Journal BiNET
Scientific Publication

Published with Open Access at Journal BiNET
Vol. 32, Issue 01: 2620-2628
Journal of Bioscience and Agriculture Research

Journal Home: www.journalbinet.com/jbar-journal.html

Effect of salinity on seed germination and seedling growth in five wheat cultivars grown in hydroponics

Md. Rashed Khan Milon[1], Md. Alamgir Hossain[2], A. K. M. Zakir Hossain[2], S. M. Abdul Alim[3], Md. Mohimenul Islam[4], Md. Alamgir Kabir[5] and Md. Selim Reza[6]

[1]Bangladesh Jute Research Institute, Dhaka, Bangladesh
[2]Department of Crop Botany, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
[3]Plant Breeding Division, Bangladesh Institute of Nuclear Agriculture, Mymensingh-2202, Bangladesh
[4]Adaptive Research and Extension Division, Bangladesh Institute of Nuclear Agriculture, Mymensingh-2202, Bangladesh
[5]Department of Agricultural Extension, Ministry of Agriculture, Bangladesh
[6]Soil Science Division, Bangladesh Institute of Nuclear Agriculture, Mymensingh-2202, Bangladesh

✉ For any information: selim.bsmrau48@gmail.com (Reza MS)
Article received: 23.11.2023; Revised: 09.01.2024; First published online: 04 February, 2024

ABSTRACT

A hydroponics experiment was done at the Crop Physiology Laboratory, Department of Crop Botany, Department of Seed Science and Technology, Bangladesh Agricultural University, Mymensingh, from March 2018 to September 2018 to explore the impact of NaCl on the development and morphological traits of wheat seedlings, as well as the salt-induced mineral status in the roots and shoots. The experiment was composed of two levels of NaCl concentrations viz., 0 (control) and 10 ds/m and five varieties viz BARI Gom-21, BARI Gom-26, BARI Gom-27, BARI Gom-28 and BARI Gom-29. The experiment was designed in a completely randomized design with three replications. Applications of 10 ds/m NaCl deeply impacted germination percentage, root and shoot length, fresh and dry mass production, leaf blade and leaf sheath length, and number of leaves in wheat seedlings. The findings showed that salinity stress impacted fresh and dry mass plants, germination %, root and shoot length, leaf length, and leaf sheath length. This suggests that certain wheat seedling cultivars are particularly vulnerable to concentrated NaCl. Yet, BARI Gom-27 performed the best out of all the tested kinds when it came to the growth of the seedlings, the percentage of germination and the presence of vital minerals in the seedlings when they were under saline stress. Based on the previously examined parameters, BARI Gom-29 demonstrated the greatest susceptibility to salt stress in this experiment.

***Key Words**: Hydroponics, Growth, Salinity, Seed germination and Wheat cultivars.*

Cite Article: Milon, M. R. K., Hossain, M. A., Hossain, A. K. M. Z. Alim, S. M. A., Islam, M. M., Kabir, M. A. and Reza, M. S. (2024). Effect of salinity on seed germination and seedling growth in five wheat cultivars grown in hydroponics. Journal of Bioscience and Agriculture Research, 32(01), 2620-2628. **Crossref:** https://doi.org/10.18801/jbar.320124.316

I. Introduction

Wheat is a grass extensively grown for its seed, a cereal grain that is a common food source worldwide. The most widely grown is common wheat (*Triticum aestivum*). About 749 million tons

Published with open access at journalbinet.com
EISSN: 2312-7945, © 2024 The Authors, Research paper

were produced worldwide in 2016 (Anonymous, 2016), wheat ranked second in grain production after maize. The amount of wheat and other grain crops produced worldwide has tripled since 1960, and this growth is predicted to continue until the middle of the twenty-first century. The creation of processed foods, whose consumption is rising due to global industrialization and the westernization of diet, is made easier by the special viscoelastic and adhesive qualities of gluten proteins, which are driving up demand for wheat. Wheat is one of the main sources of carbohydrates among cereal crops (Jones et al., 2015). Globally, it is the leading source of protein in human food, having a protein content of about 13%, which is relatively higher than the other major cereals. Wheat production is severely decreased by increased salinity.

