Original Research Article

GENETIC VARIABILITY, HERTABILITY, CORRELATION AND PATH ANALYSIS OF YIELD COMPONENT CHARACTERS IN RICE (*Oryza sativa* L.) GENOTYPES

ABSTRACT:

The present investigation consists of 22 genotypes of Rice including one check, which were grown under the Field Experiment Centre of the Department of GPB, SHUATS, Prayagraj during *Kharif* 2021 following RBD with three replications. The data was collected on 13 characters to evaluate the analysis of variance, heritability, genetic advance, correlation and path analysis. Based on the mean performance genotype **NUMALI** genotype showed high grain yield per hill followed by **MTU-1155** and **TRIVENI** were identified as desirable genotypes with highest grain yield per hill. High estimates of PCV, GCV, heritability coupled with high genetic advance as percent of mean were recorded for biological yield, number of tillers per hill and grain yield per hill. Biological yield, number of spikelets per panicle, panicle length and harvest index showed positive and highly significant association with grain yield per hill and recorded high positive direct effect on grain yield per hill at both the genotypic and phenotypic level. These characters such as biological yield, number of spikelets per panicle, panicle length and harvest index should be given prior consideration during selection for grain yield improvement in rice.

Keywords: Rice, GCV, PCV, Heritability, Genetic advance, correlation and path analysis

INTRODUCTION:

Rice, *Oryza sativa* L. (2n=24) belongs to family Poaceae (Graminae) and the genus Oryza has two cultivated species namely: *Oryza sativa* (Asian rice) and *Oryza glaberrima* (African rice). About 90% of the world's rice is grown and consumed by Asians. Asian cultivated rice is the world's most important food crop and is primary food source for more than one third of the world's population. Rice accounts for about 35 to 60% of the calories consumed by 3 billion Asians (Khush, 2005). Inflorescence of rice is known as Panicle. Rice need hot and humid climatic conditions (RH 60%) and the average temperature required throughout the life period of the rice ranges from 21 °C to 37 °C. Rice is a short day and self-pollinated plant which grown under different conditions and production system. In India rice grown as low land and upland rice. It is the world's longest domesticated grain

(10,000 years) and the primary source of nutrition for 2.5 billion people. Rice is a semi-aquatic crop of the *poaceae* family. Rice is a tropical plant, it thrives in a hot and humid climate and ismostly grown in rainfed condition, covering both the highlands and the lowlands. Rice is grown is different countries like China, India, Thailand, Japan etc. China have major grower of rice, after china, India is second largest rice producer country. Rice is cultivated all over countries except Antarctica. In India, rice is mainly grown in the state. "Rice is life" was the famous theme of the International Rice Year 2004, which denote its overwhelming importance as a food and trade them. The demand for food in most parts of world will be double by the year 2025 and nearly triple by 2050. Rice is mostly a starchy food with amylose and amylopectin fractions (78-79 percent starch). It also provides significant protein and vitamin content. Rice is high in vitamin B (thiamin and nicotinamide), as well as iron (Fe), phosphorus (P), and magnesium (Mg). In comparison to other cereals,milled rice has a low protein content (6-7%). However, it contains a lot of defective amino acids like lysine. In India rice covers more than 30 % of total cultivated area and contributes more than 40 % of total food production.

MATERIALS AND METHODS:

An investigation consists of 22 rice genotypes accessions collected from the branch of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (Uttar Pradesh) during the time of kharif-2021. Current investigation is an effort has been made toward assess the amount of genetic variability, heritability, genetic advance, correlation and path analysis in the rice accessions. Data were recorded on 13 characters *viz*; Days to 50% flowering, Days to maturity, plant height (cm), flag leaf length (cm), flag leaf width (cm), number of tillers per plant, number of panicles per hill, panicle length (cm), number of spikelets per panicle, biological yield (g), harvest index (%), test weight (g), and grain yield per hill (g).

RESULT AND DISCUSSION

A perusal of mean performance among 22 rice genotypes recorded that NUMALI genotype showed high grain yield per hill followed by MTU-1155 and TRIVENI.

High estimates of GCV and PCV were recorded for biological yield (27.67 and 29.40) and grain yield per hill (26.69 and 29.35). Moderate estimates of GCV and PCV were recorded in Flag leaf length (18.04 and 19.12), number of tillers per hill (15.76 and 16.98), number of spikelets per panicle (14.53 and 17.82), Flag leaf width (13.77 and 15.03), Plant height (11.84 and 13.53), Test weight (10.08 and 12.61), Harvest index (10.38 and 15.12). Moderate estimates of PCV were recorded in days to 50% flowering (12.06), panicle length (11.98) and number of panicles per hill (11.09). Low estimates of GCV were observed

for days to maturity (5.49) followed by days to 50% flowering (6.67), panicle length (9.58) and number of panicles per hill (6.61). Low estimates of PCV were observed for days to maturity (7.97).

