ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 9, Issue, 06, pp.52926-52931, June, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

STUDIES OF CORRELATION AND PATH ANALYSIS OF GRAIN YIELD WITH YIELD CONTRIBUTING CHARACTERS, GRAIN QUALITY CHARACTERS AND IRON CHLOROSIS IN AEROBIC RICE (*ORYZA SATIVA* L.) ON VERTISOLS

***,[1]Rajeev Dhakal, [2]Deosarker, D. B. and [3]Paudel, D. P.**

[1]Local initiatives for Biodiversity, Research and Development
[2]Vasantarao Naik Marathwada Krishi Vidhyapeeth
[3]United Mission to Nepal

ARTICLE INFO

Article History:
Received 03rd March, 2017
Received in revised form
12th April, 2017
Accepted 26th May, 2017
Published online 30th June, 2017

Key words:

Correlation,
Iron chlorosis,
Path analysis,
Rice.

ABSTRACT

The field trial was carried out at the VNMKV, Parbhani, to study the correlation of 13 yield contributing characters and nine grain quality characters with grain yield of aerobic rice genotypes on Vertisols. The experimental materials consist of 50 rice genotypes including three checks and allocated in randomized complete block design in three replications. Correlation analysis of yield contributing characters shows that all the characters under study were significantly and positively correlated with grain yield per plant except, days to 50% flowering, days to maturity and iron chlorosis reaction at both genotypic and phenotypic levels. Whereas, among grain quality characters elongation ratio was found to be positively correlated with grain yield per plant however volume expansion, protein content and amylose content were negatively correlated. Path analysis studies among yield contributing characters indicated that number of effective tillers per planthad maximum positive direct effect followed by number of grains per panicle and 1000 grain weight on grain yield per plant.Almost all the yield contributing characters exerted negative indirect effect on grain yield per plant via iron chlorosis reaction. The grain quality characters elongation ratio, L:B ratio and relative density exerted highest positive direct effect on grain yield per plant, whereas direct effect of elongation index was negative.

Citation: Rajeev Dhakal, Deosarker, D. B. and Paudel, D. P. 2017. "Studies of correlation and path analysis of grain yield with yield contributing characters, grain quality characters and iron Chlorosis in aerobic rice (*Oryza sativa* L.) on Vertisols", *International Journal of Current Research*, 9, (06), 52926-52931.

INTRODUCTION

Rice belongs to genus *Oryza,* of the family *Gramineae,* and is widely cultivated crop (FAO, 2000; Syed and Khaliq, 2008). Genus *Oryza*contains approximately 23 species, of which 21 are wild type and two; *O. sativa* and *O. glaberrima,* are cultivated worldwide (Vaughan, 2003). Rice is grown over an area of163.46 million hectare with production of 718.35 million tonnes and productivity of 4390 kg/ha in the world. In India, rice is cultivated on an area of 43.97 million hectare with production of 104.3 million tones and productivity of 2372 kg/ha. Marathwada region of Maharashtra State, is the non-traditional rice growing area with the average productivity of rice crop is lowest i.e. 0.59 t/ha and area under rice production is 0.122 lakh hectare with production of 0.072 lakh tones (Anonymous, 2014).

******Corresponding author:* **Rajeev Dhakal,**
Local initiatives for Biodiversity, Research and Development

Calcareous and alkaline soils of Bihar, heavy clay soil of Maharashtra, Karnataka and Andra Pradesh, alkaline soils in Indo-Gangetic alluvial of Uttar Pradesh and Bihar, and manganese rich soils of coastal Karnataka suffers from iron chlorosisin India (Hoan *et al*., 1992). The old tall varieties of rice grown in Marathwada region were tolerant to iron chlorosis but in quality parameters they doesn't satisfies requirements of consumers like long slender grains and grain quality of basmati type like scent, intermediate amylose content, absence of white belly and soft in cooking. Efforts were made to develop high yielding semi-dwarf rice varieties rice with better cooking quality suitable for black cotton soils and series of varieties were evolved like Prabhavati, Sugandha, Parag and Avishkar at Department of Genetics and Plant Breeding and Upland Paddy Research Scheme of VNMKV, Parbhani. Hence, this investigation was carried out to study correlation and path analysis of different yield contributing and grain quality traits along with the reaction of genotypes to iron chlorosis.

