International Journal of Research in Agricultural Sciences
Volume 5, Issue 3, ISSN (Online): 2348 – 3997

Correlation Coefficient and Path Analysis of Advance Rice Genotypes in Central Mid-hills of Nepal

N. Shrestha*, A. Poudel, S. Sharma Acharya, A. Parajuli, S. Budhathoki and K. Shrestha
*Corresponding author email id: nikee2200@gmail.com

Date of publication (dd/mm/yyyy): 26/06/2018

Abstract **— Grain yield being a complex traits, to achieve the basic aim of plant breeders of improving the yielding potential of existing varieties along with creation of new varieties with high yielding potential, this experiment was carried out to study the association of yield attributing characters with grain yield and path analysis in twelve rice genotypes in central mid hills of Nepal. The correlation coefficient analysis revealed the positive and significant association of 1000 grain weight, flag leaf area and SPAD reading with yield while plant height showed negative and non-significant correlation with yield. Path analysis showed flag leaf senescence, 1000 grain weight, flag leaf area and SPAD had positive and high direct effect on grain yield respectively. Hence direct selection of any traits namely flag leaf area, 1000 grain weight and SPAD reading can be effective for future breeding programs to improve yield trait. Improvement in these traits will result in simultaneous improvement of yield**.

Keywords **— Correlation, Path Analysis, Rice, Yield, Yield Attributing Traits**

I. INTRODUCTION

Rice is an annual, self-pollinated and semi-aquatic plant that belongs to order cyperales, family graminae and class monocotyledon. It is one of the most pivotal staple foods all over the world that feed at least 63% of the planet inhabitants and contributes on an average 20% of calorie intake of the world population and 30% of the population in Asia (Calpe and Prakash, 2007). According to estimate of (MOAD) 2016/2017, In Nepal rice crop was grown in 1.36 million hectares with the production of 4.39 million metric tons and the productivity was 3.15 t/ha. With the growing population rate of today's context, it has been estimated that the world rice production should be increased by 60% by 2030 than what it produced in 1995 (Babu et al., 2012). Due to invasion of lands for settlement and infrastructure, there is very less possibility of bringing more land into rice production (Basnet, 2017). The most economic and effective way to fill the gap between rice yield and growing population is improvement in existing varieties as well as creation of high yielding varieties. Thus for improvement in varieties, breeding efforts should be encouraged in selection and improvement of rice genotypes. Information on relation among characters, direct and indirect effects caused by each of attributes towards yield in rice gives an added advantage for the selection and hence in breeding program (babu et. al., 2012). Grain yield is a complex trait which is a result of interaction between various genetic and environmental fluctuation (Wattoo et al., 2010). According to Wattoo et al. (2010), grain yield is a complex trait that depends upon different yield attributing traits. It is further supported by Al-salim et al. (2016) stating that yield being a complex trait, knowledge should be given to all yield attributing traits associated with it for efficient selection during breeding.

According to Zahid et al. (2006) and Prasad et al. (2001), breeding strategy in rice primarily depends upon the extent and degree of correlation between characters and its magnitude as well as nature of variation. Selection only based on correlation without considering the interactions between the component characters may sometimes results in misleading (Codawat, 1980). Path analysis helps to give idea about direct and in direct effects of yield components (Azhmadizadeh et al., 2011). While correlation studies gives the relationship among plant characters, their degree of linear relationship, path coefficient analysis more clarifies in partitioning the two traits into component that measures the direct and indirect effects (Seyed, 2011). In the light of above scenario, this experiment was done to study the correlation and path analysis of yield and yield attributing characters for rice yield improvement through breeding programs.

