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Screening and Genetic Variability Studies in Submergence Tolerance Rice Germplasm Lines under Flood Prone Lowlands of Hill Zone of Karnataka, India

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A B S T R A C T

Among 525 germplasm lines none of the lines have recorded 100.00 % survival with score 1, two germplasm lines *viz.*, Jaladhi (96.00%) and IET21465 (96.00%) and 68 germplasm lines falls under 75-94% survival with the score of 5, have recorded good survival rate. High heritability was observed for all the traits among these L: B ratio (0.98), Harvest index (0.98) test weight (0.96) and yield per plant (0.94) are noticeable. Genetic advance as per cent mean was high to moderate among the characters, yield per plant (62.30) and number of productive tillers per plant (42.33) and harvest index (23.90) recorded very high genetic advance as per cent mean compare to other traits.

Introduction

Rice is a staple food for more than half of the world's population, but its production is severely being affected by the impact of abiotic stresses due to frequently changing climate. Rice plants are subjected to various abiotic stresses such as drought, submergence, salinity, cold and mineral toxicity etc.

Rice is habitually the only cereal that can be grown in flood prone rainfed lowland ecosystem. Changing climatic factors leads to vagueness of rainfall which is one of the major factors affecting the rice yield in India, Bangladesh and Mayanmar. Flash and stagnant flooding in lowland ecosystems affects plant stand seriously by causing anoxia depending on duration of submergence stress, which is considered as third most important constraint to high yield in India.

Submergence tolerance has long been regarded as an important breeding objective for rainfed lowland and deep water, rice areas. Despite this recognition there has been limited success in developing improved submergence tolerant varieties in India. Though a number of high-yielding rice varieties have been released for different lowland situations in different States, most of them do not have the required level of tolerance to submergence. In coastal areas, water stagnation is a common problem in most of the lowlands. Varietal differences in the degree of submergence tolerance have

been observed many times and this genetic resource has been used in several conventional breeding programmes in Asia.

Materials and Methods

Experiment was laid out in rainfed low land flood prone areas of Sharavathi back water region of Kesaremane village, Nagara, Shivamogga, Karnataka, to screen the rice germplasm lines for submergence tolerance during *Kharif 2015*.

A total of 525 germplasm lines of *Oryza sativa (L.)* lines which includes indigenous collections, released varieties, lines developed from different breeding strategies and local traditional cultivars are collected from different source were used in this study. Six checks have been used namely Swarna sub1, FR13A, Hemavathi, Tunga, Jyothi and Swarna. Seeds of 525 germplasm lines are sown on raised nursery beds with recommended cultural practices. 21days old seedlings were transplanted to main field with a spacing of 20 cm between rows and 15 cm between plants within a row was maintained. Transplanting was done in Augmented Design-II (Extended form of RBD) with 15 blocks comprising of 35 germplasm lines to obtain minimum of 12 error degrees of freedom and six checks repeated in each block. After a week of transplanting due to heavy rains plots were submerged with 50-60cm of water and this water level is maintained for 14 days by constructing bunds. After 14 days, excess water was drained out.

Survival percentage was calculated as {(numbers of survive hills at 15 days of re-emergence) / (the numbers of hills before submergence)*100}. Based on survival percentage germplasm lines were scored based on Standard evaluation system for rice (SES) (IRRI 1988). Based on survival percentage scores of 525 germplasm lines evaluated during *Kharif* 2015, 300 germplasm lines which recorded more than 50 per cent survival are selected for assessment of genetic variability for yield and yield related traits during summer 2016

Seeds of 300 germplasm lines which are selected based on survival percentage are planted in Augmented Design-II (Extended form of RBD) with 10 blocks comprising of 30 germplasm lines and six checks repeated in each block. After a week of transplanting, plots were submerged with 50-60cm of water and this water level is maintained for 14 days. After 14 days, excess water was drained out.

