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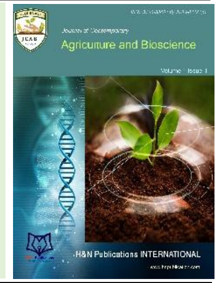

Research Article

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Screening Rice Varieties for Salinity Tolerance Based on Growth and Yield Traits

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Abstract

Salinity stress is a major environmental constraint affecting rice production worldwide. This study evaluated the performance of three salt-tolerant rice varieties (BRRI dhan97, BRRI dhan99, and BINAdhan-10) under four salinity levels (0, 3, 6, and 9 dS/m) in pot culture during the Boro season 2024-25. The experiment was conducted following a Completely Randomized Design with three replications. Results revealed significant varietal and salinity effects on all growth and yield parameters. BINAdhan-10 exhibited superior performance across most parameters, showing maximum plant height (72.33 cm), tiller number (14.42), effective tillers (11.67), panicle length (25.17 cm), filled grains per panicle (90.92), 1000-seed weight (25.70 g), and grain yield (24.40 g/pot). Salinity levels of 9 dS/m significantly reduced plant height by 3.50%, tiller number by 18.74%, and grain yield by 10.13% compared to control. The interaction effect showed BINAdhan-10 at 6 dS/m salinity produced the highest grain yield (26.33 g/pot), while BRRI dhan97 at 9 dS/m recorded the lowest (17.90 g/pot). These findings suggest that BINAdhan-10 possesses better salt tolerance mechanisms and can be recommended for cultivation in salt-affected areas.

Keywords : Salinity stress, Rice varieties, Growth parameters, Yield components and Salt tolerance.

INTRODUCTION

Rice (*Oryza sativa* L.) is the most important staple food crop, feeding more than half of the global population and providing approximately 20% of dietary energy requirements worldwide (Rahman et al., 2022). However, salinity stress has emerged as one of the most serious abiotic constraints limiting rice production, particularly in coastal and irrigated agricultural regions (Mondal et al., 2023). Globally, approximately 20% of irrigated land and 33% of coastal agricultural areas are affected by salinity, with projections indicating a significant increase due to climate change and unsustainable irrigation practices (Hossain et al., 2021; Islam et al., 2024). In Bangladesh, about 1.06 million hectares of arable land in the southern coastal belt are affected by varying degrees of salinity, severely limiting rice cultivation during the dry season (Ahmed et al., 2023). Salinity adversely affects rice plants through osmotic stress, ionic toxicity, and nutritional imbalances, ultimately reducing photosynthetic efficiency, growth rate, and grain yield (Kumar et al., 2022). Salt stress disrupts cellular homeostasis by accumulating excessive sodium and chloride ions in plant tissues, which interferes with metabolic processes and causes oxidative damage (Parihar et al., 2020). Understanding the differential responses of rice varieties to salinity is crucial for developing effective strategies to enhance productivity in salt-affected environments (Sarkar et al., 2021). Recent breeding efforts have focused on developing salt-tolerant rice varieties with improved adaptive mechanisms, including better ion exclusion, osmotic adjustment, and antioxidant defense systems (Reddy et al., 2023). Varieties such as BRRI dhan97, BRRI dhan99, and BINAdhan-10 have been developed specifically for salt-affected areas, showing promising tolerance under moderate to high salinity conditions (Rashid et al., 2024). However, comprehensive evaluation of these varieties under different salinity levels is essential to provide farmers with precise recommendations for specific environmental conditions (Singh et al., 2023).

This study was therefore undertaken to evaluate the performance of three salt-tolerant rice varieties under different salinity levels and to identify the most suitable variety for cultivation in salt-affected regions of Bangladesh.

MATERIALS AND METHODS

Experimental Site

The research was conducted under pot culture at EXIM Bank Agricultural University Bangladesh, Chapainawabganj Sadar (located in Agro-Ecological Zone 26) during the Boro season

(December-June) 2024-25 to study the performance of salt-tolerant rice varieties under different salinity stress conditions.

