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PERFORMANCE OF RICE CULTIVARS UNDER WATER SALINITY LEVELS

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ABSTRACT

A green house experiments was conducted at (Bichpuri (Agra) to study the performance of six rice cultivars. (B.P.T.-5204, Pant-4, Pant-10, Pusha Kranti, Sarju-52 and Saket-4) fewer than four levels of water salinity (control, 8, 12 and 16 dSm^{-1}). The increasing levels of water salinity significantly decreased the plant height, tillers per plant and yield of grain and straw of rice. The mean reductions were noted 15.1% during first year and 13.6% during second year in plant height and 60.8 and 64.6% in grain yield and 55.6 and 55.8% in straw yield with 16 dSm^{-1} salinity levels, respectively. Pusha Kranti variety produced tallest plants, more tillers plant^{-1} and grain and straw yields. On the basis of per cent grain yield reduction the safe limits of EC for varieties-B.P.T.-5204, Part-4, Part-10, Pusha Kranti, Sarju-52 and Saket were 13.20, 9.10, 12.07, 14.93, 14.53 and 13.73 dSm^{-1}, respectively. The superiority for salt tolerance may be arranged as Pusa Kranti > Sarju-52 > Saket-4 > B.P.T.-5204 > Plant-10 > Pant-4. Thus, the Pusha Kranti proved more salt tolerant variety in comparison to other tested varieties. The ECe of soil remarkably increased but pH value was not affected with saline irrigation water.

Keywords: Rice cultivars, growth, yield, water salinity

INTRODUCTION

Rice (*Oryza sativa* L.) is the major cereal food crop of the country and it grows in different soil-environment but its productivity is very low as compared to developed countries. The production of this cereal has shown a function of increased both in production and area but still the average production is only well about 19.04 quintal/ha. The salinity of irrigation water plays a vital role in crop production in Agra region of Uttar Pradesh. Generally irrigation water from all sources contains dissolved salts in which quantities and qualities vary greatly. In Agra region, most of the total irrigated area is salt affected due to continuous use of poor quality irrigation water. These salts affect the physical and chemical properties of soil and ultimately crop growth. Information on the salt tolerance of rice cultivars under saline conditions is very useful in selecting cultivar for salt affected soils. Keeping these points in view, the present study was undertaken with an objective to evaluate the salt tolerance of some rice varieties and their effect on growth, yield and soil properties in relation to salt stress environment.

MATERIALS AND METHOD

The greenhouse experiment was conducted in the department of Agricultural Chemistry and Soil Science, R.B.S. College, Bichpuri, Agra during the kharif season of 2008 and 2009 on a sandy lome soil having ECe 2.3 dSm^{-1}, pH 8.5, ESP 7.5, soluble cations Ca^{++} 4.2, Mg^{++} 5.3, Na^{+} 12.2 and K^{+} 0.2 meL^{-1}. Soluble anions meL^{-1} CO_3 nil, HCO_3 7.1, Cl^{-} 6.8, $SO4^{--}$ 8.1 meL^{-1} organic carbon 1.4 g kg^{-1} and available NPK and zinc in soil were 148, 12.5, 115 kg ha^{-1} and 0.56 mg kg^{-1}, respectively. Six rice varieties viz.-B.P.T.-5204, Pant-4, Pant-10, Pusha Kranti, Sarju-52 and Saket-4 with four levels of water salinity (control, 0, 8, 12 and 16 dSm^{-1}) were tested in a factorial randomized design with three replications. Earthen pots of 30 cm diameter size were filled with 8.0 kg soil. The different EC levels of irrigation water were prepared by dissolving salts in tubewell water having EC 2.4 dSm^{-1}, Na^{+} 14.1, Mg 6.1, Ca^{++} 3.1 and Cl^{-} 11.8, HCO_3^{-}8.2 and SO_4^{--}meL^{-1}. The recommended doses of N, P, K and Zn @ 120, 80, 60 and 10 kg ha^{-1} were applied as basal application through urea, single superphosphate, muriate of potash and zinc sulphate, respectively. Two seedlings of rice in each pot were planted on July 15, 2008 and on July 18, 2009, respectively. Crop was irrigated with tubewell water just after transplanting and thereafter irrigation was given with treatment water. After 10 days of transplanting, plants were thinned to one plant in each pot. The data on plant height, number of tillers plant^{-1} and yield were recorded at harvest. Soil samples collected after harvest were analysed for pH and EC by adopting standard procedures (Richards, 1954).

