Effect of Potassium Chloride on Seed Germination and Early Growth of Three Rape Seed Varieties

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Abstract: Salinity stress is one of the crucial factors affecting at different stages of growth and development of the crop. In the present research, the seeds of three rape seed varieties like Toria selection, Sindh Raya and Sarhein-95 were exposed to increasing concentrations (1 and 2%) of KCl to demonstrate the effect of salt stress on seed germination and early seedling growth of rape seed varieties. Seed germination and seedling growth decreased with the increase of KCl grown in Petri dishes within seven days. Highest germination and seedling growth was recorded in Sindh Raya than Toria and Sarhein-95. On the basis of all growth characteristics, the three genotypes were found to be more sensitive under KCl salt stress.

Keywords: KCl, seedling growth, seed germination, rapeseed.

INTRODUCTION

Rapeseed (*Brassica napus L.*) is a supply of protein and oil for human and animal expenditure. Most vegetative oils are edible for food preparation to make it more delicious and nutritious. Vegetable oils are preferred over the solid animal fats because of health benefits during their growth crop plants usually showing to different ecological condition which limits their growth and production [1]. Seed germination is initial and most critical stage of plants, several environmental stresses effects on germination. As salinity stress is one the serious problem for plants in semi-arid areas of the world [2]. In saline environment adaptation of plants is too difficult especially germination and early seedling stages is critical for the establishment of species. Seedlings are the most susceptible stage of plants and germination determines when and where seedling growth begins [3]. Salinity disturbs germination, lengths, weight and all cellular mechanism of rapeseed through several processes such as ionic stress as a result of high concentrations of toxic salt ions and osmotic stress by limiting water absorption [4,5]. Beside genetic adaptation plants can to a certain level, acclimated to salt stress, this is due to the fact that salinity affects most aspects of plant physiology, growth and development [6]. Osmotic and salt stress are responsible for both delayed or inhibition seed germination and seedling growth under this stress there is a decrease in water uptake during imbibitions and further more salt stress may cause excessive uptake of ions [7]. Nutritional imbalance caused by such ions leads to reduction in photosynthetic efficiency and other physiological disorders [8].

MATERIALS AND METHODS

The experiment was conducted in the laboratory of the department of Crop Physiology, Faculty of Crop Production, Sindh Agriculture University Tando Jam, Pakistan, during the year 2013. Complete Randomize design was used with three replications. The rapeseed varieties viz. TS (Toria selection), Sindh Raya and Sarhein-95 possessing good quality characters were obtained from Agriculture Research Institute (ARI), Tandojam, Pakistan.

Experimental Details

The experiment was laid down in complete randomize design (CRD) with three replicates, three treatments (control (distilled water) and salinity (1 and 2% KCl) levels) and three rapeseed varieties (TS (Toria selection), Sindh Raya and Sarhein-95). The thirty seeds of each rapeseed variety were surface sterilized for 10 minutes with 3% sodium hypochlorite (NaOCl) and washed thoroughly with distilled water then placed in Petri dishes containing double layered Watman No.1 filter paper moistened with distilled water (control) and two concentration of KCl, afterward the solution was applied when required. The seeds were germinated in an incubator at 25˚C for 7 days. The observation seed germination (%), root length (cm), shoot length (cm),

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Table 1: Mean Squares from Analysis of Variance for Various Morphological Traits of Rapeseed Genotypes at Seedling Stage under KCL Salt Stress

Source of variation	MORPHOLOGICAL CHARACTERS							
	df	Seed germination %	Shoot length (cm)	Root length (cm)	Shoot fresh weight (g)	Root fresh weight (g)	Shoot dry weight (g)	Root dry weight (g)
Replication	2	102.83	0.11	1.37	66.19	118.21	1.15	1.13
Treatments	2	3156.11**	79.389**	22.538**	401928.0**	11307.0**	5805.28**	369.406**
Genotype	2	969.38**	28.049**	13.290**	67140.0**	30285.0**	858.11**	163.377 **
Genotype x treatment	4	26.96**	0.549**	0.033**	1417.0**	467.0**	24.73**	4.334**
Error	18	4.94	0.119	0.009	92	45	1.64	0.717

root and shoot fresh weight (mg) and root and shoot dry weight (mg) was recorded. All the data collected of experiment subjected to analysis of variance to discriminate the superiority of treatment means and HSD test was applied following the methods of Gomez and Gomez [9] to compare the means. For this purpose a Microsoft computer package "Statistix 8.1" was used.