II. MATERIALS AND METHODOLOGY

The experiment was performed at the low land research field of national agricultural research centre (NARC) of khumaltar, lalitpur. For the experiment, twelve rice genotypes were laid out in randomized complete block design (RCBD) with three replications. Name of all studied genotypes with their parents are mentioned in table 1. Khumal-4, very popular rice variety in hills of Nepal was used the standard check against 11 promising genotypes of rice. With the net plot area of 432 m^2, each

Table 1: Names of Genotypes with their parents

S.N	Genotypes	Parents
1.	NR 11050-B-B-B-B-22	NR 10947(HIMALI/JARNELI) /M.-2
2.	NR 11115-B-B-31-3	NR 10555/HARDINATH-1
3.	NR 11105-B-B-16-2	IR 64/ PATLE
4.	NR 11104-B-B-49-3	IR 64/PATLE
5.	NR 11100-B-B-15-2-1	NR 10553/IR 64
6.	NR 11216-B-25-1	NR 10600/PALUNG-2
7.	NR 11139-B-B-B-13-3	KHUMAL-4/HANAREUMBYEO
8.	NR 11289-B-16-3	IR 67017/THULOGURDI
9.	NR 11196-B-25-3	NR 10492/DASANBYEO
10.	NR 11130-B-B-B-8-3	KHUMAL-8/HANAREUMBYO
11.	NR 11130-B-B-B-8	KHUMAL8/HANAREUMBYO
12.	KHUMAL-4	IR 28/ POKHRELI MASINO

genotype was planted in 12 m^2 under three replications. Nursery establishment was done on 2074/02/12 in area of

1.5 m^2 plot for each of genotype. Malathion was used during the nursery establishment for fungal protection. Then transplantation was done on 2074/03/16 at the rate of 1 hill per plant. Seedling transplantation was done at the geometry of (20cm*15cm): RR*PP respectively. Fertilizer was applied at the rate of 80:30:30 NPK kg/ha. Half dose of nitrogen (n) and full dose of phosphorous (p_2o_5) and potassium (k) were applied as basal dose. While half of nitrogen was applied at two split doses by top dressing during two weeding operation (25 and 50) days after transplanting respectively. All of the genotypes used for experiment are mentioned below with their parents and source. All the observations were recorded and data were subjected to statistical analysis. Statistical analysis of all characters was done following Dewey and Lu (1959) for path analysis and Singh and Chaudhary (1995) for correlation coefficient analysis.

III. Results and Discussion

Correlation of Grain Yield with Yield Attributing Traits:

The phenotypic correlation coefficient among yield and yield components is presented in Table 2. The results from experiment showed that 1000 grain weight (0.894**) had shown highly significant positive correlation with grain yield (t/ha). Further results revealed that flag leaf area (0.676*) and chlorophyll content of flag leaf (0.617*) had shown significant positive correlation with the grain yield (t/ha) while other traits i.e. days to 50% heading (0.359), days to physiological maturity (0.156), days to flag leaf senescence (0.466), panicle length, number of tillers per plant (0.181) and fertility percentage (0.555) had non-significant positive correlation with grain yield (t/ha). The result further revealed that plant height was non-significantly negatively correlated with grain yield (-0.243), it was probably due to lodging problem showed by plants during growth. 1000 grain weight showed the highest significant correlation (r = 0.894) followed by flag leaf area (r = 676) and chlorophyll content (r = 0.617). Results also showed that plan height had non-significant correlation with grain yield (t/ha).

Table 2: Correlation coefficient analysis of yield and yield contributing traits

	HD	FLS	MD	FLA	SPAD	PH	PL	TPP	TW	GY	FP
HD	1										
FLS	.809**	1									
MD	.580*	.760**	1								
FLA	.674*	.678*	.328	1							
SPAD	.669*	.580*	.541	.745**	1						
PH	-.032	-.032	-.069	-.094	.092	1					
PL	.601*	.735**	.629*	.635*	.704*	.277	1				
TPP	.354	.642*	.719**	.538	.444	-.037	.475	1			
TW	.282	.312	.084	.582*	.617*	.005	.500	.042	1		
GY	.359	.466	.156	.676*	.617*	-.243	.446	.181	.894**	1	
FP	-.206	-.106	-.202	.229	.392	.224	.158	.031	.585*	.555	1

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
HD = days to 50% heading, FLS = days to flag leaf senescence, MD = days to maturity, FLA = flag leaf area, SPAD = chlorophyll content by SPAD reading, PH (CM) = plant height in centimeter, PL (CM) = panicle length in centimeter, TPP = tillers per plant, TW = 1000 grain weight, GY (t/ha) = grain yield, FP = fertility percentage.