MATERIALS AND METHODS

The experimental materials consists of 50 rice genotypes including 3 checks viz., Basmati-370, Parag and Avishkar, collected from Upland Paddy Research Scheme, VNMKV, Parbhani (Table 1). The experiment was carried out at research field of Department of Agricultural Botany, VNMKV, Parbhani in randomized block design with three replication in *kharif* season of year 2013. The plot size assigned to each genotype was 0.9 x 3 m^2 with distance of 30 cm between the rows. For the observation of data, five randomly selected plants from each of the genotypes in all replications recorded. Observation were recorded on yield contributing characters viz., plant height, days to 50% flowering, days to maturity, number of effective tillers per plant, effective tillers per meter length, number of grains per panicle, total number of filled grains per panicle, flag leaf area, 1000 grain weight, grain yield per plant and yield per plot and average values were carried out. The flag leaf area was computed by multiplying product of length and breadth by leaf area constant 0.818 (Jadhav*et. al.,* 2001). The grains of all genotypes were used for the observation of grain quality characters viz., L:B ratio, relative density, water absorption , gel consistency, volume expansion, amylose content, crude protein content, kernel elongation ratio and kernel elongation index. Elongation ratio was computed as length of cooked kernel to length of uncooked kernel and elongation index was computed by the ratio of length: breadth ratio of cooked rice to length: breadth of milled rice as described by Parikh *et al.,* (2012). Crude protein was estimated by Micro-kjeldhal method (A.O.A.C., 1965) and gel consistency was observed by method described by Cagampang*et al.,* (1973). Amylose content was estimated by method described by Juliano (1971).

Table 1. List of genotypes

S. No.	Genotypes	S. No.	Genotypes
1.	NDR 1143	2.	CR 3693-1-1
3.	OR 2172-7-1	4.	CR 3635-1-1
5.	RP 5214-18-6-2-1-1-1-B	6.	PBNR-03-10
7.	GK 5022	8.	Rewa 1207-15
9.	PBNR- 04-28	10.	CR 3632-1-2
11.	CRR 599-4-1	12.	CR 2991-1-2-1-1-1
13.	R 2212-RF-75	14.	CRR 452-23-1-1-1-1
15.	CRR 596-8-1	16.	CR 3692-1-1
17.	CB 09 516	18.	TJP 148
19.	CB 10-504	20.	OR 1946-2-1
21.	MAS 946 (RC 2)	22.	RP Bio 4918-166-9
23.	CR 3695-1-1	24.	BAU 408-05
25.	CR 3634-1-3	26.	CR 3690-1-1
27.	CR 3630-1-3	28.	CRR 617-B-47-3
29.	CR 3633-1-3	30.	PBNR- 03 -07
31.	R-RF-48	32.	MAULS-15
33.	PBNR - 08 – 07	34.	CRR 635-3-2
35.	BAU 389-02	36.	CR 3616-2-1-2-1-1
37.	PAU 3832 - 79-4-3-1	38.	RP 5216-13-7-2-1-1-1
39.	R 1700-2240-4-2295-1	40.	CRR 499-11-2-12-1
41.	UPRI 2012-16	42.	Tulasi
43.	CRR 614-4-1	44.	PBNR – 08 – 04
45.	RP 5125-17-6-3-2-1	46.	CRR 451-15-B-A1
47.	PBNR- 03 – 20	48.	Basmati 370 (check)
49.	Parag (check)	50.	Avishkar (check)

For recording observations on iron chlorosis, 1 to 9 scale adopted by Singh and Singh (1984) was utilized with modification i.e., taking the 1, 3, 5, 7and 9 grades as 0, 1, 2, 3 and 4 respectively. The individual plants were scored on the basis of visual symptoms observed on leaves. The correlations of different yield contributing and grain quality characters with grain yield were worked out according to Johnson *et al.,* (1955). Path coefficient analysis was carried out according to Dewy and Lu (1959).

