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Estimation of Association among the Yield and Yield Attributing Traits in the Segregating Population of Rice

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Indirect selection, using correlation coefficients, linear regression coefficients and path analysis, uses a variety of yield determinants that are more heritable than yield itself and less influenced by environmental factors and therefore are stable. Therefore, indirect selection based on the characters makes the selection process more efficient, especially in the early generations. Correlation coefficient analysis and the use of path coefficients are particularly important for economical and complex traits such as yield, where direct selection is less effective. Thus the present experiment was undertaken to decipher the character association between the characters in a segregating population (F_2) obtained from a cross between Naveen x IR 64 Drt1rom the study, it was evident that the characters like leaf breadth, leaf area, plant height, panicle length, number of primary branches, number of secondary branches, number of filled grains, grain length and test

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weight had the maximum association with yield among the characters under the study. Correlation coefficient and path coefficient analysis, revealed that the characters viz., number of filled grains per plant followed bygrain breadth, total number of grains, number of secondary branches, plant height, number of panicles, leaf breadth, flag leaf area, 1000 seed weight, panicle lengthand number of primary branches had a highly significant and positive correlation with yield and positive direct effect on yield. Thus, emphasis may be given to these traits for the effective selection of promising lines under study.

Keywords: Character association; correlation studies; path analysis; rice; segregating population; F_2 generation.

1. INTRODUCTION

Rice has been cultivated as a major crop for over 7000 years and now feeds more than half of the world's population [cite reference]. It belongs to the monocot family Poaceae. Cultivated rice comprises of two species: *Oryza sativa* and *Oryza glaberrima*, however, major emphasishas been given on *O. sativa* because it is the rice grown in the majority of rice-growing countries. Except for Antarctica, rice is now planted and harvested in every continent andis still a staple diet for the vast majority of the world's population. Rice provides nutritional value to more than two-thirds of the world's population. The wide range of genetic variability in segregating populations, which is determined by the quantity of genetic variation among genotypes, provides more opportunities for selection. Many countries are currently facing the second-generation problem of growing more rice at a lower cost in a deteriorating environment. Efforts are being made using a systematic research strategy to maximize yield potential through direct and indirect selection [1]. Segregating population the availability of genetic variety and the use of appropriate selection strategies form the foundation of any crop development strategy.The wide range of variability presented by the segregating population provides the most suitable platform for wider opportunities for effective selection. And because the F_2 generation is a segregating population, it is particularly important for improvement of particular trait(s) through selection. For this, correlation studies provide knowledge on the contribution of various traits on yieldHowever, correlation does not provide the relation between cause and effect. Hence, the direct and indirect contribution of traits towards yield is predicted by path coefficient analysis [2,3]. The present investigation was carried out to assess the study the association between traits to determine the selection criteria for enhancing the effectiveness of the selection.

2. MATERIALS AND METHODS

The study was conducted on the F_2 population developed from the cross between Naveen x IR 64 Drt1. The segregating population obtained were raised as single plant progenies and evaluated at a rice research field, under the Department of Genetics and Plant Breeding, Birsa Agricultural University, Kanke, Ranchi, Jharkhand. During the *kharif* season 2021-22, the F_2 seeds obtained from the previous season were raised in single lines and were also evaluated for various yield and yield attributing traits for further selection for superior segregants. The characters like days to first flowering, days to maturity were observed per plot basis and characters like number of tillers, leaf length, leaf breadth, leaf area, plant height, number of panicles, panicle length, number of primary branches, number of secondary branches, number of filled grains, number of chaffy seeds, total number of grains, grain length, grain breadth, LBR ratio, biomass, test weight and grain yield per plant were taken on individual plant basis. The data recorded were subjected to correlation coefficient and path coefficient analysis using the software *GRAPES* (developed by the Department of Agricultural Statistics, College of Agriculture, Vellayani is based on *R* software)

3. RESULTS AND DISCUSSION

Indirect selection, using correlation coefficients, linear regression coefficients, and path analysis, uses a variety of yield determinants that are more heritable than yield itself and less influenced by genetic and environmental factors and therefore stable. Therefore, selection based on the characters selected in the indirect selection makes the selection more efficient, especially in the early generation selection process. Correlation coefficient analysis and the use of path coefficients are particularly important for economical and complex traits such as yield,

Table 1. Association study among different yield and yield attributing traits for cross 1 Naveen x IR 64 Drt1