The estimates of heritability from present investigation are presented in (Table 1). Inthe present study, heritability (broad sense) ranged from 30.57% to 89.09%. The highest heritability (above 60%) was observed for Flag leaf length (89.09%) followed by, biological yield (88.57%), number of tillers per hill (86.21%), flag leaf width (83.96%), grain yield per plant (82.70%), plant height (76.59%), number of spikelets per panicle (66.47), test weight (63.95%) and panicle length (63.91%) respectively. Moderate estimates of heritability (30-60%) were observed for days to maturity (47.27%), harvest index (47.13%), number of panicles per hill (35.60%) and days to 50% flowering (30.58%). All the characters showed high to moderate heritability. None of the characters showed low estimates of heritability (below 10%).

In the present study, high genetic advance (above 20%) was observed for by biological yield (49.70%), followed by number of spikelets per panicle (47.96), plant height (30.18%) and grain yield per plant (23.46%). Moderate (10-20%) values of genetic advance was observed for flag leaf length (16.49%) followed by days to maturity (10.40%). Lowest (below 10%) values of genetic advance was observed for days to 50% flowering (8.00%), harvest index (7.51%), panicle length (4.31%), test weight (3.73%), number of tillers per hill (3.57%), number of panicles per hill (0.92%) and flag leaf width (0.33%).

Highest estimates of genetic advance as per cent mean was recorded for biological yield (53.65%), grain yield per plant (50.00%), flag leaf length (35.09%), number of tillers per hill (30.15%), flag leaf width (25.99%), number of spikelets per panicle (24.40%) and plant height (21.35%). Moderate estimates of genetic advance as per cent mean was recorded for test weight (16.61%), panicle length (15.77%), harvest index (14.68%). Lowest estimates of genetic advance as per cent mean was observed for number of panicles per hill (8.13%), days to maturity (7.78%) and days to 50% flowering (7.59%).

High heritability coupled with high genetic advance as per cent mean was recorded for biological yield (90.51% and 19.59%), grain yield per plant (84.47% and 16.13%), flag leaf length (81.63% and 23.77%), number of tillers per hill (86.75% and 31.05%), flag leaf width (81.74% and 22.36%), number of spikelets per panicle (24.40%) and plant height (90.33% and 17.21%). and number of panicles per hill (71.43% and 21.42%). High heritability coupled with moderate genetic advance as per cent mean was observed in test weight (63.95% and 16.61%) and panicle length (63.91% and 15.77%) in the present investigation.

In the present investigation grain yield per hill showed positive significant association with biological yield (0.861**), number of spikelets per panicle (0.343*) and harvest index (0.326*). while positive and non-significant association showed with days to 50% flowering (0.1513), plant height (0.0397), panicle length (0.1330) and days to maturity (0.1537). Negative and significant association showed with flag leaf length (-0.287*) only, where as negative and non-significant association showed with flag leaf width (-0.0015), number of tillers per hill (-0.0317), number of panicles per hill (-0.2272) and test weight (-0.0378).

The correlation among the yield and yield attributing characters revealed that grain yield per hill was positively and significantly associated with days to 50% flowering (0.394*), days to maturity (-0.348*), number of spikelets per panicle (0.328*), biological yield (0.903**) and harvest index (0.369*). But positively and non-significant correlation was found with panicle length (0.1173) only. Negative and significant association showed with flag leaf length (-0.329*) and number of panicles per hill (-0.536**), while negative and non-significant correlation were found with flag leaf width (-0.0463), number of tillers per hill (-0.0145) and test weight (-0.1082).

A detailed analysis of phenotypic diagonal values showed positive direct effect of days to 50% flowering, number of tillers per hill, panicle length, number of spikelets per panicle, biological yield and harvest index with grain yield per plant. Negative direct effects were exhibited by days to maturity, plant height, flag leaf length, flag leaf width, number of panicless per hill and test weight. A detailed analysis of genotypic diagonal values showed positive direct effect of number of panicles per hill, panicle length, test weight, number of spikelets per panicle, biological yield with grain yield per plant. Negative direct effects were exhibited by days to maturity, plant height, flag leaf length, days to 50% flowering, number of tillers per hill, flag leaf width and harvest index.

CONCLUSION

From the present investigation, it is concluded that **NUMALI** was found to be superior followed by **MTU-1155** and **TRIVENI** for higher grain yield per hill. Genotypes **VARDHAN** is earliest for days to 50% flowering and **SAKET-4** is earliest for days to maturity. High PCV, GCV, heritability and genetic advance as percentage of mean were recorded for biological yield, grain yield per hill, number of tillers per hill and flag leaf length. Biological yield, number of spikelets per panicle, panicle length and harvest index showed positive and highly significant association with grain yield per hill and recorded high positive direct effect on grain yield per hill at both the genotypic and phenotypic level. These characters such as biological

yield, number of spikelets per panicle, panicle length and harvest index should be given prior consideration during selection for grain yield improvement in rice.

