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RESEARCH ARTICLE

EVALUATION OF SALINITY AND ITS IMPACT ON GROWTH OF *RAPHANUS SATIVUS* CV. NEWAR ANI PUSA CHETKI

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ABSTRACT

Radishes are grown and consumed as salad, oil and in therapeutic such as medicines. Seeds of two cultivars of *Raphanus sativus* viz. newar and pusa chetki were used to investigate the effect of different concentration of the salts (NaCl, $MgSO_4$, $CaSO_4$, K_2SO_4) including artificial sea water (prepared in various concentrations such as 0mM, 10mM, 50mM, 100mM and 200mM) on various parameter of the plant growth such as germination percentage, root length, shoot height and fresh weight of seedlings .The result showed that the different treatment of salinity had statistically considerable effects on germination percentage, root length, shoot height and fresh weight of seedlings. Higher concentrations of the salts (50- 200mM) reduced the growth parameters significantly in case of cv. pusa chetki. However, cv. newar demonstrated better performance than that of pusa chetki for most of the measured parameters such as fresh wt., shoot height and root length etc under different level of salinity levels

INTRODUCTION

The word "radish" is a derivation of the Latin word "radix," or root (Lindley, 2007). The main enzymes found in radish are phosphatase, catalase, sucrase, amylase, alcohol dehydrogenase and pyruvic carboxylase. Radish also contains a theromostable antithiamine factor i.e. S- methyl –L- cystein sulfoxide designated as methin (M.P. 173 - 174°C). Steroidal sapogenins have been also reported. Pectin (0.3% as calcium pectate) and pentosans are also reported while starch is absent. Organic acids detected include, p-coumaric, caffeic, ferulic, phenyle pyruvic, gentisic and p-hydroxybenzoic acids (Kulkarni and Sohonie, 1956). Radish leaves contain an essential oil (0.002%) containing 2- hexen -1- al (leaf aldehyde) 3 – hexane -1- ol (leaf alcohol) (Gutierrez and Perez, 2004). Radish seeds contain Sulphoraphene, which is very good for antibacterial activity against *streptococcus*, *Pyococcus*, *Pneumococcus* and *Escherichia coli*. Radishes are suggested as an alternative treatment for a variety of ailments including whooping cough, cancer, coughs, gastric discomfort, liver problems, constipation, dyspepsia, gallbladder problems, arthritis, gallstones, kidney stones and intestinal parasites. Radishes possess hydroxyl radical scavenging potency. Decontamination of Water Polluted with Phenol can be done by using *Raphanus sativus* Root (Naghibi *et al*., 2003). Radishes possess nutraceutical properties (Eskin and Tamir, 2005). Brassicaceae is considered to be a salt resistant family; as a result, radish is more appropriate to evaluate the basis of salt stress tolerance in plants (Misra *et al.*, 2001). Thus this study was carried out to investigate to what extent salinity affects seed germination and early seedling growth.

MATERIAL AND METHODS

Salt Treatment

Seeds of the cultivar of *Raphanus sativus* such as newar/jaunpuri and pusa chetki were procured from the research station of Krishi Vigyan Kendra of N.D. University, Faizabad. The artificial sea water (Mafuji, 1995) was prepared consisting of 2.72% NaCl, 0.38% $MgCl_2$, 0.17% $MgSO_4$, 0.13%$CaSO_4$, and 0.086% K_2SO_4.Various concentrations of the artificial sea water viz. 0 (control), 1/10,1/5,1/2,1/1 was prepared. All the elements of the artificial sea water were added to Murashige and Skoog (MS) medium according to set concentration. Sucrose (30g/L) and agar (8g/L) was also added in MS medium (pH 5.8 before autoclaving). Individual salt concentrations were prepared to examine the effect on growth. Various concentration of sodium chloride (NaCl), Magnesium chloride ($MgCl_2$), Magnesium sulfate ($MgSO_4$), Calcium sulfate ($CaSO_4$) and Magnesium sulfate ($MgSO_4$) were prepared.

