ESTIMATION OF GENETIC VARIABILITY, CORRELATON FOR YIELD AND YIELD COMPOMENTS IN RICE (*Oryza sativa* L.)

ABSTRACT

The present study consists of 23 rice genotypes including one check variety that were evaluated at Field Experimentation Centre of the Department of Genetics and Plant Breeding,Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (Allahabad), U.P. to study genetic variability, correlation and path coefficient for 13 quantitative characters. The experiment was conducted by using Randomized Block Design with three replications during *Kharif -2021.* Observation recorded to study the genetic variability parameters, correlation coefficient and path coefficient for yield and its attributing traits. On the basis of mean performance BPT-3291 was found to be superior in grain yield per hill followed by, SIGNET-5455, KSR-140 and RNR-15048 showed higher yield over the check (NDR359). High to moderate estimates of GCV and PCV were recorded for number of spikelets per panicle followed by number of tillers per hill, harvest index, biological yield, grain yield per hill, flag leaf width, test weight and number of panicles per hill. Grain yield indicated significant positive correlation with plant height followed by tillers per hill, panicles per hill, biological yield and harvest index in terms of phenotypic correlation coefficient whereas in terms of genotypic coefficient it showed positive and significant correlation. Path coefficient analysis showed positive significant direct effects on Biological Yield, Harvest Index and Number of Spikelets per Panicle at genotypic level whereas it showed positive and significant direct effect for days to fifty percent flowering, plant height, flag leaf width, number of panicles, test weight, biological yield, and harvest index at phenotypic level. Thus, these traits are identified as the efficient and potential for indirect selection for the improvement of rice productivity in the present experimental materials.

Keywords: Rice, GCV, PCV, Variability, Heritability, Correlation and Path analysis.

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important staple cereal food crops in the world and belongs to the genus *Oryza* of family Graminae (Poaceae). The genus includes 24 species out of which 22 are wild and two viz., *Oryza sativa* and *Oryza glaberimma* are cultivated. The basic chromosomes number (n) of the genus *Oryza sativa* is 12 (2n=24). The cultivated varieties of *Oryza sativa* grouped in to three sub species, Indica, Japonica, and Javanica. Indica rice varieties are grown throughout the tropical and subtropical regions. Japonica varieties are grown throughout the temperate zone, and Javanica varieties are grown mainly in parts of Indonesia.

One of the world's basic cereal crops, rice (Oryza sativa L.), provides roughly half of the world's population with the majority of their carbohydrate needs. It provides 160 million rural impoverished people with a living and satisfies 50% of the population's calorie needs**. (Santha et al., 2016).**

Rice ‘was the theme of international year of rice 2004 denoting its overwhelming importance as an item of food and commerce **(Pandey *et al.,* 2010).** Rice is inseparable from our day-to-day life since time immemorial as evident from its use in almost all rituals of our culture. The crop is grown in a diverse geographical and climatic conditions ranging from below sea level in Kuttanad (Kerala) to high altitude in Kashmir valley. Rice is cultivated in a hydrology range of moisture stress upland condition to waterlogged ecology.

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Heritability and genetic advance are important selection parameters. Heritability estimates along with genetic advance are normally more helpful in predicting the gain underselection than heritability estimates alone. Hence knowledge about genetic advance coupled with heritability is most useful. Character exhibiting high heritability may not necessarily give high genetic advance. High heritability should be accompanied with high genetic advance to arrive more reliable conclusion. Expected genetic advance as percent of mean indicates the mode of gene action in the expression of a trait, which helps in choosing an appropriate breeding method **(Kumar *et al.*, 2014)**

MATERIALS AND METHODS

The present investigation was carried out at the Field Experimentation Center of Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (Allahabad), U.P. during *Kharif,* 2021. The university is situated on the left side of Allahabad Rewa National Highway, about 5km from Prayagraj city. All types of facilities necessary for cultivation of successful crop including field preparation inputs, irrigation facilities were provided from the Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (Allahabad), U.P.