RESULTS AND DISCUSSION

A laboratory experiment was performed to demonstrate the effect of salt stress (KCl) on seed germination and early seedling growth of three rapeseed varieties during the year 2013, under Postgraduate research laboratory of the Department of Crop Physiology, Faculty of Crop Production, Sindh Agriculture University Tandojam, Pakistan. Three rapeseed varieties (TS (Toria selection), Sindh Raya and Sarhein-95) were studied under control (Distilled water) and the effect of two KCl levels (1% and 2%) in incubator at 25^0C. Observation (seed germination, root and shoot length, root and shoot fresh weight and root and shoot dry weight) was recorded after seven days. The analysis of variance revealed highly significant difference at $P<0.01$ for the traits viz. seed germination%, root length, shoot length, root fresh weight, shoot fresh weight, root dry weight and shoot dry weight.

Seed Germination (%)

The mean values of seed germination percentage of all rapeseed varieties were reducing under increased KCl concentrations (Figure **1**). The highest mean value was demonstrated in untreated seeds (85.55 %), than treated (1 and 2 % KCl concentration) seed (62.22 and 48.51 %), respectively. Results concerning to varieties, Sindh Raya (75.55 %) get better germination than Toria selection and Sarhein-95 varieties (65.92 and 54.81 %), respectively. Similar results as regards germination were agreed by the scientist [2,10-12]. The least germination percentage was observed from okapi common symptoms damage and growth inhibition by salt stress. Salt inhibits growth for two reasons. First, it reduces the plant's capability to uptake water, and this leads to slower growth. Second, it may enter the transpiration stream and finally injure cells in the transpiring leaves, further reducing growth [11].

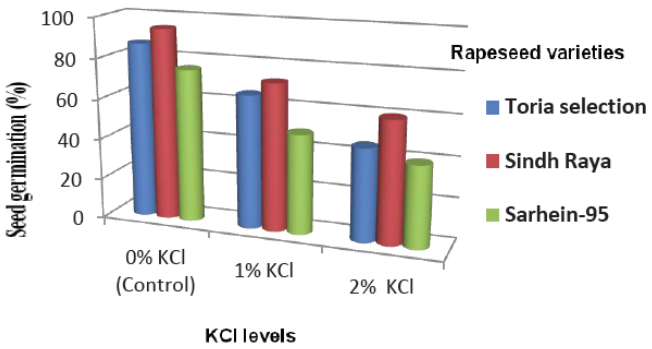

Figure 1: Effect of salt stress (KCl) on seed germination (%) of rapeseed varieties.

Root Length (cm)

Under higher concentration of KCl, the root length of rapeseed considerably got reduces (Figure **2**). The highest root length was achieved in control (5.2 cm), the root length reduced under salinity concentration

(3.8 and 2.0 cm) in 1 and 2 % KCl concentration, respectively. According to varieties, the results were accomplished; the variety Sindh Raya (5.0 cm) improved root length than varieties Toria selection and Sarhein-95 varieties (3.3 and 2.7 cm), respectively. The results regarding decreasing of root length of rapeseed varieties are supported by [13-15].

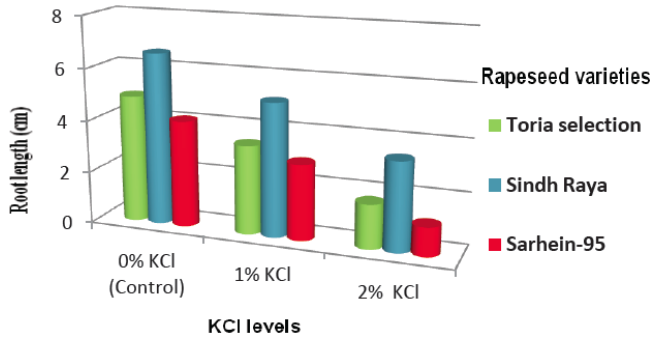

Figure 2: Effect of salt stress (KCl) on root length (cm) of rapeseed varieties.

