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Correlation and Path Analysis for Yield and Yield Component Traits in Rice (*Oryza sativa* L.) Genotypes in Hill zone

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ABSTRACT

The present investigation is carried out to study character association and path analysis for 100 rice (Oryza sativa L.) genotypes in hill zone. Character association for yield attributing traits revealed significantly positive association of grain yield per plant with days to 50 per cent flowering, days to maturity, number of tillers per plant, number of productive tillers per plant, number of spikelets per panicle, number of grains per panicle, straw yield per plant and harvest index. Hence, selection for these traits can improve yield. Path coefficient analysis revealed that days to 50 per cent flowering, number of productive tillers per plant, number of grains per panicle, straw yield per plant and harvest index exhibited positive direct effect on yield. Among these characters, days to 50 per cent flowering, number of productive tillers per plant, number of grains per panicle, straw yield per plant and harvest index possessed both positive association and high direct effects. Hence, selection for this character could bring improvement in yield and yield components.

Key words: *Correlation, Path analysis, Oryza sativa, Yield*

INTRODUCTION

Rice is the most important staple food in Asia. More than 90 per cent of the world's rice is grown and consumed in Asia, where 60 per cent of the world's population lives. It accounts for 35-60 per cent of the caloric intake of three billion Asians[4]. Rice cultivation in hills is suffering from the problem of poor productivity mainly due to erratic rainfall, poor soil fertility as well as lack of improved varieties. Poor yield potential of traditional rice cultivars necessitates the development of the high yielding cultivars for rainfed condition of hills. Most of the characters of interest to breeders are complex and are the result of the interaction of a number of components. Understanding the relationship between yield and its components is of paramount importance for making the best use of these relationships in selection. Character association derived by correlation coefficient, forms the basis for selecting the desirable plant, aiding in evaluation of relative influence of various component characters on grain yield. Path coefficient analysis discerns correlation into direct and indirect effects[8].

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The major advantage of path analysis is that it permits the partitioning of the correlation coefficient into its components, one component being the path coefficient that measures the direct effect of a predictor variable upon its response variable and the second component being the indirect effect(s) of a predictor variable on the response variable through another predictor variable[3]. Keeping the stated concepts in mind an attempt was made to study of correlation and path analysis of yield attributing traits.

MATERIAL AND METHODS

The experimental material consists of 100 AICRP rice genotypes along with three checks (Table 1). These genotypes were evaluated in an Augumented plot design during *kharif*, 2015 season at Agricultural Horticultural Research Station (AHRS), Ponnampet. The experimental field consists of ten blocks each block contains ten genotypes and three checks repeated in all blocks. The observation recorded from all the genotypes for thirteen yield attributing traits *viz.*, Days to 50% flowering, days to maturity, plant height, tillers per plant, number of productive tillers per plant, panicle length, number of spikelets per panicle, number of grains per panicle, percent spikelet fertility, test weight, grain yield per plant, straw yield per plant and harvest index were recorded in five randomly selected plant in all 100 hundred genotypes. The mean value was subjected to statistical analysis using INDOSTAT software package. The phenotypic correlation coefficients among all the traits under study were calculated following Al-Jobouri *et al.*[1] and the path analysis was carried out as per method of Dewey and Lu[3].

RESULTS AND DISCUSSION

The phenotypic correlation coefficient among 13 traits including grain yield in the present investigation is presented in Table-2. Grain yield was observed to be positively and significantly correlated with days to 50 per cent flowering, days to maturity, number of tillers per plant, number of productive tillers per plant, number of spikelets per panicle, number of grains per panicle, straw yield per plant and harvest index. Among the component traits days to 50 per cent flowering was significantly positively correlation at phenotypic level with days to maturity (0.9460), panicle length (0.2355), number of spikelets per panicle (0.2494) and harvest index (0.3796) similar results are obtained by Nandan *et al.*[7] for days to 50 per cent flowering.

The trait days to maturity is positive significant association with days to fifty per cent flowering (0.9460), number of tillers per plant (0.2927), panicle length (0.1597) number of spikelets per panicle (02362) and harvest index (0.4475). Plant height was found to have significant positive correlation at phenotypic levels with panicle length (0.2868), number spikelets per panicle (0.2876), number of grains per panicle (0.2524), straw yield per plant (0.2428) and harvest index (0.2022). A similar result obtained Kole *et al*.[6] for plant height.

