Current Journal of Applied Science and Technology

Volume 42, Issue 22, Page 34-39, 2023; Article no.CJAST.104058
ISSN: 2457-1024
(Past name: British Journal of Applied Science & Technology, Past ISSN: 2231-0843, NLM ID: 101664541)

Morphological Screening and Genetic Variability Analysis in Rice (*Oryza sativa* L.) Genotypes for Salinity Tolerance

Anoushka Singh [a*], D. K. Dwivedi [b*], N. A. Khan [b], Saurabh Dixit [b], Soumya Antardani [a], Ritendra [a], Pooja [a] and Preeti Kumari [b]

[a] Department of Plant Molecular Biology and Genetic Engineering, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229, Uttar Pradesh, India.
[b] Department of Genetics and Plant Breeding, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229, Uttar Pradesh, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/CJAST/2023/v42i224167

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/104058

Original Research Article

Received: 22/05/2023
Accepted: 28/07/2023
Published: 05/08/2023

ABSTRACT

This experiment was conducted to estimate the genetic variability and correlation between yield and yield related characters of 22 rice genotypes at Genetics and Plant Breeding Farm of Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya. This experiment was laid in Randomized Block Design (RBD) during *Kharif* season of 2022-23 under saline condition. Analysis of variance shows significant differences among 22 rice genotypes under saline

**Corresponding author: E-mail: anoushkasingh22@gmail.com;*

condition. GCV (Genotypic coefficient of variation) and PCV (Phenotypic coefficient of variation) estimates were higher for traits such as panicle bearing tillers/plant, harvest index and biological yield indicating selection of rice genotypes for yield and component traits under saline condition. High heritability coupled with higher genetic advance was observed for traits like grains/panicle, days to 50% flowering, spikelets number and plant height. Grain yield/plant was strongly related to harvest index, panicle bearing tiller /plant and biological yield per plant. Path coefficient analysis showed that harvest index followed by biological yield /plant and panicle bearing tillers/plant has positive direct effect on grain yield/plant.

Keywords: GCV; PCV; correlation; heritability; genetic advance; path analysis.

1. INTRODUCTION

"Rice (*Oryza sativa)* comes under Poaceae family (Gramineae). The haploid chromosome number of rice is n=12 (2n=24).Either the species is diploid or tetraploid. Both *O. sativa* L. and O. glaberrima L. are diploid. It is *Kharif*, annual and tropical crop. Rice after wheat is 2^{nd} most important crop covering almost 90% of area across Asia alone" [1]. United States Department of Agriculture estimates world rice production 2022-23 of 503.27 million metric tonnes. India approximately had 46 million hectares of land under cultivation of rice. Total production of rice during 2022-23 in India was 104.99 million metric tonnes (Ministry of Farmer and Agriculture Welfare).

In India, saline soil covers roughly 9.38 million ha, in which 5.5 million ha are coastal saline and 3.88 million ha are other saline soils. Saline soils area are found from Gujarat (West) to Jammu & Kashmir (Ladakh region) (North) and from the Andaman & Nicobar Islands (East) to Kanyakumari (South). Saline soil causes significant danger on the ability to raise food production to keep up with rising demand [2]. Rice is extremely susceptible to salinity, especially when it is still at seedling stage. The main reason in a variety of physiological impairments and plant-inhibiting process is a high concentration of harmful ions, especially Na^+, which is brought on by salinity. From a physiological perspective, it interferes with potassium absorption, which is crucial for maintaining membrane potential, enzyme activity and cell turgor [3]. Due to correlation, path coefficient analysis determines the direct and indirect effects used by various traits on grain yield. Through critical examination of the genetic variation influencing yield-related quantitative parameters, crop productivity under salt-stressed soil can be improved. The heritability is the percentage of the total that is passed down from parent to offspring. Genetic progress and heritability work together to predict genetic gain (Singh and Verma, 2018).