Experimental Treatments

The experiment consisted of two factors:

Factor A: Variety (3 varieties)

- V_1 = BRRI dhan97
- V_2 = BRRI dhan99
- V_3 = BINAdhan-10

Factor B: Salinity Level (4 levels)

- S_0 = 0 dS/m (control)
- S_1 = 3 dS/m
- S_2 = 6 dS/m
- S_3 = 9 dS/m

Soil Collection and Preparation

The soil for the experiment was collected from agricultural fields of Chapainawabganj Sadar Upazilla. The soil was characterized as silty clay loam with moderate organic matter content and acidic to neutral pH ranging from 5.18 to 7.5 with brown mottles. The collected soil was pulverized to remove inert materials, visible insect pests, and propagules. The soil was then sun-dried, carefully crushed, and thoroughly mixed to ensure homogeneity.

Seed Collection and Sterilization

Seeds of the tested rice varieties were collected from local agricultural inputs shops and the Chapainawabganj sub-station of the Bangladesh Institute of Nuclear Agriculture (BINA). Prior to germination, seeds were surface sterilized with 1% sodium hypochlorite solution. Glass vials containing distilled water for seed rinsing were sterilized for 20 minutes in an autoclave at 121±1°C and 15 bar air pressure.

Experimental Design and Layout

The experiment was arranged in a Completely Randomized Design (CRD) with two factors and three replications. The treatment combinations of the experiment were randomly assigned to 12 pots in each of the three replications, resulting in a total of 36 experimental units.

Salinity Treatment Preparation

Salinity treatments consisted of four levels (0, 3, 6, and 9 dS/m). The required amounts of sodium chloride (NaCl) were calculated and dissolved in water to achieve the desired electrical conductivity levels. For 3 dS/m, 5.76 g NaCl; for 6 dS/m, 11.52 g NaCl; and for 9 dS/m, 17.28 g NaCl was dissolved in 3 liters of water for each pot. The control treatment (S_0) received only distilled water without salt addition.

Pot Preparation and Seedling Establishment

Plastic pots with dimensions of 25 cm top diameter, 18 cm bottom diameter, and 20 cm depth were collected from the local market and thoroughly cleaned before use. Each pot was filled with 8 kg of prepared soil. Recommended doses of nitrogen (N), phosphorus (P), potassium (K), and sulfur (S) fertilizers were applied. The entire amount of triple super phosphate (TSP), muriate of potash (MOP), gypsum, and one-third of urea fertilizer were applied before final pot preparation. The pots were then moistened with water.

Collected seeds were soaked in water for 24 hours, washed thoroughly with fresh water, and incubated for sprouting. Seeds were sown on December 12, 2024, in a wet seedbed where required amounts of fertilizers had been applied one day prior to sowing. Six-week-old seedlings were transplanted on January 23, 2025, into the respective pots.

Application of Salinity Stress

Two weeks after transplanting, salt solutions were applied to each pot according to the treatment specifications. To avoid osmotic shock to the plants, the required amount of salt solution (640 mg NaCl per liter of distilled water for 1 dS/m) was added in three equal installments at one-week intervals until the expected electrical conductivity was reached. The salinity (electrical conductivity) of each pot was measured using a conductivity meter, and necessary adjustments were made to maintain the desired salinity levels. The remaining two-thirds of urea fertilizer was top-dressed in two equal installments at 25 and 50 days after transplanting.

Intercultural Operations

Weeds growing in the pots and visible insects were removed manually when necessary to maintain clean conditions. The soil was loosened by hand periodically during the experimental period. Watering was performed in each pot as needed to maintain consistent soil water levels and salt concentrations.

Harvesting

The crop was harvested at maturity on May 15, 2025. The harvested crop from each individual pot was bundled separately, and grain and straw yields were recorded in grams per pot.

