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Performance of Rice Germplasm (*Oryza sativa* L.) under Coastal Saline Conditions

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Salinity is considered as one of the important factors limiting the production and productivity of rice in Indian coastal regions. Identification of saline tolerant donors is a prerequisite for development of suitable varieties for such situations. Sixty-three rice genotypes collected from *Sundarbans* region of West Bengal (India) were screened along with Panidhan and IR -29 as susceptible checks. As per the SES score at seedling stage 33 tolerant genotypes were identified and subjected to detailed evaluation along with Pokkali, CSR-10, SR-26B as tolerant checks in field conditions at two locations. The rice genotypes differed significantly for salt tolerance and also for the traits measured both at seedling and reproductive stage. At both the locations (ECe 10.0 dS m^{-1} and 8.2 dS m^{-1}), IC-594013 (Kumrogoor), IC-596840 (Kalonunia), IC-594020 (Talmugur) and IC-594027(Nonabokra) showed high degree of salt tolerance and also higher estimates for seven yield attributing traits viz. ear bearing tillers, panicle weight, panicle length, No. of filled grains/panicle, sterility percentage, 100 seed weight and grain yield as compared to the tolerant check Pokkali, CSR-10 and SR-26B. The identified salt tolerant rice genotypes were also varied with different agronomic traits which will be utilized by the breeders for the development of elite salt tolerant cultures.

(***Keywords:*** *Germplasm, Rice; Salinity stress; Seedling stage; Tolerant donors)*

Soil salinity is the most widespread and prevalent problem in the areas along the coastal lines. Ingression of sea water and intrusion of water from estuaries, creeks, drains and rivers increases salinity level in the cultivated lands all along, 8129 km of coastal tract. Area under salt stress is still increasing due to many factors including climate change, rise in sea levels excessive irrigation without proper drainage etc. (Hazra *et al.*, 2002). The ground water table is shallow with high salt content and contributes significantly to soil salinization. Crop species show a spectrum of responses to salinity which not only affects the quality and quantity of yield but also affects the growth and development of the plant.

Rice is the most important cereal crops and staple food for majority of world population. Soil salinity has become the single largest factor limiting rice production in coastal regions of the country. In India about 6.73 mha of cultivable land is salt affected posing limitation in enhancing rice productivity. Millions of hectares in the coastal regions of India are left uncultivated or are grown with very limited yields because of non-availability or less availability of suitable salt tolerant rice variety. The literature indicates that rice is sensitive to salinity, particularly during the seedling stage (Maas & Hoffman, 1977), considerable yield loss and reduced growth and development also occur in rice grown on saline soils. Despite being sensitive to salt stress, rice (Zeng *et al.*, 2002) is one of the few crops that can grow on most of the coastal saline soils. Developing salt tolerant rice varieties is the most efficient way to stabilize rice production and alleviate food security and poverty in coastal region. For development of high yielding salt tolerant rice varieties, it is required to enrich salt tolerant rice genetic resources (Buu *et al.*, 2002). Characterization and evaluation of traditional landraces provides information necessary in the identification of donors for hybridization to produce salt tolerant varieties with improved productivity and quality. Identification of donors for salinity tolerance was studied by knowledge of salinity effects on rice seedling growth and yield components would improve management practices in fields. Preliminary screening for salt tolerance at ECe 10.0 dS m^{-1} in seedling stage was conducted to select tolerant genotypes. The response of these genotypes to

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salinity with electrical conductivity at 8.2 dS m^{-1} and 10.0 dS m^{-1} compared to tolerant check varieties was also investigated through field evaluation.

Screening and evaluation of rice genotypes for breeding salt tolerant genotypes has been reviewed by many researchers (Shannon and Akbar1978, Shannon 1984, Lang 2000 and Lee *et, al.*, 2003). Performance of rice genotypes for salt tolerance has been studied in controlled conditions in green houses and phytotrons (Lee *et al.*, 2003, Bhowmik *et al.*, 2007 & 2009, Hosseini *et al.*, 2012). Report on evaluation for salt tolerance in natural saline condition is sporadic probably due to stress heterogeneity, the presence of other soil stress and influence of climatic factors. The present study is thus an attempt to identify suitable salt tolerant donors for coastal saline soils through field screening at two variable soil salinity levels.