RESULTS AND DISCUSSION

Correlations

Positive and significant correlation was found between yield per plant and plant height, panicle length, number of effective tillers per plant, number of effective tillers per meter length, flag leaf area, number of filled grains per panicle, 1000 grain weight, straw yield per plot and grain yield per plot (Table 2). Similar findings were reported by Khan *et al.,* (2009) who reported significant and positive correlation of grain yield per plant with plant height, flag leaf area, number of grains per panicle and panicle length; Watoo *et al*., (2010) with plant height, number of grains per panicle and flag leaf area; Sadeghi (2011) with plant height, number of effective tillers per meter, panicle length, grains per panicle and 1000 grains weight; Bhadru *et al.,* (2012) with panicle length and number of effective tillers, and Huang *et al.,* (2013) with filled grains per plant, grains per panicle and 1000 grain weight. Shet *et al.,* (2012) also reported positive and significant correlation of grain yield per plant with number of productive tillers, panicle length, number of filled grains per panicle, straw yield and 1000 seed weight. Grain yield per plant was negatively and significantly correlated with days to 50% flowering, iron chlorosis reaction and days to maturity. Shet *et al.,* (2012) reported significant negative correlation of grain yield with days to 50% flowering. Similarly, Deosarkar (1989) reported that the correlation between grain yield per plant and iron chlorosis reaction was significant and negative, while he suggested negative correlation of grain yield per plant with days to maturity. The protein content was negatively correlated with yield per plant. Similar findings were also reported by Nayak (2007) and Shejul (2012).

Water absorption, gel consistency and protein content had recorded negative association with grain yield per plant. Similar findings were reported by Deosarkar (1985). While, elongation ratio was found to have significant and positive correlation with grain yield per plant. Volume expansion and water absorption had positive and significant correlation with each other while, water absorption was negatively and significantly correlated with relative density, which is accordance with result of Deosarkar (1989). Elongation ratio had significant and positive correlation with water absorption and negative significant correlation with amylose content, which is in line with Juliano and Pascual (1980) and Chauhan *et al.,* (1995). In present investigation L:B ratio showed positive and significant correlation with relative density whereas, significant negative correlation was observed with protein content (Table 3). Similar result was also reported by Shejul (2012).

Path analysis

In the present study, path coefficient analysis revealed that number of effective tillers per plant, number of grains per panicle and 1000 grain weight had maximum direct effect on grain yield per plant (Table 4). Similar results were also reported by Zia *et al.,* (2005), Kishor *et al*., (2007) and Watoo *et al*., (2010). Sadeghi *et al.,* (2011) reported similar findings for 1000 grain weight and grains per panicle.

Table 2. Genotypic and phenotypic correlation of yield contributing characterswith grain yield

Characters	PH	PL	ICR	DF	DM	TP	TM	FLA	FGP	UGP	TW	SYP	GYP	GYPL
PH	1	0.493**	-0.566**	-0.707**	-0.729**	0.540**	0.533**	0.462**	0.396**	-0.077	0.489**	0.538**	0.423**	0.628**
		0.281**	-0.481**	-0.455**	-0.392**	0.470**	0.463**	0.399**	0.347**	-0.060	0.414**	0.461**	0.396**	0.541**
PL		1	-0.261**	-0.107	-0.002	0.411**	0.396**	0.405**	0.119	-0.064	0.471**	0.448**	0.182*	0.475**
			-0.153	-0.043	-0.072	0.249**	0.219**	0.302**	0.084	-0.036	0.278**	0.297**	0.078	0.287**
ICR			1	0.775**	0.754**	-0.672**	-0.812**	-0.423**	-0.595**	0.208*	-0.538**	-0.772**	-0.615**	-0.791**
				0.504**	0.453**	-0.643**	-0.772**	-0.402**	-0.537**	0.202*	-0.507**	-0.742**	-0.553**	-0.754**
DF				1	0.802**	-0.488**	-0.585**	-0.137	-0.430**	0.425**	-0.667**	-0.419**	-0.534**	-0.661**
					0.726**	-0.294**	-0.408**	-0.083	-0.320**	0.274**	-0.422**	-0.288**	-0.343**	-0.436**
DM					1	-0.494**	-0.574**	-0.062	-0.373**	0.437**	-0.682**	-0.381**	-0.651**	-0.629**
						-0.273**	-0.339**	-0.039	-0.239**	0.292**	-0.359**	-0.251**	-0.345**	-0.357**
TP						1	0.919**	0.491**	0.403**	-0.104	0.320**	0.611**	0.386**	0.829**
							0.851**	0.438**	0.365**	-0.091	0.279**	0.561**	0.330**	0.814**
TM							1	0.549**	0.501**	-0.114	0.393**	0.811**	0.473**	0.859**
								0.500*	0.454**	-0.100	0.355**	0.770**	0.438**	0.806**
FLA								1	0.356**	0.035	0.269**	0.568**	0.247**	0.576**
									0.311**	0.011	0.249**	0.511**	0.179*	0.520**
FGP									1	-0.056	0.340**	0.494**	0.509**	0.710**
										-0.110	0.285**	0.469**	0.466**	0.695**
UGP										1	-0.467**	-0.093	-0.326**	-0.260**
											-0.425**	-0.097	-0.294**	-0.255**
TW											1	0.453**	0.549**	0.672**
												0.422**	0.479**	0.625**
SYP												1	0.607**	0.726**
													0.589**	0.687**
GYP													1	0.600**
														0.542**
GYPP														1