Data Collection

The following parameters were recorded during the experimental period:

- Plant height (cm) at 30, 60, 90 days after transplanting (DAT) and at harvest
- Number of tillers per hill at 30, 60, 90 DAT and at harvest
- Number of effective tillers per hill
- Number of non-effective tillers per hill
- Panicle length (cm)
- Number of filled grains per panicle
- Number of unfilled grains per panicle
- 1000-seed weight (g)
- Grain yield (g/pot)
- Straw yield (g/pot)

Statistical Analysis

The collected data were analyzed statistically following the CRD design using the Statistix 10 computer package program. Treatment means were compared using the Least Significant Difference (LSD) test and Duncan's Multiple Range Test (DMRT) at 5% level of significance. Regression analysis was performed where necessary.

RESULTS

Growth parameters

Plant height varied significantly among varieties, salinity levels, and their interactions at all growth stages (**Table 1**). Among varieties, BINAdhan-10 (V_3) produced the tallest plants throughout the growing season, recording 34.02 cm at 30 DAT, 54.09 cm at 60 DAT, 69.13 cm at 90 DAT, and 72.33 cm at harvest, which was 17.59%, 10.57%, 8.15%, and 7.51% taller than BRRI dhan97 (V_1), respectively. BRRI dhan97 consistently exhibited the shortest plant height across all growth stages. Regarding salinity effects, plant height showed an interesting pattern where S_1 (3 dS/m) produced the tallest plants at most growth stages, while S_3 (9 dS/m) significantly reduced plant height by 7.22%, 4.66%, 3.62%, and 3.50% compared to S_0 at 30, 60, 90 DAT, and harvest respectively. The interaction effect revealed that V_3S_2 (BINAdhan-10 at 6 dS/m salinity) produced the maximum plant height of 35.87 cm, 55.87 cm, 71.00 cm, and 73.87 cm at 30, 60, 90 DAT, and harvest respectively, while V_1S_3 (BRRI dhan97 at 9 dS/m) recorded the minimum values of 27.20 cm, 47.17 cm, 62.17 cm, and 65.50 cm, showing 31.86%, 18.44%, 14.21%, and 12.78% reduction respectively. Significant variations in tiller number were observed due to variety, salinity, and their interaction at all growth stages (**Table 1**). BINAdhan-10 (V_3) produced the highest number of tillers (12.42, 14.42, 14.42, and 14.42 per hill at 30, 60, 90 DAT, and

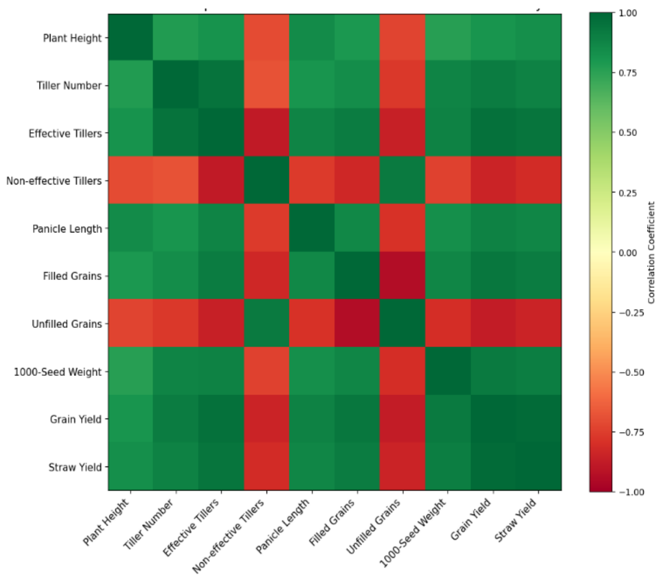

Figure 1. Correlation heatmap of growth and yield parameters of rice

harvest respectively), which was 61.93%, 49.12%, 49.12%, and 49.12% higher than BRRI dhan97 (V_1) at corresponding growth stages. Among salinity levels, S_1 (3 dS/m) produced maximum tillers at all stages, while S_3 (9 dS/m) caused a significant reduction of 22.32%, 18.74%, 18.74%, and 18.74% compared to S_0 at 30, 60, 90 DAT, and harvest respectively. The interaction effect demonstrated that V_3S_2 combination produced the highest tiller number (14.33, 16.33, 16.33, and 16.33 per hill), whereas V_1S_3 recorded the lowest values (5.67, 7.67, 7.67, and 7.67 per hill), representing a 152.74%, 112.91%, 112.91%, and 112.91% difference between the highest and lowest values at respective growth stages.