Chart 1. Analysis of variance for 13 quantitative characters among 22 genotypes of Rice.

S. No	Features	Mean Sum of Squares		
		Replications (d. f=02)	Treatments (d. f=39)	Error (d. f=78)
1	Days to 50 flowering	335.4240	259.959**	111.987
2	Plant height	193.7490	222.253**	60.237
3	Flag leaf length	170.7890	926.406**	85.655
4	Flag leaf width	10.3540	224.589**	8.805
5	Number of total tillers per hill	0.0110	0.098**	0.006
6	Number of panicles per hill	1.3590	10.999**	0.557
7	Panicle length	2.9960	2.713**	1.02
8	Number of spikelets per panicle	1.3680	25.428**	4.028
9	Days to maturity	5.760	18.298**	2.894
10	Biological yield	114.9470	2857.271**	411.224
11	Harvest Index	169.0260	2056.759**	84.816
12	Test weight	41.3890	116.184**	31.624
13	Grain yield per hill	65.5710	503.265**	32.798

Chart 2. Estimates of components of variance and genetic parameters for different characters in rice.

S. No	Characters	Coefficient of variation		Heritability	Genetic advance	Genetic advance as % of mean (5%)
		GCV	PCV			
1.	Days to 50% flowering	6.67	12.063	30.577	8	7.598
2.	Plant height	5.498	7.996	47.272	10.409	7.787
3.	Flag leaf length	11.845	13.534	76.591	30.181	21.354
4.	Flag leaf width	18.048	19.121	89.094	16.491	35.093
5.	Number of tillers per plant	13.771	15.029	83.958	0.33	25.993
6.	Number of panicle per plant	15.767	16.981	86.21	3.568	30.157
7.	Panicle length	6.617	11.09	35.606	0.923	8.134
8.	Number of spikelets per panicle	9.579	11.982	63.909	4.398	15.775
9.	Days to maturity	10.085	12.611	63.95	3.733	16.614
10.	Biological yield	14.53	17.822	66.474	47.958	24.404
11.	Harvest index	27.673	29.404	88.571	49.705	53.65
12.	Test weight	10.382	15.123	47.127	7.508	14.681
13.	Grain yield per hill	26.693	29.351	82.703	23.46	50.006