Seed Sterilization And Inoculation

Seeds were surface sterilized with 70% ethanol for 30 sec, followed by 1% Sodium hypochlirite for 30 min. Seeds were inoculated in test tubes with different concentration of salt in

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medium. The jars were incubated at 20^0C under 2000lx and 16 h photo period. Germinated seeds were counted after 14 days of the inoculation.

RESULTS AND DISCUSSION

Statistical Analysis Of Data

Analysis of variance (ANOVA) was conducted and significance of difference among treatment was tested using the least significance difference (LSD). The F- protected LSD calculated at the 0.05 level according to Steel and Torrie (1980).

Analysis of variance revealed significant difference among salinity concentrations and growth parameters of the cultivars of raphaus.

Seed Germination

The results depict a significant decline in seed germination percentage (Table 1) of both the cultivar (newar as well as pusa chetki) with increasing salt concentrations. However, germination percentage of cv. newar seeds was higher than that of pusa chetki indicating its highersalt tolerance tendency. Seed germination was observed maximum in 0 mM concentration of all the salts. Salt concentration of NaCl was found very favorable to bring 100% (0 mM) seed germination of cv. newar. In studies on eggplant (Akinci *et al*., 2004), it was found that application of 100 and 150 mM salt concentration reduced the seed germination drastically as compared to control. It was observed that the salt stress markedly reduced germination percentage and delayed germination rate which might be due to high osmotic potential or particular ion toxicity (Huangand, 1995). It has been also reported that germination rate and the germination percentage declined with the reduction of the water passage into the seeds during imbibitions (Hadas, 1977; Kaya *et al.,* 2006).

Root Length under the Salt Treatment

The results revealed that the root length was decreased constantly with increasing salt concentration. Maximum growth of the root was observed in NaCl (control) (5cm of cv. pusa chetki and 5.2 cm in cv. newar). A significant change in root length was observed with difference in concentration of the $MgCl_2$ (Fig 1). However, no significant relation among the root length and different concentrations of salts such as $MgSO_4$, $CaSO_4$ and K_2SO_4, were observed (Table 1). Application of sea water (100 and 200 mM concentrations) showed no growth in the seedlings of pusa chetki**.** The results depict that root length of both the cv. were least affected by concentration variation in the different salts. However, while comparing both the varieties with each other, it was observed that different concentrations of the salts supported more root growth in newar as compared to pusa chetki. It was observed in one of the studies (Jamil and Rha, 2013) that the application of higher concentration of NaCl reduced the root length in mustard plant as compared to control one

Shoot Height Under Salt Treatment

The result depicts a significant relationship among the shoot height of seedling and different concentrations of the salts. The maximum average shoot height was observed in the salt concentration of $MgSO_4$ (control) (6 cm in pusa chetki and 3.2 cm in newar) followed by K_2SO_4 (2.6cm in pusa chetki and 3