Yield contributing parameters

Variety, salinity, and their interaction significantly influenced effective tillers, non-effective tillers, and panicle length (**Table 2**). BINAdhan-10 (V_3) produced the maximum number of effective tillers (11.67 per hill), which was 94.50% higher than BRRI dhan97 (V_1) with 6.00 effective tillers. However, BRRI dhan97 had the highest number of non-effective tillers (1.67), being 101.20% more than BINAdhan-10 (0.83). BINAdhan-10 also recorded the longest panicles (25.17 cm), exceeding BRRI dhan97 by 33.00%. Among salinity levels, S_2 (6 dS/m) produced the highest effective tillers (10.00), while S_3 (9 dS/m) resulted in the lowest (6.00), representing a 66.67% reduction. Conversely, S_3 produced the maximum non-effective tillers (2.11), which was 539.39% higher than S_2 (0.33). Panicle length was maximum at S_1 (23.00 cm) and minimum at S_3 (19.78 cm), showing a 16.28% reduction. The interaction effect revealed that V_3S_2 produced maximum effective

Table 1. Effect of variety and different salinity level on plant height and tiller numbers at different days after transplanting (DAT)

Variety	Plant height (cm)				Number of tillers hill^{-1}			
	30 DAT	60 DAT	90 DAT	At Harvest	30 DAT	60 DAT	90 DAT	At Harvest
V_1	28.93 c	48.92 c	63.92 c	67.28 c	7.67 c	9.67 c	9.67 c	9.67 c
V_2	30.88 b	50.87 b	65.87 b	69.15 b	9.67 b	11.67 b	11.67 b	11.67 b
V_3	34.02 a	54.09 a	69.13 a	72.33 a	12.42 a	14.42 a	14.42 a	14.42 a
LS	*	*	*	*	*	*	*	*
Salinity level								
S_0	31.82 ab	51.93 ab	66.93 ab	70.27 a	10.44 a	12.44 a	12.44 a	12.44 a
S_1	32.11 a	52.11 a	67.11 a	70.44 a	10.78 a	12.78 a	12.78 a	12.78 a
S_2	31.61 b	51.61 b	66.66 b	69.83 a	10.33 a	12.33 a	12.33 a	12.33 a
S_3	29.52 c	49.51 c	64.51 c	67.81 b	8.11 b	10.11 b	10.11 b	10.11 b
LS	*	*	*	*	*	*	*	*
Interactions								
V_1S_0	29.60 fg	49.60 gh	64.60 gh	67.93 de	8.67 gh	10.67 gh	10.67 gh	10.67 gh
V_1S_1	30.30 f	50.30 fg	65.30 fg	68.77 cde	9.00 g	11.00 g	11.00 g	11.00 g
V_1S_2	28.60 h	48.60 i	63.60 i	66.93 ef	7.33 i	9.33 i	9.33 i	9.33 i
V_1S_3	27.20 i	47.17 j	62.17 j	65.50 f	5.67 j	7.67 j	7.67 j	7.67 j
V_2S_0	31.43 e	51.47 e	66.47 e	69.80 bcd	10.00 ef	12.00 ef	12.00 ef	12.00 ef
V_2S_1	32.43 d	52.43 d	67.43 d	70.67 bc	11.33 cd	13.33 cd	13.33 cd	13.33 cd
V_2S_2	30.37 f	50.37 f	65.37 f	68.70 cde	9.33 fg	11.33 fg	11.33 fg	11.33 fg
V_2S_3	29.20 gh	49.20 hi	64.20 hi	67.43 ef	8.00 hi	10.00 hi	10.00 hi	10.00 hi
V_3S_0	34.43 b	54.73 b	69.73 b	73.07 a	12.67 b	14.67 b	14.67 b	14.67 b
V_3S_1	33.60 c	53.60 c	68.60 c	71.90 ab	12.00 bc	14.00 bc	14.00 bc	14.00 bc
V_3S_2	35.87 a	55.87 a	71.00 a	73.87 a	14.33 a	16.33 a	16.33 a	16.33 a
V_3S_3	32.17 de	52.17 de	67.17 de	70.50 bc	10.67 de	12.67 de	12.67 de	12.67 de
LS	*	*	*	*	*	*	*	*
CV (%)	1.5	0.81	0.63	1.81	5.57	4.64	4.64	4.64