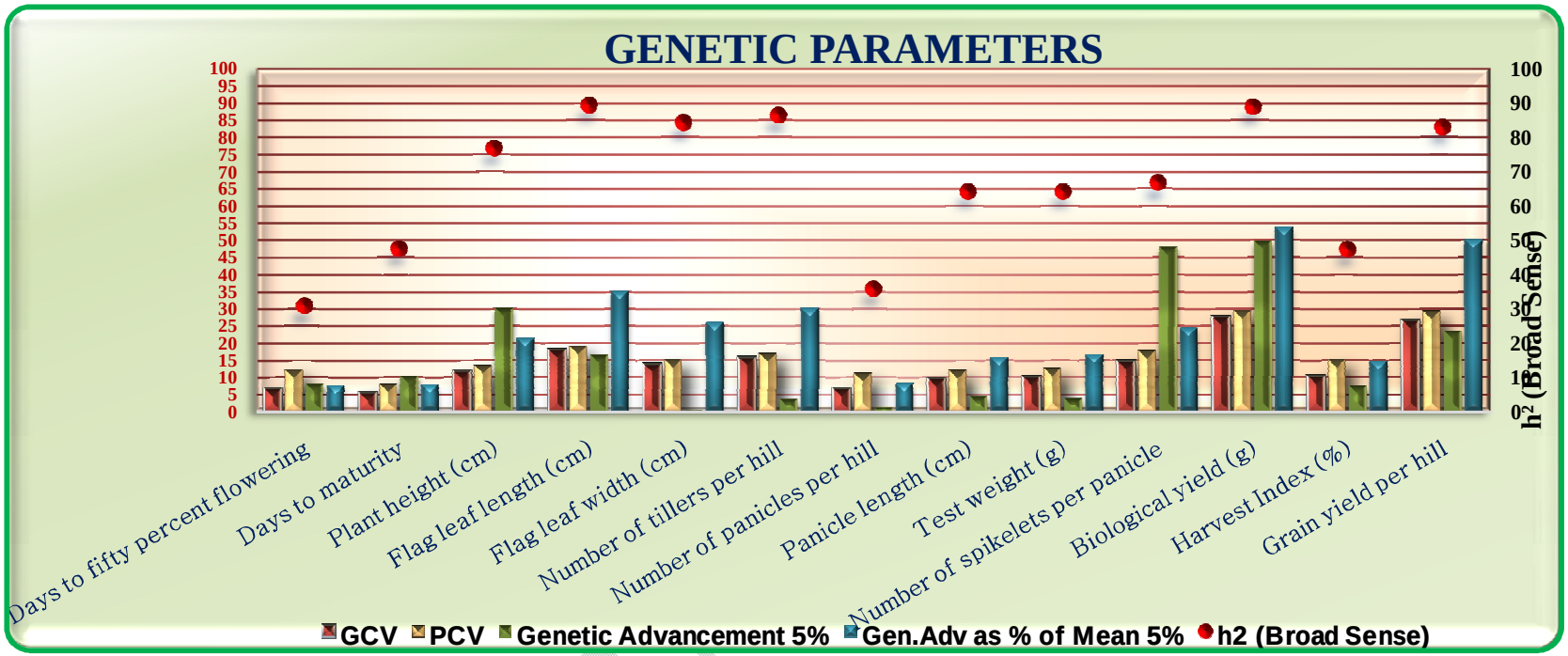

Fig 1 Histogram depicting estimates of GCV, PCV, Heritability and Genetic advance as percent of means for 13 quantitative characters in rice genotypes

Table 1: Estimation of Phenotypic correlation coefficient for yield and its related traits in 22 rice genotypes.

Traits	DF	DM	PH	FL	FW	NTPH	NPPH	PL	TW	NSPP	BY	HI	GYPH
DF	1.0000	0.607**	0.306*	-0.0058	0.1728	-0.0565	0.0717	0.1925	0.0750	0.438**	0.290*	-0.255*	0.1513
DM		1.0000	0.357*	-0.1192	0.1760	-0.0956	0.1082	0.310*	0.1712	0.415**	0.318*	-0.1967	0.1537
PH			1.0000	0.398**	-0.2008	-0.252*	-0.0010	0.497**	-0.0381	0.1137	0.245*	-0.364*	0.0397
FL				1.0000	-0.1864	-0.282*	-0.1126	0.1350	-0.1469	-0.1787	-0.1886	-0.2363	-0.287*
FW					1.0000	-0.0093	0.0952	-0.1545	0.0980	0.422**	0.0844	-0.0888	-0.0015
NTPH						1.0000	0.433**	-0.1014	-0.0274	-0.0115	-0.1028	0.0690	-0.0317
NPPH							1.0000	-0.0635	0.0003	-0.0048	-0.1600	-0.1479	-0.2272
PL								1.0000	0.271*	-0.0356	0.1805	-0.1122	0.1330
TW									1.0000	-0.1014	-0.0356	0.0578	-0.0378
NSPP										1.0000	0.338*	0.0111	0.343*
BY											1.0000	-0.1462	0.861**
HI												1.0000	0.326*
GYPP													1.0000

Table 2: Genotypical correlation coefficient for yield and its related traits in 22 rice genotypes.

Traits	DF	DM	PH	FL	FW	NTPH	NPPH	PL	TW	NSPP	BY	HI	GYPH
DF	1.0000	0.882**	0.580**	-0.262*	0.430**	-0.1699	0.244*	0.654**	0.416**	0.683**	0.662**	-0.582**	0.394*
DM		1.0000	0.605**	-0.254*	0.307*	-0.1800	0.1021	0.582**	0.390*	0.658**	0.562**	-0.513**	0.348*
PH			1.0000	0.452**	-0.265*	-0.330*	-0.248*	0.702**	-0.1427	0.1635	0.302*	-0.752**	0.0216
FL				1.0000	-0.2064	-0.322*	-0.1950	0.2026	-0.2137	-0.333*	-0.2183	-0.328*	-0.329*
FW					1.0000	-0.0194	0.0825	-0.288*	0.0793	0.576**	0.0791	-0.250*	-0.0463
NTPH						1.0000	0.894**	-0.1632	-0.0681	-0.0140	-0.1034	0.1213	-0.0145
NPPH							1.0000	-0.249*	-0.0163	0.0534	-0.379*	-0.481**	-0.536**
PL								1.0000	0.375*	-0.0080	0.2114	-0.2305	0.1173
TW									1.0000	-0.0237	-0.1414	0.247*	-0.1082
NSPP										1.0000	0.388*	-0.0706	0.328*
BY											1.0000	-0.0905	0.903**
HI												1.0000	0.369*
GYPP													1.0000

Table: 3: Direct and indirect effects of yield related traits on grain yield in 22 rice genotypes at phenotypic level.