The trait number of tillers per plant had positive significant association with days to maturity (0.2927) number of productive tillers per tillers (0.9943), per cent panicle fertility (0.1830) and straw yield per plant (0.2667). Number of productive tillers showed positive significant association at phenotypic level with the character number of tillers per plant (0.9943), per cent panicle fertility (0.1857) and straw yield per plant (0.2612). Bhadru *et al*.[2] observed similar results for number of tillers per plant. Panicle length showed significant positive correlation for the characters days to 50 per cent flowering (0.2355), days to maturity (0.1597), plant height (0.2868), number of spikelets per panicle (0.2651), number of grains per panicle (0.1978) and straw yield per plant (0.1398), similar results obtained by Bhadru *et al*.[2]. At phenotypic level the trait number of spikelets per panicle had positive significant association with days to 50 per cent flowering (0.2494), days to maturity (0.2362), plant height (0.2876), panicle length (0.2651), number of grains per panicle (0.7510) and straw yield per plant (0.2048).

Number of grains per had positive significant correlation with plant height (0.2524), panicle length (0.1978), number of spikelets per panicle (0.7510), per cent panicle fertility (0.4660), and straw yield per plant (0.1864) at phenotypic level. The spikelets fertility was positive and significantly associated with number of tillers per plant (0.1830), number of productive tillers per plant (0.1857) and number of grains per panicle (0.4660) at phenotypic level. Straw yield per plant was positive and significantly correlated with plant height (0.2428), number of tillers per plant (0.2667), number of productive tillers per plant (0.2612), panicle length (0.1398), number of spikelets per panicle (0.2048) and number of grains per panicle (0.1864). The trait harvest index is showed positive significant association with days to fifty per cent flowering (0.3796), days to maturity (0.4475) and plant height (0.2022) and positive non-significant for the characters number of spikelets per panicle (0.0667) and straw yield per plant (0.0201). The similar results were recorded by Halil *et al*. for harvest index trait.

The above inter se association amongst the traits indicated that although plant height, panicle length, per plant, and harvest index did not exhibit positive significant association with grain yield, their role in contributing towards grain yield could not be overlooked as these component traits exhibited positively significant association with important yield attributes. Thus, these traits may be assumed to indirectly contribute via other traits in governing grain yield. In this regard it is important to partition out the observed phenotypic association into direct and indirect effects of the component traits towards grain yield. A character contributing to grain yield may contribute directly or indirectly. It is essential to conduct the path analysis. The estimates of direct and indirect effect are presented in Table-3.

In the present investigation, the days 50 per cent flowering, number of productive tillers per plant, number of grains per panicle, straw yield per plant and harvest index were shown direct positive effect on grain yield, similar results were also reported by Nandan *et al.*[7].

Days to 50 per cent flowering had indirect positive effect on yield through days to maturity, plant height, number of spikelets per panicle, number of grains per panicle and harvest index. These results are confirmed with Immanuel selvaraj *et al.*. The indirect positive effect of plant height on yield through days to maturity, days to fifty per cent flowering, number of tillers per plant, number of productive tillers per plant and harvest index. Indirect positive effect of number of tillers per plant through days to fifty per cent flowering, days to maturity, plant height, number of spikelets per panicle, number of grains per panicle and harvest index was observed.

The positive direct effect of number of productive tillers on yield through characters like number of tillers per plant, per cent spikelet fertility, test weight and straw yield per plant. Panicle length shows indirect positive effect through per cent spikelets fetility, test weight and harvest index. Number of spikelets per panicle shows positive significant effect on yield through number of tillers per plant, number of productive tillers, per cent spikelet fertility and test weight.

Number of grains per panicle shows positive indirect effect on yield through all character except number of tiller per plant, number of productive tillers test weight and harvest index. Per cent spikelet fertility shows positive indirect effect *via* days to fifty per cent flowering, days to maturity, plant height, panicle length, number of spikelets per panicle and harvest index. Test weight had shown positive indirect effect on yield *via* days to fifty per cent flowering, days to maturity, panicle length, number of spikelets per panicle, per cent panicle fertility and harvest index.