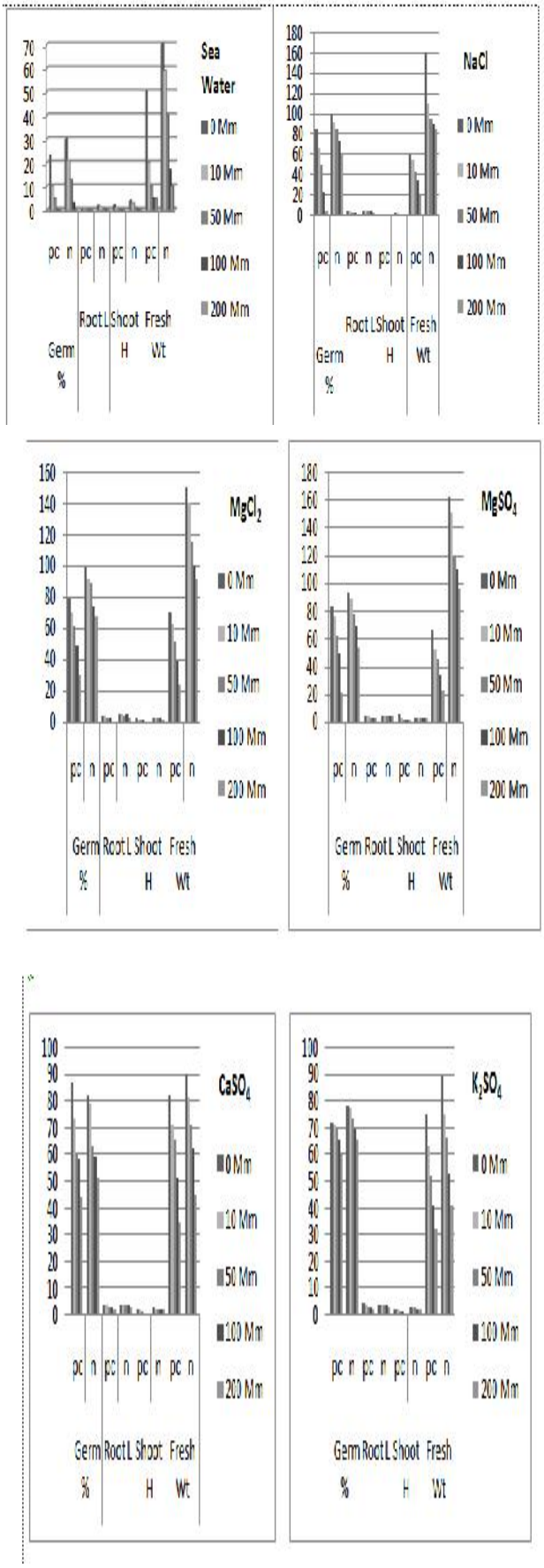

Fig 1 a-f Relationship among various concentration of the salts and growth parameters of *Raphanus sativus* cv. newar and pusa chetki

Table 1 Effect of different concentrations of salts on germination percentage, root length, shoot height and fresh wt. of seedlings of *Raphanus sativus* cv. newar and pusa chetki

	Seed germination (%)		Root Length (cm)		Shoot Height(cm)		Fresh Wt. (mg)	
	pc	newar	pc	newar	pc	newar	pc	newar
Sea Water								
0 mM	23 a	30 a	0.1 a	1.8 a	2 a	4 a	50 a	70 a
10 mM	10 b	21 b	0.5 b	1.2 a	1 b	3 b	20 ab	59 b
50 mM	5 c	12.6 c	0.1 b	0.8 b	0 c	1 b	10 b	40 c
100 mM	0 d	3 d	0 c	0.2 b	0 c	0 b	5 b	17 d
200 mM	0 d	0 d	0 c	0 b	0 c	0 b	5 b	10 e
NaCl								
0 mM	85 a	100 a	5 a	5.2 a	2.1 a	3.0 a	60 a	160 a
10 mM	66 b	92 b	4.5 a	5 a	1.8 b	2.6 a	55 b	110 b
50 mM	50 c	84.6 c	3.5 a	4 a	1.2 bc	1.7 a	43 c	95 bc
100 mM	23 d	72 d	2.3 ab	3.5 a	0.7 c	0.8 a	35 d	90 c
200 mM	5 e	60 d	1.0 ab	3 a	0.2 d	0.3 b	20 d	85 d
$MgCl_2$								
0 mM	79 a	99 a	4.06 a	4.8 a	2.0 a	3.1 a	70 a	150 a
10 mM	70 b	91 ab	3.8 b	4.6 a	1.7 a	2.9 a	63 b	140 b
50 mM	61 c	89 b	2.7 c	4.2 b	1.1 ab	2.6 a	51 c	115 c
100 mM	48 d	73 c	1.9 d	3.9 bc	0.76 b	2.3 a	39 d	100 d
200 mM	30 e	68 d	0.8 e	3.3 c	0.3 c	1.8 b	24.6 e	91 e
$MgSO_4$								
0 mM	83 a	93 a	4.2 a	4.9 a	6 a	3.2 a	66 a	162 a
10 mM	76 b	88 b	3.9 a	4.7 a	2.3 ab	2.8 ab	52 ab	150 b
50 mM	62 c	78 c	2.9 b	4.6 a	1.7 b	2.6 b	45 b	120 c
100 mM	49 d	69 d	2.0 c	3.9 b	1.1 c	2.4 c	33 c	110 d
200 mM	21 e	53 e	1.9 c	3.6 b	0.9 d	2.1 d	22 d	95 e
$CaSO_4$								
0 mM	87 a	82 a	4.3 a	4.1 a	2.4 a	3 a	82 a	90 a
10 mM	73 b	79 ab	3.8 b	4 a	2.1 a	2.7 a	71 b	81 ab
50 mM	61 c	63 b	3.1 bc	3.9 a	1.8 ab	2.56 ab	65 c	71 b
100 mM	58 d	59 c	2.9 c	3.6 a	1.1 b	2.4 b	51 d	62 c
200 mM	44 e	51 d	2.1 d	3.2 ab	0.8 c	2.2 c	35 e	45 d
K_2SO_4								
0 mM	72 a	78 a	4.4 a	4.2 a	2.6 a	3 a	75 a	89 a
10 mM	71 a	77 ab	3.8 ab	4.2 a	2.1 ab	3 a	63 b	75 b
50 mM	69 a	73 b	3.2 b	3.9 a	1.8 b	2.9 a	52 c	66 c
100 mM	65 ab	69 c	2.9 c	3.6 ab	1.2 c	2.5 ab	41 d	53 d
200 mM	60 b	65 d	2.3 d	2.9 b	0.9 d	2.2 b	32 e	41 e