*-significant at 5% and **-significant at 1% level. Figures in bold indicates genotypic correlation and normal indicates phenotypic correlation. **PH**- Plant height, **PL**- Panicle length, **ICR**- Iron chlorosis reaction, **DF**- Days to 50% flowering, **DM**- Days to maturity, **TP**- No. of effective tillers per plant, **TM**- No. of effective tillers per meter length, **FLA**- Flag leaf area, **FGP**- No. of filled grains per panicle, **UGP**- No. of unfilled grains per panicle, **TW**- Test weight, **SYP**- Straw yield per plot, **GYP**- Grain yield per plot and **GYPP**- Grain yield per plant.

Table 3. Genotypic and phenotypic correlation of grain quality parameters with grain yield

Characters	Elongation ratio	Elongation index	L/B ratio	Volume expansion	Water absorption	Protein content	Relative density	Gel consistency	Amylose content	Grain yield per plant
Elongation	1	0.5140**	0.4693**	0.0704	0.1407	- 0.3833**	- 0.0421	- 0.1950*	- 0.1928*	0.3417**
ratio		0.5466**	0.4799**	0.0960	0.0988	-0.3464**	-0.0683	-0.1616*	-0.1498	0.2996**
Elongation		1	0.1664*	0.1639*	0.1213	0.1846*	0.0284	-0.1785*	0.0638	-0.2180**
index			0.2414**	0.1682*	0.0332	-0.0016	-0.0558	-0.0885	0.0394	-0.1393
L/B ratio			1	0.2089**	-0.0225	-0.2797**	0.2451**	-0.1531	-0.1396	0.1592
				0.2136**	-0.0222	-0.2607**	0.2093*	-0.1398	-0.1241	0.1507
Volume expansion				1	0.4891**	0.0850	0.5984**	-0.1079	-0.0172	-0.2782**
					0.4579**	0.0545	0.5509**	-0.0957	-0.0130	-0.2727**

Continue……..

Water absorption	1	-0.0971	-0.2242**	0.0533	0.1073	-0.2094*
		-0.0775	-0.2148**	0.0402	0.1.44	-0.1946*
Protein		1	0.1339	0.0705	0.3377**	-0.4287**
content			0.1180	0.0621	0.2752**	-0.3632**
Relative			1	-0.1557	0.0518	-0.0115
density				-0.1424	0.0585	-0.0004
Gel				1	-0.0513	-0.0471
consistency					-0.0362	-0.0481
Amylose					1	-0.2404**
content						-0.2242**
Grain yield per plant						1

*-significant at 5% and **-significant at 1% level. Digits in bold indicates genotypic correlation and normal indicates phenotypic correlation.