2. MATERIALS AND METHODS

2.1 Plant materials and Experimental Design

The present investigation were carried out during *Kharif* season in Randomized Block Design (RBD) at Genetics and Plant Breeding Farm of Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya (U.P.) during 2022-23. All 22 genotypes were sown in nursery bed on 26 June 2023 and 35 days old healthy seedlings were transplanted on 30 July 2023 with a spacing of 20 x 15 cm with one seedling per hill.

2.2 Data Collection

Observations on quantitative traits like days to 50% flowering, plant height (cm), panicle length(cm), panicle bearing tillers per plant, spikelets per panicle, grains per panicle, spikelet fertility(%), test weight (g), biological yield /plant (g), harvest index and grain yield per plant(g) were recorded on five randomly selected plants from each replication excluding border rows while days to 50% flowering and grain yield was calculated on plot basis. Agronomic practices were carried out as per recommendation to raise a good and healthy crop.

2.3 Statistical Analysis

The analysis of variance for the design of experiment was carried out according to the procedure outlined by Panse and Sukhatme [4], coefficient of variability was done as per Burton and de Vane [5], correlation was calculated as per method suggested as per Searle [6], heritability and genetic advance was calculated as per methods of Hanson et al. (1956) and Johnson et al. [7] respectively and path analysis was computed according to Dewey and Lu [8].

3. RESULTS AND DISCUSSION

For all 11 characters, an analysis of variance (ANOVA) was performed using 22 rice genotypes under saline condition. Analysis of variance shows significant differences among treatments which shows that there was significant variation among 22 rice genotypes as presented in Table 1.

Estimates of grand mean, phenotypic coefficient of variability (PCV), genotypic coefficient of variability (GCV), heritability in broad sense (h^2b) and genetic advance in percent of mean for 11 characters in 22 rice genotypes under saline condition are presented in Table 2. It shows that in general phenotypic coefficient of variation (PCV) higher than genotypic coefficient of variation (GCV) this shows the effect of environment on the character.

High magnitude of PCV was observed for panicle bearing tillers/plant, harvest index and biological yield. This indicates that these characters can be manipulated for high yielding varieties through hybridization and selection in subsequent generations in rice improvement.

High estimates of heritability were observed for grains per panicle, days to 50% flowering, spikelet number and plant height (Table 2) under saline condition. Grains/panicle, spikelets number, days to 50% flowering, plant height, biological yield/plant, spikelet fertility %, harvest index, panicle length, test weight and grain yield/plant showed high values of genetic advance in percent of mean. Fiyaz et al. [9] and Rahman et al. [10] showed similar result.

The simple linear correlation coefficient between all the pairs of studied traits are given in Table 3. Grain yield showed highly significant and positive correlation with harvest index, panicle bearing tillers/plant and biological yield/plant and significant and negative correlation with days to 50% flowering. Under saline condition harvest index showed maximum positive direct effect followed by biological yield/plant and panicle bearing tillers/plant on grain yield/plant as presented in Table 4. This suggests that these traits can be utilized for developing high yielding varieties. Mishra et al. [11] and Kulsum et al. [12] showed similar result [13-15].

Table 1. Analysis of variance for different characters

Characters	Sources of variation		
	Replication	Treatment	Error
d.f.	2	21	42
Days to 50% flowering	8.92	280.05**	9.08
Plant height (cm)	61.60	352.97**	22.77
Panicle bearing tillers/ plant	3.05	4.89**	0.99
Panicle length(cm)	1.61	13.87**	1.34
Number of spikelets	3.18	877.08**	41.88
Grains / panicle	42.16	563.16**	16.73
Spikelet fertility (%)	5.16	61.08**	7.75
Test weight	1.67	12.24**	2.56
Biological Yield	10.45	80.35**	12.1
Harvest Index	6.81	63.93**	12.41
Grain yield	2.39	7.15**	0.8

,Significant at 5% and 1% probability levels, respectively*

Table 2. Estimates of grand mean, (PCV), (GCV), heritability in broad sense (h^2b) and genetic advance in percent of mean for 11 characters in 22 rice genotypes under saline condition

