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Genetic variability in seedling pattern of rice genotypes under water stress and normal condition

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Abstract
Study on twenty rice genotypes noticed high variability in seedling characters for varietal characteristics under normal and water stress. Seedling parameters including water holding capacity of seed (24 hours) may be responsible to specify the selection strategy of genotype(s) supportive to establish good plant. The non-aromatic Gontrabidhan-3 and aromatic Kataribhog cultivars were encouraging to grow quality seedling in both conditions. High genetic variability noticed the superior value in V_{10}. High GCV and least diversity with PCV for root length, fresh weight, dry weight and water holding capacity confirmed the high genetic variability approving for selection. High heritability (H^2 %) coupled with high genetic advance (GA %) can be used as interpreter in selection for quality seedling, a basic need for plant establishment. In alliance of seedlings parameters, vigour index showed high positive significant correlation for all characters under normal and stress. The positive correlation of fresh and dry weight was highly significant to root-shoot length, vigour index and water holding capacity though it was not followed for shoot length in stress.

Keywords: rice, seedling, variability, heritability, correlation

Introduction
The cultivated area of Rice is about 65 per cent under the total cultivated land of major agricultural crops (Adhikari *et al*., 2012) [1] considering three seasons viz., Aus (autumn rice), Aman (winter rice) and Boro (Summer rice). Rice (*Oryza sativa* L.) belongs to Gramineae family (2n=24) and occupies a pivotal place in Indian Agriculture as staple food for more than 70 percent of population. Seeds have a pivotal role in improving rice production qualitatively and qualitatively. Seeds bear the genetic distinctiveness for successful crop production that may be exploited through quality and healthy seedlings in order to increase rice productivity. One of the important determinants of rice seed quality is varietal purity. Varietal purity significantly influences the crop yield stabilization besides affecting the production practices. It is therefore important that farmers become aware the presence of contaminants in their seed-lots. The seedling potentiality is fully related to quality assurance essential for seed production. The observation on genetic variability is accepted with a set of 20 rice genotypes considering the both aromatic and non-aromatic types that can expose significant variability among the genotypes, tested for seed or seedling characters under two different conditions, justifying the genotype selection for future crop improvement programme. Variability is the key factor for any selection program, which can be generated through various ways. To attain or create variability, addition of diverse genotypes with the available collection is necessary for formation of proper variability helpful to fulfil the obligatory selection. The initial pattern of seedlings is closely linked to seed superiority that is very much accommodating in crop establishment. Usually, the description on seedling parameters in the field is the sum total of genotypic expression with interaction of various environmental effects that can reduce in laboratory observations. Hence, the diversity obtained from the lab data of seedling or seed parameters should be verified to ensure that the variability present is at genotypic level.

Materials and Methods
The overall examination based on the laboratory observations while the seeds of diverse genotypes (20) were produced and collected after maturity from Regional Research Station, Chakdah, BCKV for non-aromatic high yielding varieties and C-Block Seed Farm, Kalyani, BCKV for aromatic land races. In non-aromatic groups, the considerable genotypes were Bidhan Mashuri 1 (V_1), Bidhan Moti 7 (V_2), Bidhan Mashuri 7 (V_3), Bidhan Moti 34 (V_4), Gosai Minikit (V_5), Satabdi (V_6), Bidhan Moti 4 (V_7), Bidhan Moti 1(V_8), Gontra Bidhan 1(V_9), Gontra Bidhan 3(V_{10}) and in aromatic group Radhatilak(V_{11}), Lal badshabhog(V_{12}), Kalonunia(V_{13}), Gobindabhog(V_{14}), Kalojira(V_{15}), Radhunipagal(V_{16}), Tulaipanji(V_{17}),

Kataribhog(V_{18}), Harinakhuri(V_{19}), Badshabhog(V_{20}).The seeds of diverse types were evaluated in the RKVY laboratory under Department of Seed Science and Technology, Faculty of Agriculture, BCKV, Mohanpur, West Bengal in the year 2016-2017. The seedlings were developed through Glass-Plate method usable for seed-vigour analysis (Chakraborti, 2010) [3] under two distinct situations i.e. Normal water (C_1) and Water stress of -1 bar (C_2) using PEG 6000. The measurable seedling parameters were percent of germination, speed of germination, root-shoot length, fresh weight, dry weight. and Vigour Index. At initiation of germination up to 24 hours seed soaking, the water holding capacity (WHC) of seed (g) was measured to record the absorption potentiality of seed. The statistical analysis was done through completely randomised design of 2 factors analysis considering 3 replications in each. The outcome was achieved at 1% level of significance by using the software OP STAT. The genotypic and phenotypic coefficient of variation was estimated according to the methods of Burton (1953) [2]. Heritability in broad sense was calculated as per method given by Lush (1940) [5] and Robinson *et al.* (1949) [8]. The expected Genetic Advance as per cent of mean was worked out as suggested by Johnson *et al.* (1955) [4].