The results revealed that grain yield had positive and highly significant association with 1000 grain weight. Similar result was found by Ashan et al. (2014); Ifltekharuddaula et al. (2002); Madhavilatha et al. (2005); Abarshahr et al. (2011). Further it was also supported by wattoo et al. (2010) and Zahid et al. (2014). While this result was found contrast to this showing negative correlation with 1000 grain weight by Minnie et al. (2016). From the result which revealed positive and significant correlation of grain yield with flag leaf area indicates increase in flag leaf area of plant implies the increase in grain yield. Similar result was found in the experiment done by Tahir (2014); Simpson (1967); Buckly (2005); Chandra and das (2000). Flag leaf is of greater importance in cereals like rice, because it provides the maximum amount of photosynthates assimilates to be stored in the grains. A greater flag leaf area will eventually help to increase photosynthetic efficiency by increasing the production of photosynthesis, which is then carried or translocated into grains increasing their weight and eventually yield. Therefore, flag leaf area has a direct relationship to grain yield (Riaz and Chowdhry, 2003**).** This was also further supported by Cook and Evans (1983) where they stated that flag leaf is the most important site of photosynthesis for supplying carbon to grains. While some experiment revealed the negative correlation with flag leaf area (Ashan et al., 2014). Similar positive significant correlation was found with chlorophyll content taken by Spad meter. Similar result was found by Islam et al. (2014);Arminian et al. (2008); Yousufzai et al. (2009); Arminian et al. (2010); Limochi and Eskandari (2013); Abarshahr et al. (2011). It was further supported by

Blackmer and Schepers (1995); Maiti et al. (2004) and Boggs et al. (2003).

The correlation analysis indicated that grain yield has positive non-significant correlation with panicle length. Similar results were found in experiments conducted by kishore et al. (2015), Yadav et al. (2010), Panwar et al. (2007) and Abarshar et al. (2011). Similarly results also revealed that grain yield was positively significant correlated with flag leaf senescence. Report prepared by Bishwas, (1993) supported this result.

Days to maturity were found to be positively but non-significantly correlated with grain yield which was found to be supported by Wattoo et al. (2010). Grain yield per hectare was observed to be positively correlated with number of tillers per hill and fertility percentage that indicate that increase in these traits will result in increase in yield. Similar results were found in kishore et al. (2015). Number of tillers per plant was found to be positive and non-significantly correlated with grain yield. Similar result was found by Ashan et al. (2014); saif et al. (2002) et al. (2013); Borbora et al. (2005); Madhavilatha et al. (2005). Fertility% was found to be positively correlated with grain yield. Similar result was found by Cheema et al. (1998) and Kole et al. (2008). While Shanthi et al. (2011) and Gopikannan and Ganesh (2014) found positive significant correlation of fertility % on grain yield. From the experiment, plant height was found to have negative and non-significant correlation with grain yield. Similar result was found by Hairmansis et al. (2010), Amirthadevarathinam (1983), Abarshahr et al. (2011). But Bhadru et al. (2011); kalyan et al. (2017); Nayak et al. (2001) and Eidi kohnaki et al. (2013) found relation of plant height with grain yield contrast to this result.

CORRELATION AMONG TRAITS

The results revealed that days to 50% heading had highly significant positive association with flag leaf senescence (0.809**) and significant positive association with days to physiological maturity (0.580*), flag leaf area (0.674*), chlorophyll content (0.669*) and panicle length (0.601*) while it had non-significant positive correlation with no of tillers per plant (0.354), 1000 grain weight (0.282) and straw yield (t/ha) (0.516). Results also showed that days to 50% heading had non-significant negative correlation with plant height (-0.354) and fertility percentage (-0.206). The positive and significant correlation with panicle length and days to physiological maturity was also found by Kalyan et al., (2017), Meenakshi et al., (1999), Nagaraju et al., (2013).

