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Correlation and path coeffecient analysis in rice (*Oryza sativa* L.)

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Abstract
Genetic variability was studied for yield and yield related traits in 25 rice hybrids. The experimental materials had considerable amount of variability for all the traits. Out of the total hybrids evaluated, 5 were from public sector and 16 were from private sector. The hybrids NS-6508, LP-17201, RH-150025, US-314 and RH-131419, gave high yields of 8.3q/ha,7.9q/ha,7.26q/ha,7.1q/ha and 7.73q/ha respectively. GCV values for days to fifty percent flowering, plant height and yield are 8.39, 8.36 and 22.57 respectively. PCV values for days to fifty percent flowering, plant height and yield are 8.86, 8.00 and31.65 respectively. Heritability for days to fifty percent flowering is as high as 0.897and heritability for yield is moderate (0.508).Whereas, heritability for plant height is low (0.247). Studies on correlation in rice revealed that a character day to fifty percent flowering was positively associated and plant height was negatively associated with grain yield. Days to fifty percent flowering showed positive correlation (0.285) with yield per hectare which is significant at both 5% and 1% while plant height and panicle per metre square showed negative correlation of -0.129 and -0.992 respectively with yield per hectare. Days to fifty percent flowering and plant height were positively correlated. Path analysis revealed that days to fifty percent flowering has positive direct effect (0.360) on yield whereas plant height and panicle per metre square has negative direct effects (-0.171) and (-0.173) on yield respectively.

Keywords: Rice, Correlation, Heritability, Path analysis, Genotype, Grain yield.

Introduction
Rice (Oryza sativa L.) is one of the staple cereal crops which feed more than half of the world population. The world population is expected to reach 8 billion by the year 2030 and rice production must be increased by 50% in order to meet the growing demand (Khush and Brar, 2002) [2]. In order to meet the increasing demand for rice grain, development of high yielding genotypes with good agronomic traits for diverse ecosystem is a necessity. Hence, rice breeders are interested in developing cultivars which are high yielding along with desirable agronomic characters. Genotype and environmental factors have great effects on growth and yield of rice. Many characters that are important to breeder are complex and are result of the interaction of a number of components (Sarawgi *et al.*, 1997). Grain yield is a complex character and it is composed of several components which affect it directly or indirectly.

Correlation and path analysis gives the extent of association between yield and its components and also bring out relative importance of their direct and indirect effects, thus giving a genuine understanding of their association with grain yield. This type of analysis will help the breeder to define selection strategies for the improvement of 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 for yield improvement.

In the present investigation, correlation coefficients were computed among these characters (Table 1). Path analysis has emerged as a powerful and widely used technique for understanding the direct and indirect contributions of different characters to economic yield in crop plants so that the relative importance of various yield contributing characters can be assessed. The concept of path coefficient was developed by Wright (1921) [12] and technique was first used for plant selection by Dewey and Lu (1959) [1]. In the present study, the path coefficient analysis was carried out using correlation coefficients between four characters.

Materials and methods

The present investigation was carried out at the Rice Research Farm of department of Genetics and Plant Breeding, Birsa Agricultural University, Kanke, Ranchi during *kharif*, 2017. Geographically this place is located in between 23.434^0 N latitude, 85.321^0 E longitudes and at an altitude of 611 metres above from mean sea level. The rice cultivation and experiments in this region are mainly dependent on monsoon rain. The average annual rainfall of this area is approximately 1400mm which is mostly erratic, punctured with occasional dry spells. Nearly 80 per cent of total rainfall occurs during four monsoon months (mid june to mid october) and heavy rains generally in the month of august.

