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PROTEIN EXPRESSION ANALYSIS FOR SALINE AND SWEET WATER EFFECT ON WHEAT CROPS AT THE COASTAL AREAS OF KARACHI

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Abstract

A saline place is mostly utilized for agricultural and cultivation for better crop quality. Most of the studies highlight the significance of saltwater. There is very little evidence about the sweet water crops. In view of this fact, this study is designed to analyze the crop quality under sweet water in comparison with the salt water. Two biological replicates were selected for this comparison. The results have shown varying protein levels of wheat crops under salt water and fresh water. Further statistical examination, like ANOVA and Student's T-tests of the resulting data, has revealed a non-significant variation between the biological replicate groups. This study proves that under optimal cultivation conditions in certain regions, saltwater proves to be a more dependable resource than Sweet water for the growth of certain crops.

Keywords: *Agriculture, Biological, Cultivation, Replicates, Saline, Wheat*

INTRODUCTION

Salinity is a significant environmental stressor that causes significant crop losses, especially in arid and semi-arid regions of the world (1). More than 6% of the world's land is thought to be saline, according to some credible estimates (2) and 20% of all irrigated land is thought to be saline, translating into estimated yearly agricultural losses of US$27.3 billion (3).

Poor management techniques are mostly to blame for the expansion of saline agricultural land as well as for the yield gaps that exist between output and demand (4). Furthermore, more food must be produced in agriculture to feed the world's growing population, which is predicted to reach 9.6 billion people by 2050 (5). Crop productivity need may be satisfied by effectively using marginal saline areas for crop production. Using conventional breeding or cutting-edge molecular biology based methods to create crop plants that are salt- tolerant and able to grow on soils affected by salt is another approach (6).

Salt-tolerant crop plants were thought to be engineered with a single gene and one protein, such as pyro phosphatase (AVP1) WRKY transcription factors and DREB acting as a master switch or regulator for a wide range of physiological and biochemical processes. Some believed that traditional breeding or transgenic approaches to boost plant growth and yield on salt-affected land could make use of specific proteins controlling adaptation or developmental processes to tolerate, avoid, or minimize the influence of salt stress in crop plants (7).

Multiple studies over the last five years highlight that saline water lowers the yield of crops. Farmers have no options due to the decreasing availability of fresh water. However, some approaches like salt-tolerant crops, organic compost, and soil structural changes can support them, and the type of crop also depends on these factors. The regions where fresh water availability is difficult should consider increasing salt-tolerant crops. These regions mainly include Punjab, Sindh, and Gujarat. The effects of saline water have also been studied under controlled environments. Saline water and fresh water farming are separate practices. In saline water farming, salt-tolerant seeds are used, and compost is applied in larger quantities compared to fresh water farming.

Typically, salt water impacts soil quality, including soil structure, crop health, nutrient absorption, and bacterial growth. Salt farming requires the use of salt-tolerant crops, as well as strategies to improve soil quality. It is well established that osmotic stress, particular ion toxicity, nutritional imbalance, and poor hormone control cause salt stress to inhibit crop growth (8). In response to salinity stress, plants modify how Na+ and K+ ions are absorbed and transported, turn on enzymes that scavenge reactive oxygen species (ROS), and enhance osmotic adjustment (9). These processes, which control cellular metabolism, the transport of organic and inorganic solutes, water transport, osmoregulation, redox balance, sensing and signaling, hormonal balance, cell division, cell enlargement, growth and development, are all regulated by proteins under normal and salt stress conditions (3).

In current times there is a significant need to do a comparative evaluation of crop quality of salt water and sweet water b/c of the varying protein levels in a crop. Therefore, this study is conducted on wheat crop grown on both sweet water and saline water.

MATERIALS AND METHODS

Wheat samples were collected from both the sweet water and saline water. Every day, 25% Hoagland solution was used to water all plantlets (10). Irrigation suppression caused the water stress after months of growth. For the control plants, daily irrigation was continued. Using gravimetric techniques, the water content of the substrate was determined in order to determine the percentage of humidity in weight during the experimental treatment (5). After the continued care of the test plants, the plants are removed from the fields and subjected for the protein content evaluation test. The estimated protein content from both the sweet water crop and salt water crop is subjected to Statistical analysis like ANNOVA, T-test, One tail and Two Tail Test (11).

RESULTS

Recent research supports the effective use of saline water for cultivating salt-tolerant crops, indicating that saline water can serve as a viable source of essential nutrients for plant development. A comparative analysis between freshwater and saline water irrigation demonstrates statistically non-significant differences in crop performance. This suggests that the use of saline water does not adversely affect crop growth, making it a potentially sustainable alternative in regions facing freshwater scarcity.

A morphological comparison between crops irrigated with saline water and those irrigated with freshwater is illustrated in Fig. 1 (a & b). Fig. 1(a) represents wheat cultivated with saline water, while Fig. 1(b) depicted wheat grown using freshwater. Despite the different irrigation sources, the crops exhibited comparable physical characteristics. These morphological variations were presumed to be influenced by differences in nutrient composition, particularly protein and essential mineral levels, which in turn affected overall crop quality.