From the result, it was shown that days to maturity had positive and significant correlation with panicle length and number of tillers. Positive correlation with panicle length was also found by Singh et al. (1984) and Lakshmi et al. (2014). From the results, it was found that flag leaf senescence had highly significant positive correlation with Days to physiological maturity (0.769**) and panicle length (0.735**). It had significant positive correlation with flag leaf area (0.678*), chlorophyll content (0.580*) and tillers per plant (0.642*). Flag leaf senescence had non-significant positive association with 1000 grain weight (0.312) while it had non-significant negative correlation with fertility percentage.

From the result it had been revealed that chlorophyll content had significant positive correlation with panicle length (0.704*), 1000 grain weight (0.617*) and straw yield (0.599*). It had non-significant positive correlation with days to physiological maturity (0.541), plant height (0.092), number of tillers per plant (0.444) and fertility percentage (0.349). Number of tillers per plant was found to have highly significant positive correlation with straw days to physiological maturity (0.719**). Number of tillers per plant was found to have non-significant positive correlation with flag leaf area (0.538), panicle length (0.475), 1000 grain weight (0.042) and fertility percentage (0.031) while it had very negligible non-significant negative correlation with plant height (-0.037).

Flag leaf area was found to be significant and positively correlated with panicle length (0.635*) and 1000 grain weight (0.582*). While it was found to have non-significant positively correlated with all other traits. From the results it has been clear that many of the traits were positively correlated with each other except for plant height which also had negative association with the grain yield. The correlation ranged from low to high degree of correlation.

Table 3: Estimates of direct and indirect effect of yield attributing traits on grain yield.

	HD	FLS	MD	FLA	SPAD	PH	PL	TP	TW	FP
HD	**-2.5537**	-2.066	-1.4812	-1.7212	-1.7084	0.08172	-1.5348	-0.904	-0.7202	0.52606
FLS	1.72791	**2.13586**	1.62325	1.44811	1.2388	-0.0684	1.56986	1.37122	0.66639	-0.2264
MD	0.09824	0.12873	**0.16939**	0.05556	0.09164	-0.0117	0.10654	0.12179	0.01423	-0.0342
FLA	0.46771	0.47049	0.22761	**0.69393**	0.51698	-0.0652	0.44065	0.37333	0.40387	0.15891
SPAD	0.31356	0.27185	0.25357	0.34918	**0.4687**	0.04312	0.32997	0.2081	0.28919	0.18373
PH	-0.0138	-0.0138	-0.0297	-0.0404	0.03954	**0.42978**	0.11905	-0.0159	0.00215	0.09627
PL	-0.5132	-0.6277	-0.5372	-0.5423	-0.6012	-0.2366	**-0.854**	-0.4056	-0.427	-0.1349
TP	-0.81	-1.4689	-1.6451	-1.231	-1.0159	0.08466	-1.0868	**-2.2881**	-0.0961	-0.0709
TW	0.3561	0.39398	0.10607	0.73492	0.77912	0.00631	0.63138	0.05304	**1.26276**	0.73871
FP	0.22367	0.11509	0.21933	-0.2487	-0.4256	-0.2432	-0.1716	-0.0337	-0.6352	**-1.0858**

From the correlation it can be known that those which are positively correlated with each other and also with grain yield are of equally economic traits to increase the yield of rice per hectare. It is hence indicated that grain yield is increased whenever there is increase in positively correlated traits (Minnie. et. al., 2012) while negative correlation with other traits as well as with grain yield is also of equal importance during improvement for yield per hectare of rice production. The negative correlation signifies that increase in one will results in decrease in another and hence it can play important role in selection for breeding.

