International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(10): 107-113
www.biochemjournal.com
Received: 22-07-2024
Accepted: 02-09-2024

Dhirendra Kumar
Department of Crop Physiology, Chandra Shekhar Azad University of Agriculture & Technology, Uttar Pradesh, India

P. K. Singh
Department of Genetics & Plant Breeding, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

Bipin Kumar Chaudhary
Department of Crop Physiology, Chandra Shekhar Azad University of Agriculture & Technology, Uttar Pradesh, India

Amit Kumar
Department of Crop Physiology, Chandra Shekhar Azad University of Agriculture & Technology, Uttar Pradesh, India

Mayank Pratap
Department of Crop Physiology, Chandra Shekhar Azad University of Agriculture & Technology, Uttar Pradesh, India

Bhayankar
Department of Agronomy, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

Anupama Verma
Department of Crop Physiology, Chandra Shekhar Azad University of Agriculture & Technology, Uttar Pradesh, India

Shravan Kumar
Department of Seed Science & Technology, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

Corresponding Author:
Dhirendra Kumar
Department of Crop Physiology, Chandra Shekhar Azad University of Agriculture & Technology, Uttar Pradesh, India

Effect of critical limit of saline water irrigation in suitable rice (*Oryza sativa* L.) varieties

Dhirendra Kumar, P. K. Singh, Bipin Kumar Chaudhary, Amit Kumar, Mayank Pratap, Bhayankar, Anupama Verma and Shravan Kumar

DOI: https://doi.org/10.33545/26174693.2024.v8.i10b.2421

Abstract
The pot experiments were conducted in Complete Randomized Design (CRD) with five replications at Wire net house, Department of Crop Physiology CSAUAT Kanpur, during *Kharif* seasons in the year 2022-23 and 2023-24. The objective of investigation way to study the effect of Salinity water irrigation with various levels (Five level of Saline $T_{0.}$ (Control), $T_{1.}$ ECiw 3(dSm^{-1}), $T_{2.}$ ECiw 6(dSm^{-1}), $T_{3.}$ ECiw 9(dSm^{-1}), $T_{4.}$ ECiw 12(dSm^{-1}), and Five variety on Pant-24, Pusa Basmati-1509, Sampurna (KP)-108, Narendra-2065, CSR- 46 plants traits i.e. physiological, phenological biochemical, yield and its components of Rice. The results indicated that application of recorded higher value of plant height, dry matter accumulation (g), number of panicle plant^{-1}, number of grain plant^{-1}, biological yield, 1000 seeds weight (g) and ultimately higher grain yield (g) plant^{-1} as compared to all other corresponding tested treatments. Further, these treatment ECiw 3(dSm^{-1}) significantly maximum days for their phenological stages i.e., days of heading, anthesis and 75% flowering and days of physiological maturity as compared to all other treatments.
Based on overall relative performance proved to be more beneficial with ECiw 3(dSm^{-1}) it was concluded that were found to be better perform with respect of grain yield and other studied traits as compared to other treatment.

Keywords: Biochemical, physiological, phenological, replication, variety, salinity water, yield

Introduction

Salinity is becoming a serious problem in several parts of the world. The saline area is three times larger than land used for agriculture. Salinity is one of the key environmental factors that limit crop growth and agricultural productivity. Total area under salinity is about 953 million ha covering about 8 per cent of the land surface. Several physiological pathways, *i.e.*, photosynthesis, respiration, nitrogen fixation and carbohydrate metabolism have been observed to be affected by high salinity Amirjani, *et al.*, (2010) [4].

Salinization is one of the most important abiotic stressors for crop growth and productivity. Rice, as the major food source around the world, is very sensitive to salt, especially at seedling stage. In order to examine how salt stress influences the metabolism of rice, we compared the levels of a range of sugars and organic acids in three rice cultivars with different tolerance under salt stress over time. According to the morphological result, the shoot length and root fresh weight were only affected by salinity in the salt sensitive cultivar (Nipponbare).

