Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(5): 734-739
Received: 01-07-2020
Accepted: 03-08-2020

Shyama Kumari
Research Scholar, Department of Plant Breeding & Genetics, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

SB Mishra
Chief Scientist, Tirhut College of Agriculture, Department of Plant Breeding & Genetics, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

Nilanjaya
Assistant Professor, Department of Plant Breeding & Genetics, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

AK Singh
Assistant Professor, Tirhut college of Agriculture, Department of Plant Breeding & Genetics, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

Lal Ji Bharti
M.Sc. Student, Department of Plant Breeding & Genetics, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

Corresponding Author:
Shyama Kumari
Research Scholar, Department of Plant Breeding & Genetics, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

Character association and cause-effect relationship for yield and its attributes in rice genotypes under direct seeded condition

Shyama Kumari, SB Mishra, Nilanjaya, AK Singh and Lal Ji Bharti

Abstract
The present investigation was carried out to study the correlation and path analysis in thirty four genotypes of rice (*Oryza sativa* L.). Character association of the yield attributing traits revealed significant positive association of grain yield per plant with panicle length, number of tillers per plant, panicle length, panicle number per plant, number of grains per panicle and 1000 grain weight. Hence, selection for these traits can improve yield. The number of tillers per plant, filled grains per panicle, test weight, panicle length, total number of grains per panicle and days to maturity exhibited positive direct effect on yield. Among these characters, number of tillers per plant possessed both positive association and high direct effects. Hence, selection for this character could bring improvement in yield and yield components.

Keywords: 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. About 785 million tonnes of paddy which is 70 per cent more than the current production will be required to growing demand by 2025 (Manonmani and Khan, 2003a) [7]. Being staple food for majority of the population in India, improvement in its productivity has become crucial. 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. The correlation between yield and its components traits is due to the direct effect of the characters, it reflects true relationships between them and selection can be practiced for such a character in order to improve yield. The information derived from correlation coefficient can be augmented by partitioning into direct and indirect effects by path coefficient analysis. In the present study, an attempt was made to understand the association and path analysis of component characters for grain yield in rice genotypes.

Materials and Method
The present investigation was carried out during during *Kharif* 2017 and *Kharif* 2018 at Research Farm of Rajendra Central Agricultural University, Pusa, Samastipur, Bihar. Geographically, University Farm is situated between 25.98^0 N latitude and 85.67^0 longitudes at 51.8m above mean sea level. The experiment site was typical rainfed having clay loam soil with pH 7.5. The rice genotypes used under present study were collected from RPCAU, PUSA (Bihar) and IRRI. The details of genotypes are furnished in the Table 1. Thirty four rice genotypes were grown under drought condition opting the direct seeded method under rainout shelter. The experiment was laid out in Completely Randomized Block Design with three replications. In each replication each genotype was grown in a plot of 5 rows of 1.5 meter length each with a spacing of 20 cm between rows under direct seeded condition using the fertilizer @ 80:40:40 kg (N: P: K) per ha. Nitrogen was applied on three stages (1/3rd each at basal, maximum tillering and panicle initiation stage), while the P_2O_5 and K_2O were applied as a basal application**.** The data were recorded on five randomly selected plants from each genotype in each replication leaving the first two border rows from all the four sides, in order to avoid the sampling error. The observations were recorded as per the following procedure. Readings from five plants were averaged replication wise and the mean data was used for statistical analysis for twenty one characters *viz*, Days to fifty per cent flowering, days to