PATH COEFFICIENT ANALYSIS

Path coefficient analysis given by Dewey and Lu (1959) provides a view into interrelationships by further separating the correlation coefficients into direct and indirect effects of characters.

From the path analysis (Table 3), it showed that flag leaf senescence had most high and direct effect (2.135861) on grain yield. It was followed by 1000 grain weight with second highest direct effect (1.262755) on grain yield which also had significant and positive correlation on grain yield. Reports prepared by Akhtar *et al.* (2011) and Ratna *et al.* (2015) also agreed this result. However Eidi kohnaki *et al.* (2013) revealed the contrast report to this study showing 1000 grain weight had negative direct effect on grain yield while Sudeepthi *et al.* (2017) found similar result for 1000 grain weight.

Flag leaf area with third highest and positive direct effect (0.69393) on grain yield. This direct and positive effect of flag leaf area was also found by Abarshahr et al. (2011).

Path coefficient analysis showed the positive and direct effect of plant height on yield but its genotypic correlation was negative and non-significant. This is due to its high negative effect through panicle length on grain yield. The positive direct effect of plant height on yield was also found by Eidi kohnaki et al. (2013), Bhadru et al. (2011) and Nayak et al. (2010). Contrary of this result was found by Akhtar et al. (2011) and Ratna et al. (2015). Results of path coefficient analysis showed negative and direct effect on grain yield which is contrast from result from its genotypic correlation where it had positive association with grain yield.

Days to heading was found to have negative direct effect on grain yield and positive effect through flag leaf senescence, flag leaf area, chlorophyll content, 1000 grain weight and fertility percentage that overall results its positive correlation with grain yield. These findings were in contrast to the reports made by Khedikar et al. (2004) and Karad and Pol (2008). Fertility percentage had negative direct effect on grain yield which is in contrast with its correlation analysis where it had positive association with grain yield. It was due to its effect through 1000 grain weight through which it had positive effect on grain yield.

Further results showed that negative direct effect of number of tillers per plant on grain yield. But its contrast result with positive correlation on grain yield was found. It was due to its high indirect and positive effect through flag leaf senescence on grain yield.

IV. CONCLUSION

From results it had been seen that flag leaf area, SPAD reading and 1000 grain weight had both positive correlation as well as positive direct effect on grain yield. Hence direct selection of these traits can be done in breeding programs of rice. Improvement in these traits will result in simultaneous improvement in grain yield.

REFERENCES

[1] M. Abarshahr, B. Rabiei & H.S. Lahigi "Genetic variability, correlation and path analysis in rice under optimum and stress irrigation regimes". *Notulae Scientia Biologicae*, *3*(4), 134, 2011.

[2] N. Akhtar, M. F. Nazir, A. Rabnawaz, T. Mahmood, M. E. Safdar, M. Asif, & A. Rehman, "Estimation of heritability, correlation and path coefficient analysis in fine grain rice (Oryza sativa L.)". *The Journal of Animal & Plant Sciences*, *21*(4), 660-664, 2011.

[3] M. G. Akinwale, G. Gregorio, F. Nwilene, B. O. Akinyele, S. A. Ogunbayo, & A.C. Odiyi, "Heritability and correlation coefficient analysis for yield and its components in rice (Oryza sativa L.)". *African Journal of Plant Science*, *5*(3), 207-212, (2011).

[4] A. Amirthadevarathinam, "Genetic variability, correlation and path analysis of yield components in upland rice". *Madras agricultural journal*, 1983.

[5] Balan, A. R. Muthiah, & S. N. M. R. Boopathi, "Genetic variability, character association and path co-efficient analysis in rainfed rice, under alkaline condition". *Madras Agricultural Journal*, *86*(1/3), 122-123, 1999.

[6] D. Bhadru, D. L. Reddy, & M. S. Ramesha, "Research Note Correlation and path coefficient analysis of yield and yield contributing traits in rice hybrids and their parental lines". *Electronic Journal of Plant Breeding*, *2*(1), 112-116, 2011.