The responses of metabolites to salinity were time-, tissue- and cultivar-dependent. Shikimate and quinate, involved in the shikimate pathway, were dramatically decreased in the leaves of all three cultivars, which was regarded as a response to salinity. Many sugars in the leaves of the salt tolerant cultivar (Dendang and Fatmawati) showed earlier increases to salt stress compared to Nipponbare leaves. Moreover, only in the leaves of tolerant cultivars (Dendang and Fatimawati), malate was significantly decreased while sucrose was significantly increased. In dendang roots, mannitol levels were significantly higher than in Nipponbare roots after 14 days of salt treatment, which may be attributed to its higher salt tolerance. It is proposed that these responses in the more tolerant cultivars are involved in their resistance to high salt stress which may lay the foundation for breeding tolerant rice cultivars.

The effects of NaCl stress on growth and development of rice were studied and compared in varieties of various origins. During the vegetative stage, tall indica landraces (Nona Bokra, Buhra Rata, Panwell, and Pokkali) appeared to be resistant throughout while in japonica varieties (I Kong Pao (IKP) and Tainung 67) and elite breeding lines (IR 4630, IR 2153 and IR 31785), resistance fluctuated. Panwell, which was the only indica variety evaluated during the reproductive stage, also expressed salt resistance during booting, heading and grain maturation while varieties with the greatest variability in salt stress response during the vegetative phase (IR 4630, IR 31785 and IKP) also showed the greatest variability during reproductive development. Thus, varietal levels of resistance to salinity at different growth stages are not necessarily interdependent characteristics. Lutts *et al.*, (1995) [12] Soil salinity poses a major threat to rice crop productivity, particularly along low-lying coastal areas during the dry season. For example, roughly 1 million hectares (2.5 million acres) of the coastal areas of Bangladesh are affected by saline soils. These high concentrations of salt can severely affect rice plants' physiology, especially during early stages of growth, and as such farmers are often forced to abandon these areas.

Materials and Methods

Experimental Site

The experiment was conducted in wire net house of the department of Crop Physiology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, during *Kharif* seasons of 2022-23 and 2023-24.

Climate and Topography

The Campus of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur is situated in central Uttar Pradesh at latitude of 28° 58' North and longitude of 80° 34' at an altitude of 125 meters above sea level in gangatic alluvium soil The seasonal rainfall of about 820 mm received mostly from IInd Fortnight of June or first Fortnight of July to mid- October with a few showers in winter season.

Experimental Soil

For conduct of the experiment, the normal soil was taken from the lot available for the purpose in the department of Crop Physiology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. This soil was clay loam in soil texture having average fertility. Before preparation of the soil and fertilizer application, soil samples were collected, air dried, pulverised and sieved in laboratory to make homogenous mixture.

Details of experimentation

Experimental materials

Seeds of five Rice varieties *viz.* Pant-24, Pusa basmati-1509, Sampurna-108, Narendra-2065 and CSR-46 were obtained both years from the Economic Botanist (Kharif Cereals), C.S. Azad University of agriculture and Technology, Kanpur.

Treatments

A treatment comprises 25 combinations of 5 Levels of salinity and 5 Rice varieties as detailed below:

Levels of salinity	Varieties
T_0 - Control (Normal water irrigation)	V_1`- Pant-24
T_1- ECiw, 3 (dSm^{-1}), saline water irrigation	V_2 - PB-1509
T_2 - ECiw, 6(dSm^{-1}), saline water irrigation	V_3 - Sampurna-108
T_3- ECiw, 9 (dSm^{-1}), saline water irrigation	V_4 - Narenda-2065
T_4 - ECiw, 12 (dSm^{-1}), saline water irrigation	V_5 - CSR-46

Treatment combinations – 25

1.	V_1T_0	6.	V_2T_0	11.	V_3T_0	16.	V_4T_0	21.	V_5T_0
2.	V_1T_1	7.	V_2T_1	12.	V_3T_1	17.	V_4T_1	22.	V_5T_1
3.	V_1T_2	8.	V_2T_2	13.	V_3T_2	18.	V_4T_2	23.	V_5T_2
4.	V_1T_3	9.	V_2T_3	14.	V_3T_3	19.	V_4T_3	24.	V_5T_3
5.	V_1T_4	10.	V_2T_4	15.	V_3T_4	20.	V_4T_4	25.	V_5T_4

i) Replication: 5
ii) Experimental design and layout:- Complete Randomized design (CRD)
iii) Fertilizer level: 100 kg N, 60 P_2o_5 and 40 K_2O kg ha^{-1}
iv) Irrigation

Irrigation water of the EC 3,6,9,12 dSm^{-}1 salinity was prepared in laboratory by adding NaCl and $CaCl_2$ (4:1) and tap water was used to maintain the EC of 3,6,9,and 12dSm^{-1}. Watering was done at 7 days interval on so with equal water *i.e.* one liter in each pot at a time.