physiological maturity, plant height, number of tillers per plant, panicle length, panicle number per plant, number of grains per panicle, spikelet fertility, 1000 grain weight, leaf rolling at vegetative stage, leaf drying at vegetative stage, canopy temperature, chlorophyll content, relative water content, root length, root volume, fresh root weight, dry root weight, grain yield per plant, straw yield per plant and harvest index. The drought scores leaf rolling and leaf drying observations were taken as per SES method, 1 to 9 scales (IRRI, 1996). Leaf relative water content (RWC) was estimated by recording the turgid weight of 0.5 g fresh leaf sample by keeping in water for 4h, followed by drying in hot air oven till constant weight is achieved (Weatherly, 1950). It is given as Relative water content (%) = [(Fresh weight- Oven dry weight) / (turgid weight- Oven dry weight) x 100]. Leaf chlorophyll content was recorded by measuring leaf greenness using a portal chlorophyll meter (Monilta Camera Co. Ltd., Japan). Canopy temperature was measured using a hand-held infrared thermometer. Measurements were taken in the afternoon (1:00 to 2:00) under full sunshine conditions. Yield attributes i.e. seed yield, straw yield, harvest index and dry matter was measured at maturity. The experimental data were compiled by taking mean value over randomly selected plants from all the replications and statistical analysis for the above characters were done following Searle (1961) [14] for correlation coefficient and Dewey and Lu (1959) [1] for path analysis.

Results and Discussion

Analysis of variance (Table 2) revealed that significant differences among the genotypes for all the studied characters except chlorophyll content. The genotypic correlations in general were higher than the corresponding phenotypic correlations. The phenotypic correlations along with the contributions due to genetic and environmental causes to the phenotypic correlation among twenty one traits under investigation have been presented in Table 3. The knowledge of the nature and magnitude of inter-relationships among yield and its components is necessary for the simultaneous improvement of the characters and yield improvement. Number of tillers per plant has shown positive and significant correlation with panicle number per plant. Similar type of association was observed by Pankaj *et al*., (2010) [9]. Number of grains per panicle exhibited negative and significant correlation with leaf rolling and leaf drying as well as positive and significant correlation with straw yield per plant. Leaf rolling has shown positive and significant correlation with leaf drying while negative and significant correlation with straw yield per plant. Leaf drying has shown negative and significant correlation with straw yield per plant. Root volume has shown positive and significant correlation with fresh root weight and dry root weight. Similar type of association was observed by Reddy *et al*., (1997) [10]. Fresh root weight has shown positive and significant correlation with dry root weight Number of tillers per plant, number of grains per plant, straw yield per plant and harvest index have exhibited positive and significant correlation with grain yield per plant while leaf rolling and leaf drying exhibited negative and significant correlation with grain yield per plant. The association indicates the relative utility of all these traits for selection. Similar findings were reported by Manna *et al*., (2006) [6], Mazid *et al*., (2013) [8] and Sandeep *et al*., (2013) [11].

Strong association of these traits revealed that the selection based on these traits would ultimately improve the grain yield and it is also suggested that hybridization of genotypes possessing combination of above characters is most useful for obtaining desirable high yielding varieties. The simple correlation alone, however, is not a true reflection of the nature of association of the different traits with each other when other characters are held constant. The estimates of path coefficient analysis are furnished for yield and yield component characters in Table 4, Fig. 1. Number of tillers per plant, filled grains per panicle, test weight, panicle weight, total number of grains per panicle, days to maturity and panicle length exhibited direct positive effect on grain yield revealing that these were the major yield contributing trait in rice. These findings were in agreement with earlier reports of Sawarkar and Senapati (2014) [12] for total number of grains per panicle and panicle length Singh *et al*., (2013) [13] for days to maturity and test weight, Eradasappa *et al*. (2007) [2] for number of effective tiller and filled grain per panicle.

It revealed that number of tillers per plant had the maximum direct contribution along with significant correlation with the grain yield per plant followed by direct effect of filled grain and test weight. Immanuel *et al*., (2011) [3], Singh*et al*., (2013) [13] also reported the same. Similar result was reported by Manikya *et al*., (2013) [5]. Similar result was obtained by Sawarkar and Senapati (2014) [12]. The direct effect of number of grains per panicle was positive and high. Its indirect positive effect mainly observed through panicle weight and total number of grains per panicle, while its indirect negative effect were observed through days to 50% flowering, test weight, plant height, panicle length. The resulting effect of it with grain yield per plant was positive and significant. The positive association of effective tiller per plant with grain yield was mainly observed through its direct effect.