The 23 rice genotypes were grown in kharif-2021 in Randomized Block Design with three replications each under lowland conditions. In kharif-2021 nursery sowing for all the genotypes of rice was done on 21 June 2021 and transplanted in field after 30 days i.e., on 21 July 2021. Each genotype was planted in a row of 2 meter in length with 3 replications. A spacing of 20 cm between rows and 15 cm between plants were given and the crop was raised as per the recommended package of practice. Among the 23 genotypes grown during kharif 2021, to analyze the effect of various traits for heritability, correlation, path analysis and genetic divergence on Grain yield over the years.

STATISTICAL ANALYSIS

1. Analysis of variance (**Fisher, 1935)**

2. Coefficient of variation (**Burton and De vane, 1952)**
    a. Genotypic coefficient of variation **(GCV)**
    b. Phenotypic coefficient of variation **(PCV)**
3. Heritability broad sense **(Burton and Devane, 1953)**
4. Genetic advance **(Johnson *et al.* 1955)**
5. Correlation coefficient analysis **(Al Jibouri *et al.* 1958)**
6. Path coefficient analysis **(Dewey and Lu, 1959)**

Table 1 : Experimental material:

The experimental material for present study is obtained from the Department of Genetics and Plant Breeding, SHUATS, Prayagraj (Allahabad). The details of experimental material are as follows:

S.No	Name Of Genotypes	S.No	Name Of Genotypes
1	MTU-1271	12	SIGNET-5455
2	MTU-1061	13	BPT-204
3	MTU-1064	14	HMT
4	MTU-7029	15	SIDDHASANNALU
5	NP-9558	16	NDLR-7
6	DHAN-44	17	BPT-01
7	DHAN-50	18	BPT-02
8	DHAN-42	19	DHAN-1121
9	BPT-3291	20	RNR-15048
10	KNM-1638	21	NP124-8
11	ANKUR POOJA	22	KSRV-140
		23	NDR-359

RESULTS AND DISCUSSION

Analysis of variance indicated highly significant differences among the genotypes for all the traits. This indicates that there was an ample scope for selection of promising lines from the present gene pool for yield and its components. All the characters shown significant differences at 1% level of significance.

A detailed analysis of the results on *per se* performance of yield, yield components and quality characters of the rice genotypes studied in the present investigation revealed in

Among 23 genotypes, genotype BPT-3291(51.8g), SIGNET-5455(50.45g), KSR-140(44.4g) and RNR-15048 (39.1g) were found to be superior in grain yield.

Table 2 Analysis of Variance for 13 quantitative traits of rice genotypes

Sl.No.	**Source of Variance**	**Replications**	**Treatments**	**Error**
	Degrees of freedom	2	22	44
1	Days to fifty percent flowering	1.83	362.04**	8.64
2	Days to maturity	4.16	640.19**	6.36
3	Plant height (cm)	1.67	717.6**	19.19
4	Flag leaf length (cm)	15.62	79.35**	6.71
5	Flag leaf width (cm)	0.07	0.12**	0.06
6	Panicle length (cm)	3.37	17.17**	2.12
7	Number of tillers per hill	1.33	20.64**	1.09
8	Number of panicles	0.78	9.07**	0.97
9	Number of spikelets per panicle	194.60	9046.57**	338.26
10	Test weight (g)	0.09	29.48**	0.60
11	Biological yield (g)	99.51	709.70**	49.95
12	Harvest Index (%)	58.25	430.07**	32.61
13	Grain yield per hill (g)	10.09	166.60**	10.73

The estimate of genotypic variance ($\boldsymbol{\sigma}^2\mathbf{g}$) and phenotypic variance ($\boldsymbol{\sigma}^2\mathbf{p}$) were revealed that phenotypic variance was higher than genotypic variance for all the yield and yield attributing characters indicates that the influence of environmental factors on these traits.

An estimate of GCV and PCV revealed that phenotypic coefficient of variation was higher than genotypic coefficient of variation, which indicates the presence of environmental effect on the expression of character studied. In the present study phenotypic coefficient of variation (PCV) were higher than genotypic coefficient variation (GCV) indicating that these characters are influenced by the environment for all the characters.