Indirect effect of straw yield per plant on grain yield through all other characters is positive but *via* days to fifty per cent flowering, days to maturity. The similar results were also obtained by Immanuel selvaraj *et al.*. Harvest index shows positive direct effect on yield *via* days to fifty per cent flowering, days to maturity, number of spikelets per panicle and straw yield per plant.

Table 1: List of rice genotypes studied under present investigation with respective codes

Code	**Genotypes**	**Code**	**Genotypes**	**Code**	**Genotypes**	**Codes**	**Genotypes**
G1	IET-24385	G27	IET-25146	G 53	IET-24195	G 79	IET-25024
G2	IET-25025	G28	IET-25147	G 54	IET-24192	G 80	IET-25026
G3	IET-24395	G29	IET-25148	G 55	IET-24196	G 81	IET-25028
G4	IET-25021	G30	IET-25149	G 56	IET-24997	G 82	IET-25029
G5	IET-23725	G31	IET-25010	G 57	IET-24488	G 83	IET-25030
G6	IET-25019	G32	IET-25150	G 58	IET-24998	G 84	IET-25031
G7	IET-24414	G33	IET-25151	G 59	IET-24999	G 85	IET-25032
G8	IET-24261	G34	IET-25005	G 60	IET-25000	G 86	IET-25033
G9	IET-24292	G35	IET-25152	G 61	IET-25001	G 87	IET-25034
G10	IET-24418	G36	IET-25153	G 62	IET-25002	G 88	IET-25035
G11	IET-24365	G37	IET-25154	G 63	IET-25003	G 89	IET-25036
G12	IET-24297	G38	IET-25155	G 64	IET-25004	G 90	IET-24521
G13	IET-24235	G39	IET-25156	G 65	IET-25006	G 91	IET-25037
G14	IET-24443	G40	IET-25157	G 66	IET-25007	G 92	IET-25038
G15	IET-25012	G41	IET-25158	G 67	IET-25008	G 93	IET-25039
G16	IET-24480	G42	IET-22957	G 68	IET-25009	G 94	IET-25040
G17	IET-24451	G43	IET-24179	G 69	IET-25011	G 95	IET-25041
G18	IET-24474	G44	IET-24189	G 70	IET-25013	G 96	IET-25042
G19	IET-23930	G45	IET-23518	G 71	IET-25014	G 97	IET-25044
G20	IET-23565	G46	IET-25045	G 72	IET-25015	G 98	IET-24491
G21	IET-24471	G47	IET-24183	G 73	IET-25016	G 99	IET-25046
G22	IET-23561	G48	IET-22952	G 74	IET-25018	G 100	IET-25048
G23	IET-24367	G49	IET-24193	G 75	IET-25020	CK 1	INTAN
G24	IET-24450	G50	IET-24197	G 76	IET-25021	CK 2	KPR-1
G25	IET-25144	G51	IET-25047	G 77	IET-25022	CK 3	TUNGA
G26	IET-25145	G52	IET-24188	G 78	IET-25023		

C1- Days to 50% flowering C2-Days to maturity C3- Plant height (cm) C4- Number of tillers
C5- No. productive tillers C6- Panicle length (cm) C7- No. spikelets/panicle C8- No. grains/panicle
C9- Per cent Panicle fertility C10- Test weight (g) C11- Straw yield/plant C12- Harvest index
C13- Grain yield/plant (g)

Table 2: Estimates of phenotypic correlation coefficients for thirteen yield and yield component traits in 100 rice genotypes