It was further followed by its positive indirect effects of plant height, panicle length and test weight resulting into a considerable positive and significant association of it with grain yield. Similar findings were reported by Eradasappa *et al*. (2007) [2], Jayasudha and Sharma (2010) [4]. Number of panicle per plant, straw yield per plant and harvest index have shown positive and significant correlation comprising its positive and high direct effect on grain yield per plant. It indicates that selection based on these traits may be effective.

Table 1: List of 34 drought tolerant rice genotypes and their collection sites

S. No.	Genotypes	Sources
1.	IR 95122:13-B-7-4-7-3	IRRI, Philippines
2.	IR 91648-B-89-B-81-B	IRRI, Philippines
3.	IR 95781-15-1-1-4	IRRI, Philippines
4.	IR14D197	IRRI, Philippines
5.	IR 83140-B-11-B	IRRI, Philippines
6.	GSR IR1-DQ125-L2-D2	IRRI, Philippines
7.	IR10M243	IRRI, Philippines
8.	IR 93827-29-1-1-2	IRRI, Philippines
9.	IR 10G104	IRRI, Philippines

10.	IR 95795-53-1-1-2	IRRI, Philippines
11.	IR 93827-29-2-1-3	IRRI, Philippines
12.	GSR IR1-DQ187-Y3-D1	IRRI, Philippines
13.	IR 95793-5-2-2-3	IRRI, Philippines
14.	IR 95785-31-2-1-2	IRRI, Philippines
15.	GSR IR1-DQ62-D6-D1	IRRI, Philippines
16.	IR 93849-22-3-1-1	IRRI, Philippines
17.	IR 10A114	IRRI, Philippines
18.	IR 93810-17-1-2-3	IRRI, Philippines
19.	GSR IR1-DQ139-R1-L2	IRRI, Philippines
20.	IRRI-123	IRRI, Philippines
21.	IR 95817-5-1-1-2	IRRI, Philippines
22.	IR14D180	IRRI, Philippines
23.	IR 95817-14-1-1-2	IRRI, Philippines
24.	IR 95785-15-2-1-2	IRRI, Philippines
25.	IR 89889-34-2-1-1	IRRI, Philippines
26.	IR 96279-33-3-1-2	IRRI, Philippines
27.	IR 91648-B-89-B-12-1-B	IRRI, Philippines
28.	GSR IR1-DQ150-R5-Y1	IRRI, Philippines
29.	IR 93856-10-2-3-2	IRRI, Philippines
30.	IR 83142-B-19-B	IRRI, Philippines
31.	Rajendra Nilam	DRPCAU, Pusa
32.	Rajendra Bhagwati	DRPCAU, Pusa
33.	Abhishek	DRPCAU, Pusa
34	Sahbhagi Dhan (Check)	DRPCAU, Pusa

Table 2: Analysis of variance for twenty one morpho-physiological traits in rice genotypes under direct seeded condition

S. No.	Characters	Mean sum of squares		
		Replication (d.f.=2)	Treatments (d.f.=33)	Error
1	DFF	3.14	17.13**	3.29
2	DPM	21.30	14.37**	5.54
3	PH	1.32	144.43**	34.45
4	NOTP^{-1}	14.86	40.68**	5.36
5	PL	5.06	14.74**	2.31
6	PNP^{-1}	9.50	9.93*	5.21
7	NOGP^{-1}	168.45	1964.74**	316.52
8	SF	131.05	83.30**	22.16
9	TGWT	42.10	10.83**	1.70
10	LR	0.17	9.48**	0.43
11	LD	0.12	8.17**	0.41
12	CT	6.58	5.69**	1.10
13	CC	31.74	6.35	4.39
14	RWC	1145.38	222.45**	64.04
15	RL	4.21	5.39**	1.54
16	RV	20.05	477.46**	22.07
17	FRW	50.60	1020.37**	19.74
18	DRW	12.60	372.79**	7.66
19	GYP^{-1}	84.28	681.39**	36.60
20	SYP^{-1}	55.13	1347.44**	68.47
21	HI	7.38	17.64**	7.29