Table 4. Direct and indirect effect of yield contributing characters on grain yield per plant

Characters	Plant height	Panicle length	Iron Chlorosis reaction	Days to 50% flowering	Days to maturity	Tillers/ plant	Tillers/ meter	Flag leaf area	Filled grains/ panicle	Unfilled grains/ panicle	Test weight	Straw yield/ plot	Grain yield / plot	Correlation Grain yield/ plant
Plant height	-0.0309	-0.0087	0.0149	0.0141	0.0121	-0.0146	-0.0143	-0.0124	-0.0107	0.0019	-0.0128	-0.0143	-0.0111	0.5412**
Panicle length	-0.0048	-0.0169	0.0026	0.0007	0.0012	-0.0042	-0.0037	-0.0051	-0.0014	0.0006	-0.0047	-0.0050	-0.0013	0.2875**
Iron chlorosis reaction	-0.0435	-0.0138	0.0903	0.0456	0.0409	-0.0581	-0.0698	-0.0364	-0.0486	0.0183	-0.0458	-0.0670	-0.0500	-0.7549**
Days to 50% flowering	0.0080	0.0008	-0.0089	-0.0177	-0.0128	0.0052	0.0072	0.0015	0.0057	-0.0049	0.0075	0.0051	0.0061	-0.4364**
Days to maturity	-0.0054	-0.0010	0.0062	0.0099	0.0137	-0.0037	-0.0046	-0.0005	-0.0033	0.0040	-0.0049	-0.0034	-0.0047	-0.3578**
Tillers/plant	0.2681	0.1421	-0.3665	-0.1677	-0.1556	0.5695	0.4850	0.2495	0.2081	-0.0524	0.1592	0.3196	0.1884	0.8142**
Tillers/meter	-0.0037	-0.0048	0.0062	0.0033	0.0027	-0.0068	-0.0080	-0.0040	-0.0036	0.0008	-0.0028	-0.0062	-0.0035	0.8060**
Flag leaf area	0.0297	0.0225	-0.0299	-0.0062	-0.0029	0.0325	0.0371	0.0742	0.0231	0.0008	0.0185	0.0379	0.0133	0.5200**
Filled grains / panicle	0.1298	0.0318	-0.2012	-0.1197	0.0894	0.1366	0.1700	0.1166	0.3740	-0.0413	0.1068	0.1755	0.1745	0.6953**
Unfilled grains/ panicle	0.0040	0.0024	-0.0134	-0.0182	-0.0194	0.0061	0.0066	-0.0007	0.0073	-0.0663	0.0282	0.0061	0.0195	-0.2559**
Test weight	0.1286	0.0863	-0.1575	-0.1311	-0.1115	0.0868	0.1103	0.0775	0.0886	-0.1320	0.3104	0.1310	0.1487	0.6253**
Straw yield per plot	0.0494	0.0318	-0.0794	-0.0309	-0.0269	0.0601	0.0824	0.0547	0.0502	-0.0098	0.0452	0.1070	0.0630	0.6875**
Grain yield per plot	0.0089	0.0019	-0.0136	-0.0085	-0.0085	0.0081	0.0108	0.0044	0.0115	-0.0072	0.0118	0.0145	0.0246	0.5420**
Residual effect = 0.1719														

**-significant at 1% level. Figures in bold indicates direct effects and normal indicates indirect effects.

Table 5. Direct and indirect effects of grain quality parameters on grain yield per plant

Characters	Elongation ratio	Elongation index	L/B ratio	Volume expansion	Water absorption	Relative density	Protein content	Gel consistency	Amylose content	Correlation with grain yield per plant
Elongation ratio	0.0551	0.0301	0.0263	0.0053	0.0054	-0.0038	-0.0191	-0.0089	-0.0083	0.2996**
Elongation index	-0.0118	-0.0216	-0.0052	-0.0036	-0.0007	0.0012	0.0000	0.0019	-0.0009	-0.1393
L/B ratio	0.0168	0.0085	0.0351	0.0075	-0.0008	0.0073	-0.0092	-0.0049	-0.0044	0.1507
Volume expansion	0.0024	0.0042	0.0054	0.0252	0.0115	0.0139	0.0014	-0.0024	0.0003	-0.2727**
Water absorption	0.0007	0.0002	-0.0002	0.0031	0.0068	-0.0015	-0.0005	0.0003	0.0007	-0.1946*
Relative density	-0.0032	-0.0026	0.0099	0.0262	-0.0102	0.0475	0.0056	-0.0068	0.0028	-0.0004
Protein content	-0.0096	0.0000	-0.0072	0.0015	-0.0022	0.0033	0.0278	0.0017	0.0077	-0.3632**
Gel consistency	-0.0026	-0.0014	-0.0023	-0.0016	0.0007	0.0023	0.0010	0.0163	-0.0006	-0.0481
Amylose content	-0.0014	0.0004	-0.0012	-0.0001	0.0010	0.0006	0.0026	-0.0003	0.0095	-0.2242**
Residual effect = 0.1719										

*- indicates significant at 5 %, **- indicates significant at 1% level. Figures in bold indicates direct effects and normal indicates indirect effects.