Results and Discussion

Screening of rice germplasm for submergence tolerance during *Kharif* 2015

The observations were made for the survival per centage, in 525 germplasm lines including six checks Swarna sub1, FR13A, Hemavathi, Tunga, Jyothi and Swarna which are allocated randomly in all the 15 blocks. IRRI standard method with 1-9 score was followed to score survival rate. Out of 525 germplasm lines none of the lines have recorded 100.00 % survival with score 1, two germplasm lines *viz.*, Jaladhi (96.00%) and IET21465 (96.00%) have recorded 95-99% survival with score of 3, 68 germplasm lines falls under 75-94% survival with the score of 5, under 50-74% survival rate 230 germplasm lines are observed with 7 score and 225 germplasm showed 0-49% survival with the 9 score. Among the checks mean survival per centage of standard check FR13A was higher (96.00%) compared to Swarna sub1 and least survival rate was noticed in susceptible check Jyothi (8.00%) details of categorization of germplasm based on survival per cent is presented in Table 1. and graphical representations concerning survival of germplasm lines is presented in Fig 1. Germplasm lines with high rate of survival with good yield potential can be tested under

large scale field trials and released as a variety, germplasm lines with higher survival rate but poor yielders can be used in introgression or hybridization program to transfer elite tolerant genes to well adopted varieties. Sarkar and Bhattacharji (2011) and Akinwale *et al.*, (2012), in their experiments they have recorded huge variation of germplasm lines or cultivars to survival per cent in submergence condition and the result of present investigation is also shows similar kind of variation to survival rate.

Analysis of variance in rice germplasm lines

The analysis of variance indicated the presence of significantly higher difference among the germplasm lines for all the characters studied *viz.*, survival per cent, days to fifty per cent flowering, plant height, panicle length, number of tillers, number of productive tillers per plant, days to maturity, test weight, grain yield per plant L: B ration, harvest index and absolute growth rate in the experiment consisting of three hundred rice germplasm lines in submergence condition (Table 2).

Performance of rice germplasm lines

The observations were made for the fallowing traits, in three hundred germplasm lines including six checks Swarna sub1, FR13A, Hemavathi, Tunga, Jyothi and Swarna which are allocated randomly in all the ten blocks. The adjusted mean values obtained using Windostat version 9.2 software (Table 3).

Variability study among rice germplasm lines for yield, yield related traits under submergence condition

The germplasm lines showed significant variability for all the characters studied. Phenotypic coefficient of variation, genotypic coefficient of variation, heritability, genetic advance and genetic advance as per cent mean for different morphological, yield and related traits are presented in Table 4.

Survival per cent

GCV and PCV survival per cent was 6.28 and 7.61 per cent respectively and heritability of 0.68 was observed for this trait. Genetic advance and genetic advance as per cent mean was 10.68 and 16.22 respectively. High heritability and moderate genetic advance as per cent mean was observed for survival per cent. Sarkar and Bhattacharjee (2011) observed similar results.

Days to fifty per cent flowering

The recorded GCV and PCV for days to fifty percent flowering are 4.58 and 4.69 per cent, respectively. For days to fifty per cent flowering 0.95 of heritability was recorded. The observed genetic advance was 11.03 while genetic advance as per cent mean was 9.21. Heritability recorded for days to fifty per cent flowering was high and genetic advance as per cent mean was low. Basavaraj and Dushyanthakumar, (2014) and Singh (2016) reported high heritability coupled with low to moderate genetic advance as per cent mean.

Plant height

Plant height recorded 7.89 per cent GCV and 8.24 per cent PCV for plant height. Heritability of plant height was 0.91, observed genetic advance was 20.10 while genetic advance as per cent mean was 15.45. Heritability for plant height was high indicates high variability and genetic advance as per cent mean is moderate. Selection will be effective due to presence of moderate genetic advance as per cent mean. Basavaraj and Dushyanthakumar, (2014) reported high heritability and moderate genetic advance as per cent mean for plant height.

Table.1 Classification of the germplasm lines based on survival percentage

Score	Survival Percentage	No. of Germplasm lines
1	100%	0
3	95-99%	2
5	75-94%	68
7	50-74%	230
9	0-49%	225

Table.2 Analyses of variance for yield and yield related traits in rice germplasm lines evaluated during summer 2016

Source	d.f.	Survival percent	Days to 50% flowering	Plant height (cm)	Panicle length(cm)	No. of tillers/ plant	No. of prod. tillers/ plant	Days to maturity	Test weight (g)	Yield/plant (g)	L:B ratio	Harvest Index (%)
		Mean sum of squares										
Blocks	9	0.018	1.706	5.555	0.043	1.37	0.128	2.268	0.520	0.892	0.003	0.246
Entries	305	330.652*	55.412*	197.0**	3.786	6.712*	5.344*	60.499*	19.417	88.663**	0.169*	35.477**
Checks	5	15914.670*	795.027**	4229.600*	2.146**	68.137	70.177**	28.29.09*	70.771*	1679.045**	1.188*	794.662*
Varieties	299	68.65**	36.718**	128.739**	3.234**	3.805**	3.486**	12.949**	18.562*	62.080*	0.151*	16.961*
Checks vs. Varieties	1	747.556**	1946.880*	444.169**	176.805*	568.969*	236.821**	465.125*	18.396*	85.130**	0.188*	1775.921*
ERROR	45	0.004	1.47	0.571	0.171	0.292	0.421	2.80	0.531	0.455	0.002	0.174
Ci - Cj (CD @ 5%)		0.054	1.093	0.681	0.372	0.487	0.585	1.509	0.656	0.607	0.038	0.376
Ci – VI (CD @ 5%)		0.138	2.768	1.725	0.943	1.233	1.481	3.822	1.662	1.539	0.096	0.952

*, ** significant at 5% and 1% levels respectively.