** Significance at 1% level
* Significance at 5% level

Table 3: Estimates of phenotypic correlation coefficient between yield and its related traits in thirty four rice genotypes under direct seeded condition

S. No	Character	DFF	DPM	PH	NOTP-1	PL	PNP-1	NOGP-1	SF	TGWT	LR	LD	CT	CC	RWC	RL	RV	FRW	DRW	SYP-1	HI	GYP-1
1	DFF	1.000	0.278	0.075	0.016	0.038	0.096	0.081	0.092	-0.013	-0.156	-0.195	0.031	0.012	-0.057	0.036	0.222	0.080	0.141	0.107	-0.011	0.098
2	DPM		1.000	-0.013	0.032	0.079	0.049	0.098	0.026	0.057	-0.172	-0.189	0.055	-0.004	-0.031	-0.022	0.063	0.025	0.067	0.143	-0.032	0.134
3	PH			1.000	0.000	0.019	-0.031	0.148	0.041	0.054	-0.120	-0.110	0.046	0.052	0.004	0.040	0.225	0.188	0.212	0.139	-0.007	0.123
4	NOTP-1				1.000	0.081	0.543**	0.288	0.146	0.078	-0.273	-0.246	-0.024	0.010	0.076	-0.207	0.039	-0.066	-0.070	0.325	0.077	0.375**
5	PL					1.000	0.152	0.100	0.044	0.012	-0.145	-0.142	-0.058	-0.140	-0.001	-0.164	0.012	-0.072	-0.018	0.202	-0.079	0.115
6	PNP-1						1.000	0.151	0.121	0.060	-0.193	-0.205	-0.056	-0.002	0.009	-0.059	0.007	-0.018	0.012	0.245	0.043	0.241
7	NOGP-1							1.000	-0.069	0.126	-0.454**	-0.455**	-0.031	0.020	0.047	-0.079	-0.002	-0.031	0.026	0.457**	0.195	0.518**
8	SF								1.000	0.043	0.051	0.014	-0.040	-0.019	-0.024	-0.021	0.027	-0.034	-0.042	0.052	0.032	0.070
9	TGWT									1.000	-0.238	-0.221	-0.007	0.019	0.095	-0.004	-0.034	-0.037	-0.031	0.255	0.052	0.251
10	LR										1.000	0.947**	-0.170	0.011	-0.019	0.152	-0.048	0.063	-0.013	-0.682**	-0.212	-0.739**
11	LD											1.000	-0.184	0.056	0.014	0.131	-0.083	0.021	-0.056	-0.670**	0.207	-0.725**
12	CT												1.000	0.056	0.038	-0.064	-0.081	-0.074	-0.055	0.101	0.042	0.135
13	CC													1.000	0.068	-0.007	-0.129	-0.048	-0.019	-0.010	-0.032	0.018
14	RWC														1.000	-0.024	-0.027	-0.006	0.006	0.058	-0.078	0.035
15	RL															1.000	0.080	0.140	0.153	-0.165	-0.003	-0.174
16	RV																1.000	0.646**	0.651**	-0.031	0.022	-0.032
17	FRW																	1.000	0.908**	-0.171	-0.022	-0.188
18	DRW																		1.000	-0.100	-0.006	-0.115
19	SYP-1																			1.000	-0.167	0.793**
20	HI																				1.000	0.343**
21	GYP-1																					1.000

* and **: Significant at 5% and 1% level of significance, respectively.

