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STUDY ON SCREENING OF RICE GENOTYPE FOR THEIR SALT TOLERENCE AT GERMINATION STAGE

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Abstract

Studies were carried out at seed technology unit of department of plant breeding and genetics, Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal, Puducherry (UT) to investigate (i) Screening of rice genotypes at germination stage for their tolerance to salinity by employing various seed quality parameters. Seeds of 24 genotypes undergone salinity stress (0, 12 and 21 dSm^{-1}) for 14 days shown significant variation in ability to germinate and produce vigorous seedlings. The seed quality parameters showed significant differences due to genotypes and salinity level and their interaction. In general, salinity decreased germination %, speed of germination and led to reduction in total seedling length, fresh and dry weight of seedlings and vigour index and the magnitude of reduction increased with increasing salinity level. Rice genotypes P# 353-225-325 and P#353-225-333 showed greater salt tolerance while P#155- 49-124, P#155-49-235 and TKM 9 (local variety) registered lower salt tolerance in terms of germination percentage and seedling vigour. The result showed significant decline in seed germination and seedling vigour in all genotypes upon salt stress but the degree of reduction was varied significantly among varieties/genotypes. This results could helpful in identification of tolerant varieties which can be studied further.

Key words: Rice genotypes, Salt tolerance, Germination and Quality parameters.

Introduction

Rice (*Oryza* spp.) is an important cereal crop and is mainly used for human consumption. A 100 g of rice provides 345.0 k.cal, 78.2g of carbohydrates and 6.8 g of protein (Gopalan *et al*., 2007) inclusive of considerable amount of recommended Zinc and Niacin. Rice protein is biologically richest as it digestibility is very high (88%). Rice provides almost 50-80% of daily calorie intake amongst the poor class of the society. It's a staple food and cash crop for more than three billion people in the world (Ma *et al*., 2007). Asian farmers constitute about 92% of the world's total rice producing group (Mitin, 2009). In Asia 90% of rice is produced by small farmers who are solely dependent on rice for their livelihood and food security (ANU, 2006).

Salt stress is one of the major abiotic stresses that severely affect crop production throughout the world. More than 800 million hectares of the cultivable land in world is salt-affected (FAO, 2014). Salinity is the second most widespread soil problem in rice growing countries after drought and is considered as a serious limitation to increase rice production worldwide (Gregorio,1997). It causes yield reduction and also shrinks caloric and nutritional potential of agricultural products (Yokoi *et al*., 2002) causing leaf injury or death of plants, thus exceeding the capacity of salt compartmentalization in cytoplasm. Several studies indicated that rice is tolerant during germination, becomes very sensitive during early seedling stage (2-3 leaf stage), gains tolerance during vegetative growth stage, again becomes sensitive during pollination and fertilization and then becomes increasingly more tolerant at maturity (Lutts *et al*., 1995).

Quijano- Guerta and Kirk (2002) reported that the cheapest and easiest way to address the problem of salinity is through the development of a salt tolerant variety. For this, the foremost step is to screen the existing germ plasm of paddy to identity the potential breeding materials. Screening at field level proved to be difficult due to soil heterogeneity, climatic factors and other environmental

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factors which may influence the physiological processes. Hence, screening under laboratory conditions is considered to be advantageous over field screening. However, conventional methods of screening for salt tolerance are not easy because of environmental effects and narrow sense heritability of salt tolerance (Gregorio, 1997). Screening of genotypes for salt tolerance at early stages may be important for screening salt tolerance as a there is considerable saving in time. Therefore, the present investigation was attempted to study screening of rice genotypes at germination and early seedling stage for their tolerance to salinity.

Materials and Methods

The experiments were conducted at Seed Technology Unit Laboratory of Department of Plant Breeding and Genetics, Plant Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA & RI), Karaikal during 2016. Twenty four rice genotypes in which 20 genotypes (V 1 to V 20) derived from Near Isogenic Lines (NIL) of ADT 45/FL 478 cross and developed through repeated backcrossing to ADT45 and four varieties (V 21 to 24) were collected from the Department of Plant Breeding and Genetics, PAJANCOA & RI, Karaikal and used in germination tests to evaluate their potential saline stress tolerability under 3 different salt concentration namely 0 (control), 12 and 21 dSm^{-1}. Initial seed moisture content was maintained at safe level. Healthy and uniform seeds were selected for germination test. The details of the genotypes used are given in table 1. The analysis of variance of CRD for seed vigour traits was worked out as suggested by Panse and Sukhatme (1985). Wherever necessary the percentage values were transformed into corresponding arcsine values, before carrying out the statistical analysis. The transformed values were given in parentheses.

