Int.J.Curr.Microbiol.App.Sci (2020) *9*(9): 1304-1312

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 9 Number 9 (2020)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2020.909.160

Genetic Variability, Correlation and Path Coefficient Studies in F_3 Population of Rice (*Orzya sativa* L.)

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Keywords

Rice, Variability, Heritability, Genetic advance, Correlation, Path coefficient

Article Info

Accepted:
12 August 2020
Available Online:
10 September 2020

A B S T R A C T

The present investigation was carried out to determine genetic variability, correlation analysis and path coefficient analysis in 900 F_3 segregating progenies of the cross (Sahbhagidhan and BPT-5204 Sub-1). The population was raised at Rice research farm of department of Genetics and Plant Breeding, BAU, Ranchi during *kharif* 2018. The population exhibited high GCV and PCV for the traits *viz.* seed yield per plant, number of panicles per plant number of spikelets per plant, number of grains per plant, number of spikelets per panicle and number of grains per panicle. High heritability coupled with high genetic advance was observed for traits *viz.* plant height, number of tillers per plant, number of spikelets per panicle and number of grains per panicle. Seed yield per plant was found positively and significantly correlated with number of tillers per plant, number of panicles per plant, number of spikelets per plant, number of grains per plant, number of spikelets per panicle, number of grains per panicle, fertility percent, grain width and panicle length. Path coefficient analysis revealed that direct effect of number of spikelets per plant and number of grains per plant were high as well as positive and the indirect effect of all characters via these were positive except number of the traits *viz.* tillers per plant and number of grains per panicle for which the indirect effects on yield were negative.

Introduction

Rice (*Oryza sativa* L.), a member of poaceae family, is the major food crop of more than half of the global population and will continue to occupy the pivotal place in global food and livelihood security systems (Singh and Singh, 2008). In India rice accounts for more than 40% of food grain production. It is grown in 44.6 million hectare under 4 major ecosystems: irrigated (21 mha), rainfed lowland (14 mha), rainfed upland (6 mha) and flood – prone (3 mha) with average annual production of 96.4 million tons (NABARD, 2008). The improvement of character in a population is dependent on variability existing in the population. Improvement for specific trait has also been achieved through effective use of segregating population and fixing desirable combinations. Hence, formulation

of objectives in breeding programme should be essentially accompanied with assessment of existing variability. Therefore, the present investigation was undertaken to estimate the genetic variability parameters, namely, Genotypic Coefficient of Variability (GCV), Phenotypic Coefficient of Variability (PCV), heritability and genetic advance for different traits of economic importance in the segregating generations. It is a pre-requisite for any plant breeder to work with crop improvement programmes. Further, information on correlation co-efficient between grain yield and its component characters is essential for yield improvement, since grain yield in rice is a complex entity and is highly influenced by several component characters. Path coefficient analysis is simply a standardized partial regression coefficient which splits the correlation coefficient into the measures of direct and indirect effects. The relationship between yield and its main economic components, in segregating populations of rice, has been studied by several researchers (Kumar *et al.*, 2009; Surek and Beser, 2005; Yogameenakshi and Vivekanandan, 2010). The information on relative direct and indirect contribution of each component character toward yield will help breeders to formulate the effective criteria in selecting desirable genotypes in early segregating populations.

Materials and Methods

The material for present study consisted of 900 F_3 segregants of the cross (Sahbhagidhan and BPT-5204 Sub-1). The experiment was conducted at Rice research farm of department of Genetics and Plant Breeding, Birsa Agricultural University, Kanke, Ranchi during *kharif* 2018. Sahbhagidhan has phosphorus uptake and drought tolerance genes. However, BPT-5204 Sub-1 has submergence tolerance gene (Sub-1) and has an excellent grain cooking quality. Seedlings were transplanted to the main field at the rate of one to two seedlings per hill with a spacing of 20 × 15 cm. Normal agronomic practices were followed throughout the crop growth period to obtain a good harvest. Observations were recorded for fifteen quantitative traits viz. seed yield per plant, days to flowering, plant height, spikelets per plant, spikelets per panicle, grains per plant, grains per panicle, fertility percent, tillers per plant, number of panicle per plant, panicle length, grain length, grain width, L/B ratio and 100 seed weight. The phenotypic and genotypic coefficients of variation (PCV and GCV) were calculated using the formula given by Burton and De Vane (1953) and heritability and genetic advance by Johnson et al., (1955). The correlation coefficient was calculated as per Johnson *et al.*, (1955) and path coefficient analysis was carried out following the method of Dewey and Lu (1959).