Table.3 Performance of different rice germplasm lines for yield and yield related traits evaluated during summer 2016

	Survival percent	Days to 50% flowering	Plant height (cm)	Panicle length(cm)	No. of tillers/ plant	No. of prod. tillers/ plant	Days to maturity	Test weight (g)	Yield/plant (g)	L:B	Harvest Index
Mean	65.20	119.80	130.06	23.10	8.00	7.17	156.16	37.37	22.69	3.16	44.25
Min.	60.00	100.00	99.50	17.00	3.00	2.00	142.00	26.50	3.65	2.20	22.80
Max.	96.00	138.00	155.50	27.95	14.00	14.00	170.00	47.50	44.15	4.05	47.12
FR13A	92.00	121.00	131.92	25.90	16.00	13.60	167.00	33.72	25.80	2.57	42.97
Tunga	84.00	121.50	138.20	25.25	12.00	9.40	168.70	37.90	32.45	3.17	44.50
Hemavathi	88.00	122.30	159.20	24.54	10.30	8.60	169.20	36.05	30.40	3.62	41.48
Swarna sub1	84.00	104.70	121.60	25.24	13.10	11.40	138.50	39.50	38.95	3.17	47.12
Jyothi	8.00	108.00	105.40	24.86	8.60	6.30	141.20	40.40	9.02	2.92	26.45
Swarna	12.00	103.90	106.20	24.39	10.30	7.60	134.10	40.30	7.38	3.12	27.87

Table.4 Measurement of Variability parameters in rice germplasm lines evaluated during summer 2016

Parameter	Survial Percent	Days to 50% flowering	Plant height (cm)	Panicle length(cm)	No. of tillers/ plant	No. of prod. tillers/ plant	Days to maturity	Test weight (g)	Yield/plant (g)	L:B ratio	Harvest Index (%)
Mean	65.20	119.80	130.06	23.10	8.00	7.17	156.16	37.37	22.69	3.16	44.25
GCV (%)	6.28	4.58	7.89	7.00	21.21	22.14	1.88	10.50	31.16	11.31	11.67
PCV (%)	7.61	4.69	8.24	7.29	24.96	23.86	2.17	10.68	32.08	11.39	11.74
h^2	0.68	0.95	0.91	0.93	0.72	0.86	0.75	0.96	0.94	0.98	0.98
GA	10.68	11.03	20.10	3.22	2.97	3.09	5.26	7.94	14.14	0.73	7.75
GAM	16.22	9.21	15.45	13.97	37.12	42.33	3.37	21.27	62.30	23.14	23.90

Table.5 Germplasm lines were scored based on survival percentage

Score	Percentage Survival
1	100%
3	95-99%
5	75-94%
7	50-74%
9	0-49%

Panicle length

GCV and PCV for panicle length was 7.00 and 7.29 per cent respectively and heritability of 0.93 was observed. Genetic advance and genetic advance as per cent mean was 3.22 and 13.97 respectively for panicle length. Heritability was high and genetic advance per cent mean was moderate for panicle length and selection can made here. Basavaraj and Dushyanthakumar, (2014) reported moderate heritability and genetic advance as per cent mean in their study.

Number of tillers per plant

The recorded GCV and PCV are 21.21 and 24.96 per cent, respectively for number of tillers per plant. For number of tillers 0.72 heritability was recorded.

The observed genetic advance was 2.97 while genetic advance as per cent mean was 37.12. Genetic advance as per cent mean and heritability was high and selection will be very efficient for this trait. Vange (2009), Basavaraj and Dushyanthakumar, (2014) and Singh (2016) reported high heritability coupled with high genetic advance per cent mean for number of tillers.

