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Correlation and Path Analysis in Rice (*Oryza sativa* L.)

B. S. K. Nikhil*[1], N. R. Rangare[2] and P. Saidaiah[3]

ABSTRACT: *An experiment was carried out to study the correlation and path analysis in 40 rice (*Oryza sativa *L.) genotypes during* Kharif, *2011 at the Department of Genetics and Plant Breeding, SHIATS, Allahabad in Randomized Block Design with three replications to analyze correlation and path Analysis. Character association of the yield attributing traits revealed significantly positive association of grain yield per hill with biological yield per hill and number of panicles per hill. Hence, selection for these traits can improve yield. Path coefficient analysis revealed that biological yield per hill and harvest index exhibited positive direct effect on yield. Among these characters, biological yield per hill possessed both positive association and high direct effects. Hence, selection for this character could bring improvement in yield and yield components in rice.*

Index Terms: *Correlation, Path Analysis, Rice and Yield.*

INTRODUCTION

Rice (Oryza sativa L.) is one of the pivotal staple cereal crops feeding more than half of the world population. In view of the growing population, the basic objective of the plant breeders would always be towards yield improvement in staple food crops. It has been estimated that the world will have to produce 60% more rice by 2030 than what it produced in 1995. Therefore, to increase production of rice plays a very important role in food security and poverty alleviation. Theoretically, rice still has great yield potential to be tapped and there are many ways to raise rice yield, such as building of irrigation works, improvement of soil conditions, cultural techniques and breeding of high yielding varieties.

The knowledge on the nature and magnitude of genetic variation in respect of quantitative characters like yield and its components is essential for effective crop improvement. Selection of high yielding varieties based only on grain yield will not be much effective unless adequate information on genetic parameters are available to formulate hybridization and selection program for further improvement because the estimate of the mean serves as a basis for eliminating the undesirable genotypes.Information on association of characters, direct and indirect effects contributed by each character towards yield will be an added advantage in aiding the selection process. Correlation and path analysis establish the extent of association between yieldand its components and also bring out relative importance of their direct and indirect effects, thus giving an obvious understanding of their association with grain yield. Ultimately, this kind of analysis could help the breeder to design his selection strategies to improve grain yield. In the light of the above scenario, the present investigation is carried out with the objective of studying the character associations in rice genotypes for yield improvement.

MATERIAL AND METHODS

The experiment was conducted in *Kharif,* 2011 at Field Experimentation Centre of the Department of Genetics and Plant Breeding, SHIATS, Allahabad. The experimental materials consist of 40 rice genotypes which were grown in Randomized Block Design (RBD) with three replications during *kharif,* 2011. All necessary precautions were taken to maintain uniform plant population in each treatment per replication. All the recommended package of practices was followed along with necessary prophylactic plant protection measures to raise a good crop. Observations were recorded and the data was subjected to statistical analysis. Statistical analyses for the above characters were done following Singh and

[1] Ph.D Scholar, [2]Assistant Professor, Department of Genetics and Plant Breeding, Sam Higginbotton Institute of Agriculture Technology and Sciences, Allahabad, **E-mail: b.saikrishnanikhil@gmail.com*
[3] Assistant Professor, Department of Genetics and Plant Breeding, College of Horticulture, Rajendranagar, Hyderabad-30

Chaudhary (1995) for correlation coefficient and Dewey and Lu (1959) for path analysis.

