**Mechanism used by PGPMS against salinity**

Salinity tolerance varies greatly between species. While some of the species are halophytes and "require" salt, others are glycophytes and are sensitive to salinity. In this regard, they have each developed unique survival tactics for such an environment. To survive and reduce the effects of stress, the first type of plant strives to keep salt out of its root cells, whereas the second type lets xylem flux carry salt into its tissues, mostly the leaves. Certain halophytes can tolerate up to 1 M of NaCl in the soil due to genes that are triggered in response to salt and which result in the creation of particular proteins, whereas sensitive plant species do not have many mechanisms of their own to adapt to this abiotic stress. (Shilev, 2020)

Several strategies are used by halophytes to adapt to saline surroundings. Complex alterations at the physiological, molecular, and biochemical levels are among the basic mechanisms:

* selective ion intake or extrusion
* production of solutes and osmoprotectants
* modulation of the K+/Na+ relationship at high values
* synthesis of polyamides that participate in ROS modulation
* modulation of hormone levels along with associated enzymes I production of solutes and osmoprotectants
* modulation of toxic ion accumulation and nutrient status
* selective intake or extrusion of ions
* synthetizing polyamides that take part in ROS modulation
* antioxidant compound production
* regulation of salt overly sensitive (SOS) genes as a response to salinity-produced stress
* nitric oxide generation, which activates diverse gene expression and antioxidant enzymes
* changing photosynthetic activity
* regulation of salinity tolerance gene expression (Shilev, 2020)

The increase of plant growth caused by the production of ACC-deaminase under salt mitigates the negative effects of ethylene by modulating ACC accumulation and the activities of ACC-oxidase and ACC-synthase. In a salt-stressed environment, the Bacillus sp. consortium, which provided halotolerant species and was applied to maize rhizosphere, also induced a plant response for protection enzymes, proline, chlorophyll, and soluble sugars.

Plants need to maintain turgor and water uptake for growth while under stress conditions by keeping their internal water potential below that of the soil. It is necessary to boost osmotica, either by synthesising metabolic solutes or by absorbing soil solutes. Because they do not disrupt regular metabolic processes, low molecular mass substances that are compatible solutes to accommodate the ionic equilibrium in the vacuoles accumulate in the cytoplasm. Nowadays, solutions may be employed to obtain optimised quality properties in challenging circumstances. (Ayman EL Sabagh, Akbar Hossain , Celaleddin Barutçular, Muhammad Aamir Iqbal, M Sohidul Islam, Shah Fahad , Oksana Sytar, , 2020)

Salinity can be reduced through reclamation, water, and drainage, but managing it is exceedingly expensive. Reactive oxygen species (ROS) production and accumulation in plant cells have been linked to high salinity. Stress decreased the activity of antioxidant enzymes, making plants more vulnerable to salinity. Catalase (CAT), superoxide dismutase (SOD), peroxidase (POX), and enzymes of the ascorbate-glutathione cycle such as ascorbate peroxydase (APX), monodehydroascorbate dehydrogenase (MDHAR), and dehydroascorbate reductase serve as additional enzymatic antioxidant mechanisms (DHAR). (Shilev, 2020)

PGPMs (Plant Growth Promoting Microorganisms) can use several mechanisms to combat salinity stress in plants, such as:

**Production of plant growth regulators:**

PGPMs can produce plant growth regulators such as auxins, gibberellins, and cytokinins that help plants to overcome salinity stress by promoting root growth, enhancing photosynthesis, and improving water uptake.

**Antioxidant production**:

Salinity stress can cause the accumulation of reactive oxygen species (ROS) in plant cells, leading to oxidative damage. PGPMs can produce antioxidants such as ascorbate, glutathione, and superoxide dismutase that scavenge ROS and protect plant cells from oxidative damage.

**Osmoprotection:**

PGPMs can produce compatible solutes such as proline and glycine betaine that help plants to maintain osmotic balance and protect cellular structures from salt-induced damage.

**Nutrient acquisition:**

Salinity stress can limit nutrient uptake by plants, leading to nutrient deficiencies. PGPMs can enhance the availability and uptake of nutrients such as nitrogen, phosphorus, and potassium, which are essential for plant growth and development.

**Induction of systemic resistance:**

PGPMs can induce systemic resistance in plants against salinity stress by triggering the expression of defense-related genes and enhancing the production of defense molecules such as phytohormones, secondary metabolites, and pathogenesis-related proteins.

In nutshell, PGPMs can promote plant growth and development under salinity stress by enhancing nutrient uptake, protecting plant cells from oxidative damage, maintaining osmotic balance, and inducing systemic resistance against stress. (Shilev, 2020)