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IDENTIFICATION AND DISSEMINATION OF SALT TOLERANT RICE VARIETIES THROUGH FARMER'S PARTICIPATION IN ANDAMAN & NICOBAR ISLANDS

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ABSTRACT

A total of 17 high yielding salt tolerant rice varieties from diverse sources were evaluated with farmers' participation under salinity stress conditions in Andaman Islands during 2011. The variety CST 7 - 1 gave highest yield followed by CARI Dhan 5 in South Andaman. Overall preference of farmers was captured by variety CARI Dhan 5 followed by CSRC(S) 21 - 25, CSR36 and CST7 - 1. Besides better yield, the semi - tall stature, maximum length of panicles, higher spikelet fertility and test weight could be found as the putative favourable attributes for preference towards CARI Dhan 5. In Middle Andaman, CSR36 was preferred by most of the farmers followed by CARI Dhan 5 and CSRC - 21 - 25. The farmer's preference scores guided us to include CARI Dhan 5 and CSR36 in our seed production programme. Higher demand and dissemination of seed of these salt tolerant varieties caused visible impact of farmers' participatory variety selection approach in terms of variety adoption in Andaman & Nicobar Islands.

INTRODUCTION

Rice is the mainstay food crop of Andaman and Nicobar Islands which are located about 1000 km from mainland India in the Bay of Bengal. The rice crop is cultivated in the wet season (May to December) on about 8000 hectares land in the islands producing over 22000 tons of paddy, with productivity of about 2.75 t/ha annually. However, the annual rice demand of A & N Islands is around 60,000 tons. The enormous gap between annual demand and production is fulfilled by shipment of rice from mainland. Rice cultivation is mostly concentrated in North and Middle Andaman and South Andaman districts in the islands. The horizontal expansion of rice area has little scope due to forest cover policies for ecological concerns. In view of geographical isolation, it is worthwhile to increase the productivity vertically on sustainable basis which is achievable through appropriate varietal selection, seed production and crop management interventions compatible with the prevailing conditions (Gautam *et al.* 2013, Gautam and Singh 2013). The main reason for large gap between production and demand is low productivity of rice varieties which are mostly photosensitive and very late suiting to escape the prolonged and intense rainfall of about 3100 mm mostly occurring between May to December months.

Of the total rice area, about 3000 ha area of rice has come under varying degrees of salinity due to long coast line and especially because of tsunami - 2004. As far as salinity is concerned, it is mostly moderate (ECe< 4dS/m) owing to high rainfall during wet season thus diluting salts in transient areas between sea and land. However, moderate salinity is also invariably associated with acid sulphate soils with general toxicity of iron and aluminium. Development and deployment of salt tolerant rice varieties have undoubtedly become centre stage to harness the productivity potential of salt affected areas (Singh *et al.* 2010, Gregorio *et al.* 2002, Ismail *et al.* 2007, Gautam *et al.* 2010). Many rice germplasm and varieties have been successfully utilized for increasing productivity in salt affected areas without any additional costs on other inputs and drainage interventions. However, during the quest of salt tolerant varieties for deployment in the target areas, it is also essential that these genotypes are adaptable to the new conditions and are appreciated and adopted by the

end users for better uptake and impact due to their specific and need based requirements (Witcombe *et al.*1999, Witcombe, 2002).

Keeping these points in view, we tested a set of 17 potentially useful salt tolerant varieties with the farmers' participation at their own fields for grain yield and other attributes in the salt affected areas with the overall objective to elicit their preference and adoption in Andaman and Nicobar islands.

MATERIAL AND METHODS

The details of salt tolerant rice varieties evaluated during *Kharif* 2011 are given in Table 1. The genotypes included high yielding salt tolerant rice varieties developed and recommended by CIARI, Port Blair, CSSRI, Karnal, CSSRI - RRS, Canning Town and CRRI, Cuttack. Five exotic lines developed at IRRI, Philippines (IR lines) harbouring *Sub1* and *Saltol* QTLs (quantitative trait loci) were also included based upon their previous performance (Ali *et al.*, 2013).

Table 1: Evaluation of rice genotypes for grain yield and farmer's preference in South Andaman under coastal salinity conditions