Observation recorded

i) Plant Height
ii) Chlorophyll intensity post anthesis
iii) Relative water content
iv) Na content in grain (%)
v) K content in grain (%)

Preparation of samples:-

Observation will be recorded during the Two years of investigation tillering, heading, dough and maturity stages of crop growth. Which happened to occur at 30, 60, 90 and 120 days after transplanting

Chlorophyll intensity % pre and post anthesis

Chlorophyll content, of the leaves was determined at the pre and post anthesis stages by the method describe.

Relative Water Content (RWC)

RWC of wheat second leaf (from the top) was determined by the method described as follows:

$$RWC = \frac{\text{Fresh weight} - \text{Oven dry weight}}{\text{Turgid weight} - \text{Oven dry weight}} \text{ X } 100$$

Na and K content in grain (%)

By flame photometric method described in USDA Handbook No. 60 (1954).

Results and Discussion

Plant height (cm)

Plant height is an important character of the vegetative phase and indirectly influences the yield components. Plant height as a measure of crop growth was recorded at successive stages of crop growth 30, 60, 90 and 120 DAT. A look of these tables shows that plant height increased progressively with the age of plant. Mean plant height was recorded 102.47 and 104.33 120 days of transplant during 2022-23 and 2023-24 respectively.

Salinity level of ECiw 3 dSm^{-1} produced significantly taller plant than control at all stages during both the years. Increasing salinity levels above ECiw 3 dSm^{-1}up to ECiw 12 dSm^{-1}showed significant reduction in plant height significantly in all cases of observations. Among varieties, CSR-46 and Pusa basmati-1509 produced significantly taller plant than other varieties. The effect of salinity versus variety interaction was also found significantly on height at all stages of observations except at harvest. At all stages varietal, position against salinity was almost similar to main effect with one exception that reduction in plant height due to salinity beyond ECiw 9 dSm^{-1}. One thing may also be seen from interaction effect that maximum plant height was in variety CSR-46 while minimum in variety Sampurna-(KP) 108 during both the years.

Effect of saline water irrigation on Plant height at 120 DAT (2022-23).

Varieties Salinity levels	EC of Irrigated water					
	Pant-24	**Pusa basmati-1509**	**Sampurna-(KP)108**	**Narendra -2065**	**CSR-46**	**Mean**
T_0 (Control)	108.38	111.81	106.40	109.94	114.02	110.11
T_1 (ECiw, 3 dSm^{-1})	119.25	122.90	117.07	121.40	125.12	121.15
T_2 (ECiw, 6 dSm^{-1})	96.20	99.47	94.30	98.01	100.28	97.65
T_3 (ECiw, 9 dSm^{-1})	85.76	89.20	84.80	88.09	89.96	87.56
T_4 (ECiw, 12 dSm^{-1})	80.24	82.26	79.08	81.17	83.00	81.15
Mean	97.96	101.13	96.33	99.72	102.47	
	Salinity level		Varieties		Interaction	
SE. m±	0.822		0.822		1.029	
CD (P=0.05)	1.632		1.632		1.341	

Effect of saline water irrigation on Plant height at 120 DAT (2023-24).