The variability is classified as low if coefficient of variation (<10%), moderate (10- 20%) and high (>20%) by Subramanian and Menon (1973). GCV (%) values ranged between least of 8.86 (Panicle Length) to a highest value of 25.63(Number of spikelets per panicle) PCV (%) followed a similar pattern had a range of10.49 (Days to Fifty Percent Flowering) to a highest value of 26.79 (Number of spikelets perpanicle).

HERITABILITY:

The present investigation, all traits showed the high heritability ranging from 70.21% to 97.077%. Days to Maturity (97.07%) showed the highest heritability among all the characters followed by Test weight (94.11%), Days to Fifty percent Flowering (93.16%) and Plant Height (92.38%). Moderate and low range heritability has not observed among these characters.

The high heritability values of the considered traits in the present study indicated that those were less influenced by the environment and thus help in effective selection of the traits based on the phenotypic expression by adopting simple selection method and suggested the scope of genetic improvement.

GENETIC ADVANCE AS A PERCENTAGE MEAN (5%):

The estimation of genetic advance as percent mean is classified as low (<10%), moderate (10 to 20%) and high (>20%) proposed by Johnson *et al*., (1955).

In the present investigation all the characters showed highest genetic advance as a percentage of mean present in No of Spikelet per Panicle (49.44), No of Total Tillers per hill (44.02), Harvest Index (41.71), Biological Yield (40.48), Grain Yield per Plant (40.34), Test Weight (32.65), Flag Leaf Width (31.642), No of Panicles per Tillers (27.54), Plant Height (23.76), Flag Leaf Length (23.25), Days to Maturity (22.05) and Days to Fifty percent Flowering (20.14).

Moderate genetic advance as a percent of mean was observed in Panicle Length (15.30).

Low genetic advance as a percent has not observed.

Table 3 Genetic Parameters for 13 Quantitative Characters in Rice Genotypes

Genetic parameters	GCV	PCV	h2 (Broad Sense)	GA 5%	GA as % of Mean 5%
Days to fifty percent flowering	10.13	10.49	93.16	21.58	20.14
Days to maturity	10.86	11.02	**97.07**	29.50	22.05
Plant height	12.04	12.48	92.38	30.21	23.76
Flag leaf length	12.75	14.42	78.27	8.96	23.25
Flag leaf width	16.53	17.79	86.29	0.37	31.64

**** Significant at 1%**

GCV: Genotypic Coefficient of Variation, PCV: Phenotypic Coefficient of Variation h^2bs: heritability (Broad sense), GA: Genetic Advance, GAM: Genetic Advance as Percent of Mean

CORRELATION and PATH COEFFICIENT:

Correlation analysis among the yield and its contributing characters revealed that the genotypic correlation coefficients in most cases were higher than their phenotypic correlation coefficients indicating the association was largely due to genetic reason. At both genotypic and phenotypic levels. The significant positive correlations were observed for No of Spikelet per Panicle, No of Total Tillers per hill, Harvest Index, Biological Yield with Grain Yield per Hill, Test Weight, Flag Leaf Width, No of Panicles per Tillers, Plant Height, Flag Leaf Length, Days to Maturity and Days to Fifty percent Flowering. Direct positive effect on grain yield per hill was observed by biological yield per plant (0.413), harvest index (0.446) and number of spikelets per panicle (0.282).

