

ESTIMATION OF ASSOCIATION AMONG THE YIELD AND YIELD ATTRIBUTING TRAITS IN THE SEGREGATING POPULATION

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 are less influenced by genetic and environmental factors and therefore stable. Therefore, Selection selection based on the characters selected in the indirect selection makes these 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, where direct selection is less effective. Thus the present was undertaken to exploit the character association between the characters in a segregating population (F_2) population obtained from a cross between Naveen x IR 64 Drt1, and from 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 weight were observed to have the maximum association among the characters under the study. Correlation coefficient and path coefficient analysis, revealed that the characters like number of filled grains per plant followed by grain breadth, like total number of grains, number of secondary branches, plant height, number of panicle, leaf breadth, flag leaf area, 1000 seed weight, panicle length and number of primary branches had highly significant and positive correlation with yield and positive direct effect on yield, thus can be used to build selection criteria for the effective selection of promising lines under study. As these studies provide complete information for the response and effectiveness of the selection.

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. Rice and many other food plants are monocotyledons; these plants are clearly important. Cultivated rice is made up of two species: *Oryza sativa* and *Oryza glaberrima*, however we shall focus 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 on every continent. Rice is still a staple diet for the vast majority of the world's population. Rice provides nutritious value to more than two-thirds of the world's population. The

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36 wide range of genetic variability in segregating populations, which is determined by the quantity of genetic
37 variation among genotypes, provides more opportunities for selection. Many countries are currently facing
38 the second generation problem of growing more rice at a lower cost in a deteriorating environment.
39 Efforts will be made using a systematic research strategy to maximize yield potential through direct and
40 indirect selection (1). Segregating population, the availability of genetic variety and the use of appropriate
41 selection strategies form the foundation of any crop development strategy (2). The wide range of
42 variability presented by the segregating population provides the most suitable platform for wider
43 opportunities for effective selection. And because the F₂ generation is a segregating population, it is
44 particularly important for enhancing plant kinds by enforcing further selection improvement. Correlation
45 studies provide knowledge on contribution of various traits on yield (5). But correlation does not provide
46 the relation among cause and effect. Hence, the direct and indirect contribution of traits towards yield is
47 predicted by path coefficient analysis (9, 8). The present investigation was done to assess the genetic
48 variability and study the association between traits to determine the selection criteria for enhancing the
49 effectiveness of the selection.

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51 2. MATERIALS AND METHODOLOGIES

52 The study was conducted on the F₂ population developed from the cross between Naveen x IR 64 Drt1.
53 The segregating population obtained were raised as single plant progenies and evaluated at rice research
54 field, under Department of Genetics and Plant Breeding, Birsa Agricultural University, Kanke, Ranchi,
55 Jharkhand. During the kharif season of 2021-22, the F₂ seeds obtained from the previous season were
56 raised in single lines in land and were also evaluated for various yield and yield attributing traits for further
57 selection for superior segregants. The characters like Days-days to first flowering, days to maturity were
58 observed for per plot bases and characters like number of tillers, leaf length, leaf breadth, leaf area, plant
59 height, number of panicles, panicle length, number of primary branches, number of secondary branches,
60 number of filled grains, number of chaffy seeds, total number of grains, grain length, grain breadth, LBR
61 ratio, biomass, test weight and grain yield per plant were taken on individual plant bases. The data
62 recorded were subjected to correlation coefficient and path coefficient analysis using the software
63 GRAPES (developed by the Department of Agricultural Statistics, College of Agriculture, Vellayani which
64 is based on R software)

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66 3. RESULT AND DISCUSSION

67 Indirect selection, using correlation coefficients, linear regression coefficients, and path analysis, uses a variety of
68 yield determinants that are more heritable than yield itself and are
69 less influenced by genetic and environmental factors and therefore hence
70 stable. Therefore, selection based on the characters selected in the indirect selection makes these selection more ef-
71 ficient, especially in the early generation selection process.
72 Correlation coefficient analysis and the use of path coefficients are particularly important for economical and compl

