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Assessment of genetic parameters and correlation studies in root and shoot traits among upland rice (*Oryza sativa* L.) of Manipur in relation to drought tolerance

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Abstract
A study was undertaken to evaluate the genetic parameters and correlation between the root and shoot traits in 50 upland rice genotypes of Manipur along with 3 checks for drought tolerance. The highest GCV and PCV values were recorded in Root fresh weight with 42% and 41.9% in controlled and 34% and 33.7% in stressed conditions. This was followed by Root dry weight (35.29% & 34.79% and 25.2% & 23.97%) in controlled and stressed conditions, respectively. The estimates of heritability were observed to be high in magnitude for all the characters. Heritability ranged from 80.32 per cent (number of tillers) and 99.7 per cent (root fresh weight) in controlled and 92.36 per cent (number of tillers) and 99.36 (shoot length) in stressed conditions. Correlation reveals highly positive and significant association at 0.01% in both controlled and stressed conditions. The large genetic variation found in this population can be exploited further to develop a few forward breeding high-yielding lines with better drought tolerance ability and used as drought donors in drought breeding programs.

Keywords: Genetic variability, correlation, drought tolerance, rice

1. Introduction
Rice (*Oryza sativa* L.) is one of the most important cereal food crop which is used as a staple food by more than half of the world's population. One of the most predominant abiotic stresses that affect yield in rainfed rice ecosystems production is water deficit. Rice is highly susceptible to water stress during the reproductive stage, leading to significant reduction in grain yield. Climatic variability at higher magnitude in the region has already been documented as erratic behaviour of rainfall in terms of changing rainfall pattern, increase in frequency of high intensity rains leading to localized flash flood, reduced number of rainy days, and occurrence of midseason and terminal dry spells (Patle and Libang 2014) [1]. The unpredicted drought due to a disturbed monsoon or a long spell between two rainfall seasons causes the low productivity in this ecology.

Breeding of drought-resilient rice varieties is very much in demand for sustainable rice production in drought-prone rainfed ecology. It is thought that the ability of the plant to modify its roots to grow thicker and deeper into the soil might be an important mechanism to avoid drought stress, and there is ample evidence that assimilates are relocated to roots instead of shoots as a response to water stress (Yoshida *et al*. 1982) [2]. Selection for a well-developed root system with long, thick roots should improve the drought tolerance of upland rice because the plant would avoid water stress by absorbing water stored in the deep soil layers (Yoshida and Hasegawa 1982) [2]. Landraces have been known to possess deep roots up to 70 cm below the soil surface. A coarse and deep root system, for soil penetration and access to water reserves deep in the soil, is considered valuable for improved drought resistance under upland conditions (O'Toole and Chang, 1979; Ling *et al*., 2002) [3, 4].

In order to design an efficient breeding program for synthesis of new varieties with virtues of drought tolerance and high yielding ability, it is necessary to identify potential parents that combine well for both yield and drought tolerance. The objective of the study was to assess the genetic variability, drought tolerance behaviour, and identify promising breeding lines for different rice ecologies and drought breeding programs.

2. Materials and Methods

Fifty upland rice genotypes of Manipur along with three checks, two tolerant (Sahbaghi Dhan and MAS-26 which is an aerobic rice) and one susceptible (IR-64) were used for root and shoot studies in PVC pipes under controlled and moisture stress conditions in a Completely Randomized design. The experiment was conducted during kharif 2018 at College of Agriculture, Central University, Imphal, Manipur. All the 50 genotypes were sown in PVC pipes of 1m long with a diameter of 16cm with two replications. Each genotype was accommodated in one pipe and the seeds were direct seeded in each PVC pipe. After germination, only one seedling was allowed to grow in one pipe. All the pipes were exposed to moisture stress by withholding irrigation for a period of 15 days during tillering stage starting on 60 days after sowing. On 75th day after sowing, the pipes were removed carefully and soaked in water to loosen the soil. The roots were cleaned and eight important root and shoot traits *viz*., tiller number, root length, shoot length, root dry weight, root fresh weight, shoot dry weight, shoot fresh weight and root: shoot ratio were recorded.