Indeed, 833 million hectares of land worldwide are impacted by salt, either because of salinity (399 million ha) or the related sodality (434 million ha), FAO (2021). Salinity is generally described as the overabundance of soluble salt that interferes with or impairs the processes necessary for plant growth. It is assessed using the pH of saturated soil paste extract, electrical conductivity (EC), exchangeable Na percentage (ESP), or Na absorption ratio (SAR). Therefore, saline soils are those with EC more than 4 dSm^{-1} equal to 40mM NaCl, ESP less than 15%, and H below 8 Abrol (1986), Szabolcs (1994) and Waisel (2007). Salinity affects more than a million hectares of land in Bangladesh, lowering crop productivity (Seraj et al., 2006). Cultivated crops under saline conditions face at least two types of stresses, viz, one stress for ion toxicity and the other arises from low water availability. Salinity stress affects many aspects of plant life and inhibits growth, development, and production. Around a million hectares of agricultural land in Bangladesh's offshore and coastal regions are impacted by different salinities Karim et al. (2012). The causes for salinity in Bangladesh are a) saltwater incursion brought on by a river drying up in the winter, b) cyclone in the coastal area, and c) inflow of salts during the dry season by capillary migration from the ground to the surface. The problem of salinity is severe in the winter. Compared to the national average of 159%, cropping intensity in Bangladesh's saline regions is comparatively low, ranging from 62 percent in the coastal region of Chittagong to 114 percent in the coastal region of Patuakhali, Karim et al. (2012).

We need to boost food production in these regions to feed the millions of Bangladeshis. Finding and improving salt-tolerant crop(s) or varieties is the first step; reclaiming land impacted by salt is the second. Reclamation techniques, including enhanced irrigation techniques for salt leaching, soil supplements, surface and subsurface drainage, and land leveling, are costly and need ongoing management. Ashraf et al. (1990). The selection and improvement of existing crop cultivars to fit into the varying degrees of salt-affected land is more feasible than soil reclamation. Due to salt buildup on the surface soil and insufficient irrigation water during dry seasons, winter crop cultivation is severely restricted. The extent to which crops can withstand salinity in the soil varies. Thus, choosing crops based on their tolerance is crucial in managing saline soils.

According to research findings, during the dry season, coastal areas' soil salinity often fluctuated between EC 2 dSm^{-1} to 18 dSm^{-1}. Wheat could be grown up to 16 dSm^{-1} in various salinities Karim et al. (2012). Since the salinity in Bangladesh varies from 2 dSm^{-1} to 16 dSm^{-1}, large areas can be planted with wheat during the winter. As salinity levels rise, wheat yields in saline locations likewise decline. Salt-tolerant wheat varieties may be a good option for increasing production in these problem soils. Many researchers have attempted to screen salt-tolerant lines/cultivars on various species during the seedling growth stage. Under the circumstances, the relationship between different seeding growth factors of seed yield and yield components is crucial for creating salt-tolerant cultivars intended for use in saline production environments. With this perspective in mind, the current study was carried out to investigate how salt stress affected five Bangladeshi wheat cultivars' hydroponic germination, growth, and development, as well as their variability. Considering these facts, five high yielding wheat varieties such as BARI Gom-21, BARI Gom-26, BARI Gom-27, BARI Gom-28, and BARI Gom-29, were grown in hydroponics under salinity stress to investigate their growth characteristics.

II. Materials and Methods

Experimental Laboratory

The Experiment was conducted at Crop Physiology Laboratory, Department of Crop Botany, Bangladesh Agricultural University, Mymensingh, from March, 2018 to May, 2018.

Published with open access at journalbinet.com
EISSN: 2312-7945, ©2024 The Authors, Research paper

Petri dish and pot preparation
Petri dishes and water pot (10L) preparation started in the last week of March 2018 for the sowing of wheat seeds. Filter sheets were used with Petri dishes that had been cleaned and dried. Hogland's complete nutritional solutions were added to the black pots, and an aeration pump was installed to provide oxygen to the water. Later, the experimental pots were laid out as per treatments and design.

Planting material
The seeds of five wheat varieties were collected from the Bangladesh Agricultural Research Institute Gazipur, Bangladesh. Five varieties were: BARI Gom-21, BARI Gom-26, BARI Gom-27, BARI Gom-28 and BARI Gom-29.

Treatments of the experiment and application of NaCI and nutrients
The experiment consisted of Salinity-01: 0 dS/m, Salinity-02: 10 dS/m comprising NaCl application and control. An equal amount of macronutrients and micronutrients were given to each treatment. A concentration of 10 dS/m NaCl was given to water tanks treated with NaC1. The seeds in Petri dishes were sprayed with a 10 dS/m concentration of NaCl solution. All other nutrients except NaCl were incorporated into the tank at the recommended dose. Every seven days, 10 dSm^{-1} NaCl solutions were added to the water in the tank.

Experimental design
The experiment was designed in Completely Randomized Design (CRD) with three replications, including 10 treatments (5x2). The total number of petri dishes and water tanks used in this study was 30. The individual pot size was 10L. Random distribution of the treatments was done inside the tank. The experiment was conducted in a growth room at 25°C under a 12h light and 12 h dark regime, 70% relative humidity and pH 6.5.