Pc= Pusa chetki, N= Newar

cm in newar) and least in NaCl (2.1cm in pusa chetki and 3 cm in newar). In artificial sea water, no growth was observed in the 50 mM to 200 mM in cv. pusa chetki and 100 mM to 200 mM in cv. newar. When growth parameter of shoot height of both the cultivars (newar as well as pusa chetki) were compared in all the salt concentrations, it was found that newar was having more salt affinity for promoting growth as compared to pusa chetki. In one of the experiment, (Jamil *et al.*, 2012) while working on cowpea, it was reported that with increasing salt concentration on the seedlings, aerial shoot growth was reduced.

Salt Concentration And Fresh Weight

The result showed a constant decline in fresh weight with increasing concentrations of the salts (from control to 200 mM). However, in cv. pusa chetki no significant change in average fresh wt. of root was observed on application of concentration 10 - 200 mM (fig 1) of NaCl. It was reported that the average fresh wt of cv. newar was maximum in $MgSO_4$ (162 mg), followed by NaCl (160 mg) and least was observed in sea water (70 mg). However, in cv. pusa chetki maximum fresh wt was observed by the application of salt $CaSO_4$ (82 mg), followed by K_2SO_4 (75 mg) and least was observed in all concentrations of sea water (50 mg).

The result depict that higher concentration of salts supports fresh wt. of cv. newar more than that of cv. pusa chetki (Table 1). In one of the experiment (Kobayashi *et al.*, 2001), where various concentrations of salts were applied on tobacco plant, revealed that the desaturation of fatty acids stimulated salt tolerance in that plant.

CONCLUSION

In this study, two cultivars of *Raphanus sativus* (newar as well as pusa chetki) were subjected to various concentrations of the salts and different growth parameters were observed. It can be concluded that on application of various salts such as artificial sea water, NaCl, $MgCl_2$, $MgSO_4$ and K_2SO_4, there was least significant growth root length and shoot height. However, low concentration of the salts supported average seed germination significantly, while higher concentration of the salts supported average fresh weight of both the cultivars pusa chetki as well as newar. Salinity reduced seedling growth with the increasing NaCl concentration. The decrease in lengths of root and shoot may be due to slowing down the water absorption by the plant (Werner & Finkelstein, 1995). Demir and Arif (2003) also obtained similar results. They have found that the root growth was more badly influenced by salinity than shooting growth.

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