Results and Discussion

The superiority of seed or seedling characters facilitated the crop production that directly correlated to genotypic nature of the particular cultivar. Variable nature of diverse cultivated genotypes was grouped into various manners, where non-aromatic high yielding and aromatic land races were most prominent. The genotypic specificity of seed can be judged through the seedling characters that can be initiated at the stage of seed germination during crop cultivation. Potential seed showed good performance by expressing their superiority in seedling parameters measurable under laboratory condition. The strategic approach on different research especially in cultivation practices and breeding programme were very much dependent on seed or seedling specification, where variable nature of a crop genotype should be informative. The study was classified on root-shoot length, fresh-dry weight, percent of germination, speed of germination and decisive quality indicator vigour index. Considering the different characters, a significant variable nature was followed among all genotypes, where V_{10} and V_{18} were encouraging to grow the quality seedlings both in normal and stress. The significance difference was not found in mean value of percent of germination though a variable nature was observed in non aromatic high yielding types. But, the speed of germination in seeds of aromatic land races showed prominence in which V_{16}.V_{20} and V_{30} were top most. The conditions of water showed significant demarcation in between normal and stress for all characters except in speed of germination. In shoot length, the distinct variable nature was observed for all genotypes indicating its peak assessment in V_{18}. V_{10} showed top most value in fresh weight as well as dry weight of seedlings, which is very pertinent to quality analysis of seedlings. Vigour index was judged though measurement of seedling length and percent of germination where V_{10} indicated maximum value in a significant manner. The water holding capacity was top most in V_2 though a moderate value was observed in V_{10} and V_{18}. The water uptake potentiality of various genotypes showed the discrepancy in stress comparing to normal condition of water. In different conditions of water, normal water (C_1) was favourable for seedling growth indicating greater seedling length preciously root and shoot length in comparison to water stress situation, that finally showed its outcome in vigour index of seed.

Table 1: Study on genotypic variability of different rice genotypes considering seedling parameters under normal and stress