Results and Discussion

Variability, heritability and genetic advance

The segregants exhibited high GCV for the traits *viz*. seed yield per plant, number of spikelets per plant, number of grains per plant, number of spikelets per panicle, number of grains per panicle and number of panicles per plant. However, plant height, number of tillers per plant and number of panicles per plant displayed moderate GCV. Furthermore, high PCV was recorded for the traits *viz*. seed yield per plant, number of tillers per plant, number of panicles per plant, number of spikelets per plant, number of grains per plant, number of spikelets per panicle and number of grains per panicle. Whereas, moderate PCV was reported for plant height and fertility %. This has been depicted in (Table-1) and (Figure-1).

Table.1 Estimates of statistical and genetical parameters of different characters for F_3 generation of rice (*O. sativa* L.)

Parameters	Range	AV	GCV (%)	PCV (%)	h^2 (%)	GA	GA%
Seed yield per plant (g) (SYP)	1.2-97.2	32.3	29.9	45.4	43.5	1,317.8	40.7
Days to flowering (days) (DTF)	80.0-96.0	91.0	2.0	2.7	58.6	300.8	3.2
Plant height (cm) (PHT)	61.0-150.0	101.1	14.2	15.7	82.9	2,712.3	26.8
Number of tillers/plant (TLN)	5.0-27.0	14.0	18.5	22.5	68.2	445.5	31.6
Number of panicles/ plant (PLN)	2.0-26.0	12.0	16.9	31.1	29.7	229.7	19.1
Number of spikelets/plant (SPP)	2.0-5285.0	1611.0	32.2	46.2	48.5	74508.7	46.2
Number of grains/plant (GPP)	1.0-4420.0	1288.0	34.1	51.3	44.3	60371.6	46.8
No. of spikelets/panicle (SPL)	1.0-571.0	137.0	36.5	41.2	78.6	9136.6	66.7
Number of grains/panicle (GPL)	1.0-450.0	109.0	39.1	45.9	72.5	7450.3	68.6
Fertility percent (%) (FER)	19.2-96.7	77.7	6.6	14.0	22.2	501.2	6.4
Panicle length (cm) (PLL)	15.0-32.5	25.8	1.4	7.5	3.8	15.5	0.6
Grain length (mm) (GRL)	7.0-10.0	8.0	2.2	4.4	26.8	19.8	2.4
Grain width (mm) (GRW)	2.0-3.0	2.6	5.8	8.0	52.7	23.4	8.7
L/B ratio (LBR)	2.4-4.2	3.0	7.1	9.2	59.2	34.2	11.2
100 Seed weight (g) (SWT)	1.1-2.6	2.0	4.8	9.7	24.6	9.9	4.9

MIN- Minimum, MAX- Maximum, AV- Average, GCV(%)- Genotypic coefficient of variation, PCV(%)- Phenotypic Coefficient of Variation, h^2 (%)-heritability, GA- Genetic Advance, GA% - Genetic Advance as percent of mean

Figure.1 Graphical representation of genetical parameters of different characters for F_3 generation of rice

