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# Correlation and Path Analysis Studies in Aerobic Rice

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**A B S T R A C T**

The present study was undertaken with the objective to determine the degree of association between yield and it`s component characters and their direct, indirect effects on grain yield in aerobic rice. Twenty two aerobic genotypes with 4 check varieties were evaluated for identifying their efficiency with respect to 10 yield and yield attributing traits. The result from the study revealed that plant height ($r_p$: 0.509, $r_g$: 0.527), number of fertile grains/panicle ($r_p$: 0.616, $r_g$: 0.651), fertility percentage ($r_p$: 0.750, $r_g$: 0.807) and 100 grain weight ($r_p$: 0.635, $r_g$: 0.760) showed significant positive association with grain yield and from path analysis, high direct contribution to yield was manifested by fertility percentage followed by 100 grain weight. Number of fertile grain / panicle exhibited highest indirect effect on yield via fertility percentage followed by 100 grain weight, plant height via fertility percentage.

## Introduction

The rice environments in India are extremely diverse. Of the 44.2 million ha of harvested area, about 30.8% are rainfed lowland, 44.9% irrigated, 17.4% rainfed uplands & 6.9% flood prone which profoundly influence the overall rice productivity of the country. Water consumption per kg of rough rice ranges from 1000 to 5000 litres depending on climate, soil conditions, and crop management, and is about two to three times that of other cereals such as wheat or maize. Irrigation for agriculture consumes 2/3 of world's fresh water and rice alone consumes more than 50 percent of the water used for irrigation in Asia. A fundamental approach to reduce water inputs in rice is to grow the crop aerobically like an irrigated upland crop such as wheat and maize. Early experiments on aerobic rice reveals that the water input in aerobic rice was 50 percent lower (only 470-650mm) and water productivity was higher by 64-88 percent than irrigated lowland rice (Bouman, 2001). Aerobic rice is a production system in which specially developed varieties are grown in well drained, non-puddled and non-saturated soils. Aerobic rice is a new way of cultivating rice that requires less water than lowland rice. It entails the growing of rice in aerobic soil, with the use of external inputs such as supplementary irrigation and fertilizers and aiming at high yields (Wang *et al.,* 2000).

Aerobic way of growing rice saves water by eliminating continuous seepage and percolation, reducing evaporation and eliminating wet land preparation (Castaneda *et al.,* 2002). Selection of yield is not reliable as it is much influenced by the environment. Therefore, indirect selections through component characters became important in breeding for yield improvement.

## Materials and Methods

The experiment was conducted at Rice Research Station, O.U.A.T., Bhubaneswar during 2015 kharif season.22 aerobic rice genotypes and 4 check varieties were collected from AICRP trails on aerobic rice, conducted in a Randomized Block Design with three replications. The plot size was 5.28 meter square with spacing 20 x 15 cm. Observations were recorded for ten metric traits taking five competitive plants selected randomly from middle rows of each plot; whereas, characters like plot yield and days to 50 % flowering were recorded on plot basis and number of effective tillers was observed on square meter basis. The characters studied weredays to 50% flowering, Plant height, effective tillers/$m^2$, flag leaf area, panicle length, fertile grains/panicle, fertility percentage, 1000 grain weight, L/B ratio & plot yield. The replicated data were subjected to statistical analysis and correlation & path coefficient analysis were determined. The whole details of genotypes and their parentage are given in table 1.

## Results and Discussion

Selection of yield is not reliable as it is much influenced by the environment. Therefore, indirect selections through component characters became important in breeding for yield improvement. Hence, studies on character associations not only help to understand physical linkage but also provide information on nature and direct of selection. An attempt has been made in the present investigation to estimate the nature and magnitude of correlation of character pairs, which would facilitate selection of genotypes where a balance combination of characters is associated with the increased productivity.

The magnitude and nature of association of characters at genotypic and phenotypic levels are presented in table 2. In general, the estimates of genotypic correlation were higher than that of phenotypic correlation, indicating that the environmental causes of correlation had affected the genetic cause, thereby reducing the reliability of phenotypic correlation for use in crop improvement programme.

The highest estimates of correlation both at genotypic and phenotypic level was between yield and fertility percentage ($r_p$ = 0.750; $r_g$ = 0.807). It was followed by 100 grain weight ($r_p$ =0.635; $r_g$ =0.760), fertile grains/panicle ($r_p$ =0.616; $r_g$ =0.651), plant height ($r_p$ = 0.509; $r_g$ = 0.527), no. of tiller/$m^2$ ($r_p$ = 0.153; $r_g$ = 0.153), panicle length ($r_p$ = 0.066; $r_g$ = 0.069) and negatively significant correlation with days to 50% flowering and no. of fertile grains/panicle. Days to 50% flowering, had significant positive correlation with flag leaf area ($r_p$=0.731; $r_g$=0.768) and significant negative correlation with 100 grain weight ($r_p$= -0.908; $r_g$= -0.717) & plant height ($r_p$= -0.482; $r_g$= -0.534). Plant height had positive significant correlation with panicle length ($r_p$= 0.423; $r_g$= 0.420), fertility percentage ($r_p$= 0.459; $r_g$= 0.529) & 100 grain weight ($r_p$= 0.467; $r_g$= 0.607) and significant negative correlation with L-B ratio ($r_p$= -0.585; $r_g$= -0.692). Flag leaf area had significant negative correlation with 100 grain weight ($r_p$= -0.461; $r_g$= -0.531). Number of fertile grains/ panicle had significant positively correlated with fertility percentage ($r_p$= 0.773; $r_g$= 0.767), and significant negative correlation with L-B ratio