Sowing of seeds and hydroponics set-up
The date of seed sowing on 23 March, 2018. After washing, distilled water was used to soak the seeds. Ten imbibed seeds were placed for germination on filter papers (Adventec, Tokyo, Japan) in each petri dishes whose containing 100 µM $CaCI_2$. Thirty germination seeds were placed simultaneously in a net with water for an experimental hydroponic system containing 100 µM $CaCI_2$. Seedlings that were one week old were placed in a 10L plastic tank with four holes and three plants per hole, supported by sponge, and placed in a continuously aerated nutritional solution. Management was applied as and when needed to guarantee proper seedling germination and growth. Throughout the treatment period, all experiments meticulously monitored and adjusted the pH (6.5) of the culture solutions to ensure optimal growth and germination of the seeds. The solution was renewed with fresh nutrient solutions in 7 days intervals. Nutrient sources and the recommended dose for the experiment were $Ca(NO_3)_2$: 7µl, K_2SO_4: 7 µl, $Cacl_2$: 7 µl, Fe-EDTA: 7 µl, KH_2PO_4 : 1.75 µl, H_3BO_3: 1.75 µl, $MnSO_4$: 1.75 µl.

Recorded parameters
Germination percentages of germinated seeds at selected stages (7 days after sowing) were collected. Data were gathered on the following physical traits of seedlings at specific times (10, 15, and 20 days after sowing): Number of leaves, length of leaves, length of leaf sheath, germination percentage, fresh weight per plant, and dry weight per plant. After gathering data on the various growth phases of wheat seedlings, the root and shoot of 10, 15, and 20-day-old wheat seedlings were collected and dried, and the fresh and dried weights of all selected kinds were recorded, respectively.

Statistical analysis
Using the R studio Package Program, data were statistically analyzed for analyses of variance (ANOVA) in compliance with the fully randomized design principles. Duncan's Multiple Range Test (DMRT) was employed to evaluate differences between the various treatments.

III. Results and Discussion
Germination percentage
Effect of NaCl: NaCl had a considerable impact on the germination percentage. According to the results, the control plant had a higher germination rate than the NaCl-treated plants at every growth stage. This result is consistent with Abdul Halim et al. (1988), who reported that wheat germination

Published with open access at journalbinet.com
EISSN: 2312-7945,

percentage decreased when grown in a NaCl concentrated solution compared to the control. This result was also supported by Azmi et al. (1990) in wheat.

Effect of variety: Variety has a substantial impact on the germination percentage. The variety BARI Gom-27 had the highest germination percentage (90.58%). BARI Gom-29 had the lowest germination rate (39.90%). Under NaCl stress, genotypic differences in the germination % were also noted by Anju (1992) in wheat.

Interaction of NaCl and variety: There was a significant interaction between variety and NaC1 level on the germination percentage. In the control condition, compared to the stress condition, the germination percentage was higher. At all growth stages, the treatment combination of BARI Gom-27 with 0 dSm^{-1} NaC1 had the highest germination percentage (91.50%). BARI Gom-27 exhibited the highest germination rate (89.67%) under stressful conditions. BARI Gom-29 (37.47%) had the lowest germination percentage with 10 dS/m (Table 01).

Table 01. Effect of salinity levels on crop characters of wheat grown in hydroponics culture

Variety	Treatment	Germination percentage
BARI Gom-21	Control	67.33 e
	10 ds/m	61.67 f
BARI Gom-26	Control	81.33 c
	10 ds/m	78.33d
BARI Gom-27	Control	91.50 a
	10 ds/m	89.67 b
BARI Gom-28	Control	53.67 g
	10 ds/m	48.33 h
BARI Gom-29	Control	42.33 i
	10 ds/m	37.47 j
$LSD_{0.05}$		1.44
Level of significance		**

LSD= Least Significant Difference ** = Significant at 1% level of probability

Root length

Effect of salinity: In wheat, salinity at 10, 15, and 20 DAS significantly affected root length. The plants treated with NaC1 exhibited shorter roots than the control group throughout every growth stage, according to the findings. This outcome agrees with Ehsan et al. (1986) that wheat roots grown in a concentrated NaCl solution were shorter than those grown in control.

Effect of variety: At 10, 15, and 20 DAS, the effect of variety on root length was statistically significant. For DAS 10, 15, and 20, the genotype BARI Gom-27 displayed the longest roots (10.02, 14.07, 18.85 cm) and (4.925, 5.90, and 7.945 cm), respectively. Between 10 and 15 DAS (7.985, 10.16, and 12.95 cm) and 4.05.05, 4.5, and 5.705 cm, respectively, BARI Gom-29 had the lowest root length measured. Furthermore, the genotypic variation in root length in wheat reported by Ehsan et al. (1986) supported the current experimental result.