	DF	DM	NT	LL (cm)	LB (cm)	FLA (cm²)	PH (cm)	NP	PL (cm)	PB	SB	FG	CS	TNG	GL (mm)	GB (mm)	LB R	BIO (gm)	`1000 SW (gm)	TGW (gm)
DF	1	0.96**	-0.01	-0.01	-0.18**	-0.12*	-0.26**	0.04	-0.08	0.02	-0.03	-0.08	-0.05	-0.09	0.12*	-0.02	0.09	0.07	0.14*	-0.13*
DM		1	0.01	-0.01	-0.20**	-0.13*	-0.26**	0.07	-0.08	0.02	-0.05	-0.08	-0.06	-0.09	0.14*	-0.04	0.12*	0.11	0.16**	-0.13*
NT			1	0.06	-0.03	-0.01	0.11	0.71**	0.09	0.13*	0.07	-0.03	0.03	-0.02	0.03	0.06	0.00	0.41**	0.03	0.01
LL (cm)				1	0.09	0.59**	0.05	0.04	0.10	-0.01	0.08	0.09	0.08	0.11	-0.09	0.06	-0.11	0.01	0.04	0.07
LB (cm)					1	0.74**	0.45**	-0.07	0.21**	-0.01	0.22**	0.27**	0.03	0.28**	-0.20**	0.18**	-0.24**	-0.16**	-0.24**	0.31**
FLA (cm²)						1	0.34**	-0.01	0.20**	-0.01	0.20**	0.26**	0.07	0.27**	-0.17**	0.15*	-0.21**	-0.09	-0.12*	0.29**
PH (cm)							1	0.07	0.33**	0.07	0.37**	0.39**	-0.00	0.39**	-0.34**	0.29**	-0.39**	-0.03	-0.38**	0.42**
NP								1	0.17**	0.15*	0.15*	0.11	0.04	0.12*	0.02	0.04	0.00	0.49**	0.01	0.16**
PL (cm)									1	0.34**	0.42**	0.39**	0.11	0.42**	-0.22**	0.09	-0.20**	0.12*	-0.17**	0.37**
PB										1	0.35**	0.32**	0.19**	0.36**	-0.17**	0.00	-0.13*	0.08	-0.09	0.26**
SB											1	0.59**	0.29**	0.66**	-0.31**	0.17**	-0.31**	0.08	-0.18**	0.55**
FG												1	-0.05	0.97**	-0.32**	0.23**	-0.35**	0.02	-0.21**	0.82**
CS													1	0.21**	-0.09	0.02	-0.08	0.04	-0.10	0.04
TNG														1	-0.33**	0.23**	-0.36**	0.03	-0.23**	0.81**
GL (mm)															1	-0.19**	0.79**	0.28**	0.45**	-0.23**
GB(mm)																1	-0.75**	-0.07	-0.13*	0.28**
LB R																	1	0.23**	0.38**	-0.31**
BIO (gm)																		1	0.24**	0.08
`1000 SW (gm)																			1	-0.16**
TGW (gm)																				1

**- significant @ 5%, **- highly significant @1%, DF-days to first flowering, DM- days to maturity, NT- number of tillers, FLL- flag leaf length, FLB-flag leaf breadth, FLA-flag leaf area, PH-plant height, NP-number of panicles, PL-panicle length, NPB-number of primary branches of?, NSB-number of secondary branches of?, FG-number of filled grains, CS-number of chaffy grains, TNG-total number of grains, GL-grain length, GB-grain breadth, BIO-biomass, 10SW-10 seed weight, 1000sw-test weight, TGW- total grain weight*

Table 2. Distribution of correlation coefficient into direct and indirect effects using path coefficient analysis