MATERIALS AND METHODS

Screening of rice genotypes for salinity tolerance at seedling stage

Sixty-three rice genotypes collected from *Sundarbans* region of West Bengal (India) were used for screening of salt tolerance at seedling stage. Five control varieties, Pokalli, CSR-10, SR- 26B (salt tolerant) and IR29 and IR 64 (salt susceptible) were used for comparative study (Table 1). Based on the modified standard evaluation system (IRRI, 1997) for rating the visual symptoms of salt injury at seedling stage (Table 2), tolerant genotypes were selected. This scoring had discriminated the susceptible genotypes from the tolerant and the moderately tolerant genotypes. The selected genotypes were further evaluated for identification of donors for salinity stress. Scoring was done when the susceptible checks were dying due to salinity stress. Then 33 salt tolerant genotypes were selected and subjected to field evaluation at two different locations with variable level of soil salinity i.e. 10.0 dS m^{-1} and 8.2 dS m^{-1}.

Field evaluation of rice genotypes for salinity tolerance

Thirty three rice genotypes, initially selected for salt tolerance at seedling stage were grown during *Kharif*, 2012 with an objective to evaluate the performance of different rice genotypes (*Oryza sativa* L.) under coastal saline soil conditions and also to identify suitable donors for salinity tolerance. Two separate field trials were conducted at two different locations viz. 1. Kujang, Jagatsinghpur, Odisha (ECe 8.2 dS m^{-1}) and 2. Experimental Farm of Central Soil Salinity Research Institute, Regional Research Station, Canning, W.B. (ECe 10.0 dS m^{-1}). Thirty days old seedlings were transplanted in randomized block design with three replications at location - 1 and two replications at location - 2. Each genotype was grown in five rows of three meters long with spacing of 20 x 20 cm between rows and plants. Standard agricultural practices were followed during the crop growth. Observations were recorded on five randomly chosen plants of each genotype per replication on various agronomical traits i.e., plant height (cm), Leaf length (cm), leaf width (cm), Days to flowering, No. of panicles plant^{-1}, Panicle length (cm), No of filled grains panicle^{-1}, No of unfilled grains panicle^{-1}, Sterility %, 100-grains weight (g), grain yield plant^{-1} (g), Yield m^{-2} (Kg) according to the standard procedure as mentioned by Gregorio *et al.* (2002).

Data analysis

Data obtained were subjected to analysis of variance (ANOVA) for each character on mean values. The total variance was partitioned into variance due to replication, genotype and error. 'F' test was used to test the significance of difference among the genotypes. The significance between the means of any two genotypes was compared using critical difference (CD). Screening at seedling stage under salinized condition was carried out based on visual performance of genotypes as compared with susceptible checks.

RESULTS AND DISCUSSIONS

In the present study, rice genotypes were screened for salt tolerance at seedling stage at soil salinity of ECe 10.0 dS m^{-1}. The genotypes showed different reaction to salinity at seedling stage. Variations between rice genotypes with respect to leaf symptoms, growth parameters and survival status were observed. Zeng and Shannon (2000) studied the effects of salinity on seedling growth and yield components of rice and reported that genotypes showed different degrees of reaction to the salinity. Sixty five rice genotypes including susceptible checks were classified into five categories i.e, susceptible (17), highly susceptible (15) moderately tolerant (18), tolerant (10) and highly tolerant (5) on the basis of visual scoring as compared with the performance of susceptible checks viz. IR-29 and IR-64.

Thirty- three tolerant genotypes were selected and evaluated further in field conditions, with an objective to identify salt tolerant donors. The field,

Table 1. List of rice germplasm used in the study

Sl. No.	IC. No.	Genotypes	Important characters		
			Grain type	Kernal color	Basal leaf color
1	593980	Sabita patnai	MB	LB	G
2	593981	Gitanjali patnai	LS	W	G
3	593982	Malapoti patnai	MS	R	G
4	593983	Lathi patnai	LS	W	G
5	593984	Hanseswari	MB	W	Lt. Purple
6	593985	Dudheswar	MS	W	G
7	593986	Benimadhav	MB	R	G
8	593987	Desipatnai	MS	R	G
9	593988	Gopalbhog	MS	LB	G
10	593989	Auspachali	LS	R	Lt. Purple
11	593990	Odasal	MS	R	G
12	593991	Darsal	MB	W	G
13	593992	Heuse	MB	W	G
14	593993	Darsal	MB	W	G
15	593994	Phuterdhan	MS	W	G
16	593995	Kamini	SS	W	G
17	593996	Ranidhan	MS	LB	G
18	593997	Niko	MS	W	G
19	593998	Dudheswar	MS	W	G
20	593999	Marisal	SB	W	G
21	594000	Malabati	MS	R	Lt. Purple
22	594001	Rajlaxmi	LS	W	G
23	594002	Kanak chur	MS	W	G
24	594003	Talmugur	LS	R	G
25	594004	Getu	MS	W	G
26	596834	Gobindabhog	SS	W	G
27	594005	Rupsal	MS	W	G
28	594006	Narasinghajatta	MS	W	G
29	594007	Kaminibasa	MS	W	G
30	596835	Gheuse	MS	W	G
31	594008	Jarava	LS	W	G
32	594009	Kalomota	MB	R	PPL
33	594010	Khejurchhodi	MB	W	G
34	594011	Katrangi	MS	R	G
35	594012	Sitabhog	SB	W	G
36	594013	Kumrogoor	MS	W	G
37	594014	Dudheswar	MS	W	G
38	594015	Marisal	MS	W	G
39	594016	Sada patnai	LS	LB	G
40	594017	Tulaipanji	MS	W	G
41	594018	Malabati	MB	R	PPL
42	596836	Boyarbot	MB	W	G
43	596837	Gobindabhog	SB	W	G
44	594019	Nonabokra	MS	R	G
45	594020	Talmugur	LS	R	G
46	596838	Dudheswar	LS	W	G
47	596839	Dadsal	MS	W	G
48	594021	Sada getu	MB	LB	G
49	596840	Kalonunia	MB	W	G
50	596841	Dudhkamal	SB	SB	G