Shoot Length (cm)

Salinity effects on all the rapeseed varieties were decrease shoot length (Figure **3**). The highest shoot length was measured in control (9.5 cm) and the lowest shoot length was measured (6.2 and 3.5 cm) in 1 and 2 % KCl concentration, respectively. Varietal results regarding shoot length; the variety Sindh Raya (8.3 cm) given greater shoot length than the varieties Toria selection and Sarhein-95 (6.1 and 4.8 cm), respectively. Decreasing trend of shoot length under salt stress is also deliberated [14-16].

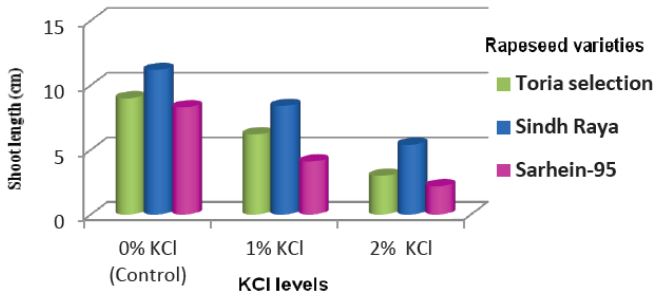

Figure 3: Effect of salt stress (KCl) on shoot length (cm) of rapeseed varieties.

Root Fresh Weight (mg root^{-10})

Root fresh weight of all the rapeseed varieties is affected under increased salinity concentrations (Figure **4**). The highest root fresh weight was observed (388.89 mg root^{-10}) in control and the lowest root fresh weight was observed (248.08 and 167.41 mg root^{-10}) in 1 and 2 % KCl concentration, respectively. Varietal results regarding root fresh weight; the variety Sindh Raya (331.93 mg root^{-10}) showed greater root fresh weight than the varieties Toria selection and Sarhein-95 (253.90 and 218.56 mg root^{-10}), respectively. Reduction in root fresh weight was also considered many scientists [13,15,17,18].

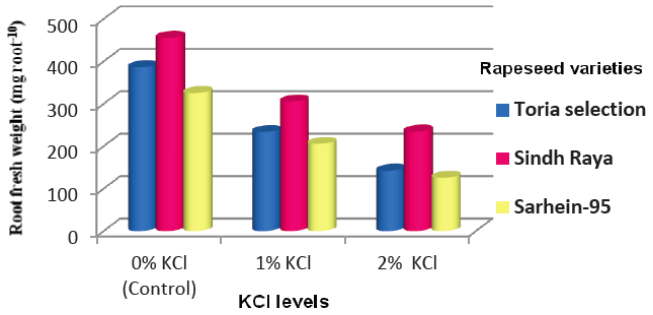

Figure 4: Effect of salt stress (KCl) on root fresh weight (mg root^{-10}) of rapeseed varieties.

Shoot Fresh Weight (mg shoot^{-10})

The mean values of shoot fresh weight of all rapeseed varieties were reducing under increased KCl concentrations (Figure **5**). The highest mean value was demonstrated in untreated (control) seeds (778.54 mg shoot^{-10}), than treated (1 and 2 % KCl concentration) seed (571.73 and 355.92 mg shoot^{-10}), respectively. Results concerning to varieties, Sindh Raya (663.09 mg shoot^{-10}) get better germination than Toria selection and Sarhein-95 varieties (549.54 and 493.58 mg shoot^{-10}), respectively. Similar results as regards germination were agreed by the scientists [15,17,19].

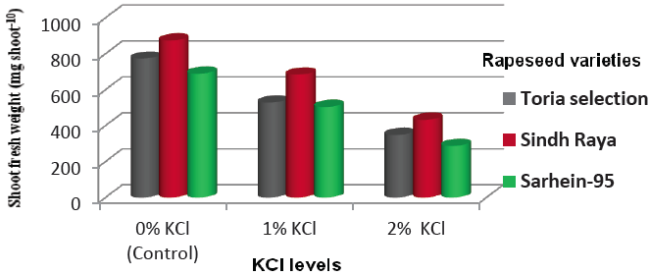

Figure 5: Effect of salt stress (KCl) on shoot fresh weight (mg shoot^{-10}) of rapeseed varieties.