Varieties Salinity levels	EC of Irrigated water					
	Pant-24	**Pusa basmati-1509**	**Sampurna-(KP)108**	**Narendra -2065**	**CSR-46**	**Mean**
T_0 (Control)	110.32	113.76	108.34	111.88	115.96	112.05
T_1 (ECiw, 3 dSm^{-1})	121.06	124.70	118.88	123.20	126.92	122.95
T_2 (ECiw, 6 dSm^{-1})	97.99	101.26	96.10	99.82	102.07	99.45
T_3 (ECiw, 9 dSm^{-1})	87.64	91.08	86.68	89.98	91.83	89.44
T_4 (ECiw, 12 dSm^{-1})	82.11	84.14	80.96	83.05	84.88	83.03
Mean	99.82	102.99	98.19	101.58	104.33	
	Salinity level		Varieties		Interaction	
SE. m±	0.837		0.837		1.323	
CD (P=0.05)	1.662		1.662		1.391	

Chlorophyll content (SPAD value)

It was measured at two crop growth stages *viz*., pre-flowering stage and post-flowering stage. The data evident to chlorophyll content (SPAD value) as affected by different varieties, dates of sowing and application of micronutrients for both the stages In general, chlorophyll SPAD value in leaf tissue was recorded higher value at pre-flowering stage and lower value at post-flowering stage during both years of study.

In case of different varieties, CSR-46 recorded significantly higher values of SPAD (28.93, 29.54 and 30.76, 31.60%) pre-flowering stage and post-flowering stage. Second best variety Pant-24 with (28.47, 29.08 and 30.38, 31.20%) pre-flowering stage and post-flowering stage. during both the years. However, least chlorophyll content SPAD value (26.79, 27.40 and 28.65, 39.50%) before flowering stage and after flowering stage was noted with variety Narendra-2065 during both the year of experimentation.

Salinity level of ECiw 3 dSm^{-1}produced significantly Dry weight $plant^{-1}$ than control at all stages during both the years. Increasing salinity levels above ECiw 3 dSm^{-1}up to ECiw 12 dSm^{-1}showed significant reduction in plant dry weight $plant^{-1}$ significantly in all cases of observations. Among variety Narendra -2065 produced significantly dry weight $plant^{-1}$ than other varieties.

In case of salinity level of ECiw 3 dSm^{-1}chlorophyll content SPAD value recorded significantly higher values of SPAD (36.55, 37.39 and 39.28, 40.40%) before flowering stage and after flowering stage. Followed by salinity level of ECiw 6 dSm^{-1} with (27.18, 27.77 and 29.47, 30.30%) pre-flowering stage and post-flowering stage. during both the years. However, lowest chlorophyll content SPAD value (19.73, 20.19 and 20.88, 21.50%) before flowering stage and after flowering stage was noted with salinity level of ECiw 12 dSm^{-1}. during both the concern years.

The interaction effect as a result of imposition of different varieties, salinity level on chlorophyll content (SPAD value) was found to be non-significant.

Effect of saline water on Chl. intensity (%) (2022-23)

Varieties / Salinity levels	EC of Irrigated water					
	Pant-24	**Pusa basmati-1509**	**Sampurna-(KP)108**	**Narendra -2065**	**CSR-46**	**Mean**
T_0 (Control)	33.00	32.75	32.22	31.94	33.20	32.62
T_1 (ECiw, 3 dSm^{-1})	37.84	36.67	35.42	34.30	38.51	36.55
T_2 (ECiw, 6 dSm^{-1})	27.81	27.03	26.53	26.17	28.34	27.18
T_3 (ECiw, 9 dSm^{-1})	23.58	23.31	22.90	22.55	24.20	23.31
T_4 (ECiw, 12 dSm^{-1})	20.12	19.76	19.38	19.00	20.40	19.73
Mean	28.47	27.90	27.29	26.79	28.93	
	Salinity level		Varieties		Interaction	
SE. m±	0.233		0.233		0.369	
CD (P=0.05)	0.463		0.463		1.036	

Effect of saline water irrigation on Chlorophyll intensity (%) pre. (2023-24).