Table 4: Estimates phenotypic matrix of direct and indirect effects on grain yield per plant in thirty four rice genotypes accession

PATH matrix of GYPP																				
	DFF	DPM	PH	NOTP-1	PL	PNP-1	NOGP-1	SF	TGWT	LR	LD	CT	CC	RWC	RL	RV	FRW	DRW	SYP-1	HI
DFF	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DPM	0.006	0.021	0.000	0.001	0.002	0.001	0.002	0.001	0.001	-0.004	-0.004	0.001	0.000	-0.001	-0.001	0.001	0.001	0.001	0.003	-0.001
PH	0.001	0.000	0.010	0.000	0.000	0.000	0.002	0.000	0.001	-0.001	-0.001	0.001	0.001	0.000	0.000	0.002	0.002	0.002	0.001	0.000
NOTP-1	0.001	0.002	0.000	0.067	0.006	0.037	0.019	0.010	0.005	-0.018	-0.017	-0.002	0.001	0.005	-0.014	0.003	-0.004	-0.005	0.022	0.005
PL	-0.001	-0.002	-0.001	-0.002	-0.024	-0.004	-0.002	-0.001	0.000	0.004	0.003	0.001	0.003	0.000	0.004	0.000	0.002	0.000	-0.005	0.002
PNP-1	-0.002	-0.001	0.001	-0.013	-0.004	-0.024	-0.004	-0.003	-0.002	0.005	0.005	0.001	0.000	0.000	0.001	0.000	0.000	0.000	-0.006	-0.001
NOGP-1	0.002	0.002	0.003	0.005	0.002	0.003	0.018	-0.001	0.002	-0.008	-0.008	-0.001	0.000	0.001	-0.001	0.000	-0.001	0.001	0.008	0.004
SF	0.001	0.000	0.001	0.002	0.001	0.002	-0.001	0.014	0.001	0.001	0.000	-0.001	0.000	0.000	0.000	0.000	-0.001	-0.001	0.001	0.000
TGWT	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
LR	0.004	0.004	0.003	0.007	0.004	0.005	0.011	-0.001	0.006	-0.024	-0.023	0.004	0.000	0.001	-0.004	0.001	-0.002	0.000	0.017	0.005
LD	0.014	0.014	0.008	0.018	0.011	0.015	0.034	-0.001	0.016	-0.070	-0.074	0.014	-0.004	-0.001	-0.010	0.006	-0.002	0.004	0.050	0.015
CT	0.000	0.001	0.001	0.000	-0.001	-0.001	0.000	-0.001	0.000	-0.002	-0.003	0.014	0.001	0.001	-0.001	-0.001	-0.001	-0.001	0.001	0.001
CC	0.000	0.000	0.002	0.000	-0.005	0.000	0.001	-0.001	0.001	0.000	0.002	0.002	0.036	0.003	0.000	-0.005	-0.002	-0.001	0.000	-0.001
RWC	-0.001	-0.001	0.000	0.001	0.000	0.000	0.001	0.000	0.002	0.000	0.000	0.001	0.001	0.017	0.000	-0.001	0.000	0.000	0.001	-0.001
RL	-0.001	0.000	-0.001	0.003	0.003	0.001	0.001	0.000	0.000	-0.003	-0.002	0.001	0.000	0.000	-0.016	-0.001	-0.002	-0.003	0.003	0.000
RV	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.001	0.000	0.000
FRW	-0.003	-0.001	-0.008	0.003	0.003	0.001	0.001	0.001	0.002	-0.003	-0.001	0.003	0.002	0.000	-0.006	-0.026	-0.040	-0.036	0.007	0.001