Root Dry Weight (mg root^{-10})

Salinity effects on all the rapeseed varieties were decrease root dry weight (Figure **6**). The highest mean values of root dry weight was observed (16.851 mg root^{-10}) in control and the lowest mean values of root dry weight was observed (8.549 and 4.248 mg root^{-10}) in 1 and 2 % KCl concentration, respectively. Varietal results regarding root dry weight; the variety Sindh

Raya (14.523 mg root^{-10}) showed better performance to root dry weight than the varieties Toria selection and Sarhein-95 (8.977 and 6.148 mg root^{-10}), respectively. Root dry weight of rapeseed varieties was reduces under salt stress agreed many scientists [15,20,21].

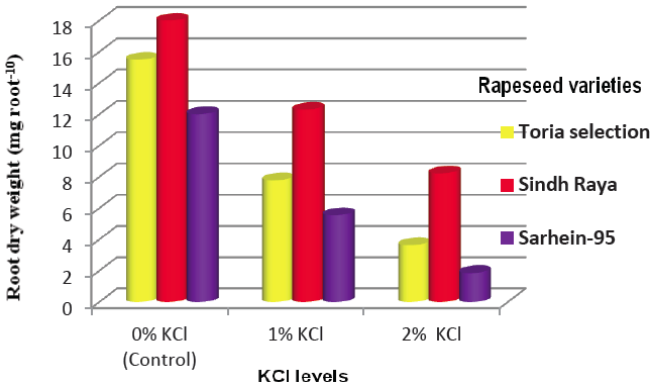

Figure 6: Effect of salt stress (KCl) on root dry weight (mg root^{-10}) of rapeseed varieties.

Shoot Dry Weight (mg shoot^{-10})

Under the higher concentration of KCl, the shoot dry weight of rapeseed considerably got reduces (Figure **7**). The highest mean values of shoot dry weight was achieved in control (67.033 mg shoot^{-10}), the shoot dry weight reduced under salinity concentration (37.220 and 16.511 mg shoot^{-10}) in 1 and 2 % KCl concentration, respectively. According to varieties, the results were accomplished; the variety Sindh Raya (51.169 mg shoot^{-10}) improved shoot dry weight than varieties Toria selection and Sarhein-95 varieties (37.249 and 32.347 mg shoot^{-10}), respectively. The results regarding shoot dry weight of rapeseed varieties are supported by [3,20,21].

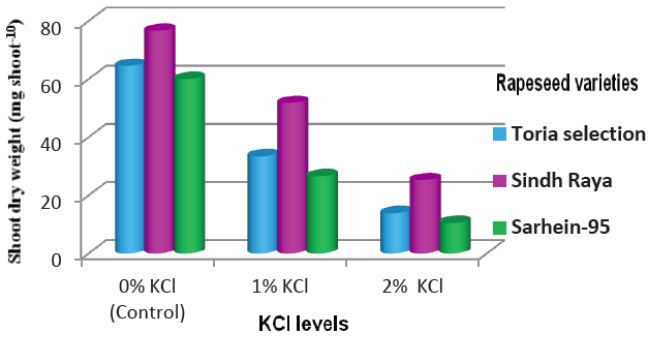

Figure 7: Effect of salt stress (KCl) on shoot dry weight (mg root^{-10}) of rapeseed varieties.

CONCLUSION

It is concluded from present study that varieties, treatments and their interaction were highly significant for all growth parameters i.e germination percentage, root and shoot length, and root and shoot fresh and dry weight. Among the treatments level all the growth parameters were decrease by increasing the salt (KCl) concentrations. Among the varietal levels, Sindh Raya recorded highest mean values, while Sarhein-95 variety demonstrate lowest mean values for all the parameters at both salt (1 and 2% KCl) concentrations. However, significant reduction at germination and seedling growth of rapeseed was observed at high salinity level, symptoms shows salt stress produces harmful effects due to osmotic pressure, limited germination, reduces root and shoot lengths and inhabit root and shoot growth.

REFERENCES

[1] Mostavafi K. Effect of Salt Stress on Germination and Early Seedling Growth Stage of Sugar Beet 2012.

[2] Mosavian SN, Eshraghi M. Effect of NaCl and CaCl2 stress on germination indicators and seedling growth of canola. International Journal of Farming and Allied Scienc 2013; I(2): 32-37.

[3] Kaymakanova M. Effect of salinity on germination and seed physiology in bean (*Phaseolus vulgaris* L.). Biotechnol Biotechnol E 2009; 23(3): 26-329. https://doi.org/10.1080/13102818.2009.10818430

[4] Pasanipour A, Farahbakhsh H, Saffari M, Keramat B. Response of fenugreek plants to short-term salinity stress inrelation to photosythetic pigments and antioxidant activity. 2013; 3(1): 80-86.