RESULTS AND DISCUSSION

The data (Table 1) indicated that the rice varieties under the influence of different water salinity levels significantly decreased the plant height and number of tillers plant^{-1} during both the years of

experimentation. The mean reduction in plant height (15.1% in 2008 and 13.6% in 2009) and tillers plant^{-1} was noted with highest level of water salinity (EC 16 dSm^{-1}) as compared to lower level of salinity. Pathan et al. (2010) have noted reduction in growth and yield of fenugreek crop and stated that less water supply and nutrient imbalance are responsible for such harmful effect of salinity on physiological activity of the plant. Singh and Chaudhary (2011) reported a reduction in yield of okra at higher salinity level. Pusha Kranti and BPT 5204 attained maximum and minimum plant height and tillers plant^{-1} during both the year, respectively. The Sarju-52 attained average height of 96.92 cm during 2008 and 97.00 cm during 2009 which was significantly higher than other varieties of rice except Pusha Kranti. The superiority of the varieties may be arranged as Pusha Kranti > Sarju-52 > Pant -4 > Pant-10 > Saket-4 > BPT 5204. So, Pusha Kranti variety was superior than other varieties of rice with respect to plant height and number of tillers plant^{-1} and variations in these characters were due to genetic behavior of each varieties.

Table 1: Plant height (cm) tillers plant^{-1}, grain and straw yield of rice cultivars (g/pot) under water salinity

Treatments	Plant height		Tillers plant^{-1}		Grain yield		Straw yield		ECe (dSm^{-1})		pH	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
EC levels (d Sm^{-1})												
Control	100.7	97.6	13.9	13.9	8.38	8.63	22.5	22.3	2.3	2.4	8.7	8.6
8	95.1	94.6	12.2	12.7	6.33	6.34	17.3	16.6	29.3	30.1	8.8	8.6
12	87.8	90.3	10.0	9.7	4.85	4.71	12.7	12.6	40.3	40.5	8.8	8.7
16	85.5	84.8	7.6	7.7	3.28	3.05	10.0	9.8	53.7	53.9	8.9	8.9
CD (P=0.05)	1.65	1.42	0.94	0.84	0.31	0.22	0.39	0.18	9.4	9.8	NS	NS
Varieties												
BPT 5204	83.2	84.0	7.7	8.5	3.48	3.27	8.7	8.5	31.5	31.6	8.8	8.8
Pant-4	91.7	90.5	9.8	10.1	4.30	4.58	11.4	10.9	32.0	32.6	8.8	8.8
Pant-10	91.5	90.0	11.6	12.0	6.45	6.61	18.8	18.4	31.4	31.6	8.8	8.7
Pusa Kranti	101.0	102.0	13.8	13.7	7.53	7.51	20.2	20.0	30.7	30.9	8.7	8.5
Sarju-52	97.0	97.0	11.7	11.3	6.93	6.88	20.2	19.8	31.2	31.3	8.8	8.7
Saket-4	90.0	87.0	10.9	10.4	5.60	5.24	14.5	14.4	31.6	31.7	8.9	8.8
CD (P=0.05)	1.34	1.16	0.77	0.69	0.26	0.18	0.32	0.15	NS	NS	NS	NS

The increasing levels (Table 1) of water salinity significantly decreased the grain and straw yield of rice during both the years. These reductions were statistically significant over lower levels of salinity and mean reduction in grain and straw yield with EC16dSm^{-1} could be estimated as 60.8 and 64.6% 55.3 and 55.8% during 2008 and 2009, respectively. Similar pattern was founded by Janki and Singh (2001) and Pathan et al. (2010). The reduction in grain and straw yied of rice may be attributed to the fact that salinity and osmotic pressure of soil solution increased with use of saline water which in turn caused nutritional disturbance. The Pusha Kranti variety produced significantly higher grain and straw yield than the rest of tested cultivars. However, maximum straw yield was noted with Sarju-52 variety in 2008 which was significantly higher to other varieties except Pusha Kranti cultivar of rice. Minimum grain and straw yields were recorded in