Varieties / Salinity levels	EC of Irrigated water					
	Pant-24	**Pusa basmati-1509**	**Sampurna-(KP)108**	**Narendra -2065**	**CSR-46**	**Mean**
T_0 (Control)	33.63	33.38	32.85	32.57	33.83	33.25
T_1 (ECiw, 3 dSm^{-1})	38.68	37.51	36.26	35.14	39.35	37.39
T_2 (ECiw, 6 dSm^{-1})	28.40	27.62	27.12	26.76	28.93	27.77
T_3 (ECiw, 9 dSm^{-1})	24.09	23.82	23.41	23.06	24.71	23.82
T_4 (ECiw, 12 dSm^{-1})	20.58	20.22	19.84	19.46	20.86	20.19
Mean	29.08	28.51	27.90	27.40	29.54	
	Salinity level		Varieties		Interaction	
SE. m±	0.238		0.238		0.377	
CD (P=0.05)	0.473		0.473		1.058	

Effect of saline water irrigation on Chlorophyll intensity (%) post (2022-23).

Varieties/Salinity levels	EC of Irrigated water					
	Pant-24	**Pusa basmati-1509**	**Sampurna-(KP)108**	**Narendra -2065**	**CSR-46**	**Mean**
T_0 (Control)	35.37	34.80	34.49	33.63	35.62	34.78
T_1 (ECiw, 3 dSm^{-1})	39.84	39.34	38.81	38.14	40.28	39.28
T_2 (ECiw, 6 dSm^{-1})	30.00	29.57	29.04	28.25	30.48	29.47
T_3 (ECiw, 9 dSm^{-1})	25.34	24.46	24.15	23.10	25.60	24.53
T_4 (ECiw, 12 dSm^{-1})	21.33	20.74	20.39	20.13	21.82	20.88
Mean	30.38	29.78	29.38	28.65	30.76	
	Salinity level		Varieties		Interaction	
SE. m±	0.249		0.249		0.394	
CD (P=0.05)	0.495		0.495		0.000	

Effect of saline water irrigation on Chlorophyll intensity (%) post. (2023-24).

Varieties / Salinity levels	EC of Irrigated water					
	Pant-24	**Pusa basmati-1509**	**Sampurna-(KP)108**	**Narendra -2065**	**CSR-46**	**Mean**
T_0 (Control)	36.3	35.7	35.4	34.5	36.5	35.7
T_1 (ECiw, 3 dSm^{-1})	40.9	40.4	39.9	39.2	41.4	40.4
T_2 (ECiw, 6 dSm^{-1})	30.8	30.4	29.9	29.1	31.3	30.3
T_3 (ECiw, 9 dSm^{-1})	26.1	25.2	24.9	23.8	26.3	25.3
T_4 (ECiw, 12 dSm^{-1})	21.9	21.3	21.0	20.7	22.4	21.5
Mean	31.2	30.6	30.2	29.5	31.6	
	Salinity level		Varieties		Interaction	
SE. m±	0.256		0.256		0.405	
CD (P=0.05)	0.509		0.509		0.000	

Relative water content (%)

For the study of plant water relations the leaf relative water content (RLWC) (%) is an important parameter to show the internal water status at particular level of water and stage of crop. It was observed that the experimental varieties were having significant variation in RLWC at 50% flowering. In experimental varieties it ranges from 73.32 to 76.06% under upland irrigated conditions. Amongst the rice varieties maximum relative water content (%) was found in variety Narendra 256 (76.06 and 74.56%) followed by Pant 24 (75.49 and 73.99%), while minimum was observed in Sampurna (73.32 and 71.82%).

In case of salinity level of ECiw 3 dSm^{-} relative water content value recorded significantly higher values (88.39, and 87.05%) first year and second year. Followed by salinity level of ECiw 6 dSm^{-1} with (75.16 and 72.54%) during both the years. However, lowest relative water content (59.09 and 57.02%) was noted with salinity level of ECiw 12 dSm^{-1}. during both the concern years. The interaction effect was found to be non-significant.

Effect of saline water irrigation on Relative water content (%) (2022-23).

Varieties / Salinity levels	EC of Irrigated water					
	Pant-24	**Pusa basmati-1509**	**Sampurna-(KP)108**	**Narendra -2065**	**CSR-46**	**Mean**
T_0 (Control)	84.03	83.36	82.10	84.33	82.64	83.29
T_1 (ECiw, 3 dSm^{-1})	89.20	88.79	87.05	89.54	87.36	88.39
T_2 (ECiw, 6 dSm^{-1})	75.87	75.50	73.30	76.42	74.72	75.16
T_3 (ECiw, 9 dSm^{-1})	68.57	68.25	66.40	69.82	67.44	68.10
T_4 (ECiw, 12 dSm^{-1})	59.76	59.28	57.73	60.20	58.50	59.09
Mean	75.49	75.04	73.32	76.06	74.13	
	Salinity level		Varieties		Interaction	
SE. m±	0.617		0.617		0.975	
CD (P=0.05)	1.226		1.226		0.000	

Effect of saline water irrigation on Relative water content (%) (2023-24).