[5] Farhoudi R, Modhej A, Afrous A. Effect of salt stress on seedlings growth and ions homeostasis of soybean (*Glysin max)* cultivars. Journal of Scientific Research and Development 2015; 2(5): 118-121.

[6] Aymen EM, Cherif H. Influence of seed priming on emergence and growth of coriander (*Coriandrum sativum L.*) seedlings grown under salt stress. Acta Agric Slovenica 2013; 1(101): 41-47.

[7] Kandil AA, Shraief AE, Abido WAE, Ibrahim MMO. Response of some canola cultivars (*Brassica napus* L.) to salinity stress and its effect on germination and seedling properties. Crop Science J 2012; 3(3): 95-103.

[8] Hakim MA, Juraimi AS, Begum MM, Hanafi MR, Ismail H, Selamat A. Effect of salt stress on germination and early seedling growth of rice (*Oryza sativa* L.). African J of Biotech 2010; 9(13): 1911-1918. https://doi.org/10.5897/AJB09.1526

[9] Gomez KA, Gomez AA. Statistical procedures for agricultural research. John Wiley and sons, Inc. London, UK 1984; 2: 13-175.

[10] Ahmadvand G, Soleimani F, Saadatian B, Pouya M. Effects of seed priming on germination and emergence traits of two soybean cultivars under salinity stress. Intl Res J of Applied and Basic Sci 2012; 2(3): 234-241.

[11] Cokkizgin A, Colkesen M. Germination responses of pea (*Pisum sativum L.*) seeds to salinity. Intl J of Agril Sci and Bio Resource Engn 2012; 1(3): 71-77.

[12] Tabar Y. Effect of salinity stress on seed germination of two canola varieties. Sci Agri 2013; 2(2): 38-41.

[13] Alavi MH, Ranjbar GA. Effects of different levels of salinity on germination, proline contents and A-, B- chlorophylls in Rapessed (*Brassica napus L.*) Intl J Agri Crop Sci 2012; 4(15): 1055-1059.

[14] Naseri R, Mirzaei A, Emami T, Vafa P. Effect of salinity on germination stage of rapeseed cultivars (*Brassica napus* L.). Intl J Agri Crop Sci 2012; 4(13): 918-922.

[15] Farhoudi R, Sharifzadeh F, Poustini K, Makkizadeh MT, Kochakpour M. The effects of NaCl priming on salt tolerance in canola (*Brassica napus*) seedlings grown under saline conditions. Seed Science and Technology 2007; 35: 754-759. https://doi.org/10.15258/sst.2007.35.3.23

[16] Hussain A, Khan ZI, Ashraf M, Rashid MH, Akhtar MS. Effect of salt stress on some growth attributes of sugarcane cultivars CP-77-400 and Coj-84. Int J Agric Biol 2004; 6(1): 188-191.

[17] Huang Z, Yang RG, Xu AX, Li JH, Lu RW, Luo P. Effects of saline stress on seed germination and seedling properties of three Types' rapeseed. J of Northwest A and F University (Natural Sciences Education) 2010; 38(7): 49-53.

[18] Jianjie S, Wu S, Xu Z, Qiu S, Luo T, Yang Y, Chen Q, Xia Y, Zou S, Huang BL, Huang B. Comparison of salt tolerance in Brassicas and some related species. American J. of Plant Sciences 2013; 4: 1911-1917. https://doi.org/10.4236/ajps.2013.410234

[19] Morant MA, Pradier E, Tremblin G. Osmotic adjustment, gas exchange and chlorophyll fluorescence of a hexaploid triticale and its parental species under salt stress. Plant Physiology 2004; 161(1): 25-33. https://doi.org/10.1078/0176-1617-00963

[20] Mohammadi GR. The influence of NaCl priming on seed germination and seedling growth of canola (*Brassica napus* l.) under salinity conditions. American-Eurasian J Agric and Environ Sci 2009; 5(5): 696-700.

[21] Bahrani A Effect of salinity on growth, ions distribution, accumulation and chlorophyll concentrations in two canola (*Brassica napus L.*) cultivars. American-Eurasian J Agric and Environ Sci 2013; 13(5): 683-689.

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