Table 1: Details of rice varieties/genotypes.

S. No.	Genotypes	Line no./ variety name	Description
1.	V1	P#353-225-233	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
2.	V2	P#353-225-325	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
3.	V3	P#353-225-326	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
4.	V4	P#353-225-333	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
5.	V5	P#482-30-29	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
6.	V6	P#482-30-144	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
7.	V7	P#482-30-173	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
8.	V8	P#482-30-264	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
9.	V9	P#482-30-373	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
10.	V10	P#482-35-83	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
11.	V11	P#482-35-112	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
12.	V12	P#155-49-112	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
13.	V13	P#155-49-124	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
14.	V14	P#155-49-134	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
15.	V15	P#155-49-138	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
16.	V16	P#155-49-148	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
17.	V17	P#155-49-165	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
18.	V18	P#155-49-174	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
19.	V19	P#155-49-228	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
20.	V20	P#155-49-235	Near Isogenic Lines (NIL) of ADT 45/FL478 cross
21.	V21	IR 29	Salt susceptible variety
22.	V22	TKM 9	Local variety
23.	V23	FL478	Salt tolerant variety
24.	V24	ADT 45	Local variety

Germination test: Three levels of salinity namely 0, 12 & 21 dSm^{-1} were prepared. Twenty five (25) seeds of each genotype were allowed to germinate on filter paper/germination paper in 10 cm diameter Petri dish for all three concentration including control (0.0 dSm^{-1}). The Petri dishes were kept under laboratory conditions in a Randomized Complete Block Design (Factorial) with three replications. Filter papers were kept under moist with equal volume of salt solutions for all Petri dishes during the experiment at room temperature (25±2) and 12 hours of light. Petri dishes were examined on daily basis for 14 days after sowing and seeds were considered germinated when the radicle was at least 2mm in length. Germination characters were recorded on 14th day after sowing.

a) Germination percentage (Ruan *et al*., 2002): Total germination percentage (%) was computed as Germination (%) = Number of germinated seeds / total number of seeds tested x 100.

b) Speed of germination (Maguire, 1962): Germination was conducted daily up to the final count day *i.e* 14 day. Emergence of radical with 2 mm was taken as criteria for germination was calculated by using the formula and expressed as absolute number: Speed of germination = $X_1/Y_1 + X_2 – X_1/Y_2 + X_n$-$(X_n$-$1)/Y_n$.

c) Total seedling length (Yokoi *et al*., 2002): Seedling length was recorded on 14th day after the seeds were placed for germination. It is the measure of the total of root and shoot of the rice seedling, means values were expressed in cm. Total length = Shoot length + root length.

d) Seedling Fresh Weight: 10

normal seedlings in each replication were taken on random at 14 days after sowing and fresh weight was measured using electronic weighing balance and the mean values were expressed in mg.

e) Seedling fresh weight reduction: Seedling fresh weight reduction= Plant fresh weight at control – plant fresh weight at salt stress/ Fresh weight at control x 100.

f) Seedling Dry Matter Production: Ten normal seedlings obtained from the standard germination test were dried in a hot air oven at 85°C for 48 hrs cooled in a desiccators weighed and expressed as mg/seedlings.

g) Seedling dry weight reduction: Seedling dry weight reduction= Plant dry weight at control – plant dry weight at salt stress/ Dry weight at control x 100.

h) Vigour Index (Abdul – Baki and Anderson, 1970): Vigour Index = Germination% X Total Seedling Length (cm).

Results and Discussion

Screening of rice genotypes for their tolerance to salinity:

Seeds of 24 genotypes kept under salinity stress for 14 days shown significant variation in ability to germinate and produce vigorous seedlings.

Germination percentage:

Germination percentage showed significant differences due to genotypes and salinity and their interaction. A significant decline in seed germination of all the genotypes upon salinity was ranged from 0 to 100 per cent. Seeds of V 21 has showed highest reduction after 14 days of salinity at 12 dSm^{-1} (19.4%) as well as at

Table 2: Effect of salinity on germination percentage in rice genotypes/varieties.