3. Results and Discussion

The analysis of variance for the seven roots and shoot characters (Table 1) showed highly significant differences among the various genotypes. This indicated that the genotypes were possessing inherent genetic variances among themselves with respect to the characters studied.

The highest GCV and PCV values were recorded in Root fresh weight with 42% and 41.9% in controlled and 34% and 33.7% in stressed condition. This was followed by Root dry weight (35.2% & 34.79% and 25.2% & 23.9%) in controlled and stressed conditions, respectively. The study suggests that phenotypic variance (Vp) and phenotypic coefficient variance (PCV) were higher than corresponding genotypic variance (Vg) and genotypic coefficient of variance (GCV) respectively for all the traits, indicating that the expression of these characters was influenced by environment. Similar results were reported by Tuhina-Khatun *et al*., (2015) [5] in rice. This suggests that selection based on these characters would be effective for future crossing.

Heritability in broad sense and the genetic advance are also important selection parameters. The estimates of heritability were observed to be high in magnitude for all the traits. The percentage of heritability is ranged from 80.32 per cent (number of tillers) and 99.7 per cent (root fresh weight) in controlled and 92.36 per cent (number of tillers) and 99.36 (shoot length) in stressed conditions (Table 2). The heritability of a few traits was greater in non-stress, and for some, it was greater in stress environments. In both the controlled and drought-stress conditions, number of tillers, root length, root dry weight and root fresh weight showed high genetic advance of mean (GAM). The results could be explained by additive gene action and selection may be done in early generations. This is in accordance with findings by Ogunbayo *et al*. (2014) [6].

Correlation analysis is necessary to determine the direction of selection and the number of traits needed to be considered in improving any character. A simple correlation summarised in Table 3 reveals highly positive and significant association at 0.01% in both controlled and stressed conditions. Therefore, indirect selection of these traits is possible. The results are in accordance with earlier findings by Moosavi *et al*. (2015) [7].

Table 1: Analysis of variances of 7 different root and shoot characters.

Sl. No.	Characters	Treatment (df=52)		Error (df=47)		CD (5%)		CV (%)	
		2018 C	2018 S	2018 C	2018 S	2018 C	2018 S	2018 C	2018 S
1	Number of tillers	2.54**	4.76**	0.62	0.43	1.57	1.31	12.32	11.26
2	Root length	259.01**	242.08**	3.05	8.54	3.51	5.88	3.95	5.36
3	Shoot length	415.30**	569.61**	2.37	4.11	3.09	4.07	1.79	2.59
4	Root dry weight	63.40**	24.55**	1.01	1.38	2.02	2.36	6.26	8.25
5	Root fresh weight	504.39**	279.45**	1.73	2.90	2.64	3.42	3.49	4.88
6	Shoot dry weight	72.16**	35.19**	1.49	0.49	2.45	1.41	5.46	4.09
7	Shoot dry weight	346.53**	321.16**	2.56	11.64	3.21	6.85	2.51	5.95

** Significant at 1% respectively.

Table 2: Estimate of mean, PCV, GCV, broad sense heritability (h^2) and genetic advance as per cent of mean for 7 characters of Manipur upland rice.

Sl. No	Traits	Mean		PCV %		GCV %		h^2 %		GA (k=2.06)		GAM (k=2.06)	
		C	S	C	S	C	S	C	S	C	S	C	S
1	N.T	6.37	5.79	19.47	27.66	15.63	25.55	80.32	92.36	2.05	3.04	32.21	52.62
2	RL	44.21	54.57	25.87	20.47	25.6	19.84	98.96	96.91	23.31	22.3	52.73	40.87
3	SL	86.27	78.16	16.74	21.65	16.66	21.52	99.49	99.36	29.6	34.65	34.32	44.33
4	RDW	16.06	14.24	35.29	25.2	34.79	23.97	98.6	95.12	11.51	7.03	71.68	49.38
5	RFW	37.78	34.89	42.09	34.02	41.96	33.71	99.7	99.08	32.66	24.23	86.45	69.45
6	SDW	22.35	17.11	27.11	24.66	26.61	24.35	98.19	98.77	12.26	8.58	54.83	50.17
7	SFW	63.91	57.28	20.66	22.47	20.52	21.76	99.35	96.83	27.02	25.68	42.28	44.83