Characters	Grand mean	Coefficient of variation		Heritability in broad sense (%)	Genetic advance in percent of mean
		PCV	GCV		
Days to 50% flowering	92.53	10.78	10.27	90.9	20.17
Plant height (cm)	100.04	11.52	10.49	82.9	19.66
Panicle bearing tillers/plant	9.71	15.57	11.75	56.9	18.26
Panicle length(cm)	21.54	10.9	9.49	75.7	17.01
Spikelets number	124.32	14.4	13.42	86.9	25.78
Grains / panicle	97.37	14.48	13.86	91.6	27.33
Spikelet fertility (%)	79.52	6.35	5.3	69.6	9.12
Test weight(g)	24.21	9.94	7.42	55.7	11.41
Biological Yield(g)	40.73	14.5	11.71	65.3	19.49
Harvest Index(g)	35.69	15.24	11.61	58	18.23
Grain yield(g)	14.33	11.92	10.15	72.5	17.80

Table 3. Phenotypic correlation under saline condition

Characters	Days to 50% flowering	Plant height (cm)	Panicle bearing tillers/plant	Panicle length	Spikelet No.	Grain per panicle	Spikelet Fertility %	Test weight (g)	Biological Yield/plant (g)	Harvest Index (%)	Grain yield / plant (g)
Days to 50% flowering	**1.000**	0.197	0.048	-0.179	0.119	0.148	-0.204	-0.068	0.069	-0.285*	-0.276*
Plant height (cm)		**1.000**	-0.101	0.273*	-0.040	-0.017	-0.224	-0.034	-0.058	0.017	-0.052
Panicle bearing tillers/plant			**1.000**	0.030	-0.143	0.206	0.175	0.048	0.287*	-0.018	0.369**
Panicle length				**1.000**	-0.176	-0.080	0.052	0.334**	0.236	0.011	0.274*
Spikelet No.					**1.000**	0.712**	-0.253*	-0.150	0.218	-0.011	0.261*
Grain per panicle						**1.000**	0.064	-0.224	0.222	0.022	0.293*
Spikelet Fertility %							**1.000**	0.184	-0.054	0.099	0.024
Test weight (g)								**1.000**	0.201	0.053	0.281*
Biological Yield/plant (g)									**1.000**	-0.655**	0.322**
Harvest Index (%)										**1.000**	0.489**

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

Table 4. Direct and indirect effect for different characters on grain yield per plant under saline condition at phenotypic level in rice genotypes

Characters	Days to 50% flowering	Plant height (cm)	Panicle bearing tillers/plant	Panicle length	Spikelet No.	Grain per panicle	Spikelet Fertility %	Test weight (g)	Biological Yield/plant (g)	Harvest Index (%)	Grain yield / plant (g)
Days to 50% flowering	**-0.027**	-0.001	0.006	-0.005	0.012	-0.007	0.008	-0.001	0.071	-0.332	-0.276*
Plant height (cm)	-0.005	**-0.006**	-0.013	0.007	-0.004	0.001	0.009	0	-0.059	0.02	-0.052
Panicle bearing tillers/plant	-0.001	0.001	**0.126**	0.001	-0.015	-0.01	-0.007	0	0.295	-0.021	0.369**
Panicle length	0.005	-0.002	0.004	**0.026**	-0.018	0.004	-0.002	0.003	0.242	0.013	0.274*
Spikelet No.	-0.003	0	-0.018	-0.005	**0.101**	-0.035	0.01	-0.001	0.224	-0.012	0.261*
Grain per panicle	-0.004	0	0.026	-0.002	0.072	**-0.049**	-0.003	-0.002	0.228	0.026	0.293*
Spikelet Fertility %	0.006	0.001	0.022	0.001	-0.026	-0.003	**-0.039**	0.001	-0.055	0.115	0.024
Test weight (g)	0.002	0	0.006	0.009	-0.015	0.011	-0.007	**0.008**	0.206	0.062	0.281*
Biological Yield/plant (g)	-0.002	0	0.036	0.006	0.022	-0.011	0.002	0.002	**1.028**	-0.762	0.322**
Harvest Index (%)	0.008	0	-0.002	0	-0.001	-0.001	-0.004	0	-0.673	**1.163**	0.489**