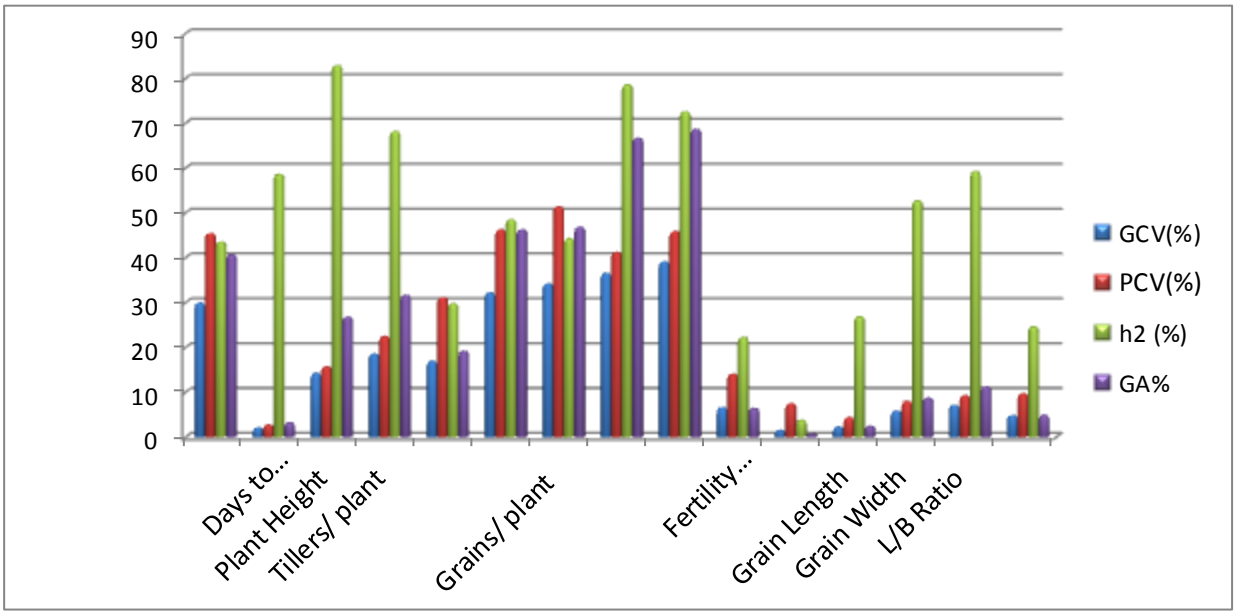

Table.2 Genotypic and Phenotypic correlation between different pairs of characters in F_3 segregants of rice (*O. sativa* L.)

		DTF	PHT	TLN	PLN	SPP	GPP	SPL	GPL	FER	PLL	GRL	GRW	LBR	SWT
SYP	**G**	-0.012	0.033	0.325	0.108	0.897	0.983	0.892	0.825	0.298	0.186	0.153	0.057	0.406	0.105
	P	-0.003	0.043	0.510**	0.595**	0.968**	0.951**	0.617**	0.658**	0.445**	0.137**	0.031	0.066*	-0.045	0.050
DTF	**G**	1	0.898	0.153	0.433	-0.038	0.323	-0.598	-0.102	0.024	0.059	0.036	0.006	-0.025	0.017
	P		-0.108**	0.049	0.080*	-0.011	0.000	-0.063	-0.041	0.049	-0.072*	-0.050	-0.025	-0.002	0.014
PHT	**G**		1	-0.054	-0.093	0.054	-0.008	0.113	0.046	-0.470	0.042	-0.441	-1.633	0.267	-0.141
	P			-0.034	-0.021	0.038	0.009	0.065	0.034	-0.136**	0.336**	0.072*	-0.039	0.075*	0.020
TLN	**G**			1	0.264	0.749	-0.029	-0.145	-0.023	0.175	-0.016	-0.025	-0.017	0.042	0.032
	P				0.830**	0.489**	0.466**	-0.101**	-0.047	0.185**	0.068*	0.052	-0.047	0.069**	0.048
PLN	**G**				1	0.094	0.028	-0.349	-0.445	-0.598	-0.059	0.474	-0.043	0.042	0.601
	P					0.567**	0.550**	-0.147**	-0.068*	0.229**	0.093**	0.070*	-0.070*	0.099**	0.043
SPP	**G**					1	0.754	0.829	0.771	0.281	-0.850	0.413	-0.046	0.205	0.122
	P						0.977**	0.670**	0.705**	0.443**	0.127**	-0.004	0.071*	-0.068*	-0.138**
GPP	**G**						1	0.853	0.808	0.415	-0.954	0.282	0.026	0.343	0.116
	P							0.658**	0.738**	0.579**	0.117**	-0.003	0.073*	-0.069*	-0.126**
SPL	**G**							1	0.913	0.510	0.242	0.415	0.216	-0.422	0.021
	P								0.967**	0.334**	0.088**	-0.041	0.124**	-0.138**	-0.190**
GPL	**G**								1	0.428	-0.008	0.224	-0.000	-0.322	0.021
	P									0.527**	0.085*	-0.034	0.123**	-0.133**	-0.176**
FER	**G**									1	0.025	-0.793	0.162	0.384	0.178
	P										-0.010	0.006	0.026	-0.021	-0.023
PLL	**G**										1	0.015	-0.037	0.042	0.016
	P											0.012	-0.049	0.046	0.019
GRL	**G**											1	0.053	0.376	0.153
	P												0.040	0.459	0.162**
GRW	**G**												1	0.574	-0.042
	P													-0.861**	-0.031
LBR	**G**													1	0.144
	P														0.117**