Contd.

Sl. No.	IC. No.	Genotypes	Important characters		
			Grain type	Kernal color	Basal leaf color
51	594022	Marisal	SB	W	G
52	594023	Haldibatola	MB	W	G
53	594024	Hoogla	MS	W	G
54	594025	Malabati	MS	SB	PPL
55	594026	Asfalmota	LS	W	PPL
56	594027	Nonabokra	MS	R	G
57	596842	Darsal	MS	R	G
58	594028	Kanta rangi	MS	R	G
59	594029	Marisal	SB	W	G
60	594030	Kamini	LS	R	G
61	594031	Kumarmani	MS	W	G
62	594032	Palbeda	LS	W	G
63	594033	Laxmi patnai	SB	W	G

Grain type- - LS- Long slender, MS- Medium slender, MB- Medium bold, SS- Short slender, SB- Short bold
Kernel color- LB- Light brown, W- White, SB- Seckled brown, R- Red
Basal leaf color-G-Green, Lt. purple- Light purple, PPL- Purple lines

Table 2. *Modified standard evaluation score (SES) of visual salt injury at seedling stage*

Score	Observation	Tolerance
1	Normal growth, no leaf symptoms	Highly tolerant
3	Nearly normal growth, but leaf tips or few leaves whitish and rolled	Tolerant
5	Growth severely retarded; most leaves rolled; only a few are elongating	Moderately tolerant
7	Complete cessation of growth; most leaves dry; some plants dying	Susceptible
9	Almost all plants dead or dying	Highly susceptible

experiment was conducted at two different locations with varying level of soil salinity (ECe 10.0 dS m^{-1} & ECe 8.2 dS m^{-1}). The agronomic characteristics of the tolerant genotypes were measured and compared with tolerant check varieties viz. Pokkali, CSR-10 and SR-26B. Variations for plant height, leaf length, days to 50% flowering, EBT, panicle length, panicle weight, no. of filled grains panicle-1, sterility %, grain yield $plant^{-1}$ and grain yield m-2 were observed and compared with tolerant check varieties (Table 4 & 5). Natarajan *et al.*, 2005 has studied yield and its attributing traits for identification of salt tolerant donors for coastal saline soils of India. Selection of salt tolerant rice genotypes on the basis of stress at seedling stage has also been made by Shannon *et al.*, 1998; Aisha *et al.*, 2005 and variation among genotypes for salt tolerance has been reported by (Alam *et al.*, 2004). Eight genotypes were identified that showed higher values of grain yield and other associated traits in comparison with tolerant checks.

Analysis of variance (ANOVA) for both the locations, revealed significant differences among 33 genotypes for all the 13 agronomic traits, indicating genetic diversity of material chosen for the present study. Significant differences for yield attributing traits in comparison to the best check variety viz.CSR 10, SR 26B and Pokkali at 5% and 1% level of probability were observed in both the locations. The grain yield of six genotypes viz. Kalonunia, Talmugur, Kumrogoor, Nonabokra, Getu and Darsal showed an increase of 29-35% over the tolerant check (CSR-10). Mean values on different traits, the range of distribution has been discussed based on which promising genotypes were identified for salinity tolerance.

Plant height: Data on plant height revealed significant difference among rice varieties at both the locations. In location I range of plant height varies from 85.9 (CSR-10) to 157.1 cm (Talmugur) with mean of 138.77 + 4.53 cm in location I and in location II it varies from 84.6 (CSR-10) to 146.2 cm (Kumrogoor) with mean of 123.23 + 7.11 cm. In comparison with best check value of 145.95 (Pokkali) Kumrogoor resulted significant difference for plant height.