RESULTS AND DISCUSSION

Selection based on the detailed knowledge of magnitude and direction of association between yield and its attributes is very important in identifying the key characters, which can be exploited for crop improvement through suitable breeding programme. Phenotypic and genotypic correlations between yield and yield components viz., days to 50 per cent flowering, plant height, flag leaf length, flag leaf width, number of tillers per hill, number of panicles per hill, panicle length, days to maturity, number of spikelets per panicle, biological yield per hill, harvest index and test weight were computed separately for rice genotypes. The results are presented in Table 1. The results revealed that the estimates of genotypic coefficients were higher than phenotypic correlation coefficients for most of the characters under study which indicated stronginherent association between the characters which might be due to masking or modifying effects of environment. Biological yield per hill and number of panicles per hill showed positive significant association with grain yield per hill. Harvest index, number of tillers per hill, days to maturity and flag leaf length showed positive non-significant association with grain yield. Whereas flag leaf width, plant height, panicle length and number of spikelets per panicle showed negative significant correlation with grain yield. Days to 50 per cent flowering and test weight showed negative non-significant association with grain yield.Related findings were carried out by Bala (2001), Bidhan *et al*. (2001), Monalisa *et al*. (2006), Habib *et al*. (2007), Kole *et al*. (2008), Chandra *et al*. (2009) and Ragvendra *et al*. (2011).

As simple correlation does not provide the true contribution of the characters towards the yield, these genotypic correlations were partitioned into direct and indirect effects through path coefficient analysis. It allows separating the direct effect and their indirect effects through other attributes by apportioning the correlations (Wright, 1921) for better interpretation of cause and effect relationship. The estimates of path coefficient analysis are furnished for yield and yield component characters in Table 2. Days to 50 per cent flowering, flag leaf length, number of panicles per hill, panicle length, number of spikelets per panicle, biological yield per hill, harvest index and test weight showed positive direct effect on grain yield per hill. Whereas plant height, flag leaf width, number of tillers per hill and days to maturity showed negative direct effect on grain yield per hill. Supported related findings were carried out by Ganesan *et al*. (1997), Meenakshi *et al*. (1999), Bala (2001), Khedikar *et al*. (2004), Madhavilatha *et al*. (2005), Gnanasekaran *et al*. (2008), Chandra *et al*. (2009), Bhandru *et al*. (2010) and Fiyaz *et al*. (2011).

Partitioning of correlation values showed that some of the characters could not produce significant correlation with single plant yield which might be either due to very high negative direct effects. Critical analysis of results obtained from character association and path analysis indicated that biological yield per hill and harvest index possessed both positive association and high positive direct effects. Hence, selection for these traits could bring improvement in yield and yield components.

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Table 1
Estimates of Phenotypic and Genotypic Correlation Coefficients between Yield and Yield Component Characters