	DF	DM	LB	FLA	PH	NP	PL	PB	SB	FG	TNG	GL (1)	GB(1)	LB R	`1000 SW	R value Y/P
DF	**-0.079**	0.023	-0.007	-0.004	-0.014	0.002	-0.001	0.000	-0.002	-0.051	-0.005	-0.024	-0.008	0.039	0.004	-0.13
DM	-0.076	**0.024**	-0.008	-0.005	-0.014	0.003	-0.001	0.000	-0.003	-0.051	-0.006	-0.028	-0.013	0.049	0.005	-0.13
LB	0.015	-0.005	**0.039**	0.027	0.025	-0.003	0.003	0.000	0.015	0.177	0.021	0.040	0.061	-0.097	-0.007	0.31
FLA	0.009	-0.003	**0.029**	**0.037**	0.019	0.000	0.003	0.000	0.014	0.169	0.019	0.035	0.049	-0.083	-0.004	0.29
PH	0.020	-0.006	0.018	0.013	**0.055**	0.003	0.005	0.001	0.025	0.258	0.031	0.068	0.100	-0.161	-0.011	0.42
NP	-0.003	0.002	-0.003	0.000	0.004	**0.051**	0.002	0.001	0.010	0.073	0.009	-0.003	0.012	0.002	0.000	0.16
PL	0.007	-0.002	0.008	0.007	0.018	0.008	**0.014**	0.003	0.029	0.256	0.031	0.043	0.030	-0.082	-0.005	0.37
PB	-0.002	0.001	0.000	0.000	0.004	0.008	0.005	**0.008**	0.024	0.207	0.026	0.034	0.001	-0.052	-0.003	0.26
SB	0.002	-0.001	0.009	0.007	0.020	0.008	0.006	0.003	**0.069**	0.387	0.053	0.063	0.056	-0.127	-0.005	0.55
FG	0.006	-0.002	0.011	0.010	0.022	0.006	0.006	0.002	0.041	**0.648**	0.072	0.063	0.077	-0.141	-0.006	0.81
TNG	0.006	-0.002	0.011	0.010	0.023	0.007	0.006	0.003	0.050	0.639	**0.073**	0.067	0.078	-0.148	-0.006	0.82
GL (1)	-0.009	0.003	-0.008	-0.006	-0.019	0.001	-0.003	-0.001	**-0.022**	-0.205	-0.025	**-0.199**	-0.065	0.320	0.013	-0.23
GB(1)	0.002	-0.001	0.007	0.005	0.016	0.002	0.001	0.000	0.012	0.150	0.017	0.039	**0.333**	-0.302	-0.004	0.28
LB R	-0.008	0.003	-0.009	-0.008	-0.022	0.000	-0.003	-0.001	-0.022	-0.226	-0.027	-0.157	-0.249	**0.404**	0.011	-0.31
`1000 SW	-0.011	0.004	-0.009	-0.005	-0.021	0.001	-0.002	-0.001	-0.012	-0.133	-0.016	-0.090	-0.042	0.152	**0.029**	-0.16

Residual effect: 0.299

** r= correlation, DF-days to first flowering, DM- days to maturity, NT- number of tillers, FLL- flag leaf length, FLB-flag leaf breadth, FLA-flag leaf area, PH-plant height, NP number of panicles, PL-panicle length, NPB-number of primary branches, NSB-number of secondary branches, FG-number of filled grains, CS-number of chaffy grains, TNG-total number of grains, GL-grain length, GB-grain breadth, BIO-biomass, 10SW-10 seed weight, 1000sw-test weight, TGW- total grain weight.*

Table 3. Selected segregants having superior characteristics based on the selection criteria

SL. NO.	PL NO	DF	DM	NT	LL	LB	FLA	PH	NP	PL	PB	SB	FG	TNG	GL	GB	LB R	BIO	`TSW	Y/P
264	B1C9 297	112	151	5	30	1.8	54	92	4	25	10	27	162	172	4	1.4	2.85	12.27	23	6.19
271	B1C9 375	113	152	8	22	1.8	39.6	99	6	22	10	22	112	122	4.3	1.2	3.58	14.69	17	6.43
239	B1C8 159	112	151	10	19	1.6	30.4	74	8	21	9	19	101	106	3.8	1.4	2.71	15.46	14	7.4
252	B1C9 128	120	159	15	28	1.2	33.6	109	11	22	6	22	142	148	4	1.9	2.10	19.19	19	8.49
263	B1C9 282	113	152	6	8	1.2	9.6	107	4	19	8	21	115	120	3.9	1.4	2.78	15.46	12	5.15
262	B1C9 280	113	152	6	27	1.5	40.5	106	4	20	8	22	108	121	3.9	1.4	2.78	21.01	20	7.18
249	B1C9 26	119	158	6	25	1.2	30	98	18	27	11	40	172	183	3.6	1.2	3	17.72	13	7.64
255	B1C9 176	112	151	19	30	1.2	36	73	17	24	9	10	110	115	4.3	1.2	3.58	16.25	22	7.18
250	B1C9 76	122	161	16	28	1.2	33.6	66	12	25	12	29	25	49	4	1.4	2.85	18.78	30	3.46
245	B1C9 14	120	159	4	30	1.2	36	71	9	28	12	46	136	191	3.8	1.3	2.92	16.81	10	10.13
260	B1C9 254	112	151	9	32	1	32	88	7	23	10	34	95	135	4.8	1.3	3.69	23.54	17	4.91
267	B1C9 342	112	151	6	32	1.5	48	105	2	23	11	33	208	222	3.7	1.3	2.84	6.38	14	12.6
268	B1C9 350	113	152	7	24	1.5	36	90	7	21	10	30	195	205	3.8	1.2	3.16	14.16	12	8.79
219	B1C8 15	110	149	8	23	1	23	86	7	26	11	9	120	131	3.9	1.5	2.6	10.89	13	8.96
105	B1C1 169	116	155	6	30	0.9	27	67	6	20	10	19	82	88	4	1.3	3.07	18.29	70	2.75
185	B1C1 190	122	167	5	24	1	24	58	5	20	7	8	58	64	4.6	1.3	3.53	12.27	33	4.33
243	B1C8 246	112	151	9	22	1	22	78	8	21	8	29	127	133	3.9	1.4	2.78	12.65	10	9.44