DRW	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SYP^{-1}	0.082	0.109	0.107	0.249	0.154	0.188	0.350	0.040	0.195	-0.522	-0.513	0.077	-0.007	0.044	-0.126	-0.024	-0.131	-0.077	0.765	-0.128
HI	-0.005	-0.014	-0.003	0.034	-0.035	0.019	0.086	0.014	0.023	-0.094	-0.091	0.019	-0.014	-0.035	-0.001	0.010	-0.010	-0.003	-0.074	0.442
GYP^{-1}	0.098	0.134	0.123	0.375	0.115	0.241	0.518	0.070	0.251	-0.739	-0.725	0.135	0.018	0.035	-0.174	-0.032	-0.188	-0.115	0.793	0.343
Partial R2	0.000	0.003	0.001	0.025	-0.003	-0.006	0.009	0.001	0.000	0.018	0.054	0.002	0.001	0.001	0.003	0.000	0.007	0.000	0.607	0.152

* and **: Significant at 5% and 1% level of significance, respectively.
Residual effect-0.355

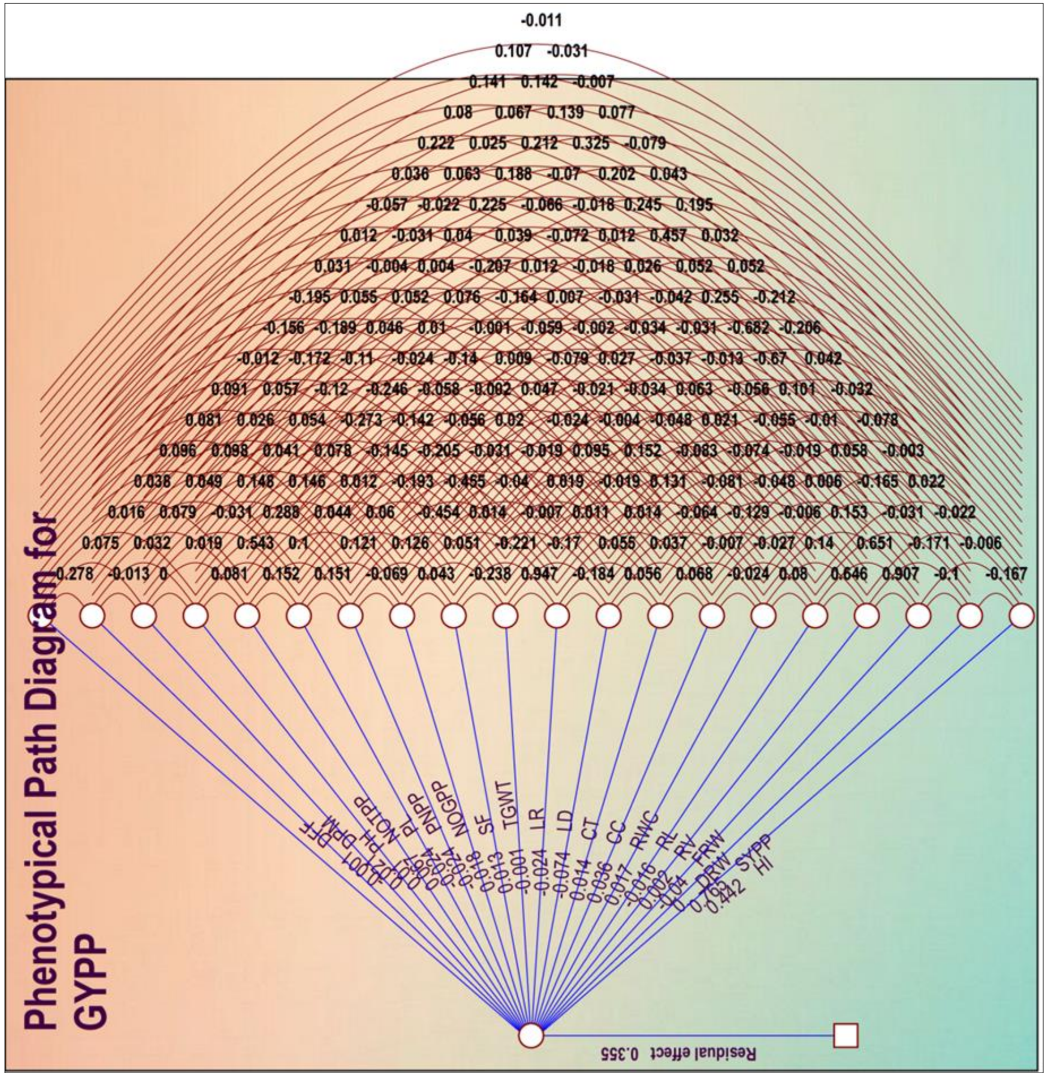

Fig 1: Phenotypic path diagram for grain yield per plant.

Acknowledgement: Authors wish to acknowledge Department of Plant Breeding and Genetics, Dr. Rajendra Prasad Central Agricultural University (RPCAU) Pusa for providing materials and other supports.

References

1. Dewey DR, Lu KH. A correlation and path coefficient analysis of crested wheat grass seed production. Agron. J. 1959; 51:515-578.
2. Eradasappa E, Nadarajan N, Ganapathy KN, Shanthala J, Satish RG. Correlation and path analysis for yield and its attributing traits in rice (*Oryza sativa* L.). Crop Res. 2007; 34(1-3):156-159.
3. Immanuel Selvaraj C, Pothiraj Nagarajan, Thiyagarajan K, Bharathi M, 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.) African Journal of Biotechnology. 2011; 10(17):3322-3334.
4. Jayasudha S, Sharma S. Genetic parameters of variability, correlation and path-coefficient for grain yield and physiological traits in rice (*Oryza sativa* L.) under shallow lowland situation. Electronic Journal of Plant Breeding. 2010; 1(5):1332-1338.