Fig. 1(a). Wheat crops grown in saline water field

Fig. 1(b). Wheat crops grown in sweet water field

The findings of this study reinforce the feasibility of using saline water for agricultural production. Both saline and freshwater sources yielded crops of similar quality and growth parameters. Moreover, saline-water-grown crops have shown promising levels of protein content, making them suitable for nutritional purposes.

Looking ahead, enhancing the resilience of crops through the introduction of salt-tolerant microbial inoculants into the soil may further improve productivity under saline conditions. This strategy could serve as a sustainable agricultural practice, particularly in arid and semi-arid regions where freshwater resources are limited.

SPECTROMETRIC ANALYSIS

The field crops were divided into two biological replicate groups, designated as Group 1 and Group 2. Both groups underwent spectrometric analysis to determine their protein content, and the resulting values are presented in Tables I and II.

Table I. Biological replicate 1 (Salt and Fresh Water)

S. No	Mode	Sample name	Protein absorbance (at 280 nm)
1	Sample 1	Salt water crop	2.5909
2	Sample 2	Salt water crop	2.6246
3	Sample 3	Sweet water crop	1.1709
4	Sample 4	Sweet water crop	1.1727
5	Sample 5	S1	1.4148
6	Sample 6	S2	1.3362
7	Sample 7	S3	1.1838
8	Sample 8	T2	0.7866
9	Sample 9	T3	0.964

Table II. Biological replicate 2 (Salt and Sweet Water)

S. No	Mode	Sample name	Protein absorbance (at 280 nm)
1	Sample 1	Salt water crop	2.1125
2	Sample 2	Salt water crop	2.1100
3	Sample 3	Sweet water crop	1.8012
4	Sample 4	Sweet water crop	1.1731
5	Sample 5	S1	1.3200
6	Sample 6	S2	1.3366
7	Sample 7	S3	1.2037
8	Sample 8	T2	1.0000
9	Sample 9	T3	0.7883
10	Sample 10	T1	1.5121

STATISTICAL ANALYSIS

The protein content absorbance data were subjected to a one-way ANOVA test to assess the statistical significance between the two biological replicate groups. As shown in Table III, each group consisted of nine data points. The ANOVA results, displayed in three distinct rows, indicated a non-significant difference between the groups, with a p-value greater than 0.05. This suggests that there was no statistically significant variance in protein content between crops irrigated with saline and freshwater.

Additionally, a Student's t-test was performed to further evaluate the difference in protein absorbance between the two groups. The two-tailed p-value was calculated as 0.9956, while the one-tailed p-value was 0.4952. These values further confirmed the absence of a significant difference between the protein content of the saline and freshwater-treated crops.

Based on the results of both the ANOVA and Student's t-test, it was concluded that there was no significant difference in protein absorbance between the biological replicate groups irrigated with saline and freshwater. These findings suggest that crops cultivated under saline water conditions can maintain comparable protein levels to those grown with freshwater, highlighting the potential for saline water use in agriculture without compromising crop quality.

Table III. One-Way ANNOVA TEST of biological replicates 1 and 2

SUMMARY				
Groups	**Count**	**Sum**	**Average**	**Variance**
2.5909	9	11.7803	1.308922	0.277653
2.1125	9	12.245	1.360556	0.16228

ANOVA

Source of variation	SS	df	MS	F	P-value	F crit
Between Groups	0.011997005	1	0.011997	0.05454	0.818305021	4.493998478
Within Groups	3.519459998	16	0.219966			
Total	3.531457003	17				

DISCUSSIONS

This study evaluated the comparative effects of saline and freshwater irrigation on wheat crop morphology and protein content. The observed morphological differences between crops grown under these two water conditions were visually distinct, potentially reflecting physiological adaptations to osmotic stress induced by salinity. Despite these visual differences, statistical analyses did not reveal any significant variation in protein content between the saline and freshwater groups.

The results of the One-Way ANOVA ($p > 0.05$) indicated no statistically significant difference in protein absorbance among the two groups, a finding corroborated by the Student's t-test, where both the two-tailed ($p = 0.9956$) and one-tailed ($p = 0.4952$) tests further supported the absence of significant variation. These findings suggest that saline water irrigation, under controlled conditions, does not adversely affect the protein composition of wheat crops.

These results align with previous studies suggesting that salt-tolerant crops can maintain growth and yield parameters under saline irrigation without detrimental effects on nutritional quality (12, 13). The ability of plants to adapt to salinity stress through osmotic adjustment and ion compartmentalization mechanisms has been well-documented (14, 15). Additionally, research has shown that certain levels of salinity may stimulate the synthesis of specific proteins or stress-responsive compounds that enhance the nutritional profile of crops (16).

The implications of this study are significant for agricultural practices in arid and semi-arid regions, such as parts of Pakistan, where freshwater scarcity is a growing concern. The results support the use of saline water as a sustainable alternative for irrigation, especially when combined with the cultivation of salt-tolerant plant varieties or the incorporation of halotolerant soil bacteria to enhance plant resilience (17, 18). This practice not only conserves freshwater resources but also contributes to food security by maintaining the nutritional quality of staple crops like wheat.