Values with the same letter are statistically non-significant as per the DMRT, * - Significant at 5% level, LS= Level of significance, CV = Coefficient of Variation, V_1 = BRRI dhan97, V_2 = BRRI dhan 99, V_3 = BINAdhan-10, S_0 = 0 ds/m, S_1 = 3 ds/m, S_2 = 6 ds/m, S_3 = 9 ds/m tillers (14.00) and panicle length (27.33 cm), while V_1S_3 recorded minimum effective tillers (1.00) and panicle length (16.33 cm), showing 1300% and 67.36% differences, respectively. The highest non-effective tillers (4.67) were observed in V_1S_3, which was 1314.29% higher than several combinations with 0.33 non-effective tillers. Significant variations in grain characteristics were observed across varieties, salinity levels, and their interactions (**Table 2**). BINAdhan-10 (V_3) produced the maximum filled grains per panicle (90.92), which was 15.82% higher than BRRI dhan97 (V_1) with 78.50 filled grains. Conversely, BRRI dhan97 had the highest unfilled grains (20.25), exceeding BINAdhan-10 by 55.77%. The 1000-seed weight was highest in BINAdhan-10 (25.70 g), being 51.71% heavier than BRRI dhan97 (16.94 g). Regarding salinity effects, S_1 (3 dS/m) produced maximum filled grains (87.11), while S_3 (9 dS/m) recorded minimum (79.11), showing a 10.12% reduction. Unfilled grains were lowest at S_1 (14.67) and highest at S_3 (18.78), representing a 28.02% increase. The 1000-seed weight was significantly reduced at S_3 (17.96 g) compared to S_1 (22.30 g), showing a 19.46% decrease. The interaction effect demonstrated that V_3S_2 produced maximum filled grains (94.67) and 1000-seed weight (28.30 g), while V_1S_3 recorded minimum filled grains (71.67) and 1000-seed weight (15.13 g), representing 32.08% and 87.05% differences, respectively. The highest unfilled grains (22.67) were observed in V_1S_3, which was 83.88% higher than V_3S_1 with 12.33 unfilled grains.

Yield parameters

Variety, salinity, and their interaction significantly affected both grain and straw yields (**Table 2**). BINAdhan-10 (V_3) produced the highest grain yield (24.40 g/pot) and straw yield (26.83 g/pot), which were 25.58% and 25.73% higher than BRRI dhan97 (V_1) with yields of 19.43 g/pot and 21.34 g/pot respectively. Among salinity levels, S_1 (3 dS/m) produced maximum grain yield (22.77 g/pot) and straw yield (25.01 g/pot), while S_3 (9 dS/m) recorded minimum yields of 20.06 g/pot and 22.04 g/pot, representing 13.51% and 13.48% reductions compared to S_1 respectively. Interestingly, S_2 (6 dS/m) maintained yields comparable to the control (S_0). The interaction effect revealed that V_3S_2 combination produced the maximum grain yield (26.33 g/pot) and straw yield (28.97 g/pot), while V_1S_3 recorded the minimum values of 17.90 g/pot and 19.63 g/pot, showing 47.09% and 47.56% differences respectively. Notably, BINAdhan-10 showed increasing yield trends up to 6 dS/m salinity before declining at 9 dS/m, indicating superior salt tolerance mechanisms compared to other varieties.

