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Anand Singh
M. Sc. (Ag) Student Deptt. of G.P.B N.D.U.A.T, Faizabad, Uttar Pradesh, India

Amar Pal Singh
Asstt. Prof. Deptt.of Hort. and forestry, N.D.U.A.T, Faizabad, Uttar Pradesh, India

Neeraj Singh
M. Sc. (Ag) Student Deptt. of Agril. Stat. N.D.U.A.T, Faizabad, Uttar Pradesh, India

Avanish Kumar Singh
M. Sc. (Ag) Student Deptt. of Agronomy N.D.U.A.T, Faizabad, Uttar Pradesh, India

Shivam Singh
M. Sc. (Ag) Student Deptt. of Pathology N.D.U.A.T, Faizabad, Uttar Pradesh, India

Himanshu Singh
M. Sc. (Ag) Student Deptt. of G.P.B N.D.U.A.T, Faizabad, Uttar Pradesh, India

Abhineet Singh,
M. Sc. (Ag) Student Deptt. of Agronomy N.D.U.A.T, Faizabad, Uttar Pradesh, India

SV Singh
M. Sc. (Ag) Student Deptt. of Pathology N.D.U.A.T Faizabad, Uttar Pradesh, India

Correspondence
Anand Singh
M. Sc. (Ag) Student Deptt. of G.P.B N.D.U.A.T, Faizabad, Uttar Pradesh, India

Studies on seed quality parameters alongwith yield attributing traits in rice (*Oryza sativa* L.)

Anand Singh, Amar Pal Singh, Neeraj Singh, Avanish Kumar Singh, Shivam Singh, Himanshu Singh, Abhineet Singh, and SV Singh

Abstract
An evaluation of twenty seven accessions of Rice (*Oryza sativa* L.) was carried out during 2017-2018 in Randomized Block Design (RBD) with three replications at CRS (Cental Research Station) Mashodha Faizabad (U.P.) revealed highly significant differences among the accessions for all seed vigour traits alongwith seed yield attributing traits. Observations were recorded on fourteen seed yield attributing traits including seed vigour traits *viz.*, Days to 50% flowering, Days to maturity, Plant height (cm), No. of tillers/plant, No. of panicle bearing tillers/plant, Panicle length(cm), No. of seeds/panicle, 1000-seed weight (g), Biological yield, Harvest Index, Germination (%), Seedling length (cm), Vigor index (Abdul-Baki, A.A. and Anderson, J.D. 1973), Seed yield/plant (g). Highly significant differences were observed among the genotypes for all the seed vigour traits. The phenotypic co-efficient of variability (PCV) ware close to genotypic co-efficient of variability (GCV) for more of the traits which indicate that environmental effect has no considerable effect on the total phenotypic variation. Heritability and genetic advance indicated that the nature action and reliability or those characters for selection and emerged as ideal traits for improvement through selection.

Keywords: Phenotypic variation, Co-efficient of variations, genetic advance, heritability, seed vigour

Introduction
Rice (*Oryza sativa* L.) is the most important staple food crop of the world because of being the major source of calories of more than half of the total global population. The importance of rice is not only as a fundamental commodity and primary food source for more than half of the world's population, but also influences issues of global concern such as food security and development. More than 90 per cent of the world's rice is grown and consumed in Asia, known as rice bowl of the world, where 60 per cent of the earth's people and two third of world's poor live. Rice being the staple food for more than 70 per cent of our national population and source of livelihood for 120-150 million rural households is backbone to the Indian Agriculture.

Rice (*Oryza sativa* L.) is a semi-aquatic annual grass plant belongs to the genus *Oryza*, tribe Oryzeae and family Poaceae. It is the second largest principal food crop in the world after wheat and is one of the main staple food crop in India. Besides being the staple food crop, it has been the cornerstone of food and culture for our people. Among seven billion people on the earth, more than half of them depend on this crop for principal source of energy in their daily diet. Rice is distributed over a wider range of latitude from 50 ^{0} N to 40 ^{0} S and is being grown up to an altitude of 2500 meters. It evolved in humid tropics as a semi aquatic plant and it has got unique adaptive nature to hot humid environment, which is not seen in any other major cereal crop.

Rice yield in India fluctuate greatly in time and space on account of its cultivation under diverse weather, ecological and socio-economic conditions. Out of the total 43.86 million ha. under rice, 20 million ha. area is irrigated and the remaining 23.86 million ha. area is cultivated in rainfed conditions. Rice can be grown under different agro-ecological environments.

Protein content of milled rice is 6-7 per cent, rice however, compares favorably with other cereals in amino acid content. The biological value of protein is high, the fat content of rice is low (2.0-2.5%) and much of the fat is lost during milling. Rice grain contains as much B group vitamin as wheat.