*,** significant at 5% and 1 % level of probability ,respectively

Table.3 Partitioning of correlation into direct and indirect effects by path analysis in F_3 segregants of rice (*O. sativa* L.) for seed yield per plant

	Correlation (Seed yield/plant) (SY)	Number of tillers /plant	Number of panicles /plant	Number spikelets plant	Number grains/ plant	Number spikele panicl	Number of grains/ panicle	Fertility percent (%)	Panicle length (cm)	Grain width (mm)
Number of tillers /plant	0.51	**-0.002**	0.082	0.299	0.139	-0.026	0.012	0.004	0.001	-0.000
Number of panicles /plant	0.595	-0.002	**0.099**	0.346	0.165	-0.038	0.017	0.005	0.001	-0.001
Number of spikelets / plant	0.968	-0.001	0.056	**0.611**	0.293	0.174	-0.179	0.011	0.001	0.001
Number of grains/plant	0.951	-0.001	0.054	0.597	**0.299**	0.171	-0.188	0.014	0.001	0.001
Number of spikelets/ panicle	0.617	0.000	-0.014	0.409	0.197	**0.260**	-0.246	0.008	0.001	0.001
Number of grains/ panicle	0.658	0.000	-0.006	0.431	0.221	0.251	**-0.255**	0.013	0.001	0.001
Fertility percent (%)	0.445	-0.001	0.022	0.270	0.173	0.087	-0.134	**0.025**	-0.000	0.000
Panicle length (cm)	0.137	-0.000	0.009	0.077	0.035	0.022	-0.021	-0.000	**0.014**	-0.000
Grain width (mm)	0.066	0.000	-0.007	0.043	0.021	0.032	-0.031	0.001	-0.001	**0.006**

Note: Bold and diagonal figures indicate the direct effect, Residual effect: 0.110

In both F_2 and F_3 generation**,** PCV of all the traits were higher than GCV indicating additive effect of environment on the expression of these traits. Similar findings were reported previously by Praveen *et al.,* (2010), Chakraborty *et al.,* (2010), Gala *et al.,* (2016) and Swapnil *et al.,* (2020). It was noted that in F_3 generation GCV and PCV values increased in comparison to F_2 generation which might be due to breakage of linkage between genes with the advancement of generation. These F_3 segregants displayed high heritability coupled with high genetic advance for traits *viz.* plant height, number of tillers per plant, number of spikelets per panicle and number of grains per panicle. However, number of spikelets per plant, number of grains per plant and seed yield per plant displayed high genetic advance coupled with moderate heritability. Similar findings were reported by Dutta *et al.,* (2013), Tuhina *et al.,* (2015) and Lingaiah *et al.,* (2015).