Genotype	Developed By *	Grain yield (t/ha)	Count of Positive and Negative Votes PS for Each Variety			
			Male	Female	Breeder	Total
Sumati	CSSRI - CNG	2.70	0.00	0.00	0.00	0.00
Bhutnath	CSSRI - CNG	1.98	- 0.01	- 0.02	0.00	- 0.01
IR84649 - 81 - 4 - B - B	IRRI	2.24	0.00	0.00	0.00	0.00
IR84649 - 275 - 3 - 2 - B	IRRI	1.85	- 0.14	- 0.13	- 0.21	- 0.15
IR84649 - 280 - 20	IRRI	1.79	- 0.05	- 0.07	- 0.13	- 0.07
IR84649 - 292 - 3 - 1 - B	IRRI	2.54	- 0.09	- 0.05	0.00	- 0.07
IR84649 - 320 - 3 - 1 - B	IRRI	0.94	0.00	- 0.03	0.00	- 0.01
C14 - 8	Local collection	0.00	0.00	0.00	0.00	0.00
CSR 4	CSSRI - CNG	2.82	- 0.16	- 0.13	- 0.17	- 0.16
CSR 23	CSSRI - KNL	2.82	0.01	0.02	0.00	0.01
CSR 36	CSSRI - KNL	2.04	0.03	0.00	0.08	0.03
CSRC(S) 21 - 25	CSSRI - CNG	2.18	0.14	0.22	0.21	0.18
Canning 7	CSSRI - CNG	0.74	0.00	0.00	0.00	0.00
Lunishree	CRRI - CTK	2.46	0.01	0.00	0.00	0.01
CST 7 - 1	CSSRI - CNG	4.03	0.02	0.03	0.04	0.03
Ranjeet	AAU, Jorhat	2.76	0.00	0.00	0.00	0.00
CARI Dhan - 5	CIARI - PB	3.91	0.24	0.17	0.17	0.21
LSD (5 %)		1.42	-	-	-	-

*CSSRI - KNL= CSSRI, Karnal, CSSRI - CNG = CSSRI, Canning Town, IRRI= International Rice Research Institute, Philippines, CRRI - CTK = CRRI, Cuttack, CIARI - PB= CIARI, Port Blair

Two rice variety trials were conducted at salinity affected farmer's field near the sea shore one each at Lalpahar, Port Blair in South Andaman district having moderate salinity (ECe~4.0dSm $^{-1}$) and another at Baratang in North & Middle Andaman district having less degree of salinity (ECe~2dSm $^{-1}$). A total of 17 promising salt tolerant rice genotypes were evaluated in three replications. The crop nursery was raised in the month of June, 2011 and one month old seedlings were transplanted in the main field at the spacing of 20 x 15 cm. Recommended doses of N, P and K were applied @ 90, 60, and 40 kg/ha, respectively. Data were recorded on 7 quantitative characters viz. days to 50 % flowering, plant height (cm), number of effective tillers/hill, panicle length (cm), grains/panicle, 1000 grain weight (g) and spikelet fertility (%) as shown in Table 2.

Table 2: Yield linked traits in rice genotypes under salinity conditions in South Andaman

Genotype/Variety	Days to flower	Plant Ht. (cm)	Tillers/ plant	Panicle length (cm)	Grains / panicle	Spikelet Fertility T(%)	Test wt. (g)
Sumati	119	106	8	22	104	76.8	28.07
Bhutnath	114	115	6	23	126	35.0	
IR84649 - 81 - 4 - B - B	114	97	5	24	115	64.2	24.00
IR84649 - 275 - 3 - 2 - B	111	100	6	24	132	24.8	25.13
IR84649 - 280 - 20	124	94	6	24	88	41.3	21.33
IR84649 - 292 - 3 - 1 - B	117	88	6	23	137	50.0	24.97
IR84649 - 320 - 3 - 1 - B	97	88	6	24	95	27.4	23.60
CH - 8	142	163	6	0	0	0	0.00
CSR 4	121	83	7	20	108	52.9	24.10
CSR 23	118	97	6	24	82	58.8	23.33
CSR 36	118	87	7	22	75	66.5	23.67
CSRC - 21 - 25	116	105	8	24	84	49.2	26.70
Canning 7	94	88	6	24	67	27.7	26.40
Lunishree	124	147	6	23	58	56.7	25.33
CST 7 - 1	118	100	7	22	82	70.2	21.50
Ranjeet	134	108	7	22	117	57.8	21.60
CARI Dhan 5	121	110	6	25	110	75.5	27.53
LSD (5 %)	3.07	6.86	NS	3.46	25.43	14.13	2.25

A field day was also conducted at the time of maturity for the selection of promising rice varieties by involving the farmers in village Lal Pahar in South Andaman. A total of 41 farmers and 6 researchers participated during the Participatory Variety Selection (PVS) scoring. Out of 41 farmers, 26 male farmers and 15 female farmers participated. Farmer's overall preference was elicited through their direct visit to individual genotypes and balloting of their votes.