Experimental details

The hybrids were taken from different public and private sectors. The experimental materials used in the present study consisted of 25 rice genotypes. They are LP-17201, NS-6508, Bio-688, JKRH-2337, JKRH-2354, IRH-107, TMRH-129, BLR-106, US-317, SD-151030, NK-20031, RH-131419, MEPH-136, RH-150025, MEPH-137, MP-3050, LP- 17301, WGRH-19, JRH-87, TNRH-290, CRHR-121, US-314, CO-51, NDR-97, BVD-110. The test genotypes were evaluated in Randomized Block Design with three replications with spacing of 20*15 cm under recommended cultural practices. The fertilizers were applied @ 120 kg nitrogen, 60 kg phosphorus and 40 kg potash per hectare through urea, DAP and muriate of potash, respectively. The full dose of phosphorus and potash and half dose of the nitrogen were applied as basal and rest of nitrogen was applied in two split doses in form of top dressing at tillering and panicle initiation stage of the crop growth. Observations were recorded on 5 randomly selected plants for different traits. The number of days taken from date of sowing to panicle emergence in 50% plants in a row plot was counted as days to 50% flowering. Plant height of a plant was recorded in cm from ground level to the tip of the main panicle excluding awns at maturity. It was then subjected to various statistical and genetical analyses.

1. Computation of correlation coefficient
2. Path coefficient analysis (Dewey and Lu, 1959) [1]

Results and discussion

Yield is the most important objective in most of the plant breeding programme. Breeding high yielding varieties of crops needs information on the extent of association between different characters and grain yield to formulate criteria for direct and indirect selection through components. In general, genotypic correlation coefficients were higher than the phenotypic correlation coefficients, indicating that though there is strong inherent association between various characters studied, the phenotypic association of a character decreased under the influence of the environmental effects. Three characters, namely days to fifty percent flowering, plant height and grain yield were studied. It was evident that the above characters would serve as useful indices of selection for improvement of grain yield.

Days to fifty percent flowering was found to be positively associated with plant height (0.174), panicle per metre square (0.262) and grain yield (0.285). Plant height was found to be positively associated with panicle per metre square (0.121) and negatively associated with grain yield (-0.129) whereas panicle per metre square was found to be negatively associated with grain yield (-0.099). The estimates of correlation coefficients obtained in present study are in agreement with previous reports in rice (Verma and Srivastava, 2004 [11]; Kishore *et al.*, 2007 [3]; Rangare *et al.*, 2012 [8]; Krishnamurthy and Kumar, 2012) [4], Mohamed *et al.*, (2012) [6], Pankaj *et al.*, (2013) [7] and Sudharani *et al.*, (2013) [10]. Path analysis revealed that days to fifty percent flowering has positive direct effect (0.360) on yield whereas plant height and panicle per metre square has negative direct effects (-0.171) and (-0.173) on yield respectively. Indirect effects of days to fifty percent flowering was found to be negative through plant height (-0.029) and panicle per metre square (-0.045). Indirect effects of plant height were found to be positive through days to fifty per cent flowering (0.062) and negative through panicle per metre square (-0.0209). Indirect effects of panicle per metre square were found to be positive through days to fifty per cent flowering (0.094) and negative through plant height (-0.0207).

Heritability for days to fifty percent flowering is as high as 0.897 and heritability for yield is moderate (0.508) whereas, heritability for plant height is low (0.247). GCV values for days to fifty percent flowering, plant height and yield are 8.39, 8.36 and 22.57 respectively. PCV values for days to fifty percent flowering, plant height and yield are 8.86, 8.00 and31.65 respectively.

Table 1: Estimates of phenotypic correlation coefficients between 4 characters of rice (*Oryza sativa* L.).

Sl.No.	Charecters	Days to fifty percent flowering	Plant height(cm)	Panicle per metre square	Yield (Kg/ha)
1	Days to fifty percent flowering	1.000	0.174	0.262	0.285
2	Plant height	0.174	1.00	0.121	-0.129
3	Panicle per metre square	0.262	0.121	1.00	-0.099
4	Yield per hectare	0.285	-0.129	-0.099	1.00

Table 2: Direct (Bold diagonal figures) and indirect effects of different characters on grain yield per hectare at genotypic level in rice (*Oryza sativa* L.).

Sl.No.	Charecters	Days to fifty percent flowering	Plant height(cm)	Panicle per metre square
1	Days to fifty percent flowering	**0.3605**	-0.029	-0.045
2	Plant height	0.062	**-0.171**	-0.020
3	Panicle per metre square	0.094	-0.020	**-0.173**

R square = 1.0035 residual effect =sqrt (1-1.0035).