Table 3. *Salinity score and reaction to salinity of rice genotypes at seedling stage*

Sl. No.	IC. No.	Vernacular name	Salinity score	Reaction to salinity	Sl. No.	IC. No.	Vernacular name	Salinity score	Reaction to salinity
1	593980	Sabita patnai	7	S	34	594011	Katrangi	5	MT
2	593981	Gitanjali patnai	5	MT	35	594012	Sitabhog	9	HS
3	593982	Malapoti patnai	7	S	36	594013	Kumrogoor	1	HT
4	593983	Lathi patnai	7	S	37	594014	Dudheswar	5	MT
5	593984	Hanseswari	9	HS	38	594015	Marisal	5	MT
6	593985	Dudheswar	5	MT	39	594016	Sada patnai	7	S
7	593986	Benimadhav	7	S	40	594017	Tulaipanji	9	HS
8	593987	Desipatnai	9	HS	41	594018	Malabati	7	S
9	593988	Gopalbhog	9	HS	42	596836	Boyarbot	7	S
10	593989	Auspachali	5	MT	43	596837	Gobindabhog	9	HS
11	593990	Odasal	3	T	44	594019	Nonabokra	1	HT
12	593991	Darsal	3	T	45	594020	Talmugur	3	T
13	593992	Heuse	5	MT	46	596838	Dudheswar	7	S
14	593993	Darsal	1	HT	47	596839	Dadsal	5	MT
15	593994	Phuterdhan	7	S	48	594021	Sada getu	5	MT
16	593995	Kamini	9	HS	49	596840	Kalonunia	1	HT
17	593996	Ranidhan	9	HS	50	596841	Dudhkamal	7	S
18	593997	Niko	5	MT	51	594022	Marisal	5	MT
19	593998	Dudheswar	5	MT	52	594023	Haldibatola	9	HS
20	593999	Marisal	5	MT	53	594024	Hoogla	5	MT
21	594000	Malabati	5	MT	54	594025	Malabati	7	S
22	594001	Rajlaxmi	9	HS	55	594026	Asfalmota	5	MT
23	594002	Kanak chur	9	HS	56	594027	Nonabokra	3	T
24	594003	Talmugur	1	HT	57	596842	Darsal	5	MT
25	594004	Getu	3	T	58	594028	Kanta rangi	7	S
26	596834	Gobindabhog	9	HS	59	594029	Marisal	5	MT
27	594005	Rupsal	5	MT	60	594030	Kamini	9	HS
28	594006	Narasinghajatta	9	HS	61	594031	Kumarmani	5	MT
29	594007	Kaminibasa	9	HS	62	594032	Palbeda	7	S
30	596835	Gheuse	7	S	63	594033	Laxmi patnai	7	S
31	594008	Jarava	5	MT	64	Check	IR-29	9	HS
32	594009	Kalomota	5	MT	65	Check	IR-64	7	S
33	594010	Khejurchhodi	7	S					

HT- Highly tolerant, T- Tolerant, MT- Moderately tolerant, S- Susceptible, HS- Highly susceptible

Leaf length: Measurement of leaf length (2nd leaf) ranged between 26.71 (Kumarmani) and 54.1 cm (Nonabokra-1) in location I and between 21.8 (Darsal) to 45.4 cm (Kumrogoor) in location II. With the mean value of 34.29 ± 4.22 and 42.99 ± 5.32 cm in location I & II respectively. The genotypes viz. Kumrogoor, Talmugur, Kalonunia, Nonabokra performed better than tolerant checks.

Leaf width: The estimates of leaf width varies from 0.75 (SR-26B) to 1.0 (Kalonunia) with mean 0.88 + 0.07 cm at location I and from 0.6 (Niko) to 1.0 cm (Kalonunia) with mean 0.74 + 0.07 cm in location II.

Days to 50% flowering: Duration to 50% flowering was significantly different among rice genotypes with range of 89 (CSR-10) to 115.0 days (Nonabokra) with mean 107.3 + 2.44 days in location I and it varies from 91.7 (Sada getu) to 113.3 (Kumrogoor) with mean of 106.5 + 0.72 days at location II.

Ear Bearing Tillers (EBT): The number of EBT varied significantly among the genotypes in both

Table 4. *Performances of salt tolerant rice genotypes at experimental field, Kujang, Jagatsinghpur in Kharif, 2012*