Correlation analysis

Correlation studies among the agronomic traits revealed that seed yield per plant was found positively and significantly correlated with traits *viz.* number of tillers per plant (0.510), number of panicles per plant (0.595), number of spikelets per plant (0.968), number of grains per plant (0.951), number of spikelets per panicle (0.617), number of grains per panicle (0.658), fertility % (0.445), panicle length (0.317) and grain width (0.066). This has been presented in (Table-2). This is in agreement with Agahi *et al.,* (2007), Lakshmi *et al.,* (2014), Hossain *et al.,* (2015), Konate *et al.,* (2016), Janakbhai *et al.,* (2017), Swapnil *et al.,* (2018), Oladosu *et al.,* (2018), Welalaw *et al.,* (2018), Kumar *et al.,* (2018) and Singh *et al.,* (2020). Positive and significant correlation of days to flowering was observed with number of panicles per plant (0.080). However, days to flowering revealed significant but negative correlation with two of the traits *viz*. plant height (-0.108) and panicle length (-0.072). Plant height exhibited positive and significant correlation with panicle length (0.336), grain length (0.072) and L/B ratio (0.075). However, it was found negatively but significantly correlated with fertility% (-0.136). Number of tillers per plant was found positively and significantly correlated with traits *viz.* number of panicles per plant (0.830), number of spikelets per plant (0.489), number of grains per plant (0.466), fertility % (0.185), panicle length (0.068) and L/B ratio (0.069). Number of panicles per plant exhibited positive and significant correlation with number of spikelets per plant (0.567), number of grains per plant (0.550), fertility % (0.229), panicle length (0.093), grain length (0.070) and L/B ratio (0.099). However, negative correlation was observed with number of spikelets per panicle (-0.147), number of grains per panicle (-0.068) and grain width (-0.070 but the magnitude of correlation with number of grains per panicle and grain width was very low. Number of spikelets per plant exhibited positive and significant association with number of grains per plant (0.977), number of grains per panicle (0.705), number of spikelets per panicle (0.670), fertility % (0.443), panicle length (0.127) and grain width (0.071). Furthermore, number of grains per plant displayed positive and significant association with number of spikelets per panicle (0.658), number of grains per panicle (0.738), fertility % (0.579), panicle length (0.117) and grain width (0.073). Positive and significant correlation of spikelets per panicle was observed with the traits *viz.* number of grains per panicle (0.967), fertility % (0.334), panicle length (0.088) and grain width (0.124). However, it was found negatively but significantly correlated with 100 seed weight (-0.190) and L/B ratio (-0.138). Number of grains per panicle was found positively and significantly correlated with fertility percent (0.527), panicle length (0.085) and grain

width (0.123). However, it was negatively but significantly correlated with 100 seed weight (-0.176) and L/B ratio (-0.133). Grain length was also found positively and significantly correlated with 100 seed weight (0.162) and L/B ratio (0.459). However, grain width was found negatively and significantly correlated with L/B (0.861) ratio only. Additionally, L/B ratio exhibited positive and significant correlation with 100 seed weight (0.117). Selection based on these traits may be rewarding and thus, leads to higher yield.

Path coefficient analysis

Using path analysis, direct and indirect effect were worked out to find out the clear idea of inter relationship between yield and yield contributing characters. The results of path analysis revealed that direct effect of number of spikelets per plant (0.611) and number of grains per plant (0.299) were high as well as positive and the indirect effect of all characters via these were positive except number of the traits *viz.* tillers per plant and number of grains per panicle for which the indirect effects on yield were negative. This has been depicted in (Table-3). The direct effect of number of spikelets per panicle (0.260) was positive as well as the indirect effect of all characters via spikelets per panicle was positive except number of panicles per plant and number of grains per panicle for which the indirect effects were negative. Moreover, direct effect of number of grains per panicle (-0.255) was negative and indirect effect of all characters through this was positive except number of panicles per plant for which the indirect effects was negative. Likewise, direct effect of number of grains per panicle was negative and indirect effect of all characters through this was positive except number of panicles per plant for which the indirect effects was negative. The direct effects of other characters were very low and hence, are not given due consideration.