Sl. No.	Geno types	Salinity level			Over all Mean	Percentage reduction at 12 dSm^{-1}	Percentage reduction at 21 dSm^{-1}
		Control (S1)	12 dSm^{-1} (S2)	21 dSm^{-1} (S3)			
1	V1	94	91	60	80	3.19	36.1
2	V2	86	83	76	85	1.1	11.6
3	V3	80	80	72	87	0	16.2
4	V4	100	100	92	92	0	8.0
5	V5	98	96	68	86	2.08	30.6
6	V6	98	94	84	88	2	14.2
7	V7	94	72	72	87	3.09	3.09
8	V8	100	97	88	86	1	12.0
9	V9	100	90	72	84	8	28.0
10	V10	78	76	76	78	1.8	2.5
11	V11	98	96	72	79	1.8	26.0
12	V12	76	73	64	76	1.3	15.7
13	V13	92	88	56	78	2.1	36.1
14	V14	90	87	64	76	1.1	28.3
15	V15	80	76	70	70	2.5	12.0
16	V16	84	74	60	70	9.5	28.5
17	V17	72	70	52	69	1.8	27.7
18	V18	96	66	64	68	15.9	33.3
19	V19	72	70	64	68	1.8	11.1
20	V20	64	62	56	70	1.8	12.5
21	V21	100	78	52	75	19.4	43.8
22	V22	84	84	56	76	0	26.3
23	V23	78	77	72	77	1	6.2
24	V24	80	80	78	79	0	2.1
MEAN		86	81.75	68.33		2.25	18.02
		CD (0.05)					
V		0.16**					
S		0.16**					
VxS		0.81**					

Table 3: Effect of salinity on speed of germination in rice varieties/genotypes.

Sl. No.	Geno types	Salinity level			Over all Mean	Percentage reduction at 12 dSm^{-1}	Percentage reduction at 21 dSm^{-1}
		Control (S1)	12 dSm^{-1} (S2)	21 dSm^{-1} (S3)			
1	V1	50	39.5	17.2	35.5	21	65.5
2	V2	38	28.5	18.0	28.1	25	52
3	V3	46.5	33.5	16.2	32	27.9	65.1
4	V4	49.3	39.5	28.2	39	19.9	42.8
5	V5	47.5	37.5	14	33	21	70.3
6	V6	42.5	33.5	26.5	34.1	21.1	37.6
7	V7	46.5	36.5	17	33.3	21.5	63.3
8	V8	38.7	30.5	19.5	29.5	21.2	49.6
9	V9	49.5	33.7	16.1	33.1	31.8	67.4
10	V10	46	34	15.1	31.7	26	67
11	V11	39.5	30.3	14.1	28	24	64.1
12	V12	37.5	32.5	11.2	27	31.5	76.4
13	V13	43.5	38	14.1	31.8	12.6	67.5
14	V14	42	36.5	18.5	32.3	13	55.9
15	V15	39.5	30.5	18.2	29.4	22.7	53.8
16	V16	52.5	42.5	10.2	35	19	80.5
17	V17	43.5	41.5	15.5	33.5	4.5	64.3
18	V18	47.5	31.5	13.7	30.9	33.6	71.1
19	V19	45	33.5	11.8	30.1	25.5	73.6
20	V20	46.5	33.5	11.1	30.4	27.9	76
21	V21	45	37.5	16.5	33	16.6	63
22	V22	49.5	34.5	23.5	35.8	30.3	52
23	V23	54.5	49.5	30.1	44.7	9.1	44
24	V24	47.5	36.5	15.1	33	23.1	68
MEAN		45.33	35.62	17.14		22.07	62.11
		CD (0.05)					
V		0.15**					
S		0.15**					
VxS		0.90**					

21 dSm^{-1} (43.8%). Whereas, lowest reduction is seen in V 24 (2.1%) followed by V 10 (2.5%) and V 7 (3.1%) table 2. A significant decline in seed germination of all the genotypes upon salinity was ranged from 0 to 100 per cent.

Speed of germination:

The differences in respect of speed of germination due to genotypes and salinity and their interaction were highly significant. Among the genotypes, V23 registered highest speed of germination at 12 dSm^{-1} (49.5) and 21dSm^{-1} (30.1) while V16 recorded lowest at 21dSm^{-1} (10.2) table 3.

