Indian J. Genet., 57 (1): 19–24 (1997)

CORRELATION AND PATH ANALYSIS OF YIELD AND YIELD COMPONENTS IN DEEP WATER RICE (*ORYZA SATIVA* L.)

D. K. VERMA, R. THAKUR AND S. B. MISHRA

Rice Section, Department of Plant Breeding, Rajendra Agricultural University Pusa (Samastipur) 848125

(Received: April 29, 1992; accepted: August 19, 1993)

ABSTRACT

The phenotypic as well as genotypic correlation and path analysis of yield and yield contributing characters were analysed in 3 sets (25 genotypes in each set) of deep water rice (*Oryza sativa* L.). Grain yield had showed highly significant r_p and r_g with PBT and grains per panicle in all the 3 sets studied. Grain yield had highly significant r_p and r_g with plant height, panicle length in Set-III only where test weight was high. PBT had highest positive direct effect on grain yield in all the three sets invariably with the difference in test weight. In Set- II and Set-III where test weight was medium and high, grains per panicle showed next highest direct effect towards grain yield. Direct effect of plant height was considerable in Set-I only.

Key words: *Oryza sativa* L., correlation, path analysis.

Among the grain crops rice (*Oryza sativa* L.) is the staple food grain of more than 60 per cent of the global population. Rice is the only crop which is grown under a wide range of agroclimatic conditions and has unique ecosystem from rainfed upland to deep water areas at water depths of 6 m. But the pay off from research were greater in irrigated areas and scientist being human, have been attracted to areas where success seemed more definitely assumed [1]. As such, ill-drained lowland and deep water and deep water areas remained almost neglected in the past. Hence, the evaluation of local germplasm from rainfed lowland and deep water condition has thus been suggested as an important tool to develop varieties [2]. Chang [3] expressed his view that in spite of rigorous selection by natural forces and by rice cultivators through the ages, the magnitude of spectrum of genetic diversity existing in the cultivated and wild rice astounds the researchers.

MATERIALS AND METHODS

Based on test weight, 75 landraces were grouped into three, sets, each having 25 rice landraces. Set-I consisted of landraces having 1000-seed weight less than 23 g, whereas

Set-III consisted of the landraces having more than 27 g and Set-II had intermediate which ranged from 23 – 27 g of test weight.

Covariance analysis of the replicated data from lines of all combinations of characters was done and used for estimation of correlation coefficients. Genotypic and phenotypic variances were estimated by using the formula suggested by Federar [4]. Phenotypic and genotypic correlation were calculated by the formula suggested by Al-Jibouri, Miller and Robinson [6] using the variance and covariance estimated from the analysis of covariance and analysis of variance table. Path coefficient analysis was computed as applied by Dewey and Lu [4].

RESULTS AND DISCUSSION

Estimates of correlation coefficients measure the degree of relationship between pairs of characters. Computation of correlation between yield contributing characters and yield are of considerable importance in plant selection.

Generally it is expected that genotypic correlation (r_g) will be less nearly equal to phenotypic correlation (r_p) in the present study. In most cases (Table 1) it was observed that the magnitude of r_g were slightly higher than the corresponding r_p. These may be attributed

Table 1. Phenotypic (r_p) and genotypic (r_g) correlation between pairs of important economic traits in rice

Character pair	Set-I		Set-II		Set-III	
	r_p	r_g	r_p	r_g	r_p	r_g
PBT vs. plant height	0.08	0.12	0.25	0.28	0.51*	0.60**
PBT vs. panicle length	0.06	0.08	–0.01	0.08	0.57**	0.68**
PBT vs. fertility percentage	0.07	0.02	–0.20	–0.42*	–0.20	–0.51**
PBT vs. yield/plant	0.55**	0.56**	0.72**	0.71**	0.87**	0.96**
Plant height vs. grains/panicle	0.34	0.49*	0.23	0.27	0.32	0.39
Plant height vs. fertility percentage	0.27	0.34	–0.25	–0.29	–0.22	–0.57**
Plant height vs. yield/plant	0.27	0.44*	0.25	0.31	0.59**	0.64**
Panicle length vs. grains/panicle	0.43*	0.46*	0.39	0.27	0.30	0.29
Panicle length vs. yield/plant	0.32	0.34	0.36	0.41	0.53**	0.58**
Grains/panicle vs. fertility percentage	0.32	0.16	0.52**	0.42	0.18	0.05
Grains/panicle vs. yield/plant	0.60**	0.58**	0.54	0.50**	0.56**	0.64*
Fertility percentage vs. yield/plant	0.19	0.01	0.20	0.01	–0.09	–0.45*