Milled rice losses valuable proteins, vitamins and minerals in the milling process during which embryo and aleurone layer are removed and much of the loss of nutrients can avoided through parboiling process. The by-products of rice milling are used for a variety of purposes. Rice bran is used as cattle and poultry feed. Rice hull can be used in manufacture of insulation materials, cement and cardboard as well as a litter in poultry keeping. Rice straw can be used as cattle feed as well as litter during winter. Rice is grown almost throughout the year in hot and humid reasons of eastern and southern parts of India where two or three crops in a year is uncommon. Rice, being the staple food for more than 70 percent of our national population along with the source of livelihood for 120-150 million rural households.it is a backbone to the Indian agriculture. Rice production (according to USDA 2016/2017) is forecast higher at 105 MMT from 43.5 million hectare compared to 2015/16 production of 103.5 million tons in India (Grain report 2016).

Materials and Methods

The study was designed to work out the status of association of different seed yield traits and direct and indirect effects of these different traits on seed yield per plant among twenty seven rice genotypes at field experiment under present investigation was conducted during Kharif 2017-18 at the Central research station (Mashodha, Faizabad) and lab experiments were conducted in Seed Testing Laboratory, Seed Technology Section, N. D. University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) India. The experimental materials of studies comprised of twenty seven Rice varieties/ lines/ genotypes excluding three check varieties *viz*., NDR97, Baranideep and Shushk Samrat these varieties were procured from genetic stock available in Rice section, Department of genetics and Plant Breeding, N. D. University of Agriculture and Technology, Narendra Nagar (Kumarganj), Faizabad (U.P.) India. The experiment was laid out in Randomized Block Design. The observation were recorded on Fourteen different seed yield traits *viz*., days to 50% flowering, days to maturity, plant height, number of seeds per panicle, panicle length, harvest index, number of tillers per plant, number of panicle bearing tillers per plant, 1000-seed weight, biological yield, Germination percent, Seedling length, Vigour index and Seed yield per plant. Standard statistical techniques such as correlation between different characters and path coefficient analysis.

Seed germination percentage was investigated under lab condition germination was estimated on the basis of 100 randomly selected seeds kept for germination in germination paper at room temperature in germinator. The samples were kept in seed germinator maintained at 20^0 c ±1. Ten seedlings were randomly taken from each replication. On 8th day seedlings were measured on meter scale, the unit of length was in cm. The vigour index was conducted as per the method prescribed by Abdul-Bali and Anderson (1973) [1] and expressed in whole number. The seed were. kept for germinate fallowing ISTA method. The seedlings were measured for seedling length to obtain seedling length.

Results and Discussions

The results of analysis of variance for Randomized Complete Block Design for eleven characters of 27 rice germplasm along with 3 check varieties have been presented in Table-1. The mean squares due to genotypes were highly significant for all the characters under study. The mean squares due to replications were non-significant for all the characters.

The success of selection in improving plant characters depends on presence of substantial genetic variability and nature of heritability and gene action. The genetic variability is the raw material of plant breeding programme on which selection acts to evolve superior genotypes. The phenotypic and genotypic coefficients of variation can be used for assessing and comparing the nature and magnitude of variability existing for different characters in the breeding materials. Heritability in broad sense quantifies the proportion of heritable genetic variance to phenotypic variance, while heritability in narrow sense represents the ratio of fixable additive genetic variance to total phenotypic variance. Estimates of heritability help in estimating expected progress through selection. The genetic advance in per cent of mean provides indication of expected selection response by taking into account the existing genetic variability and heritability of the character. The estimates of direct selection parameters, coefficients of variation, heritability and genetic advance in per cent of mean were computed for 14 characters of 30 genotypes.

The highest estimates of phenotypic (PCV) and as well as genotypic (GCV) coefficient of variation were observed for plant hieght (PCV = 15.79%, GCV = 15.12%), followed by vigour index, and 1000 seed weight. Thus, above mentioned four characters were characterized by high estimates (>10%) of PCV as well as GCV. The existence of high variability for above characters in rice has also been reported earlier by Saxena *et al.* (2005) [24], Panwar *et al.* (2007) [20], Kumar and Ramesh (2008) [15], Singh *et al.* (2008) [26], Vijaylaxmi *et al*. (2008), Kard and Paul (2008) [13], Raut (2009) [21], Sarangi *et al.* (2009) [23], Kuchnaur *et al.* (2009), Jayasudha and Sharma (2011) [12] and Ashish *et al*. (2016) [6].

The Moderate estimates (> 5% to 10%) of PCV as well as GCV were recorded in case of seeds per panicle (PCV = 8.08%, GCV = 7.41%), seedling length (PCV = 7.65%, GCV = 7.00%), 1000-seed weight (PCV = 14.74, GCV = 14.81%) and days to maturity (PCV = 12.95%, GCV = 12.84%). Remaining traits, viz. seed germination per cent (PCV = 3.11, GCV = 2.80), and panicle length (PCV = 6.51, GCV =4.65%) possessed low (<10%) values of PCV as well as GCV.

The results of the presented study in respect of genotypic and phenotypic coefficient of variation are broadly in the findings of earlier workers Mishra and Verma (2002) [6], Nayak *et al*. (2002) [18], Chand, *et al.* (2004) [8], Hasib *et al*. (2004) [10], Suman *et al.* (2005) [30] and Verma *et al*. (2013) [33].