Total seedling length:

The differences in total seedling length varied significantly between genotypes and salinity and their interaction. V4 recorded lowest reduction over control at a salinity 21dSm^{-1}. (68.7%) whereas V22 recorded highest reduction (95.8%) followed by V13 (94.2%) table 4.

Seedling fresh weight:

The differences in seedling fresh weight varied significantly between genotypes and salinity and their interaction. The reduction percentage over control was ranged from 0 (V3, V6, V10, V22) to 68.9 (V4) at 12dSm^{-1} and 83.1(V16) to 99.9 (V11) at 21dSm^{-1} table 5.

Seedling dry matter production:

The differences in dry matter production varied significantly between genotypes and salinity and their interaction. Seeds of V6, V10 and V22 recorded no reduction at the salinity (12dSm^{-1}). Seeds at the salinity

Table 5: Effect of salinity on Fresh weight (mg/seedling) in rice varieties/genotypes.

Sl. No.	Geno types	Salinity level			Over all Mean	Percentage reduction at 12 dSm^{-1}	Percentage reduction at 21 dSm^{-1}
		Con trol (S1)	12 dSm^{-1} (S2)	21 dSm^{-1} (S3)			
1	V1	303	214	32	182.8	29.37	89.7
2	V2	287	174	32	164.3	39.3	89.1
3	V3	256	256	32	181.3	0	87.5
4	V4	465	387	33	295	68.9	92.9
5	V5	306	261	24	197	14.7	92.1
6	V6	253	253	28	178	0	88.9
7	V7	295	257	29	193.6	12.8	90.5
8	V8	473	306	23	267.4	35.3	95.1
9	V9	363	287	33	227.6	20.93	91.1
10	V10	221	221	29	157	0	86.8
11	V11	489	223	29	247	52.35	94
12	V12	483	260	28	256.8	46.1	94.4
13	V13	329	278	24	210.4	15.5	92.7
14	V14	456	205	26	229	55	94.2
15	V15	329	277	24	209.8	15.8	93
16	V16	361	293	31	228.2	18.8	83.1
17	V17	252	133	28	137.7	47.2	88.8
18	V18	405	203	29	212.3	48.3	92.8
19	V19	486	240	31	252.3	50.6	93.6
20	V20	380	344	28	250.2	9.4	93.1
21	V21	319	238	38	198.1	25.39	88.4
22	V22	343	343	26	237.4	0	92.4
23	V23	1077	749	94	640	30.4	91.27
24	V24	483	206	27	238.6	57.3	94.4
MEAN		392.25	275.33	31.49		26.71	91.49
		CD (0.05)					
V		3.55**					
S		3.55**					
VxS		17.40**					

Table 4: Effect of salinity on Total seedling length (cm) in rice varieties/genotypes.

Sl. No.	Geno types	Salinity level			Over all Mean	Percentage reduction at 12 dSm^{-1}	Percentage reduction at 21 dSm^{-1}
		Con trol (S1)	12 dSm^{-1} (S2)	21 dSm^{-1} (S3)			
1	V1	11.28	6.6	2.24	6.7	41.2	80.14
2	V2	9.82	9.1	2.66	7.19	7.33	72.91
3	V3	11.1	11.1	2.5	7.19	0	75.86
4	V4	10.34	10.34	2.92	7.71	0	68.73
5	V5	8.46	8.24	1.58	5.75	2.6	78.82
6	V6	10.32	8.86	2.34	6.84	4.73	74.89
7	V7	10.34	10.12	2.12	7.19	8.35	77.30
8	V8	12.98	7.78	2.04	7.26	35.05	82.92
9	V9	14.48	7.94	2.26	7.89	41.01	83.2
10	V10	14.52	9.72	1.76	8.3	28.10	86.98
11	V11	13.93	8.24	1.48	7.55	36.21	88.55
12	V12	16.58	7.2	1.78	8.16	53.7	88.57
13	V13	12.32	9.06	0.66	7.01	19.96	94.16
14	V14	10.32	7.26	2.2	6.26	21.2	76.13
15	V15	12.54	7.14	1.62	6.76	38.12	85.96
16	V16	10.56	9.96	2.36	7.29	4.18	75.31
17	V17	10.54	6	1.94	5.82	37.10	79.66
18	V18	11.54	7.48	2.34	6.78	29.03	77.79
19	V19	12.32	9.26	2.44	7.67	18.1	78.44
20	V20	11.68	7.81	2.02	6.83	26.8	81.06
21	V21	13.38	8.24	1.96	7.52	33.4	84.16
22	V22	14.88	7.65	0.58	7.37	44.88	95.82
23	V23	16.69	11.85	3.48	10.34	43.04	86.53
24	V24	13.37	5.81	1.94	6.7	52.9	84.27
MEAN		12.23	8.50	2.05		27.71	81.59
		CD (0.05)					
V		0.73**					
S		0.73**					
VxS		3.58**					