Number of productive tillers per plant

Number of productive tillers per plant recorded 22.14 per cent GCV and 23.86 per cent PCV. Heritability for number of productive tillers per plant was 0.86; observed genetic advance was 3.09 while genetic advance as per cent mean was 42.33. Heritability and genetic advance per cent mean for this trait is high and selection for this trait is effective, Vange (2009), Basavaraj and Dushyanthakumar, (2014) and Singh (2016) reported high heritability coupled with high genetic advance per cent mean.

Days to maturity

The recorded GCV and PCV for days to maturity are 1.88 and 2.17 per cent, respectively. For days to maturity 0.75 of heritability was recorded.

The observed genetic advance was 5.26 while genetic advance as per cent mean was 3.37.Genetic advance as per cent mean was very low and heritability was high for days to maturity, Vange (2009), Basavaraj and Dushyanthakumar (2014) observed similar results in their experiments.

Test weight

Observed GCV and PCV for test weight is 10.50 and 10.68 per cent respectively and heritability of 0.96 was observed. Genetic advance and genetic advance as per cent mean for test weight was 7.94 and 21.27 respectively. Heritability and genetic advance as per cent mean was high for test weight and selection for this trait is effective.

Basavaraj and Dushyanthakumar (2014) and Singh (2016) reported high heritability and high genetic advance as per cent mean in their investigation.

Grain yield per plant

Grain yield per plant recorded 31.16 per cent GCV and 32.08 per cent PCV. Heritability for grain yield per plant was 0.94, observed genetic advance was 14.14 while genetic advance as per cent mean was 62.30. Heritability and genetic

advance as per cent mean was high and this indicates selection from both the sides is very effective. Pratap *et al.*, (2012), Basavaraj and Dushyanthakumar, (2014), Ketan and Sarkar (2014) in their studies recorded high heritability coupled with high genetic advance as per cent mean.

L:B Ratio

The recorded GCV and PCV for L:B ratio was 11.31 and 11.39 per cent, respectively. For L:B ratio 0.98 of heritability was recorded. The observed genetic advance was 0.73 while genetic advance as per cent mean was 23.14. Heritability and genetic advance as per cent mean for L:B ratio was high and Basavaraj *et al.*, (2014) reported high heritability and moderate genetic advance as per cent mean for L:B ratio.

Harvest index

Harvest index recorded 11.67 per cent GCV and 11.74 per cent PCV. Heritability of harvest index was 0.98; observed genetic advance was 7.75 while genetic advance as per cent mean was 23.90. Harvest index shows high heritability and genetic advance as per cent mean and Vange (2009) and Basavaraj *et al.*, (2014) in their studies reported high heritability for harvest index.

In the present investigation results for variability studies revealed that for almost all the yield and yield related traits massive amount of variability was observed which was proven based on high heritability and genetic advance as per cent mean. In the present investigation there is a huge scope for selection of traits for their improvement.

References

Akinwale, M. G., Akinyele, B. O., Odiyi, A. C., Nwilene, F., Gregorio, G. and Oyetunji, O. E., 2012, Phenotypic screening of Nigerian rainfed lowland mega rice varieties for submergence tolerance. *Proceedings of the World Congress on Engineering*, 1:1-6.

Basvaraja, K and Dushyanthakumar B.M., 2014. Genetic Diversity for Grain Yield and its Components in Local Rice (*Oryza sativa* L.) Genotypes under Submergence, *Electronic J. Plant Breed.*, 5(1): 67-70.

IRRI—International Rice Research Institute (1988) Standard evaluation system for rice, 3d ed. Los Baños, Philippines

KETAN, R. AND SARKAR, G., 2014, Studies on variability, heritability, genetic advance and path analysis in some indigenous *Aman r*ice (*Oryza sativa* L.), *J. Crop and Weed*, 10(2):308-315.

Pratap, N., Singh, P. K., Shekhar, R., Soni, S. K. and Mall, A. K., 2012, Genetic variability, character association and diversity analyses for economic traits in rice (*Oryza sativa* L.), *SAARC J. Agri.*, 10(2): 83-94.

Rahul Singh, 2016, Assessment of Genetic Potential for Submergence Tolerance in *indica* Rice (*Oryza sativa* L.). *M.Sc. (Agri.) Thesis*, Bihar Agricultural University, Sabour, Bhagalpur

Sarkar, R.K. and Bhattacharjee, B., 2011, Rice genotypes with SUB1 QTL differ in submergence tolerance, elongation ability during submergence and regeneration growth at re-emergence. *Rice*, 5(7):1-11.

Vange, T., 2009, Biometrical Studies on Genetic Diversity of Some Upland Rice (*Oryza sativa* L.) Accessions. *Nature Sci.*, 7(1): 21-27.

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