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Studies on Genetic Variability, Heritability and Genetic advance for yield and quality components in rice (*Oryza sativa* L.)

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Abstract
The present investigation consists of 29 rice genotypes including one check, which were obtained from IRRI (Philippines) and others from Department of Genetics and Plant Breeding, SHUATS, Allahabad. The experiment was conducted during *Kharif* 2016 in RBD with three replications. The data were recorded for 13 quantitative characters to study genetic variability, heritability and Genetic advance. Analysis of variance revealed that there is considerable variability among the genotypes. Genotypes NDR-1045 (2%EMS), IRRI-181, AOQINH-2HAN, CT-16658-S-2-8-35-R-3-1-3MP and NDR-359(C). A close perusal of variability coefficients revealed that the differences between PCV and GCV was small indicating little influence of environment on the expression of the characters studied. High to moderate estimates of GCV and PCV were recorded for grain yield per hill, harvest index, spikelets per panicle, tillers per hill, flag leaf length, panicles per hill. High estimates of heritability were observed for spikelets per panicle, days to maturity, biological yield, grain yield per hill, panicles per hill and tillers per hill. High estimates of heritability along with moderate to low estimates of genetic advance were observed for spikelets per panicle, seed yield per plant, tillers per plant, panicles per plant and biological yield per hill.

Keywords: Variability, Heritability, Genetic advance

1. Introduction
Rice (O*ryza sativa L.*) is one of the staple cereal crops of the world and it is one of the main sources of carbohydrate for nearly one half of the world population. However, more than 90% of this rice is produced and consumed in Asia, where it is a staple for a majority of the population, including the region's 560 million hungry people. Cultivation of rice is important for the food security of Asia. India has a long history of rice cultivation and stands first in rice area and second in rice production, after China.
The current global population of 7.4 billion is expected to reach 8.1 billion by 2025 and 9.6 billion by 2050 (Department of Economics and Social Affairs-2015). Most of these populations' increases will occur in developing countries of Asia and Africa, where rice is the staple food. Globally, rice is cultivated now on 159 million hectares with annual production of around 685 million tonnes and average productivity of 4.4 tonnes/ha (FAO 2104-15) [13].
Rice (*Oryza sativa L.*) is a major food crop for the world. It is mainly produced in Asia with over 90% of total production. The total global land area covered by rice is 158 million hectares with production 678 m t with an average productivity of 3.9t/ha. The world consumption of rice is increasing an average by 1% per annum yet productivity is only going up by 0.5% (Ministry of Agriculture, 2012).

2. Materials and Methods
The present investigation was carried out in the Field Experimentation Centre of Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, U.P, India. The experimental materials for the present study consisted of twenty nine genotypes of rice including 1 local check.The experiment were laid out in a Randomized Block Design (RBD) with three replications. The experimental material was planted in three replications. Each replication consisted of twenty nine genotypes randomized and replicated within each block. Twenty five days old seedlings were transplanted 20cm apart between rows and 15 cm within the row. All necessary precautions were taken to maintain uniform plant population in each treatment per replication All the recommended package of practices were followed along with necessary prophylactic plant protection measures to raise a good crop. Observations were recorded and the data was subjected to statistical analysis. The variability was estimated as per procedure for analysis of

variance suggested by Panse and sukhatme (1985**),** PCV and GCV were calculated by the formula by Burton (1952) heritability in broad sense (h2) by Burton and De Vane (1953) and genetic advance i.e., the expected genetic gain were calculated by using the procedure given by Johnson *et al.* (1955).

3. Results and Discussion

Analysis of variance revealed significant differences for all the characters indicating sufficient variability among the genotypes. This indicated that the genotypes were possessing inherent genetic variance among themselves with respect to the characters studied (Table 1**).** Bekele *et al.*, (2013) [5]. On the basis of mean performance highest grain yield per hill was observed by the genotypes NDR-1045 (2%EMS), IRRI-181, AOQINH-2HAN, CT-16658-S-2-8-35-R-3-1-3MP and NDR-359 (C).Maximum genotypic coefficient of variance(GCV) and Phenotypic coefficient of variance(PCV) was observed for grain yield per hill and spikelets per panicle indicating that these characters could be used as selection for crop improvement. Similar findings were reported by Singh *et al.*, (2002) [7]. High heritability was observed for all the character. High genetic advance were observed for number of spikelets per panicle. Similar results were also reported by Dhanwani *et al*., (2013) [8]. High heritability coupled with high genetic advance as percent mean were observed for grain yield per hill, spikelets per panicle, tillers per plant, test weight, panicles per plant, flag leaf length and biological yield per yield. Similar results were also reported by Dhanwani *et al*., (2013) [8]. High heritability coupled with high genetic advance as percent mean were observed for grain yield per plant, spikelets per panicle, tillers per plant and flag leaf length (Table 2). Similar results were also reported by Singh *et al*., (2013) [21].