In conclusion, the population exhibited high GCV and PCV for the traits *viz*. seed yield per plant, number of panicles per plant number of spikelets per plant, number of grains per plant, number of spikelets per panicle and number of grains per panicle. The PCV of all the characters were higher than genotypic coefficient of variation indicating additive effect of environment on the expression of these traits. In F_3 generation GCV and PCV values increased in comparison to F_2 generation which might be due to breakage of linkage between genes with advancement of generation. The population displayed high heritability coupled with high genetic advance as percent of mean for plant height, number of tillers per plant, number of spikelets per panicle, number of grains per panicle indicating preponderance of additive gene action and thus, selection may be effective for these traits. Seed yield per plant was found positively and significantly correlated with number of tillers per plant, number of panicles per plant, number of spikelets per plant, number of grains per plant, number of spikelets per panicle, number of grains per panicle, fertility percent, grain width and panicle length. By improving these traits in desirable direction yield of the plant can be improved. Path coefficient study reveled that if the correlation between grain yield per plant and its contributing traits is due to direct effect of traits, it describes true relationship between them and direct selection for this trait will be rewarding for grain yield improvement.

References

Agahi, K, Fotokian, M.H., and Farshadfar, E. (2007). Correlation and path coefficient analysis of yield-related traits in rice genotypes (*Oryza sativa* L.). *Asian Journal of Plant Sciences*; 6(3): 513-517.

Burton, G.W. and Vane, D. (1953). Estimating heritability in tall Fescue

(*Festuca arundinaceae*) from replicated clonal-material. *Agron. J.* 51: 515-518.

Chakraborty, R. and Chakraborty, S. (2010). Genetic variability and correlation of some morphometric traits with grain yield in bold grained rice (*Oryza sativa* L.) gene pool of Barak valley. *American Eurasian Journal of Sustainable Agriculture.* 4(1): 26-29.

Dewey, D.R. and Lu, K.H. (1959). A correlation and path-coefficient analysis of components of crested wheatgrass seed production. *Agron J.* 51:515-518.

Dutta, P., Dutta, P.N. and Borua, P.K. (2013). Morpholopical traits as selection indices in rice. A Statistical View *Universal Journal of Agricultural Research*, 1(3): 85-96. *Environment and Ecology* 2013; 27(4A): 1710-1719.

Gala, A., Ayman, Sabagh, E.L., Abdelfatah, Ghareb, Ibrahim and Rewainy, E.L. (2016). Evaluation of promising lines in rice (*Oryza sativa* L.) to agronomic and genetic performance under Egyptian conditions. *Int. J, Agri.* 8(3): 52-57.

Hossain, S., Haque, M. and Rahman, J. (2015). Genetic Variability, Correlation and Path Coefficient Analysis of Morphological Traits in some Extinct Local Aman Rice (*Oryza sativa* L). *Rice Research*. 4(1): 1-6.

Janakbhai, R.A.K. (2017). General variability, correlation, path analysis and D^2 statistics in rice (*Oryza sativa* L.). Msc. (Ag) Thesis, Department of Genetics and Plant Breeding, Navsari Agricultural University, Navsari.

Johnson, H.W., Robinson, H.I. and Comstock, R.E. (1955). Estimation of genetic and environmental variability in soybean. *Agron. J*. 47: 314-318.

Konate, A.K., Zongo, A., Kam, H., Sanni, A. and Audebert, A. (2016). Genetic variability and correlation analysis of rice (*Oryza sativa* L.) inbred lines based on agro-morphological traits. African Journal of Agricultural Research. 11(35): 3340-3346.