DF-days to first flowering, DM- days to maturity, NT- number of tillers, FLL- flag leaf length, FLB-flag leaf breadth, FLA-flag leaf area, PH-plant height, NP-number of panicles, PL-panicle length, NPB-number of primary branches, NSB-number of secondary branches, FG-number of filled grains, CS-number of chaffy grains, TNG-total number of grains, GL-grain length, GB-grain breadth, BIO-biomass, 10SW-10 seed weight, 1000sw-test weight, TGW- total grain weight where direct selection is less effective. From the Table 1, it was evident that the characters like leaf breadth, leaf area, plant height, panicle length, number of primary branches number of secondary branches, number of filled grains, grain length and test weight were observed to have the maximum association among the characters under the study. the characters like leaf breadth (0.31**), leaf area (0.29**), plant height (0.42**), number of panicle (0.16**), panicle length (0.37**), number of primary branches (0.26**), number of secondary branches (0.55**), number of filled grains (0.82**), total number of grains (0.31**) and grain breadth (0.28**) were found to be significantly and positively correlated with yield per plant. Whereas for characters like days to flowering (-0.13*), days to maturity (-0.13*), grain length (-0.23*), LBR ratio (-0.31**) and test weight (-0.16**) were found to be have negative association with the yield per plant. The association between the characters having positive correlation coefficient suggests the increment in both characters will be in the same direction, that is increase in one character will directly cause and increase in the other character, thus selection based on characters having positive association with the yield will provide with the better gains. On the other hand, the characters having negative association, here the increase in one character will cause in decrease of the other character, thus the progress between the characters are in opposite direction. The selection based on these characters will not effective [4-6].

For an effective and successful improvement program, the correlation coefficient analysis results and information do not provide complete information about the overall contribution of individual traits to yield, and thus the relationship between the traits under study. It is important to recognize the genetic basis. Even unfavorable attributes, yield-influencing responses in one trait in choosing another trait, and their underlying causes all combine to contribute to long-term improvement [2,7]. Thus, to measure the response and efficacy of selection, path analysis is calculated and the path analysis coefficients are used to map the complete information about each component's contribution to the yield. Significant correlations are divided into direct and indirect effects of ingredients on yield [8,9]. Thus in the present study, from the Table 2, containing partitioning of correlation matrix into direct and indirect effect for the Naveen x IR 64 Drt1 via path coefficient analysis, it is evident that the characters having the highest positive direct effect on yield were number of filled grains per plant (0.648) followed by length breadth ratio (0.404) and grain breadth (0.333), and characters like total number of spikelet (0.073), number of secondary branches (0.069), plant height (0.055), number of panicle (0.051), leaf breadth (0.039), flag leaf area (0.037), 1000 seed weight (0.029), days to maturity (0.024), panicle length (0.014) and number of primary branches (0.008) were also found to be a positive direct effect on yield, whereas, among the characters being correlated with the yield, the character grain length (-0.199) and days to first flowering (-0.079) were observed to have high negative direct effect on the yield. The residual effect was observed to be 0.29.

For the observations where the correlation coefficient is positive, but on the other hand, the character's direct effect is negative, then in such cases, the positive indirect effects are the main attributes of the desired positive correlation and thus the selection based on these positive indirect effects to reduce the undesirable impacts of the negative effects will be effective for selection [10,11]. And for the positive direct effects in case of negative correlation, a restricted selection has to be adopted for effected selection. Similar findings were observed for the days to maturity under the present study [12,13-18, 8].