Traits	DF	DM	PH	FL	FW	NTPH	NPPH	PL	TW	NSPP	BY	HI	GYPH
DF	**0.0297**	0.0180	0.0091	-0.0002	0.0051	-0.0017	0.0021	0.0057	0.0022	0.0130	0.0086	-0.0076	0.1513
DM	-0.0552	**-0.0910**	-0.0325	0.0108	-0.0160	0.0087	-0.0098	-0.0282	-0.0156	-0.0377	-0.0289	0.0179	0.1537
PH	-0.0173	-0.0202	**-0.0567**	-0.0226	0.0114	0.0143	0.0001	-0.0282	0.0022	-0.0065	-0.0139	0.0207	0.0397
FL	0.0000	0.0004	-0.0015	**-0.0037**	0.0007	0.0010	0.0004	-0.0005	0.0005	0.0007	0.0007	0.0009	-0.287*
FW	-0.0113	-0.0115	0.0131	0.0122	**-0.0655**	0.0006	-0.0062	0.0101	-0.0064	-0.0276	-0.0055	0.0058	-0.0015
NTPH	-0.0012	-0.0020	-0.0052	-0.0059	-0.0002	**0.0208**	0.0090	-0.0021	-0.0006	-0.0002	-0.0021	0.0014	-0.0317
NPPH	-0.0005	-0.0008	0.0000	0.0008	-0.0007	-0.0032	**-0.0074**	0.0005	0.0000	0.0000	0.0012	0.0011	-0.2272
PL	0.0127	0.0205	0.0329	0.0089	-0.0102	-0.0067	-0.0042	**0.0662**	0.0179	-0.0024	0.0120	-0.0074	0.1330
TW	-0.0016	-0.0037	0.0008	0.0031	-0.0021	0.0006	0.0000	-0.0058	**-0.0214**	0.0022	0.0008	-0.0012	-0.0378
NSPP	0.0377	0.0357	0.0098	-0.0154	0.0363	-0.0010	-0.0004	-0.0031	-0.0087	**0.0860**	0.0291	0.0010	0.343*
BY	0.2675	0.2925	0.2259	-0.1738	0.0778	-0.0947	-0.1474	0.1664	-0.0328	0.3112	**0.9215**	-0.1347	0.861**
HI	-0.1091	-0.0842	-0.1560	-0.1012	-0.0380	0.0296	-0.0634	-0.0480	0.0248	0.0048	-0.0626	**0.4283**	0.326*

Table: 4: Direct and indirect effects of yield component traits on grain yield for 22 rice genotypes at Genotypic level.

Traits	DF	DM	PH	FL	FW	NTPH	NPPH	PL	TW	NSPP	BY	HI	GYPH
DF	**-0.1174**	-0.1592	-0.0681	0.0308	-0.0504	0.0199	-0.0286	-0.0768	-0.0489	-0.0802	-0.0776	0.0684	0.394*
DM	-0.6356	**-0.4685**	-0.2833	0.1192	-0.1436	0.0843	-0.0478	-0.2726	-0.1827	-0.3081	-0.2635	0.2405	0.348*
PH	-0.2744	-0.286	**-0.473**	-0.2136	0.1254	0.1561	0.1174	-0.3322	0.0675	-0.0773	-0.1429	0.3559	0.0216
FL	0.0114	0.0111	-0.0197	**-0.0435**	0.009	0.014	0.0085	-0.0088	0.0093	0.0145	0.0095	0.0143	-0.329*
FW	-0.0974	-0.0696	0.0602	0.0468	**-0.2269**	0.0044	-0.0187	0.0653	-0.018	-0.1306	-0.0179	0.0567	-0.0463
NTPH	0.0401	0.0424	0.0778	0.0758	0.0046	**-0.2357**	-0.2106	0.0385	0.016	0.0033	0.0244	-0.0286	-0.0145
NPPH	0.0419	0.0175	-0.0427	-0.0335	0.0142	0.1535	**0.1718**	-0.0428	-0.0028	0.0092	-0.0651	-0.0826	-0.536**
PL	0.3138	0.279	0.3368	0.0972	-0.138	-0.0783	-0.1196	**0.4796**	0.1798	-0.0039	0.1014	-0.1105	0.1173
TW	0.0217	0.0203	-0.0074	-0.0111	0.0041	-0.0035	-0.0008	0.0195	**0.052**	-0.0012	-0.0074	0.0129	-0.1082
NSPP	0.3063	0.2948	0.0733	-0.1493	0.258	-0.0063	0.0239	-0.0036	-0.0106	**0.4483**	0.174	-0.0317	0.328*
BY	0.7713	0.6555	0.3521	-0.2544	0.0922	-0.1205	-0.4414	0.2465	-0.1649	0.4524	**0.922**	-0.1055	0.903**
HI	0.012	0.0106	0.0155	0.0068	0.0051	-0.0025	0.0099	0.0048	-0.0051	0.0015	0.0019	**-0.0206**	0.369*