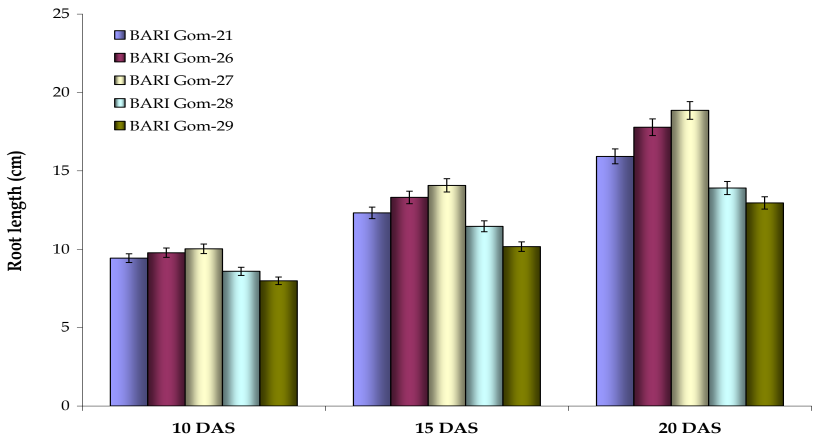

Figure 01. Effect of salinity and varieties on root length of wheat in hydroponics

Published with open access at journalbinet.com
EISSN: 2312-7945, ©2024 The Authors, Research paper

Interaction of salinity and variety: At 10, 15, and 20 DAS, there was a significant interaction between salinity and variety on root length (Figure 01). The treatment combination of BARI Gom-27 with 0 dS/m NaCl (10.10, 14.20, and 19.5 cm) and (6.00 and 8.00 cm), respectively, showed the longest root lengths. The treatment combination with 10dS/m NaC1 (9.81 and 12.11 cm) and (4.35 and 5.61 cm) shoot length showed the lowest recorded values at 10, 15, and 20 DAS in BARI Gom-29.

Shoot length

Effect of salinity: In wheat, salinity significantly affected shoot length at 10, 15, and 20 DAS. According to the results, the control plant's shoot length was greater than that of the NaC1-treated plants at every growth stage. This outcome is in line with the findings of Ehsan et al. (1986), who found that growing wheat in a concentrated NaCl solution reduced shoot length compared to control.

Effect of variety: Regarding the effect of variety at 10, 15, and 20 DAS, shoot length was statistically significant. At 10, 15, and 20 DAS (4.925, 5.90, and 7.945 cm), the genotype BARI Gom-27 displayed the longest shoots. At 10, 15, and 20 DAS (4.05, 4.5, and 5.705 cm), BARI Gom -29 had the lowest shoot length ever measured. In wheat, genotypic variation in shoot length was also noted by Ehsan et al. (1986), which corroborated the current experimental outcome.

Interaction of salinity and variety: Shoot length was significantly impacted by the interaction of salinity and variety at 10, 15, and 20 DAS (Table 02). In the BARI GOM-27 treatment combination with 0 dS/m NaCl (5.00, 6.00, and 8.00 cm), the longest shoot length was noted. With 10dS/m NaC1 (4.08, 4.35, and 5.61 cm) shoot length, the lowest was recorded in the treatment combination at 10, 15, and 20DAS in BARI GOM-29.

Table 02. Combined effect of salinity level and varieties on root length and shoot length of wheat grown in petri dish.

Variety	Treatment	Root length (cm)			Shoot length (cm)		
		10 DAS	15 DAS	20 DAS	10 DAS	15 DAS	20 DAS
BARI Gom-21	Control	9.52	12.60 e	16.74d	4.30	4.85 e	7.15c
	10 ds/m	9.33	12.05 f	15.10 e	4.19	4.70 fg	6.96d
BARI Gom-26	Control	9.88	13.70 c	18.23b	4.50	5.31c	7.50b
	10 ds/m	9.67	12.90 d	17.33 c	4.41	5.00 d	7.00d
BARI Gom-27	Control	10.10	14.20 a	19.50a	5.00	6.00a	8.00a
	10 ds/m	9.89	13.95 b	18.20 b	4.85	5.80b	7.89a
BARI Gom-28	Control	8.67	11.80 g	14.80e	4.22	4.75f	6.10e
	10 ds/m	8.50	11.12 h	13.00 g	4.08	4.61 g	5.90f
BARI Gom-29	Control	8.10	10.50 i	13.80f	4.10	4.65 g	5.80f
	10 ds/m	7.87	9.81j	12.11h	4.30	4.35h	5.61g
$LSD_{0.05}$		0.388	0.132	0.403	0.162	0.093	0.120
Level of significance		NS	**	**	NS	*	**
CV (%)		2.49	0.62	1.49	2.13	1.12	1.04

LSD= Least Significant Difference, ** = Significant at 1% level of probability, * = Significant at 5% level of probability, NS = Not significant, CV=Coefficient of Variation.