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73 extraitssuchasyield,wheredirectselectionislesseffective.From the table 1, it was evident that the characters
74 like leaf breadth, leaf area, plant height, panicle length, number of primary branches, number of
75 secondary branches, number of filled grains, grain length and test weight were observed to have the
76 maximum association among the characters under the study. And the characters like leaf breadth
77 (0.31**), leaf area (0.29**), plant height (0.42**), number of panicle (0.16**), panicle length (0.37**),
78 number of primary branches (0.26**), number of secondary branches (0.55**), number of filled
79 ~~grains~~(grains (0.82**), total number of grains(0.31**) and grain breadth(0.28**) were found to be
80 significantly and positively correlated with yield per plant. Whereas,for-characters like days to flowering (-
81 0.13*), days to maturity (-0.13*), grainlength (-0.23*), LBR ratio (-0.31**) and test weight (-0.16**) were
82 found to be have negative association with the yield per plant. The association between the characters
83 having positive correlation coefficient suggests the increment in both characters ~~will be~~ in the same
84 direction, that is increase in one character will directly cause ~~and~~ increase in the other character, thus
85 selection based on ~~the~~ characters having positive association with the yield will be selective and
86 moderate selection will provide with the better gains. On the other hand, the characters having negative
87 association, ~~here the increase in one character will cause in decrease of the other character, thus shows~~
88 the progress ~~between the characters are~~ in opposite direction. ~~The and the~~ selection based on these
89 characters will not ~~be~~ effective (10, 3,7).

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91 Foraneffectiveandsuccessfulimprovementprogram,the correlationcoefficientanalysisresults~~andinformation~~
92 onotprovidecompleteinformationabouttheoverallcontributionofindividualtraitstoyield,andthustherelationship
93 betweenhetraitsunderstudy ~~is~~ ~~needed~~.Itisimportanttorecognizethegeneticbasis
94 ~~also~~.Evenunfavorableattributes,yield-
95 influencingresponsesinonetraitinchoosinganothertrait,andtheirunderlyingcausesallcombinetocontribute
96 ng-termimprovement,(9, 15).Thus to measure the response and efficacy of selection,
97 pathanalysisiscalculatedis
98 ~~done~~andthepathanalysiscoefficientsareusedtomapthecompleteinformationabouteachcomponent'scontribut
99 iontotheyield.Significantcorrelationsaredividedintodirectandindirecteffectsofingredientsonyield (12,17).
100 Thus in the present study, from the table 2, containing partitioning of correlation matrix into direct and
101 indirect effect for the Naveen x IR 64 Drt1 via path coefficient analysis, it is evident that the characters
102 having the high positive direct effect on yield were number of filled grains per plant (0.648) followed by
103 length breadth ratio (0.404) and grain breadth (0.333), and characters like total number of spikelet
104 (0.073), number of secondary branches (0.069), plant height (0.055), number of panicle (0.051), leaf
105 breadth (0.039), flag leaf area (0.037), 1000 seed weight (0.029), days to maturity (0.024), panicle length
106 (0.014) and number of primary branches (0.008) were also found to ~~be~~have positive direct effect on yield,
107 ~~whereas a~~Among the characters ~~being~~ correlated with the yield, the characters grain length (-0.199) and
108 days to first flowering (-0.079) were observed to have high negative direct effect on the yield. The residual
109 effect was observed to be 0.29.

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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 (11,6). And for the positive direct effects in case of negative correlation, a restricted selection has to be adopted for effected selection. The similar findings were observed for the days to maturity under the present study (13,14 12).

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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 (cm ²)	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 (cm ²)						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

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*- 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, 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, 1000^{sw}SW-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
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
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
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
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
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
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
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
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
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
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
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
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
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
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
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

Residual effect: 0.299

* r= correlation, DF-days to first flowering, DM- days to maturity, NP- number of tillers, FL- flag leaf length, FLB-flag leaf breadth, FLA-flag leaf area, PH- plant height, NPnumber 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.

Comment [DKL24]: mention the foot notes correctly

value
Y/P
-0.13
-0.13
0.31
0.29
0.42
0.16
0.37
0.26
0.55
0.81
0.82
-0.23
0.28
-0.31
-0.16

Table 3: Selected Segregants segregants having superior characteristics characters based on the selection criteria

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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.

4. CONCLUSION

On the basis of the study conducted via correlation coefficient and path coefficient analysis, the characters like 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 build selection criteria for the effective selection of promising lines under study. As these studies provide complete information for the response and effectiveness of the selection. The selected segregants based on the created selection criteria are stated in the table 3.

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