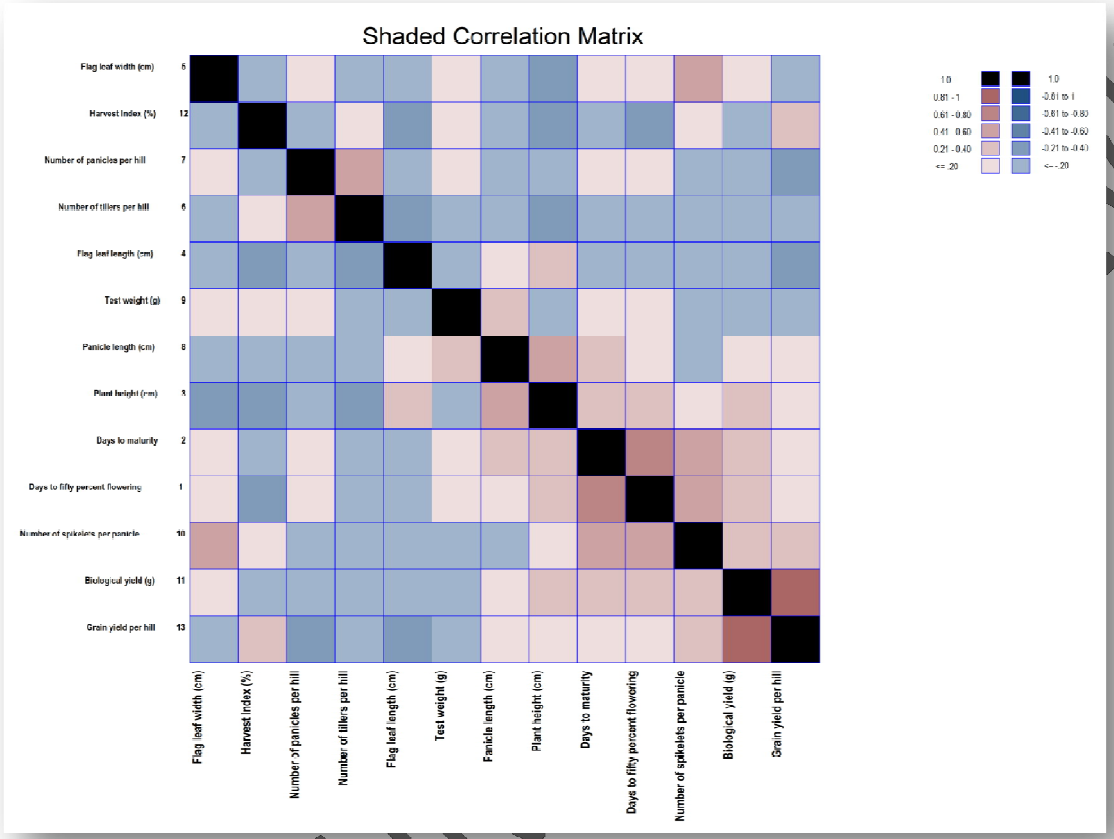

Fig. 2 Phenotypic path diagram for 13 quantitative characters of rice genotypes

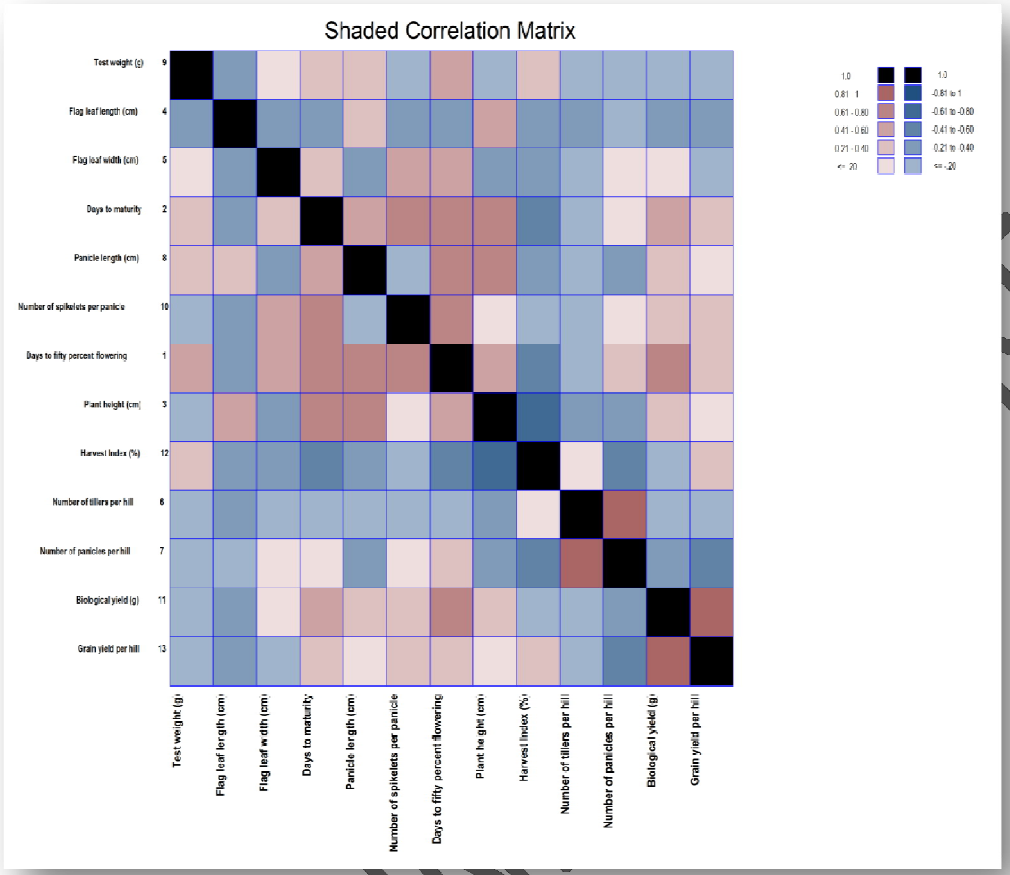

Fig 3: Genotypical Path diagram for grain yield per hill for 13 Quantitative characters of rice genotypes

References :

Allam, C. R., Jaiswal, H. K., & Qamar, A. (2015). Character association and path analysis studies of yield and quality parameters in basmati rice (*Oryza sativa* L.). *Journal of Progressive Agriculture*, ***6***(1), 117-121.

Aditya, J. P. & Bhartiya, A. (2013). Genetic variability, correlation and path analysis for quantitative charcters in rainfed upland rice in Uttarakhand hills. *J. Rice Res.*, 6 (2), 24-34.

Ashok, S., Jyothula. A. D. P. B. & Ratanbabu, D. (2016). Character association and path analysis for yield components and grain quality parameters of rice (*Oryza sativa* L.). *International Journal of Agricultural Science and Research*, 6 (6), 253–258.

Babu, V. R., Shreya, K., Dangi, K. S., Usharani, G., & Nagesh, P. (2012). Genetic variability studies for qualitative and quantitative traits in popular rice (*Oryza sativa* L.) hybrids

Dhurai, S. Y., Reddy, D. M., & Ravi, S. (2016). Correlation and path analysis for yield and quality characters in rice (*Oryza sativa* L.). *Rice Genomics and Genetics*, ***7***..

Dhanwani, R. K., Sarawgi, A. K., Solanki, A. & Tiwari, J. K. (2013). Genetic variability analysis for various yield attributing and quality traits in rice *(O. sativa* L.). *The Bioscan*, 8 (4), 14013-1407.

Edukondalu, B., V. Ram Reddy, T. Shobha Rani, Ch. Aruna Kumari and Soundharya, B. 2017. Studies on Variability, Heritability, Correlation and Path Analysis for Yield, Yield Attributes in Rice (*Oryza sativa* L.). *International Journal Of Current Microbiology And Applied Science* **6**(10): 2369-2376.