Variety	% of Ger(Tr. value)		Sp. G		RL(cm)		SL(cm)		DW(g)		FW(g)		WHC(g)		VI	
	C_1	**C_2**	**C_1**	**C_2**	**C_1**	**C_2**	**C_1**	**C_2**	**C_1**	**C_2**	**C_1**	**C_2**	**C_1**	**C_2**	**C_1**	**C_2**
V_1	91.66(73.77)	82.33(65.66)	19.93	19.30	13.83	15.19	10.14	13.78	0.08	0.06	0.36	0.32	0.317	0.176	2,198.16	2,391.32
V_2	85(67.81)	85.33(68.21)	20.20	19.52	15.33	15.92	11.78	11.10	0.10	0.04	0.40	0.17	0.347	0.224	2,311.38	2,305.69
V_3	85(67.81)	84.67(67.72)	19.68	19.84	15.39	13.68	9.95	13.15	0.08	0.05	0.27	0.21	0.276	0.176	2,157.20	2,274.85
V_4	88.33(70.56)	81.33(64.85)	20.88	19.04	14.37	15.53	9.82	12.32	0.08	0.06	0.34	0.22	0.245	0.139	2,134.31	2,264.56
V_5	90(72.46)	78.33(62.87)	18.90	18.47	12.88	15.15	9.98	11.30	0.09	0.06	0.34	0.32	0.244	0.162	2,052.23	2,075.90
V_6	88.33(70.56)	80.33(64.07)	19.25	18.29	14.56	16.73	9.44	11.98	0.08	0.05	0.26	0.21	0.271	0.160	2,119.66	2,306.48
V_7	83.33(66.33)	81.33(64.85)	19.60	19.59	11.58	15.71	10.80	12.22	0.10	0.05	0.29	0.18	0.300	0.172	1,865.85	2,275.64
V_8	91.66(73.77)	83.67(66.61)	20.33	19.40	19.15	19.90	10.12	13.28	0.10	0.06	0.38	0.35	0.327	0.208	2,685.93	2,777.37
V_9	85(67.81)	82.33(65.70)	19.06	18.57	14.55	14.12	9.30	13.33	0.08	0.07	0.33	0.28	0.323	0.192	2,028.06	2,257.75
V_{10}	91.66(73.77)	85.33(68.21)	19.01	18.70	20.55	21.21	10.24	10.10	0.10	0.07	0.44	0.38	0.265	0.147	2,821.68	2,668.72
V_{11}	88.33(70.56)	81.66(65.03)	18.69	18.89	10.40	10.14	7.78	8.67	0.04	0.03	0.20	0.14	0.207	0.120	1,606.10	1,537.96
V_{12}	86.66(69.08)	79.00(63.10)	18.73	18.71	11.45	11.06	10.49	12.54	0.05	0.02	0.26	0.12	0.146	0.100	1,901.58	1,863.46
V_{13}	83.33(66.33)	83.66(66.61)	20.06	20.05	10.51	10.12	11.61	12.86	0.07	0.04	0.32	0.21	0.242	0.129	1,847.46	1,924.09
V_{14}	85(67.81)	81.00(64.53)	17.53	18.13	10.68	8.89	9.74	11.59	0.05	0.03	0.21	0.12	0.191	0.084	1,738.73	1,658.32
V_{15}	86.66(69.08)	81.33(64.85)	18.54	17.47	7.09	6.89	8.82	11.22	0.05	0.03	0.27	0.17	0.194	0.135	1,382.44	1,476.90
V_{16}	85(67.81)	82.00(65.48)	20.69	20.70	11.77	12.93	11.41	12.36	0.06	0.04	0.22	0.17	0.155	0.142	1,977.78	2,053.04
V_{17}	86.66(69.08)	79.00(63.10)	20.25	19.83	13.05	15.09	11.64	12.03	0.06	0.04	0.26	0.18	0.206	0.128	2,140.45	2,046.98
V_{18}	86.66(69.08)	82.00(65.48)	21.40	20.36	13.34	15.09	11.74	16.60	0.07	0.03	0.28	0.21	0.245	0.160	2,170.83	2,594.62
V_{19}	85(67.81)	81.33(64.85)	17.80	18.61	14.32	12.60	8.79	17.00	0.07	0.06	0.26	0.25	0.326	0.156	1,967.21	2,407.62
V_{20}	90(72.46)	82.00(65.48)	19.75	21.26	10.11	11.40	9.93	12.47	0.05	0.03	0.23	0.17	0.180	0.095	1,803.37	1,960.00
Mean	69.69	65.36	19.51	19.24	13.24	13.86	10.17	12.49	0.07	0.04	0.29	0.22	0.250	0.150	2045.52	2156.06
	V	C V × C	V	C V ×C	V	C V ×C	V	C V ×C	V	C V ×C	V	C V ×C	V	C V ×C	V	C V × C
LSD (0.01)	NS	1.25 NS	1.2	NS NS	1.26	0.39 1.78	0.83	0.26 1.18	0.008	0.002 0.011	0.020	0.006 0.029	0.018	0.006 0.025	201.58	63.74 NS
G.A (%)			3.24	2.70	28.93	34.48	12.97	19.34	87.50	39.53	27.41	46.75	28.38	23.69	18.95	20.26
H^2 (%)			34.54	29.4	84.38	96.10	82.34	89.97	87.52	91.46	91.40	95.77	94.02	82.81	78.12	84.52

% of Ger (Tr. value) = germination percentage with Tr. Value, Sp.G= Speed of germination, RL = Root length, SL = Shoot length, DW = Dry weight, FW= Fresh weight, WHC= Water holding capacity hour^{-1}, VI= Vigour index

In seedling parameters, the interacted values of variety x water condition showed significant variable nature for all interacted values of root-shoot length, fresh & dry weight, but in speed of germination and vigour index the non-significant interaction in values were observed. In every breeding programme, the mean performance and variability were the

important factors for selection of genotype (s). On the basis of mean performance, the undesirable plant may be eliminated and the nature of variability may be considered in selection procedure. Heritability plays an important role in the selection process of plant breeding because, it is an estimation process utilizing the additive genetic variance and it plays an important role in selection of elite genotypes from segregating population. The phenotypic coefficient of variation (PCV) was higher than those of genotypic coefficient of variation for all the traits (Table.1) that was an indication of the greater genotype x environment interactions. This result was in accordance with the report of Singh *et al.* (2005) [9], and Ragvendra *et al.* (2011) [6].