N.T- number of tillers, RL-root length, SL-shoot length, RDW-root dries weight, RFW-root fresh weight, SDW-shoot dry weight, SFW-shoot fresh weight, PCV-phenotypic coefficient of variation, GCV-genotypic coefficient of variation, h2 bs- Broad sense heritability, GA-genetic advance, GAM- genetic advance as per cent of mean.

Table 3: Correlation among seven quantitative characters in 53 rice genotypes.

Trait	Environment	N.T	RL	SL	RDW	RFW	SDW	SFW
N.T	Controlled	1						
	Stressed	1						
RL	Controlled	0.307*	1					
	Stressed	0.564**	1					
SL	Controlled	0.072	0.546**	1				
	Stressed	0.037	0.191	1				
RDW	Controlled	0.072	0.17	0.179	1			
	Stressed	0.204	0.387**	0.204	1			
RFW	Controlled	0.064	0.296*	0.071	0.721**	1		
	Stressed	0.441**	0.477**	-0.019	0.66**	1		
SDW	Controlled	0.036	0.09	0.184	0.661**	0.57**	1	
	Stressed	0.285*	0.269	0.477**	0.489**	0.438**	1	
SFW	Controlled	0.14	0.303*	0.436**	0.552**	0.494**	0.657**	1
	Stressed	0.234	0.311*	0.636**	0.374**	0.402**	0.625**	1

N.T- number of tillers, RL-root length, SL-shoot length, RDW-root dries weight, RFW-root fresh weight, SDW-shoot dry weight, SFW-shoot fresh weight

4. Conclusion

The present study highlighted the existence of diversity among the 50 upland rice genotypes of Manipur. High heritability in broad sense recorded for almost all the traits demonstrates that these characters could be successfully transferred to offsprings if their selection is performed in hybridization programme. The correlation analysis revealed that the root and shoot traits have significant correlation with each other. So, these traits may be considered as the selection criteria for the drought tolerance in rice.

5. References

1. Patle GT, Libang A. Trend analysis of annual and seasonal rainfall to climate variability in North-East region of India. J Appl Nat Sci. 2014;6(2):480-483.
2. Yoshida S, Hasegawa S. The rice root system: Its development and function. In Drought Resistance in Crops with Emphasis on Rice; Paddy field: Manila, Philippines. 1982;10:97-134.
3. O'Toole JC, Chang TT. Drought resistance in cereals: a case study. In: Mussell, H., Staples, R.C. (Eds.), Stress Physiology in Crop Plants. John Wiley and Sons, New York, 1979.
4. Ling ZM, Li ZC, Yu R, Mu P. Agronomic root characters of upland rice and paddy rice (*Oryza sativa* L.). J Chin. Agric. Univ. 2002;7:7-11.
5. Tuhina-Khatun M, Hanafi MM, Yusop MR, Wong MY, Salleh FM, Ferdous J. Genetic variation, heritability, and diversity analysis of upland rice (*Oryza sativa* L.) genotypes based on quantitative traits. BioMed. Res. Inter. 2015, ID 290861.
6. Ogunbayo SA, Sié M, Ojo DK, Sanni KA, Akinwale MG, Toulou B, *et al*. Genetic variation and heritability of yield and related traits in promising rice genotypes (*Oryza sativa* L.). J Plant Breed. Crop Sci. 2014;6(11):153-159.
7. Moosavi M, Ranjbar G, Zarrini HN, Gilani A. Correlation between morphological and physiological traits and path analysis of grain yield in rice genotypes under Khuzestan. Biol. Forum Int. J. 2015;7(1):43-47.