Correlation between growth and yield parameters of rice varieties under salinity stress

The correlation analysis revealed that grain yield was most strongly associated with effective tillers per hill (r = 0.96**), straw yield (r = 0.98**), filled grains per panicle (r = 0.93**), and 1000 seed weight (r = 0.92**), indicating these traits are critical determinants of yield performance under salinity stress. Effective tillers emerged as a

Table 2. Effect of variety and different salinity level on yield contributing parameters and yield of rice

Variety	Number of effective tillers hill^{-1}	Number of non-effective tillers hill^{-1}	Panicle length(cm)	Number of filled grains panicle^{-1}	Number of unfilled grains panicle^{-1}	1000 Seed weight (g)	Grain yield (g pot^{-1})	Starw yield (g pot^{-1})
V_1	6.00 c	1.67 a	18.92 c	78.50 c	20.25 a	16.94 c	19.43 c	21.34 c
V_2	8.75 b	0.92 b	21.67 b	84.33 b	16.17 b	19.71 b	21.71 b	23.86 b
V_3	11.67 a	0.83 b	25.17 a	90.92 a	13.00 c	25.70 a	24.40 a	26.83 a
LS	*	*	*	*	*	*	*	*
Salinity level								
S_0	9.56 b	1.00 b	22.78 a	86.44 a	15.78 c	21.67 a	22.32 ab	24.51 a
S_1	9.67 b	1.11 b	23.00 a	87.11 a	14.67 d	22.30 a	22.77 a	25.01 a
S_2	10.00 a	0.33 c	22.11 b	85.67 a	16.67 b	21.21 a	22.24 b	24.48 a
S_3	6.00 c	2.11 a	19.78 c	79.11 b	18.78 a	17.96 b	20.06 c	22.04 b
LS	*	*	*	*	*	*	*	*
Interactions								
V_1S_0	8.00 f	0.67 bc	20.33 e	81.33 ef	19.33 bc	18.00 fg	20.33 fg	22.33 fg
V_1S_1	8.00 f	1.00 bc	20.67 e	82.33 ef	18.33 c	18.40 fg	20.70 f	22.70 f
V_1S_2	7.00 g	0.33 c	18.33 f	78.67 f	20.67 b	16.23 gh	18.80 h	20.70 h
V_1S_3	1.00 h	4.67 a	16.33 g	71.67 g	22.67 a	15.13 h	17.90 i	19.63 i
V_2S_0	9.00 e	1.00 bc	22.67 d	85.67 cde	15.33 de	20.10 ef	22.07 de	24.20 de
V_2S_1	10.00 d	1.33 b	23.67 cd	88.67 bcd	13.33 fg	23.20 cd	23.47 c	25.77 c
V_2S_2	9.00 e	0.33 c	20.67 e	83.67 def	16.67 d	19.10 f	21.60 e	23.77 e
V_2S_3	7.00 g	1.00 bc	19.67 e	79.33 f	19.33 bc	16.43 gh	19.70 g	21.70 g
V_3S_0	11.67 b	1.33 b	25.33 b	92.33 ab	12.67 g	26.90 ab	24.57 b	27.00 b
V_3S_1	11.00 c	1.00 bc	24.67 bc	90.33 abc	12.33 g	25.30 bc	24.13 bc	26.57 bc
V_3S_2	14.00 a	0.33 c	27.33 a	94.67 a	12.67 g	28.30 a	26.33 a	28.97 a
V_3S_3	10.00 d	0.67 bc	23.33 d	86.33 cde	14.33 ef	22.30 de	22.57 d	24.80 d
LS	*	*	*	*	*	*	*	*
CV (%)	3.79	41.39	2.95	4.04	4.96	6.99	2.33	2.3