*,** Significant at P = 0.05 and 0.01, respectively.

to the environmental causes. The r_p is an estimated value whereas r_g is derived one which is very much effected by genotype x environment interaction. The r_p may be more reliable estimates for examining the degree of relationship between character pairs. Further, the genotype portion of the association can be indirectly judged from the estimates of coheritability.

Out of all the 21 character combination studied in the 3 sets, grain yield had showed highly significant r_p and r_g with panicle bearing tillers/plant, PBT (0.55 and 0.56; 0.72 and 0.71; 0.87 and 0.96 in Set-I, Set-II and Set-III, respectively) and grains per panicle (0.60 and 0.58; 0.54 and 0.50; 0.56 and 0.64 and Set- I, Set-II and Set-III respectively). Grain yield had showed highly significant r_p and r_g with plant height (0.59 and 0.64), panicle length (0.53 and 0.58) where test weight is high in Set- III only. In Set-I where test weight is low plant height and showed significant r_g (0.49) with grains per panicle. Panicle length had showed significant r_p (0.43) and r_g (0.46) with grains per panicle in Set-I only. Although the value is negative, but PBT had showed significant r_g with fertility percentage is Set- III (–0.42) and highly significant in Set-III (–0.51). In Set-II itself grains per panicle had showed significant correlation coefficients (0.42) at genotypic level, but highly significant correlation coefficients (0.52) at phenotypic level with fertility percentage. In Set-III where test weight is high PBT had showed, significant r_p with plant height (0.51) but highly significant r_g (0.60); highly significant r_p and r_g with panicle length in Set-III (0.57 and 0.68 respectively). In Set-III itself PBT had showed negative highly significant r_g with fertility percentage (–0.51). In addition to these plant height had showed negative high significant r_g with fertility percentage (–0.57). The above findings strongly suggests that plant with high number of PBT having high number of grains per panicle should be selected for grain yield improvement in deep water rice. But when the test weight is high plant height and panicle length should also be more for obtaining high grain yield, however the fertility percentage would decrease if the plant height and PBT increased. Therefore, it is advisable that when the test weight is high a balance between PBT, plant height and fertility percentage must be achieved for increasing grain yield in the landraces where test weight is high.

Path coefficient analysis was based on correlation coefficient, using grain yield as the dependent factor (effect) and six other quantitative characters, viz., PBT, plant height, panicle length, grains per panicle, fertility percentage and days to fifty per cent flowering as independent factor (causes). Correlation coefficient of each independent quantitative character was partitioned into direct and indirect effects towards grain yield.

The results of path analysis at genotypic level (Tables 2, 3, 4) revealed that PBT and highest positive direct effect on grain yield in all the three sets invariably with the difference in test weight (0.60, 0.83 and 0.99) and in all the three sets it had significant correlation with yield (0.56, 0.71 and 0.96). This strongly suggests that PBT will give highest direct effect on

Table 2. Direct (diagonal) and indirect effects (Set-I) in rice

Characters	No. of PBT	Plant height	Panicle length	Grains per panicle	Fertility percentage	Days to 50% flowering
No. of PBT	**0.61**	0.27	0.04	0.5	0.02	0.14
Plant height	0.02	**0.17**	0.05	0.08	–0.06	0.03
Panicle length	0.01	0.01	**–0.07**	0.01	0.01	0.01
Grains per panicle	–0.05	0.08	0.26	**0.46**	0.08	0.01
Fertility percentage	–0.01	–0.05	0.01	–0.02	**–0.15**	0.01
Days to 50% flowering	–0.02	–0.03	0.04	0.01	0.01	**–0.10**
'r' with yield per plant	0.56**	0.44*	0.34	0.58**	0.01	–0.08

Residual effect = 0.4946.