Table 4 Correlation Coefficient Analysis

Traits		DF50	DM	PH	FLL	FLW	NTT	NPT	PL	BM	H.I.	NGPP	TW	GY
DF50	P	1	0.707**	-0.0062	-0.2214	0.265*	-0.095	-0.405**	-0.422**	0.410**	-0.356*	0.483**	-0.578**	-0.1731
	G	1	0.764**	-0.0101	-0.239*	0.282*	-0.0900	-0.445**	-0.526**	0.446**	-0.374*	0.542**	-0.698**	-0.1923
DM	P		1	-0.0094	-0.128	0.1864	-0.1189	-0.431**	-0.415**	0.317*	-0.0456	0.340*	-0.456**	-0.0967
	G		1	-0.0045	-0.1285	0.2155	-0.1622	-0.466**	-0.467**	0.341*	-0.0616	0.395**	-0.503**	-0.0981
PH	P			1	0.500**	-0.077	0.358*	0.0201	0.0479	0.0479	0.369*	0.321*	-0.320*	-0.0408
	G			1	0.573**	-0.1049	0.448**	0.0152	0.0549	0.0604	0.421**	0.346*	-0.367*	-0.0500
FLL	P				1	-0.283*	0.1875	0.1069	0.2131	-0.1972	0.328*	0.0272	-0.0047	0.0118
	G				1	-0.281*	0.256*	0.1461	0.310*	-0.239*	0.369*	0.0040	-0.0029	0.0275
FLW	P					1	0.363*	0.388*	0.2217	0.475**	-0.0264	0.2198	0.0017	0.2169
	G					1	0.389**	0.406**	0.257*	0.534**	-0.0177	0.266*	-0.0634	0.2001
NTT	P						1	0.267*	0.2091	0.0334	0.303*	0.1944	-0.0741	0.1171
	G						1	0.397**	0.404**	0.0166	0.354*	0.278*	-0.1356	0.1602
NPT	P							1	0.905**	-0.0091	0.310*	-0.1306	0.351*	0.2251
	G							1	0.928**	-0.0064	0.339*	-0.2329	0.390**	0.1554
PL	P								1	0.0173	0.250*	-0.0345	0.312*	0.307*
	G								1	0.0328	0.289*	-0.1729	0.360*	0.2238
BM	P									1	-0.336*	0.510**	-0.244*	0.269*
	G									1	-0.366*	0.529**	-0.266*	0.282*
H.I.	P										1	-0.0107	0.1398	0.2026
	G										1	0.0070	0.1485	0.2236
NGPP	P											1	-0.571**	0.433**
	G											1	-0.632**	0.413**
TW	P												1	0.444**
	G												1	0.446**
GYP	P													1
	G													1

DF50: Days to 50% Flowering, **DM**: Days to Maturity, **PH**: Plant Height, **FLL**: Flag Leaf Length, **FLW**: Flag Leaf Width, **NTT**: Number of Total Tillers, **NPT**: Number of Productive Tillers, **PL**: Panicle Length, **BM**: Biomass, **H.I**: Harvest Index, **NGPP**: Number of Grains per Panicle, **TW**: Test Weight, **GYP**: Grain Yield per Plant, **P**: Phenotypic, **G**: Genotypic

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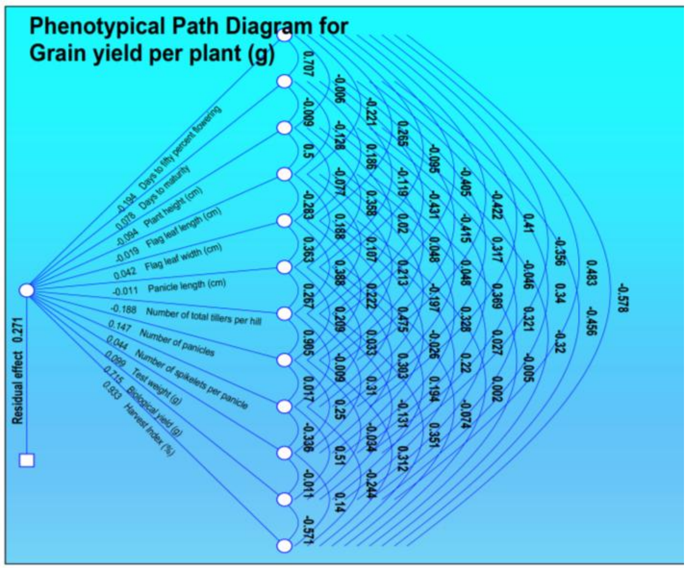
Figure 1: Phenotypical Correlation Diagram