V_{10} (GB 3) and V_{18} (Kataribhog) were encouraging in both normal and stress with high genetic variability among genotypes. The value of GCV was high for root length, fresh weight, dry weight of seedlings and water holding capacity at 24 hours of seed. High heritability and genetic advance were observed in fresh weight, dry weight followed by root length. Normally, the seedling length exclusively root length was greater in presence of water stress.

Table 2: Correlation study on seedling parameters of rice genotypes under normal and stress conditions

Characters	Germination (%)	Speed of Germination	Root Length(cm)	Shoot Length(cm)	Dry Weight(g)	Fresh Weight(g)	Water Holding Capacity
Sp. G	0.135^{NS} (0.015^{NS})						
RL	0.274^{*}(0.190^{NS})	0.170^{NS}(0.051^{NS})					
SL	- 0.018^{NS}(0.023^{NS})	0.457^{**}(0.180^{NS})	0.160^{NS}(0.072^{NS})				
DW	0.162^{NS}(0.142^{NS})	0.172^{NS}(- 0.172^{NS})	0.711^{**}(0.715^{**})	0.284^{*}(0.152^{NS})			
Fr. W	0.275^{*}(0.177^{NS})	0.300^{*}(- 0.111^{NS})	0.634^{**}(0.654^{**})	0.338^{**}(0.177^{NS})	0.735^{**}(0.837^{**})		
WHC	0.479^{**}(0.451^{**})	0.298^{*}(0.122^{NS})	0.916^{**}(0.856^{**})	0.418^{**}(0.488^{**})	0.664^{**}(0.656^{**})	0.688^{**}(0.632^{**})	
VI	0.013^{NS}(0.167^{NS})	0.062^{NS}(- 0.024^{NS})	0.568^{**}(0.579^{**})	- 0.005^{NS}(0.183^{NS})	0.737^{**}(0.576^{**})	0.551^{**}(0.447^{**})	0.431^{**}(0.573^{**})

Values indicated in parenthesis are the correlation values under stress condition, **- highly significant, *- significant, NS – Non-significant

A strong positive correlation was observed for seedling parameters though non-significant nature was displayed only in germination, speed of germination and shoot length particularly under stress. Heritability was high for maximum trades though it was extremely low in percent of germination and speed of germination particularly in normal water. High heritability does not indicate the high genetic gain for all cases. Hence, the heritability along with genetic advance should be considered for this study. These findings suggested the scope for improvement of these characters through direct selection of seed. Heritability along with genetic advance increases the efficiency of selection (Rai *et al.*, 2014) [7] by assessing the influence of environmental factors as well as additive gene action helpful for successful breeding programme.

The observed result specified the core set of germplasm contained high genetic variability. The seedling weight and water absorption capacity of seed are the most significant characteristics with an attitude of positive significant correlation that may be extremely valuable in selection of rice genotypes under new alluvial zone of West Bengal.

References

1. Adhikari B, Bag MK, Bhowmick MK, Kundu C. Rice in West Bengal. Rice knowledge management portal (www.rkmp.co.in), Directorate of Rice Research, Rajendranagar, Hyderabad, Andhra Pradesh, 2012; p 88.
2. Burton GW, De Vane EH. Estimating heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material. Agronomy Journal. 1953; 45:478-481.
3. Chakraborti P, Effect of Na-salt on seedlings of sesame genotypes. Crop Research, 2010; 36(1,2and3):160-165.
4. Johnson WW, Robinson HF, Comstock RE. Genotypic and phenotypic correlation in soybeans and their implications in selection. Agron. J. 1955; 47:477-482.
5. Lush JL, Intra –rice correlation and the regression of offspring in rams as a method of estimating heritability of characters. Proceedings of American Society of Animal Production. 1940; 33:293-301.
6. Ragvendra Tiwari, Suresh BG, Mishra VK, Ashutosh Kumar, Ashok Kumar. Genetic variability and character association in direct seeded upland rice (*Oryza sativa*). Environment and Ecology. 2011; 29(4A):2132-2135.
7. Rai SK, Suresh BG, Pal PK, Lavanya GR, Kumar R, Sandhya. Genetic variability and path coefficient studies for grain yield and other yield attributing traits in rice (*Oryza sativa* L.). International Journal of Life Science Research. 2014; 2(4):239-234.
8. Robinson HF, Comstock RE, Harvey PH. Estimates of heritability and the degree of dominance in corn. Agron. J. 1949; 41:353-359.
9. Singh SP, Singhara GS, Parray GA, Bhutt GN. Genetic variability and heritability in rice. Environment and Ecology. 2005; 23(special 3):549-551.