Table 1: Analysis of variance for 14 characters in rice germplasm

Characters	Source of variation		
	Replications	**Treatments**	**Error**
Degree of freedom	**2**	**29**	**58**
Days to 50% Flowering	0.278	31.985**	0.588
Days to Maturity	0.278	44.223**	0.588
Plant Height cm	52.341	674.237**	19.778
Tillers/ Plant	0.286	2.060**	0.207
Panicle Bearing Tillers/ Plant	0.126	1.647**	0.055
Panicle Length cm	0.410	9.938**	0.697
Seeds/ Panicle	13.878	613.180**	36.395
Test Weight	0.012	9.507**	0.004
Biological Yield/Plant	0.409	22.259**	2.625
Harvest Index	0.001	5.665**	0.006
Germination %	2.233	19.738**	1.440
Seedling Length	0.262	10.748**	0.648
Vigour Index	3735.595	124929.060**	5560.861
Yield/ Plant	0.850	10.478**	1.137

*,** Significant at 5 (%)and 1 (%) probability levels, respectively.

Table 2: Estimates of range, grand mean, coefficients of variation (%), heritability and genetic advance for 14 characters in rice germplasm

S. No	Characters	Range (lowest-Highest)	Grand Mean (X)	Coefficient of variation		Heritability in broad sense (%)[$h^2_{(bs)}$%]	Genetic advance in percent of mean (G %)
				PCV (%)	GCV (%)		
1.	Days to 50% flowering	71-86	80.44	4.13	4.02	94.68	8.06
2.	Days to maturity	98-114	108.14	3.60	3.53	96.11	7.12
3.	Plant height (cm)	68-124	97.70	15.79	15.12	91.69	29.82
4.	Tillers/ plant	9.78-12.8	10.87	6.66	5.98	80.63	11.06
5.	Panicle bearing tillers/ plant	7.50-9.83	8.37	6.77	6.23	84.71	11.81
6.	Panicle length cm	18.50-22.88	20.87	6.51	4.65	81.55	6.84
7.	Seeds/ panicle	163.33-229.67	187.11	8.08	7.41	84.08	14.00
8.	1000- seed weight	18.93-27.93	21.14	8.53	8.37	96.18	16.90
9.	Biological yield/plant	75.52-86.24	80.90	5.01	2.11	71.37	1.84
10.	Harvest index	38.20-43.43	40.61	3.46	3.35	93.58	6.67
11.	Germination %	85-95	88.20	3.11	2.80	80.90	5.19
12.	Seedling length (cm)	23.03-31.27	26.20	7.65	7.00	83.86	13.21
13.	Vigour Index	2043.37-2844.20	2312.32	9.21	8.63	87.74	16.65
14.	Seed yield/ plant (g)	28.85-36.80	32.87	6.78	5.05	73.24	7.73

5.3 Heritability and genetic advance

The important direct selection parameters, heritability in broad sense [$h^2_{(bs)}$] and genetic advance in per cent of mean (Ga), provide index of transmissibility of traits which gives indication about the effectiveness of selection in improving the characters. The high order of heritability coupled with moderate genetic advance in per cent of mean was observed for plant height, 1000-seed weight, Vigour index, seed per panicle, seedling length, panicle bearing tillers per plant, no. of tillers per plant, days to maturity, days to 50% flowering, harvest index, panicle length, seed germination percent, seed yield per plant and biological yield per plant. (Table 2). Above mentioned characters, exhibiting very high h^2 also showed high and medium GCV and PCV values, which indicated that these would be ideal traits for improvement through selection owing to their high transmissibility and variability. Thus, the germplasm lines evaluated and /or segregating generations derived from them may provide very high response to selection for the characters exhibiting high heritability along with very high genetic advance in per cent of mean The high estimates of heritability and genetic advance observed in present study are in agreement with available literature in rice Chaudhary and Motiramani (2003) [9]; Islam *et al*. (2004); Verma *et al*. (2006) [13]; Singh *et al.* (2007) [27]; Kumar and Ramesh (2008) [15]; Raut *et al.* (2009) [21]; Ahmadikhan (2010) and Seyoum *et al.* (2012) [25].

Among the remaining cheaters seeds per panicle recorded moderate heritability, high genetic advance and high GCV and PCV values, which indicate that traits may provide reasonable selection response, if the lines evaluated in present investigation are subjected to exploitation in breeding programme. The occurrence of moderate heritability and moderate genetic advance in per cent of mean with moderate to low GCV and PCV were observed values for panicle length and germination index indicated chances of little improvement through selection due to high variability even if heritability values were moderate. The use of simple selection methods will not be suitable for improving the characters showing low or moderate estimates for these parameters.

The high heritability and high genetic advance was observed for most of the characters under study are in accordance with the earlier reports Verma *et al.,* (2006) [13]; Singh *et al.,* (2007) [28]; Karad and Paul (2008); Kumar and Ramesh, (2008); Vijaylaxmi *et al.,* (2008); Bughio *et al.* (2009); Raut *et al.* (2009) [21]; Sarangi *et al.* (2009) [23]; Ahmadi khan (2010) and Akinwale *et al.* (2011) [3].

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