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RESPONSE OF RICE UNDER SALT STRESS

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Abstract: *About World's half population is fed up with rice, a highly popular and staple food worldwide. Due to rice's classification as a glycophyte, soil salinity poses a significant global issue. Salinity negatively influences rice grain yield, reproduction, and growth. One of the main obstacles in the coastal region of the world, salinity is the main obstacle. With conventional and cutting-edge breeding techniques, this issue can be resolved. We have concentrated on the breeding strategies that will be employed to address this problem. With the help of salt-resistant genes and marker-assisted selection, we can develop a salt-tolerant variety. Problems with salinity worldwide have been the topic in this review regarding how it affects rice and other plants.*

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Introduction

Rice is one of the most significant foods; about half the world's population is fed by rice. Rice is among the monocot plant species, which is susceptible to salinity, and increasing salt concentration in soil harms the rice yield (Ashraf, 2009). Among the main abiotic factors, salinity is one that directly affects all agricultural crops, especially rice. Natural and anthropogenic salinization are the two kinds of salinization. The 1st one is closely related to the origins of the water table's margin, the impact of sea intrusion and coastal regions, the main mineral that makes up the rock, the deposition of salts transported by the breeze, seepage and upward and upward capillary flow caused by evapotranspiration (Iqra et al., 2020; Mallano et al., 2022; Masood et al., 2015). Secondary irrigation, on the other hand, results from improper management, the use of badly affected soil not suitable for irrigation due to soil erosion and use of irrigation depths as a result of improper irrigation systems, excessive use of fertilizers, use of industrial waste for farming irrigation and so on (Rodríguez Coca et al., 2023). Sodium chloride is the main cause of salinity which is highly soluble and can badly affect the production of crops. Excessive salts and low water availability are the main reasons that convert fertile land into marginal one (Ahmad et al., 2021; Asif et al., 2020; Rodríguez Coca et al., 2023).

Salinity effect on growth stages

According to studies, the seedling and the reproductive growth phase are when it is most susceptible to salinity stress, even though it occurs throughout the entire growth period in the soil (Naseem et al., 2020; Shafique et al., 2020; Zheng et al., 2023). Osmotic potential and ionic poisoning are the foundation of 2 notions. Since the osmotic potential between sediments and plant cells has changed during the 1st stage, osmotic stress reduces the growth in a relatively short amount of time, negatively impacting growth and development. Depending upon the salinity concentration in the root zone, salt concentration and translocation start to occur within the plant at the 2nd stage of ion toxicity (Ghafoor et al., 2020; Muqadas et al., 2020; Riaz et al., 2019). Growing salt stress has a considerable impact on productivity like no. spikelet's plant, no. of Plant's panicle, no. of tillers per plant, 1000 seed weight, etc. (Ali et al., 2021; Farooq et al., 2021; Nawaz et al., 2020)

Effect on nutrient transport

Nutrient uptake in plants is linked with salinity, which has been seen in plant tissues in various plants like rice (Abdelgadir et al., 2005). High levels of Sodium and Chlorine lead to ionic discord, inhibiting other nutrients' absorption by other plant cells and tissues. Due to competition, the primary elements with reduced contents and unbalanced ratio in the plant are Potassium, Calcium and Maganese (Sudhir and Murthy, 2004) found that the amount of Sodium, Calcium and Maganese in the root and shoot of the rice plant under high salt stress, while silicon and boron availability in plants decreased when the salt content was elevated (Salim, 2014). High Sodium

Chloride content in most cereals products, involving rice, reduces the zinc concentration and increases the Cadmium (Amanullah et al., 2016).

Ethylene production and salt stress

Ethylene is crucial for flowering, leaf senescence and several abiotic stress reactions in plants (Zhang et al., 2014). Stress hormone; ethylene is produced more when the rice is under salt stress conditions (Hussain et al., 2017).

Defense mechanism of rice against salinity

The defense mechanism of a plant against the drastic effects of salinity can be divided into three steps: a) Osmoctic adjustment hydraulic stress tolerance, b) Strict controls of sodium ion uptake at the molecular level and Na+ exclusion from leaf blades, c) A Tissue's tolerance to accumulated Sodium or in some specie i.e., Chlorine through compartmentalization and absorbed salts (Munns and Tester, 2008).

Rice Adoption towards Saliniy

Rice production heavily depends upon the plant's ability to tolerate salinity (Barus et al., 2013). A number of adaptive reactions at cell, molecular and physiological levels play a role in tolerance of the rice or salinity resistance. Following some adaptations towards salt stress are:

Stomata closing

In many plant species, salinity stress lowers the rate of photosynthesis (Dionisio-Sese and Tobita, 2000). For monocots plants, for example, rice, the closing of the stomata, a decrease in sink activity a reduction in the rubisco deficiency is observed, the displacement of essential ions from the leaf's surface, which causes alteration to porosity, as well as grana swelling and failure, are the plausible causes of the declining photosynthetic rate (Flowers and Yeo, 1981), or could be as a result of direct salinity effect on stomata permeability by a decrease in turgidity of guard cell and the partial cell atmosphere of carbon dioxide (Dionisio-Sese and Tobita, 2000). To live under salt stress, the stomata must be closed, and the total area of the stomatal opening increases noticeably with a larger AsA redox state leading to a higher transpiration rate. Na+, which regulates the transpiration rate following the amount of sodium in the environment, is controlled by stomatal guard cells (Chen et al., 2004).

Osmotic balancing

The most crucial physiological factor is osmotic correction because it establishes the rice plant's upper limit of tolerable concentration of toxic ions. The best action is to decrease the NaCl compartmentalization in vacuoles or develop in the cell cytoplasm (Asch and Wopereis, 2001; Zubair et al., 2016). In addition, Physiologist and genetic architects are noticing the concentration of soluble substances in the cytoplasm of plant cells, sugars and glycine betaine *etc*. (Jampeetong and Brix, 2009). It suggests that under osmotic condition carbohydrate may be more significant for rice than proline (Nounjan and Theerakulpisut, 2012). Plants keep osmotic and homeostasis, responding quickly to osmotic and ionic signals to combat opposing biotic and abiotic stressors (Hussain et al., 2017). Another crucial effect of rice plants is their leaf area. Combined with the power of transpiration and dilution, it can lessen the effect of high Sodium accumulation in rice leave (Ali et al., 2016; Sarwar et al., 2022; Sarwar et al., 2021).

Conclusion

The process by which the salt stress effect is uncertain how rice photosynthesizes or how better and poorer spines form. This review article teaches us about the salinity impact on the growth and development of rice as well as the management techniques for increasing grain yield. Scientists should concentrate on the biotic and abiotic factors because of bad growth of superior and inferior spikelets causing low rice yield. Future studies should aim to identify and breed tolerance germplasm that takes advantage of a variation of phenotypic and genotypic traits.

Conflict of interest

The author declared an absence of conflict of interest.

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