Table 2: Interaction effect of salinity and varieties on grain and straw yield of rice

EC levels (dSm^{-1})	Varieties											
	BPT-5204		Pant-4		Pant-10		Pusha Kranti		Sarju-52		Saket-4	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Grain yield (g/pot)												
Control	4.90	5.40	7.70	8.60	10.0	10.25	10.2	10.80	9.50	9.33	8.0	7.40
8	4.00	3.20	4.20	4.80	8.00	7.90	7.90	8.10	7.90	8.30	6.0	5.75
12	3.00	2.85	3.10	2.90	4.90	5.25	7.00	6.80	6.20	6.00	4.9	4.45
16	2.00	1.62	2.20	2.00	2.90	3.05	5.00	4.35	4.10	3.90	3.5	3.25
CD (P=0.05)	0.63	0.44										
Straw yield (g/pot)												
Control	10.9	11.8	17.9	16.9	28.0	27.8	27.9	28.5	27.1	26.4	23.0	22.2
8	9.8	9.0	13.3	12.8	21.1	20.8	22.9	21.1	21.8	21.1	15.0	14.9
12	8.1	7.2	8.2	8.0	15.1	14.6	17.0	16.8	16.9	17.2	10.9	11.7
16	6.0	5.8	6.2	6.1	11.0	10.2	13.0	13.6	15.0	14.5	9.00	8.75
CD (P=0.05)	0.79	0.37										

BPT-5204 variety in both the years. On the basis of average grain yield, the superiority of the varieties may be arranged as Pusha Kranti > Sarju-5 > Pant-10 > Saket-4 > Pant-4 > BPT-5204. Thus it is concluded that Pusha Kranti was more suitable as compared to other varieties of rice, if irrigated with salinity rich irrigation water.

The interaction effect between EC and variety (Table 2) was significant. Higher levels of salinity decreased significantly grain and straw yield of each variety as compared to lower levels of salinity. Variety Pusha Kranti resulted in maximum grain and straw yield which was significantly higher than other varieties. Lowest yield was noted in BPT 5204 under 16 dSm^{-1} which was significantly lower as compared to other combination of EC and varieties. Lal et al. (1999) reported similar results in barley.

Table 3: Percent yield of grain (Pooled of 2 years)

Rice varieties	**Salinity levels of irrigation water (dSm^{-1})**			
	Control	**8**	**12**	**16**
BPT-5204	100	69.90	56.69	35.14
Pant-4	100	55.21	36.80	25.76
Pant-10	100	78.51	50.07	29.33
Pusa Kranti	100	76.19	65.71	44.47
Sarju-52	100	86.07	64.82	42.50
Saket-4	100	76.23	60.64	44.41

The safe limits of salinity (EC) were calculated on the basis of per cent grain yield reduction. The safe limits of EC for varieties namely BPT-5204-, Pant-4 9. Pant-10, Pusa Kranti-, Sarju-52 and Saket-4 were 13.20, 9.10, 12.07, 14.93, 14.53 and 13.73 dSm^{-1} respectively. Among these varieties, Pusha Kranti variety proved more salt tolerant as compared to other tested varieties, Sarju-52 also tested next salt tolerant variety. The superiority for salt tolerance may be arranged as Pusha Kranti > Sarju-52 > Saket-4 > BPT-5204 > Pant-10 > Pant-4. It is clear from Table 1 that the considerable enhancement of ECe was noted with increasing water salinity levels during both the years. ECe values of the soil ranged from 2.3 to 53.9 dSm^{-1}. The resultant ECe of experimental soil was 2.3, 3.7, 3.3 and 3.3 times more than applied irrigation water of control, 8, 12 and 16 dSm^{-1} respectively. The maximum ECe was noted under highest levels of water salinity. The pH values of experimental soil were not affected markedly due to EC levels and rice verities. pH vale of the soil varied from 8.6 to 8.9. A minute change in pH values was noted with increasing level of salinity during both the years. However, comparatively low pH values were noted under Pusha Kranti variety during both the years. Similar results were also reported by Sharma and Pal (2001).

The results of this study lead to a conclusion that Pusha Kranti was more suitable for cultivation under water salinity.

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