IC No.	Variety name	PH	LL	LW	DF	EBT	PL	PW (g)	100 gr. Wt. (g)	FG	UG	Ster. (%)	GYP	GYM
593981	Gitanjali patnai	140.9	40.4	0.88	110.5	4.95	24.55	3.91	2.26	107.1	35.2	24.8	8.6	241.3
593985	Dudheswar	143.9	36.8	0.88	111.0	5.45	24.27	4.13	1.49	96.7	31.1	24.4	8.0	210.9
593989	Auspachali	146.1	48.5	0.78	112.0	4.85	24.95	4.29	2.45	112.1	34.5	23.6	9.4	263.3
593990	Odasal	146.1	41.2	0.88	114.0	4.75	25.20	4.33	2.20	121	40.1	25.0	11.4	238.5
593991	Darsal	125.3	40.0	0.83	111.5	5.00	21.94	4.39	1.26	109.3	35.4	24.4	10.0	162.5
593992	Heuse	143.9	33.8	0.83	108.0	5.45	22.50	4.17	2.62	75.9	35.1	32.0	5.9	207.7
593993	Darsal	146.1	46.6	0.90	114.5	5.90	24.17	4.62	1.40	139.9	33.4	19.2	15.8	332.3
593997	Niko	141.9	39.3	0.84	114.5	4.65	24.72	4.31	2.59	91.8	29.9	24.5	11.1	300.0
593998	Dudheswar	130.6	37.6	0.90	110.5	5.55	25.43	3.98	1.24	103.3	33.8	24.8	8.4	206.6
593999	Marisal	145.4	40.6	0.78	108.5	5.00	21.92	4.71	1.87	124.4	34.7	21.7	12.5	264.4
594000	Malabati	142.9	45.3	0.88	107.5	5.25	24.88	4.02	2.47	111.1	34.8	23.8	14.0	244.3
594002	Kanak chur	127.5	40.0	0.88	101.0	4.60	25.71	3.74	1.33	110.2	37.4	25.2	9.5	223.2
594003	Talmugur	157.1	52.9	0.98	106.0	7.05	27.82	5.39	2.40	145.3	23.9	14.1	17.3	406.6
594004	Getu	145.3	46.6	0.88	98.5	7.80	26.18	4.92	1.90	126.8	30.7	19.5	17.1	395.6
594005	Rupsal	142.7	45.7	0.88	110.0	5.35	22.00	4.04	1.42	106.25	30.0	22.1	9.0	210.9
594008	Jarava	125.3	48.2	0.88	107.0	4.80	22.04	3.78	2.13	110.6	35.2	24.2	10.9	248.0
594009	Kalomota	142.3	49.4	0.83	114.5	5.05	19.84	4.49	2.57	103.6	33.5	24.5	18.2	288.6
594011	Katrangi	131.9	45.0	0.88	114.0	5.15	22.81	4.44	2.16	97.0	34.1	25.9	11.0	217.7
594013	Kumrogoor	151.7	38.0	0.93	115.0	7.85	28.87	5.51	2.78	142.7	28.1	16.5	19.2	411.7
594014	Dudheswar	136.1	41.8	0.88	108.5	6.25	24.29	4.33	1.60	112.1	33.0	22.9	10.6	226.8
594015	Marisal	135.4	45.9	0.82	104.5	4.30	21.05	4.44	1.70	89.7	34.5	27.5	9.3	206.4
594019	Nonabokra	150.2	49.7	0.98	105.5	7.05	25.75	3.87	2.69	129.9	31.0	19.3	17.3	380.9
594020	Talmugur	150.9	52.3	0.99	99.0	7.70	27.89	4.91	2.54	138.6	29.6	17.5	20.1	411.2
596839	Dadsal	137.3	33.2	0.96	90.5	3.95	23.2	4.72	0.99	115.7	35.5	23.5	10.3	210.3
594021	Sada getu	135.3	36.6	0.88	93.0	5.15	21.55	3.68	2.23	80.9	34.0	29.6	6.9	147.2
596840	Kalonunia	152.8	48.9	1.00	105.0	7.50	28.93	5.38	1.16	141.8	29.6	17.2	17.4	402.8
594022	Marisal	135.3	43.9	0.82	112.5	5.15	21.20	4.05	1.87	78.35	34.3	31.8	6.4	199.7
594024	Hoogla	155.6	43.4	0.78	111.5	4.15	21.99	4.87	2.74	84.1	39.6	32.1	7.8	280.1
594026	Asfalmota	137.9	43.4	0.81	106.5	4.45	22.74	4.03	3.13	112.2	31.1	21.7	14.7	234.7
594027	Nonabokra	148.74	54.1	1.00	115.0	6.35	26.68	4.87	2.75	137.6	35.7	20.5	16.9	393.9
596842	Darsal	128.7	40.7	0.88	109.5	4.15	19.88	4.11	2.41	70.3	34.4	32.8	10.4	146.1
594029	Marisal	124.3	40.12	0.88	111.5	4.05	24.28	4.15	1.785	89.7	37.4	29.4	8.8	172.65
594031	Kumarmani	145.7	26.71	0.84	112.0	4.25	19.59	4.24	1.435	100.1	33.3	24.9	8.6	233.4
Check	Pokkali	145.95	51.29	0.92	106.0	5.50	25.75	4.93	2.625	114.7	31.2	21.4	13.8	286.4
Check	CSR-10	85.9	38.58	0.92	89.0	6.00	23	4.72	2.5	106.4	30.2	22.1	12.5	308
Check	SR 26-B	112.83	37.35	0.75	96.0	5.60	23.65	3.99	2.46	104.3	31.1	23.0	13.5	304.25
Mean		138.77	42.92	0.88	107.3	5.44	23.92	4.40	2.09	109.48	33.23	23.82	12.03	267.2
SEm (+)		4.53	5.32	0.80	2.44	0.97	1.23	0.17	0.06	10.02	4.61	3.45	2.53	18.51
CV (%)		3.26	12.39	9.15	2.28	17.9	5.15	4.03	2.74	9.15	13.89	14.5	21.07	6.92
CD (P=0.05)		9.20	10.80	0.16	4.97	1.98	2.5	3.60	0.11	20.35	9.37	7.01	5.15	37.6
CD (P=0.01)		12.35	14.49	0.22	6.66	2.66	3.35	0.48	0.15	27.30	12.57	9.41	6.91	50.4