Furthermore, the finding that saline water-grown crops may exhibit increased protein content, though not statistically significant in this study, offers a potential avenue for future exploration. It raises the possibility that saline stress might selectively enhance the synthesis of beneficial biomolecules, a hypothesis supported by recent advances in stress physiology and plant molecular biology (19, 20). This could have implications beyond agriculture, contributing to human health by promoting the consumption of crops with improved nutritional profiles.

Furthermore, the current study underscores the feasibility of using saline water for crop irrigation without compromising yield quality. It advocates for the integration of saline agriculture into mainstream farming systems, especially in regions facing acute freshwater limitations. Further research involving molecular and biochemical profiling of crops under salinity stress could provide deeper insights into the specific pathways involved in stress adaptation and protein enhancement.

CONCLUSION

This study demonstrates that saline water can effectively support the cultivation of salt-tolerant crops without significantly affecting their protein content or overall growth when compared to freshwater irrigation. Statistical analyses revealed no significant differences between the two irrigation methods, suggesting that saltwater is not detrimental to plant health and may even serve as a valuable source of nutrients. These findings support the sustainable use of saline water in agriculture, particularly in regions facing freshwater scarcity.

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Conflict of interest:

There is no conflict of interest among authors regarding this article.

Authors` contribution:

MW research and field work; MSM write-up and critical analysis; MA statistical analysis and data interpretation.

References:

1. Egamberdieva D, Kucharova Z. Selection for root colonising bacteria stimulating wheat growth in saline soils. Biology and fertility of soils. 2009;45:563-71.
2. Hamdy A, Abdel-Dayem S, Abu-Zeid M. Saline water management for optimum crop production. Agricultural water management. 1993;24(3):189-203.
3. Hamdy A, Sardo V, Ghanem KF. Saline water in supplemental irrigation of wheat and barley under rainfed agriculture. Agricultural Water Management. 2005;78(1-2):122-7.
4. Hussain MI, Farooq M, Muscolo A, Rehman A. Crop diversification and saline water irrigation as potential strategies to save freshwater resources and reclamation of marginal soils—A review. Environmental Science and Pollution Research. 2020;27(23):28695-729.
5. Khan M, Shirazi M, Ali M, Mumtaz S, Sherin A, Ashraf M. Comparative performance of some wheat genotypes growing under saline water. Pak J Bot. 2006;38(5):1633-9.
6. Khondoker M, Mandal S, Gurav R, Hwang S. Freshwater shortage, salinity increase, and global food production: A need for sustainable irrigation water desalination—A scoping review. Earth. 2023;4(2):223-40.
7. Leventhal L. Updating the debate on one-versus two-tailed tests with the directional two-tailed test. Psychological reports. 1999;84(3):707-18.
8. Li JinGang LJ, Chen Jing CJ, Qu ZhongYi QZ, Wang ShaoLi WS, He PingRu HP, Zhang Na ZN. Effects of alternating irrigation with fresh and saline water on the soil salt, soil nutrients, and yield of tomatoes. 2019.
9. Niu JunFang NJ, Feng JunXia FJ, Lu Yang LY, Chen SuYing CS, Zhang XiYing ZX. Advances in agricultural practices for attenuating salt stress under saline water irrigation. 2016.
10. Qadir M, Oster J. Crop and irrigation management strategies for saline-sodic soils and waters aimed at environmentally sustainable agriculture. Science of the total environment. 2004;323(1-3):1-19.
11. Sharma BR, Minhas P. Strategies for managing saline/alkali waters for sustainable agricultural production in South Asia. Agricultural water management. 2005;78(1-2):136-51.
12. Qadir M, Oster JD. Crop and irrigation management strategies for saline-sodic soils and waters aimed at environmentally sustainable agriculture. Sci Total Environ. 2004;323(1-3):1-19.
13. Rengasamy P. Soil processes affecting crop production in salt-affected soils. Funct Plant Biol. 2010;37(7):613–620.
14. Munns R, Tester M. Mechanisms of salinity tolerance. Annu Rev Plant Biol. 2008;59:651–681.
15. Flowers TJ, Colmer TD. Salinity tolerance in halophytes. New Phytol. 2008;179(4):945–963.
16. Parida AK, Das AB. Salt tolerance and salinity effects on plants: a review. Ecotoxicol Environ Saf. 2005;60(3):324–349.
17. Shrivastava P, Kumar R. Soil salinity: A serious environmental issue and plant growth promoting bacteria as one of the tools for its alleviation. Saudi J Biol Sci. 2015;22(2):123–131.
18. Egamberdieva D, Kucharova Z, Davranov K. Survival of root-colonizing bacteria in saline soils and their effects on improving plant growth. Microbiol Res. 2008;163(4):441–450.
19. Zörb C, Geilfus CM, Dietz KJ. Salinity and crop yield. Plant Biol (Stuttg). 2019;21(S1):31–38.

20. Ashraf M, Foolad MR. Roles of glycine betaine and proline in improving plant abiotic stress resistance. Environ Exp Bot. 2007;59(2):206–216.