(21dSm^{-1}) showed lowest reduction over control for V16 (41.6%) followed by V10 (43.4%) and V3 (43.8%) while drastic reduction noticed in V 11(49.95%), followed by V8 (47.55%) table 6.

Vigour index:

Vigour index showed significant differences due to genotypes, salinity and their interaction. A significant decline in seed vigour of all the genotypes upon salinity stress was recorded. V4 recorded highest value of seed vigour at 12dSm^{-1} (1088) and 21dSm^{-1} (268) after salinity stress. The lowest seed vigour was recorded for the seeds of V17 (420) at 12dSm^{-1}, whereas least seed vigour was obtained in V22 (32) followed by V13 (36) at 21dSm^{-1} table 7.

Discussion

The seed germination % showed significant differences due to genotypes and salinity level. The percentage of germination decreased in all genotypes with increasing salinity level. Significant higher germination % was found in V24 followed by V10 and V7 at 21dSm^{-1}. The highest speed of germination was observed at control while the lowest at 21dSm^{-1}. V5 recorded no reduction percentage whereas V10, V15, V4, V24 and V33 registered lowest reduction percentage over control. Hakim *et al*., (2010) suggested that in addition to toxic effects of certain ions, higher concentrations of salt reduces the water potential in the medium which hinders water absorption by germinating seeds and result reduction in germination. The variability have also been reported in salinity tolerance among rice varieties at

Table 6: Effect of salinity on Dry weight (mg/seedling) in rice varieties/genotypes.

Sl. No.	Geno types	Salinity level			Over all Mean	Percentage reduction at 12 dSm^{-1}	Percentage reduction at 21 dSm^{-1}
		Con trol (S1)	12 dSm^{-1} (S2)	21 dSm^{-1} (S3)			
1	V1	151.5	107	15.8	91.4	14.6	44.85
2	V2	143.5	87	15.9	82.15	19.65	44.55
3	V3	128	128	16.05	90.68	0	43.75
4	V4	232.5	193.5	16.5	147.5	34.35	46.45
5	V5	153	130.5	12	98.5	7.35	46.05
6	V6	126.5	126.5	14	89	0	44.45
7	V7	147.5	128.5	14.45	96.8	6.4	45.25
8	V8	236.5	153	11.6	133.7	17.65	47.55
9	V9	181.5	143.5	16.45	113.8	10.46	45.55
10	V10	110.5	110.5	14.5	78.5	0	43.4
11	V11	244.5	111.5	14.6	123.5	26.17	49.95
12	V12	241.5	130	13.75	128.4	23.05	47.2
13	V13	164.5	139	12.2	105.2	7.75	46.35
14	V14	228	102.5	13.05	114.5	27.5	47.1
15	V15	164.5	138.5	11.8	104.9	7.9	46.5
16	V16	180.5	146.5	15.3	114.1	9.4	41.55
17	V17	126	66.5	14.05	68.8	23.6	44.4
18	V18	202.5	101.5	14.55	106.1	24.15	46.4
19	V19	243	120	15.5	126.1	25.4	46.8
20	V20	190	172	13.35	125.1	4.7	46.55
21	V21	159.5	119	18.75	99.05	12.69	44.2
22	V22	171.5	171.5	13.2	118.7	0	46.2
23	V23	538.5	374.5	47	320	15.2	46.63
24	V24	241.5	103	13.5	119.3	28.65	47.2
MEAN		196.12	137.66	15.74		13.35	45.74
	CD (0.05)						
V	3.55**						
S	3.55**						
V x S	17.40**						

Table 7: Effect of salinity on seed vigour in rice varieties/genotypes.