Figure 2: Genotypical Correlation Diagram

Path Coefficient Analysis

Traits		DF50	DM	PH	FLL	FLW	NTT	NPT	PL	BM	H.I.	NGPP	TW
DF50	P	**-0.1943**	-0.1374	0.0012	0.0430	-0.0514	0.0184	0.0786	0.0819	-0.0796	0.0691	-0.0939	0.1122
	G	**0.4423**	0.3380	-0.0045	-0.1058	0.1245	-0.0398	-0.1966	-0.2325	0.1974	-0.1655	0.2395	-0.3088
DM	P	0.0555	**0.0784**	-0.0007	-0.0100	0.0146	-0.0093	-0.0338	-0.0326	0.0248	-0.0036	0.0267	-0.0357
	G	-0.1741	**-0.2278**	0.0010	0.0293	-0.0491	0.0369	0.1061	0.1064	-0.0777	0.0140	-0.0900	0.1146
PH	P	0.0006	0.0009	**-0.0938**	-0.0469	0.0072	-0.0336	-0.0019	-0.0045	-0.0045	-0.0346	-0.0301	0.0300
	G	-0.0005	-0.0002	**0.0502**	0.0287	-0.0053	0.0225	0.0008	0.0028	0.0030	0.0211	0.0174	-0.0184
FLL	P	0.0041	0.0024	-0.0093	**-0.0186**	0.0053	-0.0035	-0.0020	-0.0040	0.0037	-0.0061	-0.0005	0.0001
	G	0.0314	0.0169	-0.0753	**-0.1315**	0.0369	-0.0337	-0.0192	-0.0407	0.0314	-0.0486	-0.0005	0.0004
FLW	P	0.0111	0.0078	-0.0032	-0.0119	**0.0420**	0.0152	0.0163	0.0093	0.0200	-0.0011	0.0092	0.0001
	G	0.0398	0.0304	-0.0148	-0.0396	**0.1413**	0.0550	0.0574	0.0363	0.0754	-0.0025	0.0376	-0.0090
NTT	P	0.0010	0.0013	-0.0038	-0.0020	-0.0039	**-0.0107**	-0.0028	-0.0022	-0.0004	-0.0032	-0.0021	0.0008
	G	0.0058	0.0105	-0.0289	-0.0166	-0.0252	**-0.0647**	-0.0257	-0.0261	-0.0011	-0.0229	-0.0180	0.0088
NPT	P	0.0760	0.0809	-0.0038	-0.0201	-0.0728	-0.0501	**-0.1878**	-0.1699	0.0017	-0.0583	0.0245	-0.0659
	G	0.4427	0.4638	-0.0151	-0.1455	-0.4046	-0.3950	**-0.9959**	-0.9241	0.0064	-0.3380	0.2319	-0.3888
PL	P	-0.0620	-0.0611	0.0070	0.0313	0.0326	0.0308	0.1331	**0.1471**	0.0025	0.0367	-0.0051	0.0459
	G	-0.4931	-0.4383	0.0515	0.2905	0.2413	0.3791	0.8702	**0.9379**	0.0308	0.2712	-0.1621	0.3380
BM	P	0.0182	0.0140	0.0021	-0.0087	0.0211	0.0015	-0.0004	0.0008	**0.0443**	-0.0149	0.0226	-0.0108
	G	-0.0352	-0.0269	-0.0048	0.0188	-0.0421	-0.0013	0.0005	-0.0026	**-0.0789**	0.0289	-0.0418	0.0209
H.I.	P	-0.0352	-0.0045	0.0365	0.0325	-0.0026	0.0300	0.0307	0.0247	-0.0333	**0.0990**	-0.0011	0.0138
	G	-0.1002	-0.0165	0.1128	0.0989	-0.0047	0.0946	0.0909	0.0774	-0.0981	**0.2678**	0.0019	0.0398
NSPP	P	0.4907	0.3457	0.3255	0.0277	0.2232	0.1974	-0.1326	-0.0350	0.5180	-0.0109	**1.0154**	-0.5796
	G	0.5473	0.3994	0.3496	0.0041	0.2687	0.2810	-0.2353	-0.1747	0.5350	0.0070	**0.7110**	-0.6385
TW	P	-0.5388	-0.4251	-0.2985	-0.0044	0.0016	-0.0692	0.3277	0.2912	-0.2280	0.1304	-0.5325	**0.9329**
	G	-0.8986	-0.6475	-0.4717	-0.0037	-0.0816	-0.1745	0.5023	0.4637	-0.3416	0.1911	-0.8131	**0.8470**
GYP	P	-0.1731	-0.0967	-0.0408	0.0118	0.2169	0.1171	0.2251	0.307*	0.269*	0.2026	0.433**	0.444**
	G	-0.1923	-0.0981	-0.0500	0.0275	0.2001	0.1602	0.1554	0.2238	0.282*	0.2236	0.413**	0.446**