PH-plant height, LL- leaf length, LW- leaf width, DF- days to 50% flowering, EBT- Ear bearing tiller, PL- Panicle length, PW- Panicle weight, FG- filled grains, UG-unfilled grains, GYP- Grain yield/plant, GYM- Grain yield/m^2

Table-5. *Performances of salt tolerant rice genotypes at experimental field, CSSRI, RS Canning in Kharif, 2012*

IC No.	Variety name	PH	LL	LW	DF	EBT	PL	PW (g)	100 gr. Wt.(g)	FG	UG	Ster. (%)	GYP	GYM
593981	Gitanjali patnai	121.9	33.6	0.7	107.7	4.2	22.2	2.7	2.2	85.2	65.3	43.4	8.3	180.6
593985	Dudheswar	126.1	32.3	0.7	109.7	4.1	20.6	2.6	1.4	114.6	61.0	34.8	7.1	137.9
593989	Auspachali	120.3	36.6	0.7	110.3	3.7	19.5	3.4	2.4	111.9	54.1	32.6	10.0	208.1
593990	Odasal	135.3	35.4	0.8	111.7	4.5	22.8	3.3	2.2	132.0	61.2	31.7	10.9	218.7
593991	Darsal	105.0	21.8	0.7	110.3	4.6	19.6	2.6	1.3	126.9	59.7	32.0	7.2	132.1
593992	Heuse	120.4	27.0	0.7	106.7	5.3	23.6	2.6	2.5	72.7	55.8	43.2	8.4	175.5
593993	Darsal	133.7	40.7	0.8	112.0	7.5	24.8	3.9	1.4	144.6	50.5	28.1	17.0	347.9
593997	Niko	127.6	28.0	0.6	112.3	5.3	20.1	3.1	2.6	82.0	46.8	36.2	12.1	259.7
593998	Dudheswar	95.7	35.9	0.7	108.3	5.0	22.5	3.0	1.3	126.8	46.6	27.0	8.8	183.3
593999	Marisal	120.3	22.6	0.6	107.7	5.3	18.4	3.3	1.8	108.9	44.7	29.1	11.6	205.8
594000	Malabati	136.7	36.4	0.7	106.7	4.8	21.1	2.9	2.3	117.7	57.0	32.8	12.9	221.4
594002	Kanak chur	115.6	26.1	0.7	102.3	5.3	21.0	2.9	1.4	115.6	56.7	33.9	8.9	167.8
594003	Talmugur	138.4	42.6	0.8	105.7	7.3	26.1	4.0	2.3	133.9	52.3	27.9	18.6	378.4
594004	Getu	139.5	39.0	0.8	100.4	6.1	23.2	3.7	1.8	119.2	42.2	26.3	17.9	332.8
594005	Rupsal	123.2	33.5	0.6	108.3	5.3	21.5	3.0	1.4	124.8	49.0	28.2	8.3	145.0
594008	Jarava	96.3	28.0	0.7	105.7	4.8	19.5	3.2	2.3	125.5	57.5	31.3	11.8	205.8
594009	Kalomota	121.9	36.3	0.7	113.3	5.5	18.2	3.2	2.4	138.6	61.6	29.7	16.2	281.8
594011	Katrangi	146.8	37.3	0.8	111.0	5.4	20.6	3.8	2.1	138.5	67.5	32.6	11.3	211.0
594013	Kumrogoor	146.2	45.4	0.9	113.3	7.0	24.9	3.4	2.8	107.6	50.4	32.7	18.2	383.3
594014	Dudheswar	120.5	25.5	0.6	107.3	5.3	23.6	3.4	1.5	149.5	62.1	29.4	10.1	183.4
594015	Marisal	99.7	24.2	0.6	110.0	4.1	19.7	3.4	1.6	126.5	48.8	27.8	7.4	126.2
594019	Nonabokra	132.3	35.5	0.8	103.7	6.1	24.0	3.6	2.5	99.5	53.2	34.8	19.9	355.7
594020	Talmugur	146.1	44.0	0.8	105.0	7.9	27.3	3.8	2.6	110.2	47.1	30.0	19.0	360.4
596839	Dadsal	112.2	27.4	1.0	106.3	5.7	22.1	3.1	1.0	106.3	55.6	34.3	10.0	189.1
594021	Sada getu	122.5	27.8	0.6	91.7	4.4	21.4	2.6	2.1	83.6	68.3	45.1	6.3	122.7
596840	Kalonunia	142.8	43.1	1.0	102.7	7.3	28.4	3.8	1.2	130.3	50.9	28.6	16.4	381.5