4. CONCLUSION

Based on the study conducted for correlation coefficient and path coefficient analysis, the characters like the number of filled grains per plant followed by grain breadth, along with characters like total number of grains, number of secondary branches, plant height, number of panicles, leaf breadth, flag leaf area, 1000 seed weight, panicle length and number of primary branches can be used to formulate selection criteria for the effective selection of promising lines under study. These studies provide complete information for the response and effectiveness of the selection.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Abarshahr M, Rabiei B, Lahigi H S. Genetic variability, correlation and path analysis in rice under optimum and stress

irrigation regimes. Not. Sci. Biol. 2011; 3(4):134- 142.
2. Dewey Douglas R, KH Lu. A correlation and path-coefficient analysis of components of crested wheatgrass seed production. Agronomy Journal. 1959; 51(9):515-518.
3. Chhangte Lalrinchhani, Renuka Devi. Correlation and path analysis studies in aromatic rice germplasm of North-East region of India. The Pharma Innovation Journal. 2019;8(10):01-04.
4. Immanuel SC, Pothiraj N, Thiyagaraja K, Bharathi M and Rabindran R. Genetic parameters of variability, correlation and path coefficient studies for grain yield and other yield attributes among rice blast disease resistant genotypes of rice (*Oryza sativa* L.). Afr. J. of Biotechnol., 2011; 10(17):3322-3334.
5. Ahmed MM, Yassir Elsheikh MA. Variability, correlation and path coefficient analysis for yield and its components in rice. African Crop Sci. J., 2007;15 (4):183-189.
6. Basavaraja T, Gangaprasad S, Kumar D, Hittlamani S. Correlation and path analysis of yield and yield attributes in local rice cultivars (*Oryza sativa* L.). Electr. J.Plant Breeding. 2011;2(4):523-526.
7. Roy RK, Majumder RR, Sultana S, Hoque ME, Ali MS. Genetic variability, correlation and path coefficient analysis for yield and yield components in transplant aman rice (*Oryza sativa* L.). Bangladesh J. of Bot. 2015;44(4):529-535.
8. Lakshmi MV, Suneetha Y, Yugandhar G, Lakshmi NV. Correlation studies in rice (*Oryza sativa* L.). Int. J. Genetic Eng. and Biotech 2014;5(2):121-126.
9. Shet RM, Rajanna MP, Ramesh S, Sheshshayee MS, Mahadevu P. Genetic variability, correlation and path coefficient studies in F2 generation of aerobic rice (*Orzya sativa* L.). Electro J Plant Breed. 2012;3(3):925- 931.
10. Jeffrey LN, Aaron JL, Kenvin PS. Multi-trait Improvement by predicting genetic correlations in breeding crosses. Genes/Genomes/ Genetics. 2019;9(10): 3153-3165.
11. Bernardo R. Breeding for Quantitative Traits in Plants, Stemma Press, Woodbury, Minnesota; 2010.
12. Muthuvijayaragavan R, Murugan E. Inter – Relationship and Path Analysis in F2 Generation of Rice (*Oryza sativa* L.) under Submergence. Int.J.Curr.Microbiol. App. Sci. 2017;6(9):2561-2571.
13. Nanda Kalpataru, Bastia DN, Ashutosh Nanda. Character association and path coefficient analysis for yield and its component traits in slender grain rice (*Oryza sativa* L.). Electronic Journal of Plant Breeding. 2019;10 (3):963-969.
14. Abdul Fiyaz R, KT Ramya L, Chikkalingaiah BC, Ajay C Gireesh, Kulkarni RS. Genetic variability correlation and path coefficient analysis studies in rice (*Oryza sativa* L.) under alkaline soil condition. Electr. J. Plant Breeding. 2011; 2(4): 531-537.
15. Ali EN, Rajeswari S, Saraswathi R, Jeyaprakash P. Genetic variability and character association for earliness, yield and its contributing traits in F2 population of rice (*Oryza sativa* L.). Electron. J. Plant Breed. 2018;9(3):1163-1169.
16. Allard RW. Principles of Plant Breeding. John Wiley and Sons, New York. 1960;458.
17. Shashidhar HE, Pasha F, Janamatti MM, Vinod S, Adnan Kanbar. Correlation and path coefficient analysis in traditional cultivars and doubled haploid lines of rainfed lowland rice (*Oryza sativa* L.). Oryza, 2005;42(2): 156-159.
18. Yadav SK, Suresh BG, Pandey P, Kumar B. Assessment of genetic variability, correlation and path association in rice (*Oryza sativa* L.). J. Biosci. 2010: 18:1-8.

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