5. Manikya Minnie C, Reddy Dayakar T, Raju Surinder CH. Correlation and path analysis for yield and its components traits (*Oryza sativa* L.). J Res. Angrau. 2013; 41(1):132-134.
6. Manna M, Ali M, Sasmal BG. Variability, correlation and path coefficient analysis in some important traits of lowland rice. Crop Res. 2006; 31(1):153-156.
7. Manonmani S, Fazlullah Khan AK. Studies on combing ability and heterosis in rice. Madras Agric. J. 2003a; 90:228-231.
8. Mazid MS, Rafii MY, MM Hanafi, HA Rahim, M Shabanimofrad, MA Latif *et al*. Agro-morphological characterization and assessment of variability, heritability, genetic advance and divergence in bacterial blight resistant rice genotypes. African Journal of Botany. 2013; 86:15-22.
9. Pankaj G, Pandey DP, Dhirendra S. Correlation and path analysis for yield and it's components in rice (*Oryza sativa* L.). Crop Improvement. 2010; 37(1):46-51.
10. Reddy JN, De RN, Suriya Rao AV. Correlation and path analysis in lowland rice under intermediate (0-50 cm) water depth. Oryza. 1997; 34:187-190.
11. Sandeep Kumar Soni, VK Yadav, N Pratap, VP Bhadana, Ram T. Selection criteria, yield relationship with component traits and grouping of tropical Japonica, Indica lines and derived hybrids of Rice (*Oryza sativa* L.). SAARC J Agri. 2013; 11(2):17-32.
12. Sawarkar A, Senapati B. Polygenic variations and cause effect relationship in some photoinsensetive recombinant inbred lines (RFL's) of Basmati derivative. Afri. J. Biotech. 2014; 13(1):112-118.
13. Singh AK, Singh Parveen Sharma, Singh PK. Studies on Genetic Characteristic of Upland Rice (*Oryza sativa* L.). International Journal of Agriculture, Environment & Biotechnology. 2013; 6(4):515-520.
14. Searle SR. Phenotypic, genetic and environmental correlation. Biometrics. 1961; 17:474-480.