	Characters	*Days to 50% flowering*	*Plant height*	*Flag leaf length*	*Flag leaf width*	*Tillers/ hill*	*Panicles/ hill*	*Panicle length*	*Days to maturity*	*Spikeles/ panicle*	*Biological yield/hill*	*Harvest index*	*Test weight*	*Grain yield/hill*
1	Days to 50% flowering	**1.0000** **(1.0000)**	0.0411 (0.0134)	-0.0162 (-0.0439)	0.0836 (0.0725)	0.2041* (0.2747)*	0.1550 (0.2367)	0.0977 (0.0911)	0.6806** (0.8289)*	0.2272* (0.2728)*	0.0196 (0.0178)	-0.1135 (-0.1259)	0.2689** (0.2927)**	-0.0358 (-0.0385)
2	Plant height		**1.0000** **(1.0000)**	0.1849* (0.3047)*	0.4717** (0.5417)**	-0.1532 (-0.2564)	-0.1589 (-0.2545)	0.1556 (0.2119)	-0.0077 (-0.0171)	0.1889* (0.2239)*	-0.2971** (-0.3164)**	-0.1191 (-0.1181)	-0.0147 (-0.0251)	-0.4028** (-0.4207)*
3	Flag leaf length			**1.0000** **(1.0000)**	0.3290** (0.5233)**	0.0608 (0.2356)	0.0473 (0.2297)	0.0228 (-0.0793)	-0.0319 (-0.0245)	0.1579 (0.2353)	0.0642 (0.0984)	-0.0626 (-0.0916)	-0.1148 (-0.1969)	0.0448 (0.0472)
4	Flag leaf width				**1.0000** **(1.0000)**	0.0109 (-0.0303)	-0.0559 (-0.1431)	0.1963* (0.2054)*	-0.0099 (-0.0076)	0.4487** (0.5157)**	-0.4316** (-0.4837)**	0.0160 (0.0281)	-0.0418 (-0.0035)	-0.4560** (-0.5150)**
5	Tillers/ hill					**1.0000** **(1.0000)**	0.9237** (0.9150)**	-0.1324 (-0.0859)	0.1824* (0.2321)*	-0.0172 (0.0192)	-0.0346 (-0.0880)	0.2619** (0.3805)**	0.0919 (0.0684)	0.0822 (0.0943)
6	Panicles/ hill						**1.0000** **(1.0000)**	-0.2007* (-0.2106)*	0.2133* (0.2979)*	0.0240 (0.0894)	0.0732 (0.0594)	0.2445** (0.3960)**	0.0326 (0.0118)	0.1931* (0.2765)*
7	Panicle length							**1.0000** **(1.0000)**	0.0162 (0.0367)	0.0828 (0.1003)	-0.2825** (-0.3329)**	0.0681 (0.0849)	0.0349 (0.0377)	-0.2572** (-0.3239)**
8	Days to maturity								**1.0000** **(1.0000)**	0.2294* (0.2440)*	0.0638 (0.0762)	0.0510 (0.0466)	0.1999* (0.2048)*	0.0823 (0.0873)
9	Spikelets/ panicle									**1.0000** **(1.0000)**	-0.3173** (-0.3342)**	0.1267 (0.1651)	0.0991 (0.0827)	-0.2493** (-0.2600)**
10	Biological yield/hill										**1.0000** **(1.0000)**	-0.4121** (-0.4430)**	0.0623 (0.0606)	0.8504** (0.8763)**
11	Harvest index											**1.0000** **(1.0000)**	-0.1750 (-0.2285)	0.1136 (0.0354)
12	Test weight												**1.0000** **(1.0000)**	-0.0217 (-0.0388)
13	Grain yield/hill													**1.0000** **(1.0000)**

** significant at 5% level * significant at 1% level
Figures in parenthesis are genotypic correlation coefficients

Table 2
Estimates of Direct and Indirect Effects between Yield and Yield Components