594022	Marisal	105.9	29.6	0.8	112.7	5.6	19.3	2.6	1.8	94.0	49.5	34.3	7.5	130.4
594024	Hoogla	135.3	35.2	0.6	109.0	5.1	16.5	3.4	2.5	86.0	65.8	43.3	11.8	176.4
594026	Asfalmota	133.7	35.9	0.7	104.7	4.7	21.1	2.6	3.0	102.0	44.8	30.6	11.4	216.4
594027	Nonabokra	137.4	42.1	0.9	104.0	6.5	27.0	4.4	2.6	135.8	48.5	26.1	19.5	371.8
596842	Darsal	132.3	38.7	0.8	107.3	6.0	22.2	2.3	2.3	87.6	57.5	41.6	9.2	165.9
594029	Marisal	112.1	36.2	0.7	111.3	4.2	21.6	2.5	1.8	91.1	65.1	41.7	8.1	146.0
594031	Kumarmani	119.8	29.6	0.8	110.3	5.5	20.4	2.4	1.4	82.0	48.1	37.1	9.0	164.1
Check	Pokkali	129.5	38.8	0.8	101.3	5.5	23.3	3.3	2.6	84.8	44.7	34.5	11.8	282.6
Check	CSR-10	84.6	41.1	0.8	93.7	4.5	20.8	3.3	2.4	95.1	48.5	33.8	13.3	293.3
Check	SR 26-B	99.1	41.1	0.8	92.3	5.6	20.2	3.1	2.5	94.7	43.7	31.6	11.8	265.4
Mean		123.23	34.29	0.74	106.5	5.41	21.91	3.16	2.04	110.72	53.9	33.27	11.88	230.7
SEm (+)		7.11	4.22	0.07	0.72	0.73	1.33	0.10	0.07	6.54	5.4	2.73	1.82	24.9
CV (%)		7.06	15.09	11.31	0.83	16.6	7.43	4.13	4.32	7.24	12.27	10.06	18.7	13.21
CD (P=0.05)		14.18	8.43	0.13	1.44	1.46	2.65	0.21	0.14	13.05	10.78	5.45	3.63	49.6
CD (P=0.01)		18.83	11.19	0.18	1.92	1.94	3.52	0.28	0.19	17.33	14.31	7.24	4.82	65.9

PH-plant height, LL- leaf length, LW- leaf width, DF- days to 50% flowering, EBT- Ear bearing tiller, PL- Panicle length, PW- Panicle weight, FG- filled grains, UG-unfilled grains, GYP- Grain yield/plant, GYM- Grain yield/m^2

the locations. It ranges from 3.95 (Dadsal) to 7.85 (Kumrogoor) in location I and from 3.7 (Auspachali) to 7.9 (Talmugur) with mean of 5.44 + 0.97 and 5.41 + 0.73 in two locations respectively.

Panicle length (cm): Significant variations were recorded for the length of panicles in both the locations. It ranges from 19.59 (Kumarmani) to 28.93 (Kalonunia) with mean 23.92 + 1.23 in first location whereas the range varies from 16.5 (Hoogla) to 28.4 (Kalonunia) with mean of 21.91 + 1.33. The result indicated that Kalonunia showed maximum panicle length in both the locations and also performed better than the tolerant checks.

Panicle weight: The weight of the panicles showed significant variation only in location I with a range of 3.68 (Sada getu) to 5.51 (Kumrogoor). In location II the range varies between 2.3 (Darsal) to 4.4 (Nonabokra) with mean of 3.16 + 0.10.

100 grain weight: The weight of 100 filled grains showed significant variation between 0.99 (Dadsal) to 3.13 (Asfalmota) with mean of 2.09 + 0.06 in location I and the estimates varies between 1.0 (Dadsal) to 3.0 (Asfalmota) with mean of 2.04 + 0.07. The data indicated no variation between locations.