Traits	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
C1	**0.0416**	0.0394	-0.0011	-0.0140	-0.0139	0.0098	0.0104	0.0008	-0.0132	-0.0064	-0.0017	0.0158
C2	-0.0433	**-0.0458**	0.0018	0.0134	0.0132	-0.0073	-0.0108	-0.0009	0.0135	0.0072	0.0030	-0.0205
C3	0.0001	0.0001	**-0.0029**	0.0003	0.0003	-0.0008	-0.0008	-0.0007	0.0000	-0.0001	-0.0007	0.0006
C4	0.0280	0.0243	0.0089	**-0.0831**	-0.0826	-0.0003	0.0151	0.0045	-0.0152	-0.0015	-0.0222	0.0107
C5	-0.0264	-0.0227	-0.0077	0.0785	**0.0789**	0.000	-0.0142	-0.0040	0.0147	0.0012	0.0206	-0.0095
C6	-0.0033	-0.0023	-0.0041	-0.0001	0.0000	**-0.0142**	-0.0038	-0.0028	0.0013	0.0013	-0.0020	0.0002
C7	-0.0141	-0.0133	-0.0162	0.0102	0.0102	-0.0149	**-0.0564**	-0.0423	0.0123	0.0080	-0.0115	-0.0038
C8	0.0010	0.0011	0.0134	-0.0029	-0.0027	0.0105	0.0398	**0.0529**	0.0247	-0.0078	0.0099	-0.0021
C9	0.0125	0.0017	0.0002	-0.0072	-0.0073	0.0037	0.0086	-0.0184	**-0.0396**	-0.0007	-0.0002	0.0050
C10	0.0017	0.0097	-0.0003	-0.0002	-0.0002	0.0010	0.0015	0.0016	-0.0002	**-0.0109**	-0.0008	0.0008
C11	-0.0419	-0.0658	0.2423	0.2661	0.2607	0.1395	0.2044	0.1860	0.0039	0.0695	**0.8507**	0.0201
C12	0.1947	0.2296	-0.1037	-0.0659	-0.0619	-0.0083	0.0342	-0.0201	-0.0648	-0.0398	0.0103	**0.5130**
r value	0.1506	0.1560	0.1306	0.1951	0.1947	0.1187	0.2280	0.1566	-0.0626	0.0200	0.8554	0.5303

** Significance at 1%, * Significance at 5%

Table 3: Estimates of direct (diagonal) and indirect effects (of diagonal) of thirteen yield and yield components on grain yield at phenotypic level in 100 rice genotypes

Traits	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
C1	**1**												
C2	0.9460**	**1**											
C3	-0.0256	-0.0387	**1**										
C4	-0.3372**	0.2927**	0.1072	**1**									
C5	-0.3349**	-0.2874**	-0.0980	0.9943**	**1**								
C6	0.2355**	0.1597*	0.2868**	0.0038	-0.0002	**1**							
C7	0.2494**	0.2362**	0.2876**	-0.1814*	-0.1803*	0.2651**	**1**						
C8	0.0193	0.0202	0.2524**	-0.0541	-0.0506	0.1978**	0.7510**	**1**					
C9	-0.3169**	-0.2941**	-0.0056	0.1830**	0.1857**	-0.0947	-0.2180**	0.4660**	**1**				
C10	-0.1529*	-0.1569*	0.0288	0.0182	0.0148	-0.0913	-0.1411*	-0.1479*	0.0185	**1**			
C11	-0.0420	-0.0660	0.2428**	0.2667**	0.2612**	0.1398*	0.2048**	0.1864**	0.0039	0.0697	**1**		
C12	0.3796**	0.4475**	0.2022**	-0.1284	-0.1207	-0.0161	0.0667	-0.0392	-0.1263	-0.0775	0.0201	**1**	
C13	0.1506*	0.1560*	0.1306	0.1951**	0.1947**	0.1187	0.2280**	0.1566*	-0.0632	0.0200	0.8554**	0.5303**	**1**

** Significance at 1%, * Significance at 5%

Where,

C1- Days to 50% flowering C2-Days to maturity C3- Plant height (cm) C4- Number of tillers
C5- No. productive tillers C6- Panicle length (cm) C7- No. spikelets/panicle C8- No. grains/panicle
C9- Per cent Panicle fertility C10- Test weight (g) C11- Straw yield/plant C12- Harvest index

CONCLUSION

The grain yield had significant and positive phenotypic association with days to fifty per cent flowering, days to maturity, number of tillers per plant, number of productive tillers per plant, panicle length, straw yield per plant and harvest index. It would be rewarding to lay emphasis on these characters in selection program for yield improvement.

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