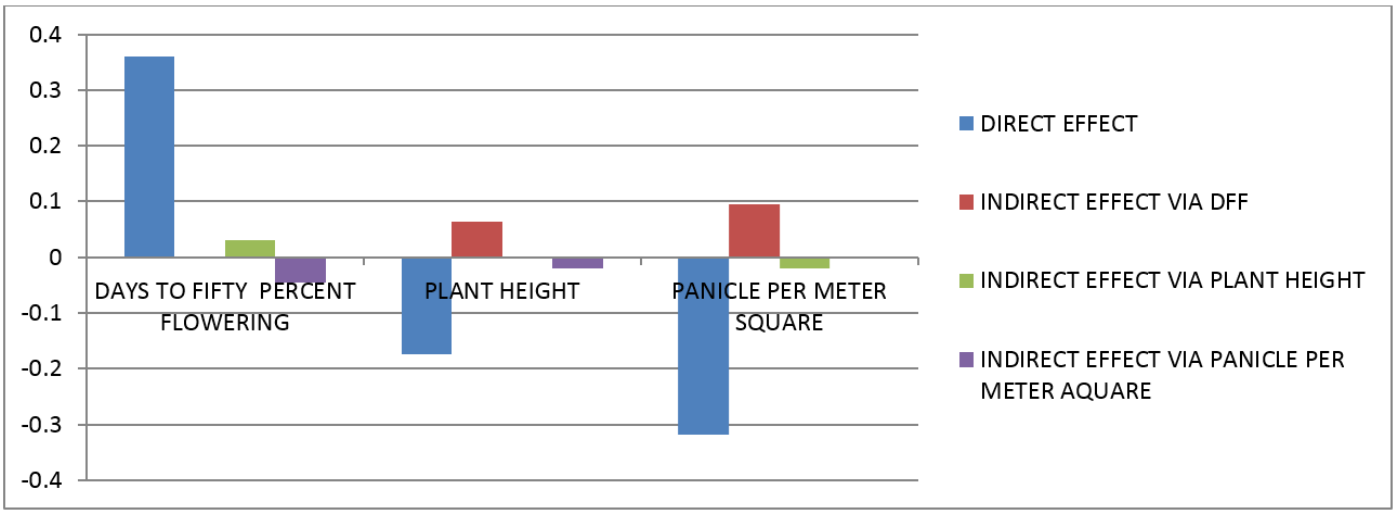

Fig 1: Graphical representation of Direct and indirect effects of different characters on grain yield per plant at phenotypic level in rice (*Oryza sativa* L.)

Table 3: Mean of different charecters of rice (*Oryza sativa* L.)

Sl.No	Varieties	Days to fifty percent flowering	Plant height(cm)	Panicle per metre square	Yield(Kg/ha)
1	LP-17201	90	102.3	234	7900
2	NS-6508	90	99.6	223	8333.3
3	Bio-688	86	113.6	225	7566.6
4	JKRH-2337	81	109	250	4500
5	JKRH-2354	73	108.3	255	1766.6
6	IRH-107	91	111	240	5400
7	TMRH-129	83	111	214	7066.6
8	BLR-106	83	113.3	217	5066.6
9	US-317	91	102.3	226	5100
10	SD-151030	83	100.3	241	6400
11	NK-20031	90	103	241	6700
12	RH-131419	86	101.6	211	7733.3
13	MEPH-136	89	104.6	215	5533.3
14	RH-150025	83	112	205	7266.6
15	MEPH-137	75	104	198	3300
16	MP-3050	82	99.3	223	5500
17	LP- 17301	82	105.6	162	4500
18	WGRH-19	85	110	245	6400
19	JRH-87	79	101.6	223	6133.3
20	TNRH-290	99	101	311	6833.3
21	CRHR-121	79	101.3	245	5733.3
22	US-314	87	112	212	7133.3
23	CO-51	77	101	198	4900
24	NDR-97	84	114.3	208	6033.3
25	BVD-110	104	120	277	4333.3

National Check Hybrid (NCH) - US-314; National Check Variety (NCV) - CO-51; Zonal Check Variety (ZCV) - NDR-97; Local Check Variety (LCV) - BVD-110

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