Sl. No.	Geno types	Salinity level			Over all Mean	Percentage reduction at 12 dSm^{-1}	Percentage reduction at 21 dSm^{-1}
		Con trol (S1)	12 dSm^{-1} (S2)	21 dSm^{-1} (S3)			
1	V1	1060	600	134	45.22	45.22	87.3
2	V2	844	755	202	10.50	10.50	76
3	V3	888	888	180	0	0	80
4	V4	1034	1034	268	0	0	74.7
5	V5	829	791	107	4.58	4.58	87.5
6	V6	1011	832	196	7.7	7.7	80.6
7	V7	971	728	152	20.9	20.9	84.3
8	V8	1298	754	179	41.9	41.9	86.2
9	V9	1448	714	162	50.6	50.6	88.8
10	V10	1132	738	133	38.8	38.8	88.2
11	V11	1365	791	106	42	42	92.3
12	V12	1260	525	113	58.3	58.3	91.3
13	V13	1133	797	36	29.6	29.6	96.8
14	V14	928	631	140	32.7	32.7	84.9
15	V15	1003	542	113	45.9	45.9	88.7
16	V16	887	737	141	16.9	16.9	84.1
17	V17	758	420	100	44.59	44.59	86.8
18	V18	1107	493	149	55.4	55.4	86.5
19	V19	887	648	156	26.4	26.4	82.4
20	V20	747	484	113	35.2	35.2	84.8
21	V21	1338	642	101	35.4	35.4	92.4
22	V22	1249	642	32	48.5	48.5	97.4
23	V23	1301	912	250	29.9	29.9	80.7
24	V24	1069	464	151	56.5	56.5	85.8
MEAN		1064.45	690.08	142.25			
	CD (0.05)						
V	5.22**						
S	5.22**						
V x S	26.44**						

germination (Vibhuti *et al*., 2015 and Pradheeban *et al*., 2015). The genotype V9 recorded lowest reduction in total seedling length at 21dSm^{-1}. The effect of salinity stress on seedling length showed significant difference.

Reduction in seedling length is common phenomena of many crop plants under saline condition. The shoot and root length of seedlings grown in salt solutions also showed decreasing trend, indicating that the salt stress not only affected germination but also the growth of seedlings, which indicates that synthetic ability of seed and thus dry matter production of seedlings was affected. This is in conformity with that findings of Hakim *et al*., (2010) and Pradheeban *et al*., (2015) and they observed that shoot and root length was conspicuously affected by salt. V16 followed V10 and V10 and V3 recorded lowest and V11 highest reduction in dry matter production. Effect on root and shoot dry weight reduction in seedling growth as a result of salt stress has been reported in several authors (Pradheeban *et al*., 2015). V4 and V22 recorded the highest and lowest value of seed vigour, respectively. Seed vigour index declined with the increases in salt concentration. It has been also reported that salinity suppresses the uptake of essential nutrients like P and K (Nasim *et al*., 2008), which could adversely affect seedlings growth and vigour. Prisco and Vieria (1976) reported that under stress conditions there is a decrease in water uptake both during imbibition's and seedling establishment and in the case of salt stress, this can be followed by uptake of ions. This results in physiological and biochemical changes in both anabolic and catabolic organs of the seeds and seedlings (Prisco *et al*., 1981).

Conclusion

Seeds of 24 genotypes undergone salinity stress (0, 12 and 21 dSm^{-1}) for 14 days shown significant variation in ability to germinate and produce vigorous seedlings. The seed quality parameters showed significant differences due to genotypes and salinity and their interaction. Lowest reduction over control in germination % was observed in V24 followed by V10 and V7. V5 recorded no reduction percentage whereas V10, V15, V4, V2, V24 and V33 registered lowest reduction percentage over control in speed of germination. V9 recorded lowest reduction in total seedling length followed by V22, V2 and V13. V16 followed V10 and V3 recorded lowest reduction in dry matter production. V4 recorded highest value of seed vigour. In general, salinity decreased germination %, speed of germination and led to reduction in total seedling length, fresh and dry weight of seedlings and vigour index and the magnitude of reduction increased with increasing salinity level. Rice genotypes V2 and V4 showed greater salt tolerance while V1, V21 and V22 registered lower salt tolerance based in terms of germination and seedling vigour.