Leaf length

Effect of salinity: At 10, 15, and 20 DAS, salinity levels had a significant impact on leaf length. The control plant's leaf length was greater than that of the NaC1-treated plants at 10, 15, and 20 DAS, according to the results. This outcome is in line with the findings of Boursier et al. (1987), who found that growing in a concentrated NaC1 solution reduced leaf length compared to the control.

Effect of variety: Varieties had a significant impact on leaf length at 10, 15, and 20 DAS. The findings indicated that as one aged, leaf length rose. BARI Gom-27 had the longest leaves at 10, 15, and 20 DAS, measuring 15.75, 16.90, and 18.86 cm for 10, 15, and 20 DAS, respectively. On the other hand, BARI Gom-29 showed the lowest leaf length at 10, 15, and 20 DAS (14.85, 15.70, and 16.58 cm). Gupta et al.'s (1989) observations of genotypic variations in leaf length in wheat substantiated the current experimental result.

Published with open access at journalbinet.com
EISSN: 2312-7945, © 2024 The Authors, Research paper

Interaction of salinity and variety: At 10, 15, and 20 DAS, there was a significant interaction between the salinity level and variety on leaf length (Table 03). The longest leaf length was measured in the treatment combination of BARI Gom-27 with 0dS/m NaC1 at 10, 15, and 20 DAS (16.00, 17.10, and 19.02 cm). However, BARI Gom-29 with 10dS/m NaC1 (14.70, 15.61, 16.26 cm) at 10, 15, and 20 DAS, respectively, had the shortest leaf length.

Leaf sheath length

Effect of salinity: Salinity levels had a significant impact on the length of the leaf sheath at 10, 15, and 20 DAS. According to the results, the control plant had a longer leaf sheath than the NaC1-treated plants at 10, 15, and 20 DAS. The findings align with Boursier et al. (1987), who observed a decrease in leaf sheath length when grown in a concentrated NaCl solution compared to the control.

Effect of variety: Varieties had a significant impact on leaf sheath length at 10, 15, and 20 DAS. The findings indicated that as one aged, leaf length rose. BARI Gom-27 showed longer leaf sheath lengths at 10, 15, and 20 DAS (2.905, 4.020, and 4.920 cm) for these DAS values. On the other hand, BARI Gom-29 showed the lowest leaf sheath length at 10, 15, and 20 DAS (2.3, 3.1, and 3.59 cm). Gupta et al.'s (1989) observations of genotypic variations in leaf sheath length in wheat corroborated the current experimental result.

Interaction of salinity and variety: Leaf sheath length at 10, 15, and 20 DAS was significantly impacted by the interaction of variety and salinity level (Table 03). At 10 and 20 DAS (3.0 and 5.0 cm), the treatment combination of BARI GOM-27 with 0 dS/m NaC1 produced the longest leaf sheath length. Conversely, BARI GOM-29 with 10dS/m NaCl (2.17, 3.00, and 3.2 cm) at 10, 15, and 20 DAS showed the shortest leaf sheath length.

Table 03. Combined effect of salinity level and varieties on leaf length and leaf sheath length of wheat grown in petridish.

Variety	Treatment	Leaf length (cm)			Leaf sheath length (cm)		
		10 DAS	15 DAS	20 DAS	10 DAS	15 DAS	20 DAS
BARI Gom-21	Control	15.39 c	16.50c	18.47c	2.81c	3.80	4.40c
	10 ds/m	15.00e	16.00e	17.89f	2.70d	3.50	4.12de
BARI Gom-26	Control	15.81b	16.76b	18.95a	2.90b	3.90	4.80b
	10 ds/m	15.20d	16.33d	18.33d	2.79c	3.61	4.50c
BARI Gom-27	Control	16.00a	17.10a	19.02a	3.00a	4.15	5.05a
	10 ds/m	15.50c	16.69b	18.70b	2.81c	3.89	4.79b
BARI Gom-28	Control	15.20d	16.00e	18.11e	2.63d	3.50	4.17d
	10 ds/m	14.89e	15.93ef	17.50g	2.50e	3.19	4.00ef
BARI -29	Control	15.00e	15.80f	16.91h	2.50 e	3.20	3.89f
	10 ds/m	14.70f	15.61g	16.26i	2.17 f	3.00	3.29g
$LSD_{0.05}$		0.143	0.162	0.132	0.076	0.054	0.143
Level of sig.		**	**	**	**	NS	**
CV (%)		0.53	0.60	0.43	1.59	0.96	2.00

LSD= Least Significant Difference, ** = Significant at 1% level of probability, * = Significant at 5% level of probability, NS = Not significant

Leaves number

Effect of salinity: Salinity had a considerable impact on leaf production at 10, 15, and 20 DAS. Compared to plants treated with NaCl, control plants had more leaves overall.

