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Indian Mangrove: Life in a Pickle

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Introduction:

Mangroves (*Avicennia officinalis*) are an array of trees and plants that thrive in coastal intertidal areas, or the transition between land and water. Over millions of years, these unique trees have evolved to withstand extreme conditions like shifting tides, seawater inundation, and soils depleted of nutrients. All around the world, particularly in Asia, Africa, Australia, and the Americas, mangroves can be found in tropical and subtropical areas. They develop a diversified and complex ecosystem that supports a broad variety of marine and terrestrial organisms in tidal zones where the water is brackish, a mixture of salt and freshwater. The distinctive characteristics adaptations that mangroves have made to survive in saltwater conditions are what make them unique. They have intricate root systems that aid in both anchoring them in the mud and loose soil of the intertidal zone and aiding in the absorption of oxygen from the atmosphere during high tide. Additionally, mangroves can filter salt from the water and can withstand salt concentrations that would be fatal to the majority of other plants. Mangrove forests are an invaluable asset for people because they offer a habitat for fish and other marine life, shield communities on the coast from storm surges and erosion, and produce goods like wood and fuel. However, logging, aquaculture, urbanisation, and other human activities pose a threat to mangrove forests.

Salt Tolerance Ability:

Mangroves are well renowned for their capacity to withstand environments with high salinities. The ability to store salt in leaves, exclude salt from their roots, and maintain water balance in the presence of salt stress are only a few examples of the physiological and biochemical changes responsible for this salt tolerance. The capacity of mangroves to keep salt away from their roots is one of their main adaptations. They achieve this by possessing a thick coating of cells called the exodermis on the root surface that is resistant to salt. As a barrier, this layer keeps the salt from penetrating the roots and harming the plant. Mangroves have another adaption in that they can store salt in their leaves. They accomplish this by

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making use of specialised cells on the surface of their leaves known as salt glands. These glands expel extra salt from the plant onto the surface of the leaves, where rain or tidal waters can readily wash it away. In facing the effects of salt stress, mangroves may also keep the water balance. They achieve this utilising a mechanism known as osmoregulation, which involves the plant's intake and movement of ions and water. They are able to do this even in the presence of high salt concentrations, which aids in maintaining a balance between water and salt in their cells. Evaporation elevates the salt level, and tide changes the salinity, which results in hypersaline conditions for mangroves. For mangroves, high salinity and salinity variation are problems. Mangroves use a variety of physiological and biochemical strategies, including salt excretion, salt build-up, salt secretion, accumulation of suitable solutes, and stimulation of antioxidative enzymes, to deal with this harsh condition.

Crop Improvements Prospects:

Researchers and plant breeders who are interested in developing crops that can flourish in saline soils have taken an interest in mangroves' salt tolerance. Mangrove species have been used with moderate efficacy to increase the salt tolerance of crop plants. For instance, mangrove genes for salt tolerance have been found and transplanted into crop plants including wheat, tomato, and rice, which has increased salt tolerance. The microorganisms that live in and near mangroves and are adapted to the high saline levels in the soil and water have also been the subject of research. These microorganisms may help in the development of new crop treatments or biofertilizers because some of them have been proven to have favourable impacts on plant growth and salt tolerance. A possible approach has been to find and isolate salt tolerance-related genes from mangrove species, then use genetic engineering to transfer those genes into rice plants.

It has also been discovered that a number of mangrove genes, including those that control ion transport, osmoprotection, and antioxidant defence, increase the salt tolerance of rice plants. In rice plants, these genes have been effectively inserted, improving salt tolerance and boosting crop production in saline soils.

Conclusions and Future Aspects:

Globally, salinity is a significant abiotic stressor that has a significant impact on plant growth and crop production. Because of their detrimental effects on potassium feeding, cytosolic enzyme activity, photosynthesis, and metabolism, sodium ions in saline soil are hazardous to plants. Mangroves can withstand excessive salinity because they reject salts that could be detrimental. Some mangrove species actively excrete the salts that leak into the plant through specialised salt glands in their leaves, while other species do it through ultra filtration at the cortical cell membranes at the roots. Whilst it comes to increasing plant salinity tolerance, the biggest difficulty will be to combine these genes and promoters in a methodical and logical approach. When implemented, the ability to genetically modify crops and industrial plants to tolerate salt by using genes obtained from mangroves would be a crucial instrument in the fight to solve the planet's long-term food, energy, and environmental concerns.

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