Varieties / Salinity levels	EC of Irrigated water					
	Pant-24	**Pusa basmati-1509**	**Sampurna-(KP)108**	**Narendra -2065**	**CSR-46**	**Mean**
T_0 (Control)	83.51	82.84	81.58	83.81	82.12	82.77
T_1 (ECiw, 3 dSm^{-1})	87.86	87.45	85.71	88.20	86.02	87.05
T_2 (ECiw, 6 dSm^{-1})	74.25	73.88	71.68	74.80	73.10	73.54
T_3 (ECiw, 9 dSm^{-1})	66.62	66.30	64.45	67.87	65.49	66.15
T_4 (ECiw, 12 dSm^{-1})	57.69	57.21	55.66	58.13	56.43	57.02
Mean	73.99	73.54	71.82	74.56	72.63	
	Salinity level		Varieties		Interaction	
SE. m±	0.605		0.605		0.957	
CD (P=0.05)	1.203		1.203		0.000	

Na content in grain (%)

It was determined in per cent dry weight basis separately in grain of rice for different treatments. Data showed that sodium content in grain was comparatively less than in straw during both years. Increase in salinity level of irrigation water significantly increased the sodium content in grain. Significantly minimum sodium content in grain was estimated 0.066 and 0.069% in untreated (normal water irrigation) during year 2022-23 and 2023-24, respectively. These values were increased by 0.080 and 0.082 times at 3 dSm^{-1}, 0.090 and 0.094 times at 6 dSm^{-1}, 0.104 and 0.109 times at 9 dSm^{-1} and; 0.154 and 0.159 times at 12 dSm^{-1} salinity levels of irrigation water in first and second year, respectively. In case of varieties, sodium content in grain was significantly maximized (0.101 and 1.105%) in variety Pusa Basmati-1509 during year 2020-21and 2021-22 respectively with significant variation between all varieties.

Though interaction effect of salinity levels versus rice varieties was found non-significant on sodium content in grain but position of varieties could not alter at different salinity levels. Ranks of varieties at different salinity levels remained almost the same as was in case of main effect. Water irrigation in case of both grain and straw during the both the years of investigation.

Effect of saline water irrigation on Na content in grain (%) (2022-23).

Varieties / Salinity levels	EC of Irrigated water					
	Pant-24	**Pusa basmati-1509**	**Sampurna-(KP)108**	**Narendra -2065**	**CSR-46**	**Mean**
T_0 (Control)	0.064	0.068	0.066	0.067	0.065	0.066
T_1 (ECiw,3dSm^{-1})	0.078	0.082	0.080	0.081	0.079	0.080
T_2 (ECiw,6dSm^{-1})	0.088	0.092	0.090	0.091	0.089	0.090
T_3 (ECiw,9dSm^{-1})	0.100	0.106	0.104	0.105	0.102	0.104
T_4 (ECiw,12dSm^{-1})	0.150	0.158	0.154	0.155	0.153	0.154
Mean	0.096	0.101	0.099	0.100	0.098	
	Salinity level		Varieties		Interaction	
SE. m±	0.001		0.001		0.001	
CD(P=0.05)	0.002		0.002		0.000	

Effect of saline water irrigation on Na content in grain (2023-24).