[7] A. K. Biswas, & S. K. Mandal, "Senescence of Flag Leaf and Glume in Rice: Role of Grains during Source-Sink Modification by Physical and Chemical Means". *Journal of Agronomy and Crop Science*, *171*(1), 13-19, 1993.

[8] T. K. Borbora, G. N. Hazarika and A. K. Medhi "Correlation and path analysis for plant and panicle characters in rice (Oryza sativa)". Agr. Biotech., Jorhat., 30(20): 215-220, 2005.

[9] T. Buckley, "The control of stomata by water balance". New Phytologist, 168(2), 275-292, 2005.

[10] K. Chandra and A. K. DaS, "Correlation and Interaction of physiological parameters in rice under rainfed transplanted condition". J. *Crop Res., Assam Agric. Univ*, *19*, 251-254, 2005.

[11] A. A. Cheema, Y. Ali, M. A. Awan, & G. R. Tahir, "Path analysis of yield components of some mutants of Basmati rice". *Trop. Agric. Res. Ext*, *1*, 34-38, 1998.

[12] G. R. Das, T. Ahmed and H.C. Bhattacharjee, "Association between flag leaf and grain dimension in rice". J. Res. *Assam Agric. University*, 2: 96–98, 1998.

[13] D. Dewey, & K. Lu, "A Correlation and Path-Coefficient Analysis of Components of Crested Wheatgrass Seed Production. *Agronomy Journal*, 51(9), 515, 1959.

[14] M. Gopikannan & S. K. Ganesh, "Inter-relationship and path analysis in rice (Oryza sativa L.) under sodicity". *Indian Journal of Science and Technology*, *6*(9), 5223-5227, 2013.

[15] A. Hairmansis, B. Kustianto, Supartopo and Suwarno, "Correlation analysis of agronomic characters and grain yield of rice for tidal swamp areas". *Indonessian J. Agr. Sci*., 11(1): 11. doi:10.21082/ijas.v11n1.2010.p11-15, 2010.

[16] K. M. Iftekharuddaula, K. Akhtar, M. S. Hassan, K. Fatima and A. Badshah, "Character association and selection criteria in irrigated rice". *J. Biol. Sci*., 2(4): 243-246, 2002.

[17] Kalyan, K. V. Radha Krishna & L. V. Subba Rao, "Correlation coefficient analysis for yield and its components in rice (Oryza sativa L.) genotypes". Int. J. Curr. Microbiol. App. Sci, 6(7), 2425-2430, 2017.

[18] S. R. Karad & K. M. Pol, "Character association, genetic variability and path coefficient analysis in rice (Oryza sativa

L.)". *International Journal of Agricultural Sciences*, *4*(2), 663-666, 2008.

[19] V. P. Khedikar, A. A. Bharose, D. Sharma, Y. P. Khedikar, & A. S. Khillare, "Path coefficient analysis of yield components of scented rice". *J. Soils and Crops*, *14*(1), 198-201, 2004.

[20] T. Meenakshi, A. Amirthadevarathinam & S. Backiyarani, "Correlation and path analysis of yield and some physiological characters in rainfed rice". *Oryza*, *36*(2), 154-156, 1999.

[21] J. I. Wattoo, A. S. Khan, Z. Ali, M. Babar, M. Naeem, M. A. Ullah & N. Hussain, "Study of correlation among yield related traits and path coefficient analysis in rice (Oryza sativa L.)". *African Journal of Biotechnology*, *9*(46), 7853-7856, 2010.

[22] M. A. Zahid, M. Akhter, M. Sabar, Z. Manzoor, & T. Awan, "Correlation and path analysis studies of yield and economic traits in Basmati rice (Oryza sativa L.)". *Asian J. Plant Sci*, *5*(4), 643-645, 2006.

AUTHOR'S PROFILE

Nikee Shrestha
Undergraduate student
B.Sc. Agriculture
Institure of Agriculture and Animal Science,
Lamjung Campus, Nepal