Kumar, M., Sharma, P.R., Krakash, N. and Singh, P.K. (2009). Selection criteria for high yielding genotypes in early generation of rice. SAARC J Agri. 7: 37-42.

Kumar, S., Chauhan, M.P., Tomar, A., Kasana, R.K. and Kumar, N. (2018). Correlation and path coefficient analysis in rice (*Oryza sativa* L.). The Pharma Innovation Journal. 7(6): 20-26.

Lakshmi, M.V., Suneetha, Y., Yugandhar, G. and Lakshmi, N.V. (2014). Correlation studies in rice (*Oryza sativa* L.). *International Journal of Genetic Engineering and Biotechnolog*. 5(2): 121-126.

Lingaiah, N. (2015). Genetic variability, heritability and genetic advance in rice (*Oryza sativa* L.). *Asian Journal of Environmental Science.* 10(1): 110-112.

NABARD, (2008). Annual report, 2007-08. India

Oladosu, Y., Rafii, M.Y., Magaji, U., Abdullah, N., Miah, G., Chukwu, S.C., Hussin, G., Ramli, A. and Kareem, I. (2018). Genotypic and Phenotypic Relationship among Yield Components in Rice under Tropical Conditions. BioMed Research International. 8936767, 1-10.

Praveen and Anurag, P.J. (2010). Estimation of genetic parameters in indigenous rice. *AAB Bioflux.* 2(1): 79-84.

Singh, A.K. and Singh, N. (2008) Studies on genetic variability and heritability in balsam (*Impaties balsamina*). *J. Ornamental Horticulture*. 10, 128-30.

Singh, D., Kumar, A., Kumar, R., Kushwaha,

N., Mohanty, T.A. and Kumari, P. (2020). Genetic Variability Analysis of QPM (*Zea mays* L.) inbreds using morphological characters. *Int.J.Curr.Microbiol.App.Sci.* 9(02): 328-338.

Surek, H. and Beser, N. (2005). Selection for grain yield and its components in early generation in rice (*Oryza sativa* L.). Trakia Univ J Sci. 6:51-58.

Swapnil, Prasad, K., Chakraborty, M., Singh, D.N., Ekka, J.P. and Kumari, P. (2020). Genetic variability, correlation and path coefficient studies in F_2 generation of rice (*Orzya sativa* L.). *International Journal of Chemical Studies* 2020; 8(4): 3116-3120.

Swapnil, Prasad, K., Sinha, A., Kumari, P., Ekka, J.P. and Kumar, A. (2018). Correlation and path coefficient analysis in rice (*Oryza sativa* L.). *Journal of Pharmacognosy and Phytochemistry*. SP4: 380-383

Tuhina, K.M., Hanafi, M.M., Rafii, Yusop, M., Wong, M.Y., Salleh, F.M. and Ferdous, J. (2015). Genetic variation, heritability and diversity analysis of upland rice (*Oryza sativa* L.) genotypes based on quantitative traits. *Biomed Res. Int.* 290861.

Welelaw, A.T. (2018). Genetic variability, correlation and path coefficient analysis of upland rice (*Oryza sativa* L.) genotypes in Benishangul Gumuz, Ethiopia. M.Sc.(Ag) Thesis, Haramaya University.

Yogameenakshi, P. and Vivekanandan, P. (2010). Association analysis in F_1 and F_2 generations of rice under reproductive stage drought stress. Electronic Journal of Plant Breeding. 1(4):890-898.

How to cite this article:

Swapnil, Krishna Prasad, Manigopa Chakraborty, D.N. Singh, Jenny Priya Ekka and Priyanka Kumari. 2020. Genetic Variability, Correlation and Path Coefficient Studies in F_3 Population of Rice (*Orzya sativa* L.). *Int.J.Curr.Microbiol.App.Sci.* 9(09): 1304-1312.
doi: https://doi.org/10.20546/ijcmas.2020.909.160