DF50: Days to 50% Flowering, **DM**: Days to Maturity, **PH**: Plant Height, **FLL**: Flag Leaf Length, **FLW**: Flag Leaf Width, **NTT**: Number of Total Tillers, **NPT**: Number of Productive Tillers, **PL**: Panicle Length, **BM**: Biomass, **H.I**: Harvest Index, **NGPP**: Number of Grains per Panicle, **TW**: Test Weight, **GYP**: Grain Yield per Plant, **P**: Phenotypic, **G**: Genotypic



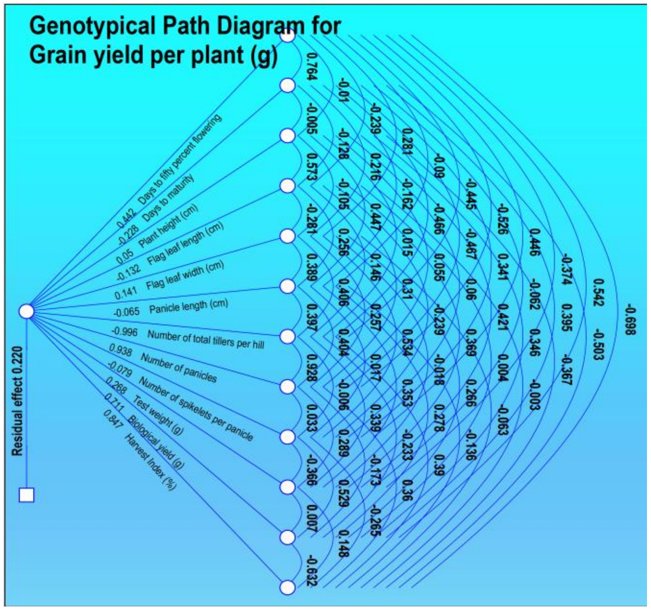


Figure 3: Phenotypical Path Diagram **Figure 4: Genotypical Path Diagram**

CONCLUSION

It is concluded from the current study that among 23 genotypes of Rice, BPT-3291 was found superior followed by SIGNET-5455 for grain yield per hill, DHAN-44 is the earliest days to maturity. Analysis of Variance related that significance variability was found from all the yield contributing characters high PCV and GCV and days to maturity high heritability coupled with high genetic advance as percent mean. From grain yield per hill (40.347) harvest index% (41.716) biological yield (40.487) number of tillers for hill (44.027) The significant positive correlations were observed for No of Spikelet per Panicle, No of Total Tillers per hill, Harvest Index, Biological Yield with Grain Yield per Hill, Test Weight, Flag Leaf Width, No of Panicles per Tillers, Plant Height, Flag Leaf Length, Days To Maturity and Days to Fifty percent Flowering. Direct positive effect on grain yield per hill was observed by biological yield per plant (0.413), harvest index (0.446) and number of spikelets per panicle (0.282). These characters indicated that they may be included in selection criteria for crop improvement programme in rice.

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