Effect of variety: Because of variation, the number of leaves produced by each plant varied greatly at 10, 15, and 20 DAS. The genotype BARI Gom-27 yielded the maximum number of leaves per plant at DAS 8, 10, 15, and 20. For 10, 15, and 20 DAS, respectively, BARI Gom-19 (6, 7, and 7) had the fewest leaves/plants.

Interaction of salinity and variety: Variety and salinity had a significant interaction effect on leaf production (Table 04). The treatment combination of BARI Gom-27 with 0 dS/m NaCl (12 at 20 DAS) had the most leaves/plant, while the treatment combination of BARI Gom-29 (7) with 10 dS/m NaCl had the fewest leaves.

Published with open access at journalbinet.com
EISSN: 2312-7945, ©2024 The Authors, Research paper

Fresh weight

Effect of salinity: Salinity had a considerable impact on each plant's fresh weight at 10, 15, and 20 DAS. The fresh weight per plant in the control group was higher than that of the NaCl-treated group at 10, 15, and 20 DAS, according to the results.

Effect of variety: Because of variety, the fresh weight per plant varied greatly at 10, 15, and 20 DAS. According to the results, the fresh weight per plant increased with age in all genotypes. BARI Gom-27 had the maximum fresh weight per plant at 10, 15, and 20 DAS (74.29, 132.0, and 201.6 mg per plant). On the other hand, BARI Gom-29 showed the lowest fresh weight per plant at 10, 15, and 20 DAS (20.31, 91.26, and 167.3 mg per plant).

Interaction of salinity and variety: On fresh weight per plant at 10, 15, and 20 DAS, there was a significant interaction between variety and salinity level (Table 04). The highest fresh weight per plant was observed using BARI Gom-27 in combination with 0 dS/m NaC1 at 10, 15, and 20 DAS (80.10, 160.7, and 238.2 mg per plant). But in BARI Gom-29 with 10dS/m NaCl, the fresh weight was the lowest (23.11, 100.3, and 180.8 mg per plant for 10, 15, and 20 DAS, respectively).

Dry weight

Effect of salinity: The dry weight of each plant varied significantly depending on the presence or absence of salinity. The dry weight per plant was higher in the control group at 10, 15, and 20 DAS compared to the plants treated with NaC1. The higher dry weight per plant in 0 dS/m NaCl compared to 10 dS/m NaCl could be attributed to longer roots and shoots in the former case compared to the latter. Abdul Halim et al. (1988) supported this finding in wheat. The mechanism of NaC1 tolerance based on mineral uptake and utilization was reported by Chhipa and Lal (1985). According to their opinion, the tolerant cultivars effectively absorbed and used Ca and P in the presence of NaCl while absorbing less NaC1, which promoted root growth and ultimately enhanced plant growth and development. Conversely, susceptible NaC1 cultivars showed reduced uptake of Ca and P and increased uptake of NaCl at higher concentrations of NaCl; root growth was severely suppressed due to cellular damage in peripheral root cells, which resulted in reduced nutrient uptake; these cultivars also showed reduced growth and development of NaC1 susceptible plants and produced less dry mass. The NaCl-treated variety in this experiment produced less dry mass than the control condition.

Effect of variety: Starting at 10, 15, and 20 DAS, there was a statistically significant effect of variety on dry weight per plant. In BARI Gom-27, the highest dry weight per plant was recorded at 10, 15, and 20 DAS (17.00, 51.60, and 83.67 mg, respectively). This is in contrast to BARI Gom-28, which had the lowest dry weight (53.00 mg per plant at 20 DAS) and was statistically equal to BARI Gom-29 (50.33 mg per plant at 20 DAS). The present experimental result was corroborated by genotypic variation in dry weight in wheat, as reported by Abdul Halim et al. (1988).