Values with the same letter are statistically non-significant as per the DMRT, * - Significant at 5% level, LS= Level of significance, CV = Coefficient of Variation, V_1 = BRRI dhan97, V_2 = BRRI dhan 99, V_3 = BINAdhan-10, S_0 = 0 ds/m, S_1 = 3 ds/m, S_2 = 6 ds/m, S_3 = 9 ds/m central parameter with strong positive correlations with most yield-contributing traits and strong negative correlation with non-effective tillers (r = -0.89**), suggesting its importance as a selection criterion in salt tolerance breeding programs. The strong negative correlation between filled and unfilled grains (r = -0.94**) indicates that salinity stress affects grain filling efficiency. All correlations were significant at 1% probability level, demonstrating robust relationships among the studied parameters.

DISCUSSION

The present study revealed substantial variations in growth and yield parameters among rice varieties and salinity levels, which can be attributed to differential physiological and biochemical responses to salt stress. The superior performance of BINAdhan-10 across most parameters suggests enhanced salt tolerance mechanisms, including better osmotic adjustment, ion homeostasis, and maintenance of metabolic functions under saline conditions. Salt-tolerant varieties typically possess efficient Na^+/K^+ selectivity mechanisms, where they restrict sodium uptake while maintaining adequate potassium accumulation in shoots, thereby preventing ionic toxicity and maintaining cellular functions (Negrão et al., 2020). The higher tiller production and effective tiller number in BINAdhan-10 may be associated with better auxin and cytokinin balance under salt stress, as these phytohormones regulate tillering capacity and are often disrupted by salinity (Wani et al., 2021). The reduction in plant height at higher salinity levels, particularly at 9 dS/m, can be explained by osmotic stress and reduced cell turgor pressure, which limits cell expansion and elongation (Hussain et al., 2023). Excessive sodium accumulation inhibits cell division and expansion by disrupting water uptake and reducing the activity of cell wall-loosening enzymes such as expansins (Zelm et al., 2020). Interestingly, the slight stimulation observed at 3 dS/m salinity in some parameters may be attributed to low-level stress priming, where mild salt exposure activates defense mechanisms without causing significant damage (Abbas et al., 2022). The decline in effective tillers at 9 dS/m salinity results from impaired carbohydrate partitioning and reduced photosynthetic efficiency, as salt stress damages chloroplast structure and inhibits photosystem II activity (Farooq et al., 2020). The reduction in filled grains and increase in unfilled grains under high salinity stress can be attributed to impaired pollen viability, reduced fertilization efficiency, and disrupted assimilate translocation during grain filling (Chanda et al., 2021). Salinity induces oxidative stress during reproductive stages, leading to lipid peroxidation of pollen membranes and reduced pollen germination capacity (Kumar et al., 2023). Additionally, salt stress disrupts source-sink relationships by inhibiting sucrose synthesis and phloem loading, thereby limiting carbohydrate availability for grain development (Sehar et al., 2022). The decrease in 1000-seed weight under severe salinity reflects impaired starch biosynthesis in developing grains, as salt stress downregulates key enzymes including ADP-glucose pyrophosphorylase and starch synthase (Paul et al., 2021). The enhanced performance of BINAdhan-10 under moderate salinity (6 dS/m) demonstrates activated stress adaptation mechanisms, including accumulation of compatible solutes such as proline and glycine betaine, which maintain osmotic balance and protect cellular structures (Roy et al., 2020). These findings align with recent studies showing that salt-tolerant rice varieties maintain higher antioxidant enzyme activities, including superoxide dismutase, catalase, and ascorbate peroxidase, which scavenge reactive oxygen species and prevent oxidative damage (Mahmud et al., 2024). However, our results contrast with some studies reporting linear yield reduction with increasing salinity, suggesting genotype-specific responses and the importance of variety selection for specific salinity environments (Islam et al., 2023).

CONCLUSION

BINAdhan-10 demonstrated superior salt tolerance with maximum growth and yield under varying salinity levels, particularly showing resilience up to 6 dS/m. This variety can be recommended for cultivation in moderately salt-affected areas to ensure stable rice production and food security.

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