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References

Abdul-Baki,A.A. and J.D. Anderson (1973). Vigour determination by multiple criteria. *Crop Sci*., **13:** 630-637.

ANU (2006). Technological transformation of productivity, profitability and sustainability: Rice. In the first ten K.R. Narayanan orations: Essays by eminent persons on the rapidly transforming Indian economy. Australia South Asia research centre the Australian national university.

FAO. (2104). Extent of salt affected soils.http://www.fao.org/ soils - portal/soil-management/management - of - some-problem - soils/salt - affected-soils/more-information - on - salt - affected-soils/en/{last accessed 03/12/2014}.

Gopalan, C., B.V. Rama Sastri, S. Balasubramanian (2007). Nutritive value of Indian foods. India: National Institute of Nutrition (NIN), ICMR.

Gregorio G.B. (1997). Tagging salinity tolerance genes in rice using amplified fragment length polymorphism (AFLP). 'Ph.D. thesis, University of the Philippines, *Los Banos*. 118.

Hakim, M.A., A.S.J. Begum, M.M. Hanafi, M.R. Ismail and A. Selamat (2010). Effect of salt stress on germination and early seedling growth of rice. *African Journal of Biotechnology,* **9(13):** 11-18.

Lutts, S., J.M. Kinet and J. Bouharmont (1995). Changes in plant responses to NaCl during development of rice (*Oryza sativa* L.) varieties differing in salinity resistance. *J. Experimantal Botany,* **46:** 1843-1852.

Ma, H.L., J.G. Zhu, G. Liu, Z.B. Xie, Y.L. Wang, L.X. Yang and Q. Zeng (2007). Availability of soil nitrogen and phosphorus in a typical rice–wheat rotation system under elevated atmospheric (CO_2). *Field crops research,* **100(1):** 44-51.

Maguire, J.D. (1962). Speed of germination-Aid in selection and evaluation for seedling emergence and vigor 1. *Crop science,* **2(2):** pp.176-177.

Mitin, A. (2009). Documentation of selected adaptation strategies to climate change in rice cultivation. East Asia Rice Working Group, 8.

Nasim, M.U.H.A.M.M.A.D., R. Qureshi, T.A.R.I.Q. Aziz, M. Saqib, S.H.A.F.Q.A.T. Nawaz, S.T. Sahi and S. Pervaiz (2008). Growth and ionic composition of salt stressed *Eucalyptus camaldulensis* and *Eucalyptus teretcornis*. *Pakistan Journal of Botany,* **40(2):** 799-805.

Pradheeban, L., S.P. Nissanka and L.D.B. Suriyagoda (2015). Screening commonly cultivated rice cultivars in Sri Lanka with special reference to Jaffna for salt tolerance at seedling stage under hydroponics. *Int. J. Agric. Agric. R.,* **7:** 1-13.

Prisco, J.T. and G.H.F. Vieira (1976). Effects of NaCl salinity on nitrogenous compounds and proteases during germination of *Vigna sinensis* seeds. *Physiologia Plantarum,* **36(4):** 317-320.

Prisco, J.T., J. Eneas Filho and E. Gomes Filho (1981). Effect of NaCl salinity on cotyledon starch mobilization during germination of *Vigna unguiculata* L. Walp seeds. *Revista brasileira de Botánica,* **4:** 63-71.

Quijano-Guerta, C. and G.J.D. Kirk (2002). Tolerance of rice germplasm to salinity and other soil chemical stresses in tidal wetlands. *Field crops research,* **76(2-3):** 111-121.

Ruan, S. and Q. Xue (2002). Effects of chitosan coating on seed germination and salt-tolerance of seedling in hybrid rice (*Oryza sativa* L.). *Zuo wu xue bao,* **28(6):** 803-808.

Vibhuti, C.S., K. Bargali and S.S. Bargali (2015). Seed germination and seedling growth parameters of rice (*Oryza sativa* L.) varieties as affected by salt and water stress. *Indian Journal of Agricultural Sciences,* **85(1):** 102-108.

Yokoi, S., R.A. Bressan and P.M. Hasegawa (2002). Salt stress tolerance of plants. *JIRCAS working report,* **23(1):** 25-33.