Almost all of the yield contributing characters exerted negative indirect effect on grain yield per plant via iron chlorosis reaction among which indirect effect of number of tillers per plant was highest followed by filled grains per panicle and 1000 grain weight. These results were accordance with Deosarkar (1989). Among quality characters, elongation ratio, L:B ratio and relative density exerted highest positive direct effect on grain yield per plant, whereas direct effect of elongation index was negative(Table 5). Similar result was reported earlier by Deosarkar (1985), Nandeshwar *et al.,* (2010) and Sanghera *et al.,* (2013) for L:B ratio.

Conclusion

The study of correlation revealed that plant height, panicle length, number of effective tillers per plant, number of effective tillers per meter length, flag leaf area, number of filled grains per panicle and 1000 grain weight had positive and significant association with grain yield per plant selection of such characters can be handful. However, significant negative correlation was recorded by days to 50% flowering, days to maturity, iron chlorosis reaction and number of unfilled grains per panicle. Whereas, path analysis indicated that number of effective tillers per plant exerted the highest positive direct effect on grain yield per plant followed by number of grains per panicle. The study may b helpful in selection of parents and hybridization for the improvement of rice.

Acknowledgement

The authors would like to acknowledge the provided by faculty members of Department of Agricultural Botany, VNMKV; Roshan Babu Ojha, Vijaya Boda, Rajdeep Bansode, Pritesh Tyade and all the support staffs of Department of Genetics and Plant Breeding of VNMKV.

REFERENCES

A.O.A.C. 1965. Official methods of analysis. Association of Official Analytical Chemists, 10. edn. Whashington, D.C.

Anonymous, 2014. 48th Annual Maharashtra state rice workshop. Progress report, *Kharif.*

Bhadru, D., Chandra Mohan, Y., Tirumala Rao, V., Bharathi, D. and Krishna, L. 2012. Correlation and path analysis studies in gall modge resistant cultivars of rice (*Oryza sativa* L.). *International Journal of Applird Biology and Pharmaceutical technology.* 3 (2): pp. 137-140.

Cagampang, G. B., Perez, C. M. and Juliano, B. O. 1973. A gel consistency test for eating quality of rice. *J. Sci. Food Agr.*24: pp. 1589-1594.

Chauhan, J. H., Chauhan, V. S. and Lodh, S. B. 1995. Comparative analysis of variability and correlations between quality components of traditional rice varieties. *Oryza*. 32: 78-80.

Deosarkar D. B. 1989. Inheritance of iron chlorosis tolerance in vertisols, plant height, yield and grain quality traits in indica rice (*Oryza sativa* L.). Phd Thesis. Marathwada Agricultural University.

Deosarkar, D. B. 1985. Variability studies for grain yield, yield components and quality characters in some breeding lines of rice. M.Sc. Thesis, Marathwada Krishi Vidyapeeth, Parbhani.

Dewy, D. R. and K. H. Lu. 1959. A correlation and path-coefficient analysis of crested wheatgrass seed production. *Agronomy Journal.* 51: pp. 515-518.

Food and Agriculture Organization, FAO. 2000. Rice Information Vol. 22. January.

Hoan, N. T., Prasada Rao, U. and Siddiq, E. A. 1992. Genetics of toletance to iron chlorosis on rice. *Plant and Soil*. 146: pp. 233-239

Huang, Dahui, Gang Qin, Chi Lui, Zengfeng Ma, Yuexiong Zhang and Yong Yan, 2013. Feasibility of utilization of wild rice (*Oryzarufipogan*Griff.) genetic diversity in rice breeding for high yield. *Advanced Journal of Food Science and Technology.* 5 (5): pp. 640-645.