($r_p$= -0.541; $r_g$= -0.646). Fertility percentage have siginificant positive correlation with 100 grain weight ($r_p$= 0.525; $r_g$= 0.566) negative correlation with L-B ratio ($r_p$= -0.474; $r_g$= -0.584).

Path analysis has been used to understand the direct and indirect effects of each character on grain yield and the application of selection pressure in a better way for yield improvement, partitioning of correlation coefficient into direct and indirect effects. The phenotypic correlations coefficients were used for carrying out path coefficient analysis and presented in table 3. It was revealed from the table 3 that high direct contribution to yield was manifested by fertility% (0.478) followed by 100 grain weight(0.201) and panicle length(0.145). Fertile grains per panicle exhibited highest indirect effect on yield via L-B Ratio (0.370) followed by 100 grain weight via fertility percentage (0.251).

**Table.1** Details of rice germplasm for 26 aerobic rice genotypes used in the study

| S. No. | Designation | Cross combination |
|---|---|---|
| 1. | TRC 2014-14/IR 82589-B-B-2-2 | IRRI-1321/ IR 74371-54-1-1 |
| 2. | TRC2014-11/ IR83377-B-B-123-2 | IR 71700-247-1-1-2/ SambhaMahsuri |
| 3. | CR DHAN202(ZC) | |
| 4. | RCPR-19-IR 84899-B-179-13-1-1-1 | IR 78877-208-B-1-1/ IRRI 134 |
| 5. | MANDAKINI | |
| 6. | BRR0006(IR87759-2-2-1-1) | IR 80463-B-39-3/ IR 81421-B-B-66 |
| 7. | RCPR8(IR84899-B-179-16-1-1-1) | IR 78877-208-B-1-1/ IRRI 132 |
| 8. | CR DHAN201(NC) | |
| 9. | KMP 128 | IR 64/ Bharani |
| 10. | KPH 272(HYBRID) | |
| 11. | NPH912(HYBRID) | NPS 2001A/ NPS 2334 |
| 12. | NPH8899(HYBRID) | NPS 8001A/ NP1001R |
| 13. | PA6129(HC) | |
| 14. | RAU1484-Aer-04 | OG 6709-7/APO |
| 15. | BRR0007(IR87638-10-1-1-3) | Dhagaddeshi/ ir 78585-98-2-2 |
| 16. | R1973-206-2-86-1 | MTU 1010 x RP 4092 |
| 17. | MC13 | MC 13A/ MC13R |
| 18 | RCPR-20-IR83929-B-B-291-2-1-1-2 | IR 78878-53-2-2-2/ CT6510-24-1-2 |
| 19. | TRC-2015-14 | Naveen/ Fulbadam |
| 20. | CR3856-44-22-2-1-10-3-1 | IR 73963-86-1-5-2-2/ CR 2324 |
| 21. | R1986-296-2-86-1 | Dateswari/ R 1493 |
| 22. | CR 3948-2-1-2-2-1 | Lalat/ CR 2340-11 |
| 23. | RP5587-B-B-B-305-13 | IR 64/ IR 75870-5-8-5-B-2-B |
| 24. | CR3947-1-3-1-1-1 | IR 64/ PSB RC18 |
| 25. | CR3580-3-1-1-1-1-1 | Lalat/ N22 |
| 26. | TRC-2015-12 | Naveen/ Kataktara |

**Table.2** Estimates of phenotypic and genotypic correlation co-efficient among various characters for 26 aerobic rice genotypes