4. Conclusion

The present investigation included 29 genotypes of rice was carried out in order to study the nature and amount of variability, heritability and genetic advance for 13 quantitative characters and 5 quality parameters of best performing rice genotypes based on yield and number of spikelets. On the basis of mean performance, the highest grain yield per hill was observed for the rice genotypes NDR-1045(2%EMS) was found superior in grain yield followed by IRRI-181(29.63) and CT-18148-6-9-5-1-2MMP (28.13g). High heritability coupled with high genetic advance as percent mean were observed for grain yield per hill, spikelets per panicle, tillers per plant, test weight, panicles per plant, flag leaf length and biological yield per yield. Similar results were also reported by Dhanwani *et al*., (2013) [8]**.** Selection of plants based on these traits would certainly lead to improvement in grain yield.

Table 1: Analysis of variance for 13 characters in 29 RICE GENOTYPES during *Kharif*-2016

S. No	Parameter	Mean sum of squares		
		Replications (Df=2)	Treatments (Df=28)	Error (Df=56)
1	Days To 50% Flowering	5.92	232.90	6.79
2	Plant Height	12.77	462.95	5.08
3	Flag Leaf Length	2.60	76.99**	1.69
4	Flag Leaf Width	0.00028	0.05**	0.001
5	Tillers Per Hill	0.25	12.26**	0.09
6	Panicles Per Hill	0.055	5.30**	0.03
7	Panicle Length	4.88	14.65**	1.74
8	Spikelets Per Panicle	1.39	2637.26**	11.81
9	Days To Maturity	1.47	156.50	0.84
10	Biological Yield	0.56	189.42	1.08
11	Harvest Index	1.65	156.42	12.49
12	Test Weight	0.011	16.21**	0.16
13	Grain Yield Per Hill	0.33	78.94**	0.49

*Significant at 1% and 5% level of significance respectively.

Table 2: Genetic parameters for 13 quantitative characters in 28 GENOTYPES of rice during *Kharif* -2016

S. No	Characters	Vg	Vp	Coefficient of variation		h^2% (B.S)	GA	GA as % of mean
				GCV	PCV			
1	Days to 50% Flowering	75.372	82.163	9.122	9.524	91.7	17.129	17.998
2	Plant Height	152.624	157.712	12.275	12.478	96.8	25.036	24.876
3	Flag Leaf Length	25.102	26.795	14.889	15.383	93.7	9.990	29.688
4	Flag Leaf Width	0.017	0.018	9.738	10.026	94.3	0.262	19.485
5	Tillers per hill	4.059	4.151	18.413	18.619	97.8	4.105	37.510
6	Panicles per hill	1.757	1.793	14.865	15.013	98.0	2.704	30.320
7	Panicle Length	4.304	6.044	8.132	9.637	71.2	3.606	14.135
8	Spikelets per Panicle	875.147	886.966	20.493	20.631	98.7	60.533	41.933
9	Days to Maturity	51.885	52.735	5.805	5.852	98.4	14.718	11.862
10	Biological Yield	62.777	63.866	13.712	13.830	98.3	16.182	28.005
11	Harvest index	47.974	60.473	19.138	21.487	79.3	12.709	35.115
12	Test Weight	5.350	5.511	9.830	9.976	97.1	4.695	19.952
13	Grain Yield per hill	26.150	26.645	24.371	24.601	98.1	10.436	49.736

σ^2g = Genotypic variance. σ^2p = Phenotypic variance. h^2 = Heritability (broad sense), GCV = Genotypic coefficient of variation. PCV = Phenotypic coefficient of variation.

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