	Characters	*Days to 50% flowering*	*Plant height*	*Flag leaf length*	*Flag leaf width*	*Tillers/ hill*	*Panicles/ hill*	*Panicle length*	*Days to maturity*	*Spikelets/ panicle*	*Biological yield/hill*	*Harvest index*	*Test weight*	*Grain yield/hill*
1	Days to 50% flowering	**0.0395**	0.0016	-0.0006	0.0033	0.0081	0.0061	0.0039	0.0269	0.0090	0.0008	-0.0045	0.0106	-0.0358
		(0.1377)	(0.0018)	(-0.0060)	(0.0100)	(0.0378)	(0.0362)	(0.0126)	(0.1142)	(0.0376)	(0.0025)	(-0.0173)	(0.0403)	(-0.0385)
2	Plant height	-0.0011	**-0.0269**	-0.0050	-0.0127	0.0041	0.0043	-0.0042	0.0002	-0.0051	0.0080	0.0032	0.0004	-0.4028
		(-0.0004)	**(-0.0285)**	(-0.0087)	(-0.0154)	(0.0073)	(0.0073)	(-0.0060)	(0.0005)	(-0.0064)	(0.0009)	(0.0034)	(0.0007)	(-0.4207)
3	Flag leaf length	-0.0003	0.0031	**0.0167**	0.0055	0.0010	0.0008	0.0004	-0.0005	0.0026	0.0011	-0.0010	-0.0019	0.0448
		(0.0006)	(-0.0043)	**(-0.0141)**	(-0.0074)	(-0.0033)	(-0.0032)	(0.0011)	(0.0003)	(-0.0033)	(-0.0014)	(0.0013)	(0.0028)	(0.0472)
4	Flag leaf width	-0.0003	-0.0016	-0.0011	**-0.0035**	0.0008	0.0020	-0.0007	0.0009	-0.0016	0.0015	-0.0001	0.0001	-0.4560
		(0.0031)	(0.0231)	(0.0223)	**(0.0426)**	(-0.0013)	(-0.0061)	(0.0087)	(-0.0003)	(0.0219)	(-0.0206)	(0.0012)	(-0.0001)	(-0.5150)
5	Tillers/ hill	-0.0139	0.0104	-0.0041	-0.0007	**-0.0680**	-0.0628	0.0090	-0.0124	0.0012	0.0024	-0.0178	-0.0062	0.0822
		(-0.0529)	(0.0494)	(-0.0454)	(0.0058)	**(-0.1926)**	(-0.1762)	(0.0165)	(-0.0447)	(-0.0037)	(0.0169)	(-0.0733)	(-0.0132)	(0.0943)
6	Panicles/ hill	0.0055	-0.0057	0.0017	-0.0020	0.0329	**0.0357**	-0.0072	0.0076	0.0009	0.0026	0.0087	0.0012	0.1931
		(0.0438)	(-0.0471)	(0.0425)	(-0.0265)	(0.1694)	**(0.1851)**	(-0.0390)	(0.0551)	(0.0165)	(0.0110)	(0.0733)	(0.0022)	(0.2765)
7	Panicle length	0.0006	0.0010	0.0001	0.0012	-0.0008	-0.0013	**0.0063**	0.0001	0.0005	-0.0018	0.0004	0.0002	-0.2572
		(0.0011)	(0.0026)	(-0.0010)	(0.0025)	(-0.0010)	(-0.0026)	**(0.0122)**	(0.0004)	(0.0012)	(-0.0040)	(0.0010)	(0.0005)	(-0.3239)
8	Days to maturity	-0.0310	0.0004	0.0015	0.0005	-0.0083	-0.0097	-0.0007	**-0.0456**	-0.0105	-0.0029	-0.0023	-0.0091	0.0823
		(-0.1254)	(0.0026)	(0.0037)	(0.0011)	(-0.0351)	(-0.0451)	(-0.0066)	**(-0.1512)**	(-0.0369)	(-0.0115)	(-0.0070)	(-0.0310)	(0.0873)
9	Spikelets/ panicle	0.0052	0.0043	0.0036	0.0102	-0.0004	0.0005	0.0019	0.0052	**0.0227**	-0.0072	0.0029	0.0022	-0.2493
		(-0.0018)	(-0.0015)	(-0.0016)	(-0.0035)	(-0.0001)	(-0.0006)	(-0.0007)	(-0.0016)	**(-0.0067)**	(0.0023)	(-0.0011)	(-0.0006)	(-0.2600)
10	Biological yield/hill	0.0211	-0.3211	0.0694	-0.4664	-0.0374	0.0791	-0.3053	0.0689	-0.3429	**1.0808**	-0.4454	0.0673	0.8504
		(0.0199)	(-0.3530)	(0.1098)	(-0.5397)	(-0.0982)	(0.0663)	(-0.3714)	(0.0851)	(-0.3730)	**(1.1159)**	(-0.4944)	(0.0676)	(0.8763)
11	Harvest index	-0.0649	-0.0681	-0.0358	0.0091	0.1498	0.1398	0.0390	0.0292	0.0725	-0.2356	**0.5719**	-0.1001	0.1136
		(-0.0696)	(-0.0652)	(-0.0506)	(0.0155)	(0.2102)	(0.2188)	(0.0469)	(0.0257)	(0.0912)	(-0.2448)	**(0.5526)**	(-0.1263)	(0.0354)
12	Test weight	0.0036	-0.0002	-0.0016	-0.0006	0.0012	0.0004	0.0005	0.0027	0.0013	0.0008	-0.0024	**0.0136**	-0.0217
		(0.0053)	(-0.0005)	(-0.0036)	(-0.0001)	(0.0013)	(0.0002)	(0.0007)	(0.0037)	(0.0015)	(0.0011)	(-0.0042)	**(0.0183)**	(-0.0388)

Residual effect (Phenotypic) = 0.119
Residual effect (Genotypic) = 0.039
Figures in parenthesis are genotypic effects

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