Table 04. Combined effect of salinity level and varieties on number of leaves/plant of wheat grown in petri dish

Variety	Treatment	No. of leaves/plant		
		10 DAS	15 DAS	20 DAS
BARI Gom-21	Control	7.33 c	8.67d	9.00e
	10 ds/m	7.00d	8.00 f	8.97 e
BARI Gom-26	Control	7.67b	9.00c	10.50 c
	10 ds/m	7.39 c	8.50 e	10.00d
BARI Gom-27	Control	8.00a	10.00 a	12.33 a
	10 ds/m	7.90a	9.67b	11.67 b
BARI Gom-28	Control	6.67e	7.81g	8.67 f
	10 ds/m	6.19f	7.33h	8.00g
BARI -29	Control	6.30f	7.33h	8.00g
	10 ds/m	6.00g	7.00i	7.80 h
$LSD_{0.05}$		0.120	0.142	0.187
Level of significance		**	**	**
CV (%)		0.97	0.97	1.15

LSD= Least Significant Difference, ** = Significant at 1% level of probability, * = Significant at 5% level of probability

Published with open access at journalbinet.com
EISSN: 2312-7945, © 2024 The Authors, Research paper

Interaction of salinity and variety: Plant dry weight at 10, 15, and 20 DAS was significantly impacted by the interaction between variety and NaC1 level (Table 05). The highest dry weight per plant was observed in BARI Gom-27 treatment combination with 0dS/m NaC1 at 10, 15, and 20 DAS (17.00, 51.60, and 83.67 mg plant). Therefore, BARI Gom-29 with 10dS/m NaC1 had the lowest dry weight (11.00 and 33.00 mg per plant for 10 and 15 DAS, respectively).. However, at 20 DAS, BARI Gom-29's dry weight per plant was 45.10 mg. Analyzing the dry mass production decrease under NaC1, the results indicated that BARI Gom-27 had the least dry mass loss due to NaCl toxicity. However, BARI Gom-29 showed the greatest decrease in dry mass production, suggesting that these genotypes were more vulnerable to NaC1 toxicity than the other genotypes in wheat.

Table 05. Combined effect of salinity level and varieties on fresh weight per plant and dry weight per plant of wheat grown in petri dish

Variety	Treatment	Fresh weight per plant (mg)			Dry weight per plant (mg)		
		10 DAS	15 DAS	20 DAS	10 DAS	15 DAS	20 DAS
BARI Gom-21	Control	14.91d	46.15d	70.00	39.20d	113.50c	190.20c
	10 ds/m	13.75f	42.15e	67.33	30.50e	89.20f	160.7ef
BARI Gom-26	Control	15.70 c	49.00b	80.00	47.00c	118.80b	199.30b
	10 ds/m	14.63e	45.50d	76.00	39.16d	100.00e	163.00ef
BARI Gom-27	Control	17.00a	51.60a	83.67	80.10a	160.70a	238.20a
	10 ds/m	16.10b	48.17c	81.13	68.47b	103.40de	165.10e
BARI Gom-28	Control	12.80g	40.15f	53.00	25.10f	106.20d	177.00d
	10 ds/m	12.15h	37.50g	50.66	19.61g	85.00fg	157.60f
BARI Gom-29	Control	11.50i	35.30h	50.33	23.11f	100.30e	180.80d
	10 ds/m	11.00j	33.00i	45.10	17.50g	82.20g	150.00g
$LSD_{0.05}$		0.170	0.762	3.08	2.62	4.97	6.27
Level of significance		**	*	NS	**	**	**
CV (%)		0.73	1.04	2.76	3.94	2.76	2.07

LSD= Least Significant Difference, ** =Significant at 1% level of probability, * =Significant at 5% level of probability, NS=Not significant

IV. Conclusion

The NaC1 concentration of 10dS/m had a tremendous negative effect on germination percentage, growth, and development of wheat seedlings, whereas, among the varieties, BARI Gom-27 had the highest tolerance to NaC1 toxicity concerning growth and development. To draw a precise conclusion, further pot, and field experiments are needed to confirm the tolerance level of those varieties in the soil based on the growth and yield.

Acknowledgement

The authors gratefully acknowledge the Department of Crop Botany, Seed Science and Technology of Bangladesh Agricultural University, Mymensingh and Bangladesh Institute of Nuclear Agriculture (BINA) for providing research facilities and logistic support.

V. References

[1]. Abdul-Halim, R. K., Salih, H. M., Ahmed, A. A. and Abdul-Rahem, A. M. (1988). Growth and development of maxipak wheat as affected by soil salinity and moisture levels. Plant and Soil, 112, 255-9. https://doi.org/10.1007/BF02140003

[2]. Abrol, I. P. (1986). Salt-affected soils: problems and prospects in developing countries. Global aspects of food production, 283-305.

[3]. Anju, P. (1992). Effect of different levels of soil salinity on germination, growth and yield of wheat (*Triticum aestivum* L.). Indian Journal Agricultural Research, 26,100-6.

[4]. Ashraf, M., Bokhari, M. H. and Waheed, A. (1990). Screening of local/exotic accessions of mung bean (*Vigna radiata* (L.) WILczEK) for salt tolerance. Japanese Journal of Tropical Agriculture, 34(3), 169-75.