Varieties/ Salinity levels	EC of Irrigated water					
	Pant-24	**Pusa basmati-1509**	**Sampurna-(KP)108**	**Narendra -2065**	**CSR-46**	**Mean**
T_0 (Control)	0.067	0.071	0.069	0.070	0.068	0.069
T_1 (ECiw,3dSm^{-1})	0.080	0.084	0.082	0.083	0.081	0.082
T_2 (ECiw,6dSm^{-1})	0.092	0.096	0.094	0.095	0.093	0.094
T_3 (ECiw,9dSm^{-1})	0.106	0.112	0.110	0.111	0.108	0.109
T_4 (ECiw,12dSm^{-1})	0.155	0.163	0.159	0.160	0.158	0.159
Mean	0.100	0.105	0.103	0.104	0.102	
	Salinity level		Varieties		Interaction	
SE. m±	0.001		0.001		0.001	
CD(P=0.05)	0.002		0.002		0.000	

K- Content in grain (%)

It was determined in per cent in grain of Rice separately under different treatments.

In grain, the potassium content under 3 dSm^{-1} salinity levels was increased over untreated significantly but thereafter, a sharp significant reduction in potassium content was observed with each increase in salinity up to 12 dSm^{-1} salinity levels in all observations. Rates of reduction in potassium content of grain beyond 3 dSm^{-1} salinity were found 1.260 and 1.257% at , 1.157 and 1.150% at 9 dSm^{-1} and; 1.127 and 1.121% at 12 dSm^{-1} salinity levels among 2022-223 and 2023-24., respectively.

Among varieties, significantly maximum potassium content was estimated in variety Narendra-2065 in all observations. It was followed in merit by Pusa basmati-1509, CSR-46, Pant-24 and Sampurna kp-108 in case of grain. Results remained almost similar during both years of study. Variety Narendra-2065 had maximum potassium content of 1.220% and 1.215% in grain of Rice. In grain, this value was found 1.217, 1.212, 1.214% and 1.209%, 1.211% and 1.206% and 1.207 and 1.202% higher potassium content during first and second year, respectively.

Interaction of salinity versus variety was not found significant in most of the observations on potassium content. However, variety Narendra-2065 with 3 dSm^{-1} salinity level had numerically highest potassium content in grain during both years of investigation.

Effect of saline water irrigation on K content in grain (2022-23).

Varieties / Salinity levels	**EC of Irrigated water**					
	Pant-24	**Pusa basmati-1509**	**Sampurna-(KP)108**	**Narendra -2065**	**CSR-46**	**Mean**
T_0 (Control)	1.305	1.310	1.300	1.314	1.309	1.307
T_1 ($ECiw, 3dSm^{-1}$)	1.257	1.265	1.252	1.268	1.260	1.260
T_2 ($ECiw, 6dSm^{-1}$)	1.214	1.220	1.210	1.224	1.217	1.217
T_3 ($ECiw, 9dSm^{-1}$)	1.153	1.160	1.151	1.163	1.158	1.157
T_4 ($ECiw, 12dSm^{-1}$)	1.125	1.130	1.121	1.133	1.128	1.127
Mean	1.211	1.217	1.207	1.220	1.214	
	Salinity level		Varieties		Interaction	
SE. m±	0.010		0.010		0.016	
CD(P=0.05)	0.020		0.020		0.000	

Effect of saline water irrigation on K content in grain (2023-24).

Varieties Salinity levels	**EC of Irrigated water**					
	Pant-24	**Pusa basmati-1509**	**Sampurna-(KP)108**	**Narendra -2065**	**CSR-46**	**Mean**
T_0 (Control)	1.301	1.306	1.296	1.310	1.305	1.303
T_1 ($ECiw, 3dSm^{-1}$)	1.254	1.262	1.249	1.265	1.257	1.257
T_2 ($ECiw, 6dSm^{-1}$)	1.209	1.215	1.205	1.219	1.212	1.212
T_3 ($ECiw, 9dSm^{-1}$)	1.146	1.153	1.144	1.156	1.151	1.150
T_4 ($ECiw, 12dSm^{-1}$)	1.119	1.124	1.115	1.127	1.122	1.121
Mean	1.206	1.212	1.202	1.215	1.209	
	Salinity level		Varieties		Interaction	
SE. m±	0.010		0.010		0.016	
CD (P=0.05)	0.020		0.020		0.000	

Conclusion

The result of present investigation could be concluded that irrigation with saline water of 3dsm^{-1} had no adverse effect on crop plants; rather it was beneficial to the crop. In case of Rice variety, CSR-46 can be recommended for cultivation in the areas prone to saline water irrigation. Due to better germination ability, dry matter accumulation, less sodium and higher potassium content low sodium and potassium ratio, better yield attributes rice variety CSR-46 can be utilized by breeders in varietal improvement programme for salt tolerance under saline water irrigation.