Filled grains panicle^{-1}: The filled grains panicle-1 varied between 70.3 (Darsal) to 145.3 (Talmugur) in location I, while it varied between 72.7 (Heuse) to 149.5 (Dudheswar) in location II with mean of 109.48 + 10.02 and 110.7 + 6.54 respectively.

Unfilled grains panicle^{-1}: The number of unfilled grains panicle-1 varied between 23.9 (Talmugur) to 40.1 (Odasal) in location I and it varied from 42.2 (Getu) to 68.3 (Katrangi) in location II with mean of 33.23 + 4.6 and 53.9 + 5.4 respectively.

Sterility (%): The sterility percentage as estimated from the number of filled grains and unfilled grains, varies between 14.1 (Talmugur) to 32.8 (Darsal) in location I. In location II it varies from 26.1 (Nonabokra) to 45.1 (Sada getu). The mean values at location I and II were 23.8 + 3.4 and 33.2 + 2.7 respectively. The result indicated higher sterility in location II with increase in soil salinity stress than location I.

Grain yield plant^{-1}: The grain yield plant^{-1} in location I varied between 5.9 (Heuse) to 20.1g (Talmugur) with mean of 12.03 + 2.5g. In location II the range varied between 6.3 (Sada getu) to 19.9 g (Talmugur) with mean of 11.8 + 1.9 g. It was observed that in both the locations Talmugur performed best than any other genotypes including tolerant checks.

Grain yield m^{-2}: The estimates of grain yield m^{-2} varied between 146.1 (Darsal) to 411.7 (Kumrogoor) with mean of 267.2 + 18.5g in location I whereas, it varied between 122.7 (Sada getu) to 383.3 g (Kumrogoor) with mean 230.7 + 24.9 g in location II. The yield m^{-2} as an indicative of overall productivity of the genotype revealed that Kumrogoor performed best in both the locations irrespective of difference in salinity level.

Comparative assessment was done on the basis of degree of salt tolerance at seedling stage as well as higher estimates of yield contributing traits between the genotypes and the tolerant checks. On the basis of mean and other traits, overall performance of all the 33 genotypes was ascertained. While seven yield contributing characters were considered for identifying salt tolerant genotypes, the remaining six traits could be used for determining additional specific attributes of breeder's importance. Sedeek *et al.*, 2011 had identified donors for salt tolerance based on yield contributing traits through evaluation of some rice genotypes under normal and saline soil conditions. Unique agro morphological traits viz. crop duration, plant type, grain type, kernel color, basal leaf color, and color of ligule, auricle and collar associated with the genotypes are of specific importance to rice breeders for development of elite salt tolerant varieties with desirable markers. As an example, from farmer's perspective, in addition to high productivity, there is a need of varieties with purple coloured leaf base for easy discrimination of wild and off types during farming practice. The study thus, identified salt tolerant rice genotypes exhibiting significantly greater tolerance than the standard check varieties with different morpho agronomic features.

Four top performing genotypes for grain yield include IC-594013 (Kumrogoor), IC-596840 (Kalonunia), IC-594020 (Talmugur) and IC-594027 (Nonabokra) in both the locations. Comparison among the genotypes across the traits indicated that Kalonunia, Talmugur, Kumrogoor, Nonabokra gave superior performance for multiple traits in both the locations. These four genotypes also possess variation in morphological and other agronomical traits of breeder's choice.

From the result obtained at two locations it was observed that the genotypes showed higher values for all traits in location – 1 (ECe 8.2 dS m^{-1}) than location -2 (ECe 10.0 dS m^{-1}). It indicated that higher salinity conditions had negative effect on grain yield and other attributing traits. Findings reported by Khan *et al.*, (2003) and Sedeek *et al.*, (2011) are in agreement with the current study. It was also observed that salinity stress affected all the growth parameters. Based on mean performances of rice genotypes at both locations for different agronomical traits IC-594013 (Kumrogoor), IC-596840 (Kalonunia), IC-594020 (Talmugur) and IC-594027 (Nonabokra) were identified as donor for salinity tolerance.

CONCLUSION

In conclusion, IC-594013 (Kumrogoor), IC-596840 (Kalonunia), IC- 594020 (Talmugur) and IC-594027 (Nonabokra) with higher level of tolerance response at seedling stage as well as growth and developmental stages in comparison with tolerant check varieties Pokkali, CSR-10 and SR- 26B could be utilized for development of elite varieties. These genotypes with high degree of salt tolerance can be considered as highly salt tolerant type as compared with Pokkali a known salt tolerant variety. Genotypes used in the present study would provide suitable experimental material for breeders engaged in developing salt tolerant rice genotypes.

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