[5]. Ashwani, K. R. and Teruhino, T. (2010). Abiotic stress tolerance in plants. Department of Biotechnology and Molecular Biology. University of Dhaka. 229-242.

EISSN: 2312-7945,

[6]. Azmi, A. R. and Alam, S. M. (1990). Effect of salt stress on germination, growth, leaf anatomy and mineral element composition of wheat cultivars. Acta Physiologiae Plantarum, 12(3), 215-24.
[7]. Boursier, P., Lynch, J. and Lauchli, A. (1987). Epstein E. Chloride partitioning in leaves of salt-stressed sorghum, maize, wheat and barley. Functional Plant Biology, 14(4), 463-73. https://doi.org/10.1071/PP9870463
[8]. Chhipa, B. R. and Lal, P. (1985). Effect of soil salinity on yield, yield attributes and nutrient uptake by different varieties of wheat. Anales de edafologia y agrobiologia, 44(11-12), 1681-1691.
[9]. Ehsan, B. A., Ahmad, N., Piracha, I. A. and Khan, M. A. (1986). Salt tolerance of three wheat varieties. Journal of Agricultural Research (Pakistan), 24(1), 53-58.
[10]. FAO. (2005). land and plant Nutrition management service. http://www.fao.org/ag/agl/agll/spush.
[11]. FAO. (2021). Global network on integrated soil management for sustainable use of salt-affected soils, World Soil Day campaign.
[12]. Gupta, S. C. and Srivastava, J. P. (1989). Effect of salt stress on morpho-physiological parameters in wheat (*Triticum aestivum* L.). Indian Journal of Plant Physiology, 32(2), 169-171.
[13]. Karim, Z., Hussain, S. G. and Ahmed, M. (2012). Salinity problems and crop intensification in the coastal regions of Bangladesh BARC soil Publication. Bangladesh Agricultural Research Council. 13, 63.
[14]. Seraj, Z., Lisa, L. A., Islam, M. R., Begum, R. and Das, D. K. (2006). Genetic diversity of saline coastal rice (*Oryza sativa* L.) landraces of Bangladesh. Abiotic stress tolerance in plants, 229-44. https://doi.org/10.1007/1-4020-4389-9_16
[15]. Szabolcs, I. (1994). Soil sand salinisation In: Pessarakali M (Ed) Handbook of plant and crop stress.
[16]. Waisel. (2007). Biology of halophytes. New York: Academic Press.
[17]. Anonymous (2016). FAOSTAT database collections. Food and Agriculture Organization of the United Nations Rome, 2016. URL: http://faostat.fao.org
[18]. Jones, J. M., Pena, R. J., Korczak, R. and Braun, H. J. (2015). Carbohydrates, grains, and wheat in nutrition and health: an overview. Part I. Role of carbohydrates in health. Cereal Foods World, 60(5), 224-233.

HOW TO CITE THIS ARTICLE?

Crossref: https://doi.org/10.18801/jbar.310224.316

MLA
Milon, M. R. K. et al. "Effect of salinity on seed germination and seedling growth in five wheat cultivars grown in hydroponics". Journal of Bioscience and Agriculture Research, 32(01), (2024): 2620-2628.

APA
Milon, M. R. K., Hossain, M. A., Hossain, A. K. M. Z. Alim, S. M. A., Islam, M. M., Kabir, M. A. and Reza, M. S. (2024). Effect of salinity on seed germination and seedling growth in five wheat cultivars grown in hydroponics.. *Journal of Bioscience and Agriculture Research*, 32(01), 2620-2628.

Chicago
Milon, M. R. K., Hossain, M. A., Hossain, A. K. M. Z. Alim, S. M. A., Islam, M. M., Kabir, M. A. and Reza, M. S. "Effect of salinity on seed germination and seedling growth in five wheat cultivars grown in hydroponics". Journal of Bioscience and Agriculture Research, 32(01), (2024): 2620-2628.

Harvard
Milon, M. R. K., Hossain, M. A., Hossain, A. K. M. Z. Alim, S. M. A., Islam, M. M., Kabir, M. A. and Reza, M. S. 2024. Effect of salinity on seed germination and seedling growth in five wheat cultivars grown in hydroponics. Journal of Bioscience and Agriculture Research, 32(01), pp. 2620-2628.

Vancouver
Milon, MRK, Hossain, MA, Hossain, AKMZ. Alim, SMA, Islam, MM, Kabir, MA and Reza, MS. Effect of salinity on seed germination and seedling growth in five wheat cultivars grown in hydroponics. Journal of Bioscience and Agriculture Research, 2024 February, 32(01): 2620-2628.

Published with open access at journalbinet.com
EISSN: 2312-7945,