R Square = 0.9742 Residual effect = 0.1606

Bold values show direct and normal values show indirect effect

4. CONCLUSION

The analysis of variance shows there is presence of sufficient variability among rice genotypes under saline condition. Values of phenotypic coefficient of variation were higher than genotypic coefficient of variation for all the eleven characters under saline condition. Higher magnitudes of phenotypic coefficient of variation were found for panicle bearing tillers/plant, harvest index, biological yield/plant, grain/panicle and spikelet number. High estimates of heritability were observed for grain per panicle, days to 50% flowering, spikelet number, plant height. Whereas medium estimates of heritability were observed for grain yield per plant, spikelet fertility, biological yield per plant, harvest index, panicle bearing tillers per plan and test weight. Under saline condition grains/panicle showed highest value of genetic advance and spikelet fertility showed lowest value of genetic advance. Grain yield showed highly significant and positive phenotypic correlation with harvest index, panicle bearing and biological yield/plant. Harvest index showed maximum positive direct effect on grain yield followed by biological yield/plant and panicle bearing tillers/plant.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ghosh B, Md. Ali N, Saikat G. Response of rice under salinity stress J Res Rice. 2016;4:167.
DOI: 10.4172/2375-4338.1000167
2. Dagar JC. Bull. of National Inst. Eco. 2005;15:69-81.
3. Huong CT, Anh TTT, Duong VX, Trung NT, Khanh TD, Xuan TD. Assessing Salinity Tolerance in Rice Mutants by Phenotypic Evaluation Alongside Simple Sequence Repeat Analysis. Agri. 2020;10(6).
4. Panse VG, Shukhatme PV. Statistical Methods For Agricultural workers. 2ndEdn. ICAR, New Delhi. 1967;152-157.
5. Burton GW, de Vane EM. Estimating heritability in all foscue *(F. arundica*) for replicated clonal material. Agron. J. 1953;45:478-487.
6. Searle SR. The value of indirect selection I. Mass selection. Biometrica. 1961;21:682-709.
7. Johnson HW, Robinson HP, Comstock RE. Estimates of genetics and environmental variability in soyabean. Agron. J. 1955; 47:314-318.
8. Dewey DR, Lu KH. A correlation and path coefficient analysis of crested wheat grass seed production. Agron. J. 1959;51:515-518.
9. Fiyaz A, Ramya KT, Ajay BC, Gireesh C, Kulkarni RS. Genetic variability, correlation and path coefficient analysis studies in rice (*Oryza sativa* L.) under alkaline soil condition. Electr. J. of Plant Breed. 2011;2(4):531-537.
10. Rahman MA, Haque M, Sikdar B, Islam MA, Matin MN. Correlation Analysis of Flag Leaf with Yield in Several Rice Cultivars. J. of Life and Earth Sci. 2014; 8:49–54.
11. Mishra VK, Dwivedi DK, Sunil K, Verma OP. Screening for salinity tolerance at vegetative and reproductive stages in rice (*Oryza sativa* L.). Environment and Ecology. 2012;30(2):355-360.
12. Kulsum U, Sarker U, Rasul MG. Genetic variability, heritability and interrelationship in salt-tolerant lines of T. Aman rice. Genetika. 2022;54(2): 761-776.
13. Bhargava K, Shivani D, Phushpavalli SNCVL, Sundaram RM, Beulah P, Senguttuvel P. Electr. J. of Plant Breed. 2021;12(2):549-555.
14. Chamar JP, Joshi RP, Katkani D, Sahu D, Patel V. Genetic variability, heritability and correlation coefficient analysis in rice. The Pharma Innov. J. 2021;10(5): 763-769.
15. Dhurai SY, Bhati PK, Saroj SK. Studies on genetic variability for yield and quality characters in rice (*Oryza sativa* L.) under integrated fertilizer management. The Bioscan. 2014;9(2):845-848.

© 2023 Singh et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/104058