References

1. Adilakshmi D, Rani MG. Variability, character association and path analysis in rice varieties under submergence. Crop Research (Hisar). 2012;44(1/2):146-51.
2. Adlian A, Kurniasih B, Indradewa D. Effect of saline irrigation method on the growth of rice (*Oryza sativa* L.). Ilmu Pertanian (Agricultural Science). 2020;5(1):19-24.
3. Ali Y, Aslam Z, Ashraf MY, Tahir GR. Effect of salinity on chlorophyll concentration, leaf area, yield and yield components of rice genotypes grown under saline environment. International Journal of Environmental Science & Technology. 2004;1:221-5.
4. Amirjani MR. Effect of NaCl on some physiological parameters of rice. European Journal of Biological Sciences. 2010;3(1):6-16.
5. Amirjani MR. Effect of NaCl stress on rice physiological properties. Archives of Phytopathology and Plant Protection. 2012;45(2):228-243.
6. Aref F. Effect of saline irrigation water on yield and yield components of rice (*Oryza sativa* L.). African Journal of Biotechnology. 2013;12(22).
7. Bunnag S, Pongthai P. Selection of rice (*Oryza sativa* L.) cultivars tolerant to drought stress at the vegetative stage under field conditions. American Journal of Plant Sciences. 2013;4(09):1701.
8. Hariadi YC, Nurhayati AY, Soeparjono S, Arif I. Screening six varieties of rice (*Oryza sativa*) for salinity tolerance. Procedia Environmental Sciences. 2015;28:78-87.
9. Islam MZ, Baset Mia MA, *et al*. Effect of different saline levels on growth and yield attributes of mutant rice. Journal of Soil and Nature. 2007;1(2):18-22.

10. Jumpa T, Phetcharaburanin J, Suksawat M, Pattanagul W. Physiological traits and metabolic profiles of contrasting rice cultivars under mild salinity stress during the seedling stage. Notulae Botanicae Horti Agrobotanici Cluj-Napoca. 2023;51(2):13211-13211.
11. Kanawapee N, Sanitchon J, Lontom W, Threerakulpisut P. Evaluation of salt tolerance at the seedling stage in rice genotypes by growth performance, ion accumulation, proline and chlorophyll content. Plant and Soil. 2012;358:235-49.
12. Lutts S, Kinet JM, Bouharmont J. Changes in plant response to NaCl during development of rice (*Oryza sativa* L.) varieties differing in salinity resistance. Journal of Experimental Botany. 1995;46(12):1843-52.
13. Puvanitha S, Mahendran S. Effect of salinity on plant height, shoot and root dry weight of selected rice cultivars. Scholars Journal of Agriculture and Veterinary Sciences. 2017;4(4):126-31.
14. Rodríguez Coca LI, García González MT, Gil Unday Z, Jiménez Hernández J, Rodríguez Jáuregui MM, Fernández Cancio Y. Effects of sodium salinity on rice (*Oryza sativa* L.) cultivation: A review. Sustainability. 2023;15(3):1804.
15. Rodriguez PR, Stacy R, *et al*. Effects of salinity on growth, shoot water relations and root hydraulic conductivity in tomato plants. Journal of Agricultural Science. 1997;128:439-444.
16. Sultana N, Ikeda T, Itoh R. Effect of NaCl salinity on photosynthesis and dry matter accumulation in developing rice grains. Environmental and Experimental Botany. 1999;42(3):211-220.
17. Sultana T, Islam R, Chowdhury MSN, Islam MS, Hossain ME, Islam MM. Performance evaluation of two rice varieties under different levels of NaCl salinity stress. Bangladesh Research Publications Journal. 2014;10(2):186-195.
18. Zhou Y, Lam HM, Zhang J. Inhibition of photosynthesis and energy dissipation induced by water and high light stresses in rice. Journal of Experimental Botany. 2007;58(5):1207-1217.