Ekka, R. E., Sarawgi, A. K., & Kanwar, R. R. (2011). Correlation and path analysis intraditional rice accessions of Chhattisgarh. *Journal of rice research*, **4**(1), 11- 18.

Gour, L., Koutu, G. K., Singh, S. K., Patel, D. D., Shrivastava, A., & Singh, Y. (2017). Genetic variability, correlation and path analyses for selection in elite breeding materials of rice (*Oryza sativa* L.) genotypes in Madhya Pradesh, *The Pharma Innovation Journal*, **6**(11): 693-696.

Hossain, S., Haque, M. & Rahman, J. (2015). Genetic variability, correlation and pathcoefficient analysis of morphological traits in some extinct local aman rice (*Oryza sativa* L). *Rice Res.,* 4 (1), 2375-4338.

Hossain, M., Ivy, N., Raihan, M., Kayesh, E., & Maniruzzaman, S. (2021). Genetic Variability,

Correlation and Path Analysis of Floral, Yield and its Component Traits of Maintainer Lines of Rice (Oryza sativa L.). Bangladesh Rice Journal, 24(1), 1–9.

Hasan, M. J., Kulsum, M. U., Akter, A., Masuduzzaman, A. S. M., & Ramesha, M.S. (2011). Genetic variability and character association for agronomic traitsin hybrid rice *Oryza sativa* L.). *Bangladesh Journal of Plant Breeding andGenetics*, ***24***(1), 45-51.

K Parimala, Ch Surender Raju, S Sudheer Kumar, S Narender Reddy (2021). Genetic variability, correlation and path analysis in rice (Oryza sativa L.). International Journal of Ecology and Environmental Sciences, Volume 3, Issue 1, 2021, Pages 385-387.

Khan, A. S., Muhammad, I. & Muhammad, A. (2009). Estimation of genetic variability and correlation for grain yield components in rice (*Oryza sativa* L.).*American-Eurasian J. Agri. & Env. Sci.*, 6 (5), 585-590.