RESULTS AND DISCUSSION

Among all genotypes, CST 7 - 1 gave significantly highest yield as expressed in t/ha (4.03) followed by CARI Dhan 5 (3.91), CSR4, CSR23 (2.82), Ranjeet (2.76) and Sumati (2.70) at Lal Pahar (Table 1). However, overall perception of farmers for yield and other desirable traits was captured by CARI Dhan 5 (preference score of 0.21) followed by CSRC(S) 21 - 25 (preference score of 0.18) as shown in Table 1. CSR4 (preference score of - 0.16)

was the least preferred variety among all 17 varieties and thus showed negative impact on farmer's preference. The choice of rating among the groups of farmers also differed. Women farmers preferred CSRC(S) 21 - 25 (0.21) followed by CARI Dhan 5 (0.17). However, men farmers gave a preference score of 0.24 for CARI Dhan 5 followed by CSRC(S) 21 - 25 (0.14). The pattern of least preferred varieties by men and women farmers was almost same. CSR36 and CST7 - 1 were other preferred varieties under tested conditions.

Regarding agro - morphological traits, it was observed that C14 - 8 took maximum days for flowering (142 days) followed by Ranjeet (134 days). On the other hand, IR 84649 - 320 - 3 - 1 - B flowered earliest (97 days) followed by Canning 7 (94 days). C14 - 8 attained maximum plant stature (163 cm) followed by Lunishree (147 cm). The farmers' preferred varieties CARI Dhan 5 (110 cm) and CSRC - 21 - 25 (105 cm) were having relatively taller height revealing that semi - tall stature could be one of the favourable attributes for such conditions. CARI Dhan 5 also recorded maximum length of panicle (25 cm), higher spikelet fertility (75.5 %) and more test weight (27.53 g). These might be some of the favourable attributes responsible for maximum preference towards CARI Dhan 5 under tested conditions.

Besides, these 17 varieties were also tested at Baratang in North & Middle Andaman district under farmers' supervision at relatively low salinity stress (ECe~2 dSm^{-1}). Under tested conditions, CSR36 was preferred by most of the farmers followed by CARI Dhan 5 and CSRC - 21 - 25 (Table 3). At Baratang, farmers described CSR36 to possess good appearance, high yielding ability, easy to cut, semi - dwarf stature, good grain quality, less insect attack and less duration for maturity.

Table 3: Performance and preference of genotypes at Baratang (Middle Andaman)

Varieties	Grain yield (t/ha)	Preference Rank	Remarks by farmers
Sumati	1.79	6	Good looking and high yielding
Bhutnath	1.75	3	Good looking and high yielding
IR84649 - 292 - 3 - 1 - B	1.59	1 and 2	Lodging resistant
IR84649 - 280 - 20	2.38	1 and 2	Lodging resistant
IR84649 - 275 - 3 - 2 - B	1.43	1 and 2	-
IR84649 - 81 - 4 - B - B	1.43	1 and 2	Lodging resistant
C 14 - 8	0.00	-	Very late in maturity
CSR 36	1.98	1and 2	Good looking, high yielding, easy to cut, semi - dwarf stature, good taste, less insect attack, less duration for maturity
CSRC 21 - 25	2.70	3	Good looking and high yielding
Canning 7	0.63	5	-
Lunishree	1.59	5	-
CST 7 - 1	2.62	6	Good looking, high yielding, easy to cut, semi - dwarf stature
Ranjeet	1.59	-	
CARI Dhan 5	2.78	3 and 4	Good looking, high yielding, easy to cut, semi - dwarf stature

Though better performance of varieties like CARI Dhan 5 and CSR36 under salt affected conditions was already known, their specific preferences by island farmers were indicated and revealed through this study. Taking cue from this study, we included CARI Dhan 5 and CSR36 in the Breeder seed and labelled production programme mediated through farmer's participation since 2011 onwards. Consequently, about 20 quintal and 25 quintal seed of CARI Dhan 5 and CSR36 respectively has been produced and disseminated especially in the saline affected areas of Andaman & Nicobar Islands during 2011 - 13 by CIARI, Port Blair. The above seed dissemination is expected to have covered at least 80 ha and 100 ha, respectively by CARI Dhan 5 and CSR36 in the Islands. Besides, seed of other salt tolerant rice varieties *viz.* CARI Dhan 4 and CSR23 were also distributed to the tune of 6 quintal and 4 quintal, respectively and both these varieties together might have occupied at least 40 ha. Therefore, at least 220 ha rice area in the Bay islands is expected to be occupied by salt tolerant varieties selected by farmer's participatory approach which is expected to increase in coming years as well.

The results and findings revealed the effectiveness of farmer's participatory variety selection for enhanced rice production on sustainable basis in salt affected areas of the islands. It was also proven that higher yield *per se* under salinity conditions may not be necessarily sufficient attribute for farmers. Therefore, other attributes suiting to farmers need to be searched for and developed in salt tolerant varieties. Similar experiences on this emerging approach were also observed in previous findings (Ceccarelli *et al.*, 2001, Singh *et al.*, 2014, Witcombe *et al.*, 1999, 2001). Future studies may focus on precise understanding and enumerating the specific attributes required to be incorporated in a salt tolerant variety besides higher grain yield. Such participatory experiences can be emulated in other areas also for achieving higher crop productivity through varietal technology.

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