| Characters | | Days to 50% flowering | Plant height (cm) | No. of effective tillers/plant | Panicle length (cm) | Flag leaf area ($cm^2$) | No. of fertile grains/panicle | Fertility % | L-B Ratio | 100 grains weight (gm) |
|---|---|---|---|---|---|---|---|---|---|---|
| Plant height(cm) | $r_p$ | -0.482 | | | | | | | | |
| | $r_g$ | -0.534 | | | | | | | | |
| No.of effective tillers/plant | $r_p$ | -0.064 | 0.225 | | | | | | | |
| | $r_g$ | -0.067 | 0.232 | | | | | | | |
| Panicle length (cm) | $r_p$ | -0.281 | 0.423 | 0.372 | | | | | | |
| | $r_g$ | -0.326 | 0.420 | 0.383 | | | | | | |
| Flag leaf area ($cm^2$) | $r_p$ | 0.731 | -0.243 | -0.300 | -0.237 | | | | | |
| | $r_g$ | 0.768 | -0.297 | -0.315 | -0.263 | | | | | |
| No. of fertile grains/panicle | $r_p$ | -0.236 | 0.231 | -0.025 | -0.218 | -0.034 | | | | |
| | $r_g$ | -0.259 | 0.269 | -0.025 | -0.236 | -0.033 | | | | |
| Fertility % | $r_p$ | -0.400 | 0.459 | 0.316 | -0.130 | -0.221 | 0.773 | | | |
| | $r_g$ | -0.441 | 0.529 | 0.334 | -0.147 | -0.230 | 0.767 | | | |
| L-B Ratio | $r_p$ | 0.068 | -0.585 | 0.071 | 0.079 | -0.263 | -0.541 | -0.474 | | |
| | $r_g$ | 0.027 | -0.692 | 0.090 | 0.039 | -0.286 | -0.646 | -0.584 | | |
| 100 grains weight (gm) | $r_p$ | -0.717 | 0.467 | 0.163 | 0.207 | -0.461 | 0.256 | 0.525 | -0.145 | |
| | $r_g$ | -0.908 | 0.607 | 0.196 | 0.212 | -0.513 | 0.251 | 0.566 | -0.343 | |
| Plot yield (kg/ha) | $r_p$ | -0.596 | 0.509 | 0.153 | 0.069 | -0.356 | 0.616 | 0.750 | -0.481 | 0.635 |
| | $r_g$ | -0.634 | 0.527 | 0.153 | 0.066 | -0.380 | 0.651 | 0.807 | -0.527 | 0.760 |

**Table.3** Direct and indirect effects of component traits on yield at phenotypic level for 26 aerobic rice genotypes

| Characters | Days to 50% flowering | Plant height(cm) | No. of tillers/$m^2$ | Panicle length (cm) | Flag leaf Area ($cm^{2)}$ | Fertile grains/ panicle | Fertility % | L-B Ratio | 100 grain wt.(gm) | Plot yield (kg/ha) |
|---|---|---|---|---|---|---|---|---|---|---|
| Days to 50% flowering | -0.157 | 0.084 | 0.005 | -0.041 | -0.121 | -0.008 | -0.191 | -0.024 | -0.144 | -0.596 |
| Plant height (cm) | 0.076 | -0.174 | -0.018 | 0.061 | 0.040 | 0.008 | 0.220 | 0.203 | 0.094 | 0.509 |
| No. of tiller / $m^2$ | 0.010 | -0.039 | -0.080 | 0.054 | 0.050 | -0.001 | 0.151 | -0.025 | 0.033 | 0.153 |
| Panicle length (cm) | 0.044 | -0.074 | -0.030 | 0.145 | 0.039 | -0.007 | -0.062 | -0.027 | 0.042 | 0.069 |
| Flag leaf area ($cm^2$) | -0.115 | 0.042 | 0.024 | -0.034 | -0.165 | -0.001 | -0.106 | 0.091 | -0.092 | -0.356 |
| No.of fertile grain/panicle | 0.037 | -0.040 | 0.002 | -0.032 | 0.006 | 0.034 | 0.370 | 0.188 | 0.051 | 0.616 |
| Fertility % | 0.063 | -0.080 | -0.025 | -0.019 | 0.037 | 0.026 | 0.478 | 0.165 | 0.105 | 0.750 |
| L-B Ratio | -0.011 | 0.102 | -0.006 | 0.011 | 0.043 | -0.018 | -0.227 | -0.347 | -0.029 | -0.481 |
| 100 grain weight(gm) | 0.112 | -0.081 | -0.013 | 0.03 | 0.076 | 0.009 | 0.251 | 0.050 | 0.201 | 0.635 |

In the present study plant height, number of fertile grains/panicle, fertility percentage and 100 grain weight showed significant positive association with grain yield. This revealed that selection on the basis of these characters bears relevance to grain yield. Similar results have been reported by Goswami *et al.*, (2000), Yadav *et al.,* (2010), Immanuel Selvaraj *et al.*, (2011) and Mulugeta Seyoum *et al.*, (2012).

Thus, from the above observations on direct and indirect effect of different traits on yield, it is concluded that the traits like fertility percentage, 100 grain weight, should be considered as important selection criteria for realization of higher yield. These findings in relation to different component traits are in agreement with works on path analysis by Mishra and Verma (2002), Salimath, *et al.*, (2011). Kumar, *et al.,* (2014), Sarma *et al.*, (2015).

In the present study, all the component traits exhibited positive association with yield, except 50% flowering, flag leaf area, L/B ratio. The characters like plant height, number of fertile grains/panicle, fertility percentage and 100 grain weight showed significant positive association with grain yield. This revealed that selection on the basis of these characters bears relevance to grain yield.

It was revealed from that high direct contribution to yield was manifested by fertility percentage followed by 100 grain weight. Number of fertile grain / panicle exhibited highest indirect effect on yield via fertility percentage followed by 100 grain weight, plant height via fertility percentage. Thus, from the above observations on direct and indirect effect of different traits on yield, it is concluded that the traits like fertility percentage, 100 grain weight, should be considered as important selection criteria for realization of higher yield.

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