No. of grains/panicle</th>
<th>No. of Filled grains/panicle</th>
<th>Spikelet fertility</th>
<th>1000 seed weight</th>
<th>Seed yield / plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days to 50% flowering</td>
<td>0.0442</td>
<td>0.0567</td>
<td>0.0068</td>
<td>0.0473</td>
<td>-0.0751</td>
<td>0.0749</td>
<td>-0.0333</td>
<td>-0.0095</td>
<td>0.1121</td>
</tr>
<tr>
<td>Plant height</td>
<td>0.0127</td>
<td>0.1967</td>
<td>0.06</td>
<td>0.0543</td>
<td>-0.0882</td>
<td>0.1333</td>
<td>0.0053</td>
<td>0.0711</td>
<td>0.4453</td>
</tr>
<tr>
<td>Panicle length</td>
<td>0.0033</td>
<td>0.1303</td>
<td>0.0905</td>
<td>0.016</td>
<td>-0.0537</td>
<td>0.0978</td>
<td>0.0136</td>
<td>0.0656</td>
<td>0.3635</td>
</tr>
<tr>
<td>Productive tillers / plant</td>
<td>0.0082</td>
<td>0.0417</td>
<td>0.0057</td>
<td>0.256</td>
<td>-0.0398</td>
<td>0.0576</td>
<td>0.0035</td>
<td>0.0066</td>
<td>0.3395</td>
</tr>
<tr>
<td>Total No. of grains/panicle</td>
<td>0.011</td>
<td>0.0574</td>
<td>0.0161</td>
<td>0.0337</td>
<td>-0.302</td>
<td>0.3726</td>
<td>-0.0452</td>
<td>-0.0703</td>
<td>0.0732</td>
</tr>
<tr>
<td>No. of Filled grains/panicle</td>
<td>0.0082</td>
<td>0.0652</td>
<td>0.022</td>
<td>0.0367</td>
<td>-0.2798</td>
<td>0.4021</td>
<td>0.0016</td>
<td>-0.058</td>
<td>0.198</td>
</tr>
<tr>
<td>Spikelet fertility</td>
<td>-0.0115</td>
<td>0.0083</td>
<td>0.0096</td>
<td>0.007</td>
<td>0.1071</td>
<td>0.005</td>
<td>0.1275</td>
<td>0.0481</td>
<td>0.301</td>
</tr>
<tr>
<td>1000 seed weight</td>
<td>-0.0017</td>
<td>0.0564</td>
<td>0.0239</td>
<td>0.0068</td>
<td>0.0856</td>
<td>-0.0941</td>
<td>0.0247</td>
<td>0.2481</td>
<td>0.3498</td>
</tr>
</tbody>
</table>

Bold values are direct effects, residual effect = 0.7778
Another important yield contributing trait is spikelet fertility (%), as evident from positive direct effect of 0.1275 on grain yield. Indirect positive influence of spikelet fertility on grain yield was observed through plant height, total number of grains per panicle and 1000 seed weight while it showed negative influence through days to 50% flowering.

Next important trait, which showed moderate positive direct effect (0.2481) on grain yield per plant was 1000 grain weight. With respect to indirect effects, positive effects on yield were through plant height, productive tillers per plant, total number of grains per panicle and spikelet fertility, whereas negative effects were observed through days to 50% flowering and number of filled grains per panicle.

Path coefficient analysis revealed that among the yield components, the quantitative trait, number of filled grains per panicle had highest positive direct effect on grain yield followed by number of productive tillers per plant, 1000 seed weight, plant height, spikelet fertility and days to 50% flowering. Earlier findings of Pandey et al., (2012), for number of productive tillers per plant and panicle length; Seyoum et al., (2012), Yadav and Rajendrakumar (2012) for number of filled grains per panicle) were also in same lines.

A critical analysis of both character association and path analysis indicated that among the yield components in rice, number of filled grains per panicle and number of productive tillers per plant were determined. Other important traits for simultaneous consideration for yield enhancement are spikelet fertility, plant height and 1000 seed weight under aerobic situation.

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