Kishore, N. S., Srinivas, T., Nagabhushanam, U., Pallavi, M. & Sameera, S. K.(2015). Genetic variability, correlation and path analysis for yield and yield components in promising rice (*Oryza sativa* L.) genotypes. *SAARC J. Agri.*, 13(1), 99-108.

Kritika Williams, Aman Mishra, Akansha Verma, BG. Suresh and Lavanya, G. R. (2021). Genetic Variability and Correlation Studies for Yield and Yield Related Traits in Rice (Oryza sativa L.) Genotypes. Int.J.Curr.Microbiol.App.Sci. 10(01): 752-764.

Kumari, N., Kumar, R., & Kumar, A. (2019). Genetic Variability and Association of Traits in Mutant Lines of Rice (*Oryza sativa* L.) for SubmergenceTolerance. *Current Journal of Applied Science and Technology*, 1- 7.

Kumar, S., Singh, D., Satyendra, A. S., Kant, S., Kumar, A., Pal, K. & Kumar, M. (2012). Variability, heritability and genetic advance in rice (*Oiyza sativa* L.) under aerobic condition. *Env. & Eco.*, 30 (4), 1374-1377.

Lingaraja, L., Mohammad, S., Sriharsha, V. & Suresh, B. (2015). Estimation of genetic variability, direct and indirect effects of yield contributing traits on grain yield in aerobic rice (*Oryaza sativa* L.) germplasm. *The Ecoscan*, 9 (2), 357-361.

Nandan, R., & Singh, S. K. (2010). Character association and path analysis in rice (*Oryza sativa* L.) genotypes. *World Journal of Agricultural Sciences*, ***6***(2), 201-206.

Nayak, R., Singh, V. K., Singh, A. K. & Singh, P. K. (2016). Genetic variability, character association and path analysis of rice genotypes. *Ann. Plant & Soil Res.*, 18, 161-164.

Osman, K. A., Mustafa, A. M., Ali, F., Yonglain, Z. & Fazhan, Q. (2012). Genetic variability for yield and related attributes of upland rice genotypes in semi aridzone (Sudan). *Afri. J. Agri. Res*., 7 (33), 4613-4619.

Pachauri, A., Sarawgi, A. K., Bhandarkar, S., & Ojha, G. C. (2017). Genetic variability and association study for yield contributing traits of promising core rice germplasm accessions (*Oryza sativa* L.). *Research on Crops*, **18**(1).

Pandey, P., Anurag, P. J., Tiwari, D. K., Yadav, S. K., & Kumar, B. (2009). Genetic variability, diversity and association of quantitative traits with grain yield in rice (*Oryza sativa* L.). *Journal of Bio-Science*, **17**, 77-82.

Pandey, S., Doss, D. D., & Shashidhar, H. E. (2018). Correlation and path analysis of yield determinants and micronutrient content in rice (*Oryza sativa* L.). *Journal of Pharmacognosy and Phytochemistry*, **7**(1), 2723-2728.

Patel, H. R., Patel, V. P., Patel, P. B., Rathod, A. J. & Pampaniya, A. G. (2018). Genetic variability, correlation and path analysis for grain yield and component traits in f3 segregating population of rice (*Oryza sativa* L.). *Int. J. Chem. Stu*., 6 (2), 2327-2331.

Panigrahi, A. K., Bharathi, M., & Kumaravadivel, N. (2018). Genetic variability and character association studies in advanced backcross generation of rice (*Oryza sativa* L.). *Journal of Pharmacognosy and Phytochemistry*, **7**(1), 2397-2400.

Rai, S.K., Suresh, B.G., Rai, P.K., Lavanya, G.R., Kumar, R., and Sandhya (2014). Genetic Variability, Correlation and Path Coefficient Studies for Grain Yield and Other Yield Attributing Traits in Rice *(Oryza Sativa* L.). *International Journal of Life Sciences Research*, **2**(4), 229-234.

Ratna, M., Begum, S., Husna, A., Dey, S. R., & Hossain, M. S. (2015). Correlation and path coefficients analyses in Basmati rice. *Bangladesh Journal of Agricultural Research*, **40**(1), 153-161.

Shaikh, S. A., Umate, S. M., Syed, A. J., & Deosarkar, D. B. (2017). Study on Genetic Variability, Heritability and Genetic Advance in Rice (*Oryza sativa* L.) Genotypes. *International Journal of Pure and Applied Bioscience*, **5**(4), 511- 515.

Sumanth, V., Suresh, B. G., Ram, B. J. & Srujana, G. (2017). Estimation of genetic variability, heritability and genetic advance for grain yield components in rice (*Oryza sativa* L.). *J. Pham. & Phyto*., 6 (4), 1437-1439.

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