*,**Significant at P = 0.05 and 0.01, respectively.

grain yield in deep water rice, hence in selection experiments in rice, PBT should invariably be given due consideration. In Set- II and Set-III where test weight is medium and high, grains per panicle showed next highest direct effect towards grain yield (0.59 and 0.31). Hence in selection experiments in deep water rice, grains per panicle should also be given due importance. Direct effect of plant height was considerably in Set-I only (0.16) but it has significant correlation with yield (0.44). In Set-III, although plant height had significant correlation with yield (0.64) but its direct effect was negative (–0.01) and its value was compensated by the higher direct effects of plant height through PBT (0.53). In the same

Table 3. Direct (diagonal) and indirect effects (Set-II) in rice

Characters	No. of PBT	Plant height	Panicle length	Grains per panicle	Fertility percentage	Days to 50% flowering
No. of PBT	**0.83**	0.20	0.07	–0.15	–0.05	–0.03
Plant height	–0.01	**–0.02**	0.01	–0.01	0.01	0.01
Panicle length	0.01	0.11	**0.18**	0.05	–0.01	0.03
Grains per panicle	–0.11	0.10	0.16	**0.60**	–0.02	0.03
Fertility percentage	–0.03	0.02	–0.01	0.03	**0.06**	–0.21
Days to 50% flowering	0.01	–0.01	–0.01	–0.01	0.01	**–0.05**
'r' with yield per plant	0.71**	0.31	0.41	0.50**	0.01	–0.23

Residual effect = 0.1996.

**Significant at P = 0.01.

way panicle length had significant correlation with yield (0.58) but its direct effect was about half of the correlation values (0.22). This suggested that is also has effect via PBT. In Set-III itself the correlation values of fertility percentage and its direct effect both are negative (–0.45 and –0.01, respectively). This suggests that in Set-III for improvement in yield fertility percentage should be increased considerably.

Table 4. Direct (diagonal) and indirect effects (Set-III) in rice

Characters	No. of PTB	Plant height	Panicle length	Grains per panicle	Fertility percentage	Days to 50% flowering
No. of PTB	**1.00**	0.53	0.68	0.39	–0.51	0.14
Plant height	–0.01	**–0.01**	–0.01	–0.01	0.01	–0.01
Panicle length	–0.15	–0.01	0.22	–0.07	0.07	0.06
Grains per panicle	0.12	0.12	0.09	0.31	0.02	0.01
Fertility percentage	0.01	0.01	0.01	–0.01	–0.01	–0.01
Days to 50% flowering	–0.01	–0.02	0.02	–0.01	–0.01	–0.36
'r' with yield per plant	0.96**	0.64**	0.58**	0.64	–0.45	–0.14

Residual effect = 0.1271.

**Significant at P = 0.01.

Residual effects observed for different sets indicated that the characters studied have accounted for 51% in Set-I, 81% in Set-II, and 88% in Set-III. Hence, some more characters must be studied in Set-I where test weight in low.

The findings of the present study apart from being of basic in nature have enormous practical applicability for rice cultivation in the lowland and deep water rice ecologies of the country and information obtained through the present study if exploited may provide an opportunity to increase productivity of rice in the disadvantaged ecologies.

The extensive correlation and path analysis studies involving grain yield and its attribute is an approach which may provide a reliable base upon which future lowland and deep water rice breeding programme may be designed.

ACKNOWLEDGEMENTS

The first author gratefully acknowledges the financial help received from the R.A.U., Bihar, Pusa, Samastipur by way of a Junior Research Fellowship during the course of this study. The authors thankfully acknowledge the help given by the Chairman, Department

of Plant Breeding R.A.U., Bihar for providing facilities to conduct the experiments and by the Chairman, Department of Statistics, R.A.U., Bihar for computer analysis.

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