Jadhav, A. S., Dahiphale, V. V. and Gunjkar, M. U. 2001. Leaf area constant for basmati and non-basmati cultivars of rice under upland condition. *Annals of Plant Physiology*. 14 (1): pp. 5-6.

Johnson, H. W., Robinson H. F. and Comstock, R. E. 1955. Estimation of genetic and environmental variability in soybean. *Agronomy Jounal,* 47: 314-318.

Juliano, B. O. 1971. A simplified assay for milled rice amylose. *Cereal Science Today.*16: pp. 334-340, 360.

Juliano, B. O. and Pauscal, C. G. 1980. Quality characteristics of milled rice grown in different countries. IRRI Research Paper Series 48. Manila (Philippines): International Rice Research Institute. Pp. 25.

Khan, A. S., Muhammad Imran and Muhammad Ashfaq. 2009. Estimation of genetic variability and correlation for grain yield components in rice. *American-Eurasian J. Agric.& Environ. Sci.* 6 (5): pp. 585-590.

Kishor, N., Sandhya., N. A., Ansari, V., RavindraBabu, N., Shohha Rani, L., Subba Rao, V. and Ravichandran, 2007. Correlation and path analysis in aromatic and non-aromatic rice genotypes. *Agric. Sci. Digest.* 27 (2): pp. 122-124.

Nandeshwar, B. C., Pal, S. Senapati, B. K. and De, D. K. 2010. Genetic variability and characters association among biometrical traits in F_2 generation of some rice crosses. *Electronic Journal of Plant Breeding,* 1 (4): pp. 758-763.

Nayak, A. R. 2007. Genetic architecture of quality characters in scented rice. *Agric. Sci. Digest*. 27 (2): pp.103-106.

Parikh, M., N. K. Rastogi and Sarawgi, A. K. 2012. Variability in grain quality traits of aromatic rice (*Oryza sativa* L.). *Bangladesh J. Agril. Res.* 37 (4): pp. 551-558.

Sadeghi, Seyed Mustafa, 2011. Heritability, phenotypic correlation and path coefficient studies for some agronomic characters in landraces of rice varieties. *World Applied Sciences Journal.* 13 (5): pp.1229-1233.

Sanghera, Gulzar S., Subash C. Kashyap and Gulam A. Parray. 2013. Genetic variation for grain yield and related traits in temperate red rice (*Oryza sativa* L.) ecotypes. *Not. Sci. Biol*. 5 (3): pp.400-406.

Shejul M. B. 2012. Variability studies fir grain yield and grain quality characters in upland rice (*Oryza sativa* L.). M. Sc. Thesis. Marathwada Krishi Vidhyapeeth.

Shet, RatnakarManjunath, M. P., Rajanna, S., Ramesh, M. S., Sheshshayee and Mahadevu, P. 2012. Genetic variability, correlation and path coefficient studies in F2 generation of aerobic rice (*Orzya sativa* L.). *Electronic Journal of Plant Breeding.*3 (3): pp. 925-931.

Singh, B. N. and Singh, B. P. 1984. Tolerance for iron chlorosis in rice. *Int. Rice Res. Newslett.*2 (6): pp 8-9.

Syed, E. and Khaliq, I. 2008. Quantitative in heritance of some physiological traits for spring wheat under two different population densities. *Pak. J. Bot*.,40 (2): pp 581-587.

Vaughan, D. A. 2003. Gene pools in the genus *Oryza.* In: Nanda J. S., Sharma S. D., editors. *Monograph on genus Oryza.* Enfield, N. H. (USA). Science Publishers, Inc. Pp: 113-138.

Wattoo, J. I., Abdus Salam Khan, Ali Zulfiqar, Muhammad Barbar, Muhammed Aman Ullah and Nazim Hussin, 2010. Study of correlation among yield related traits and path coefficient analysis traits (*Oryza sativa* L.). *African Journal of Biotechnology.*9 (46): pp. 7853-7856.

Zia, U. Q., Cheema, A. A. and Tahir, G. R. 2005. Association analysis of some yield influencing traits in aromatic and non aromatic rice. *Pak. J.Bot.*37 (3): pp. 335-339.

****