Salinity stress is a major abiotic stress that negatively affects plant growth and development. It occurs when the concentration of salt in the soil exceeds the tolerance level of plants. The excess salt causes osmotic stress, ion toxicity, and nutrient imbalance, resulting in reduced plant growth and productivity. Recently, several chemical and physical strategies have been developed to ameliorate salinity stress in plants.

Osmoprotectants are compounds that protect cells from osmotic stress. Glycine betaine, Proline, trehalose, and mannitol are some of the osmoprotectants that have been used to mitigate salinity stress (Ashraf and Fooled, 2007). Osmoprotectants are compounds that help plants tolerate abiotic stresses, such as salinity stress, by maintaining cellular homeostasis and stabilizing macromolecules. Glycine betaine is a quaternary ammonium compound that accumulates in many plant species in response to osmotic stress. It acts as a compatible solute and helps maintain turgor pressure and cellular water balance under stress conditions. Studies have shown that exogenous application of glycine betaine can improve plant growth and yield under salinity stress (Ahmad et al., 2019; Parida et al., 2004).Proline is an amino acid that accumulates in plants in response to various stresses, including salinity stress. It acts as an osmoprotectants and helps maintain cellular homeostasis by stabilizing membranes, scavenging reactive oxygen species (ROS), and regulating ion transport. Studies have shown that exogenous application of proline can improve plant growth and yield under salinity stress (Ahmad et al., 2019; Ashraf and Foolad, 2007).Trehalose is a disaccharide that acts as an osmoprotectant in plants. It helps stabilize cellular membranes, regulate ion transport, and protect macromolecules from damage under stress conditions. Studies have shown that exogenous application of trehalose can improve plant growth and yield under salinity stress (Ahmad et al., 2019; Wang et al., 2015).Mannitol is a sugar alcohol that acts as an osmoprotectant in plants. It helps maintain cellular water balance and stabilizes membranes under stress conditions. Studies have shown that exogenous application of mannitol can improve plant growth and yield under salinity stress (Ahmad et al., 2019; Parida et al., Plant growth regulators, such as abscisic acid (ABA) and cytokinins, have been used to improve plant growth under salinity stress conditions. ABA regulates stomatal closure and reduces water loss, while cytokinins promote cell division and expansion (Hasegawa et al., 2000).

Abscisic acid (ABA): ABA is a plant hormone that plays a key role in regulating plant growth and development, including response to abiotic stresses such as salinity stress. Studies have shown that exogenous application of ABA can improve plant growth and yield under salinity stress (Ji et al., 2019; Munns and Tester, 2008).GA is a plant hormone that regulates various aspects of plant growth and development, including stem elongation and seed germination. Studies have shown that exogenous application of GA can improve plant growth and yield under salinity stress (Munns and Tester, 2008; Sheikh et al., 2018).Cytokinins are plant hormones that regulate cell division and differentiation, as well as other aspects of plant growth and development. Studies have shown that exogenous application of cytokinins can improve plant growth and yield under salinity stress (Munns and Tester, 2008; Sheikh et al., 2018).

Ethylene is a plant hormone that regulates various aspects of plant growth and development, including fruit ripening and senescence. Studies have shown that exogenous application of ethylene can improve plant growth and yield under salinity stress (Munns and Tester, 2008; Sheikh et al., 2018). Salinity stress causes oxidative stress, leading to the accumulation of reactive oxygen species (ROS). Antioxidants such as ascorbic acid, glutathione, and tocopherols scavenge ROS and protect plants from oxidative damage (Gill and Tuteja, 2010).

Ascorbic acid is a well-known antioxidant that plays an important role in plant growth and development, as well as in mitigating oxidative stress caused by various environmental factors, including salinity stress. Studies have shown that exogenous application of ascorbic acid can improve plant growth and yield under salinity stress (Ahmad et al., 2016; Farooq et al., 2016).Alpha-tocopherol is a potent antioxidant that can scavenge free radicals and protect cells from oxidative damage. Studies have shown that exogenous application of alpha-tocopherol can improve plant growth and yield under salinity stress (Shahid et al., 2017; Ashraf et al., 2017).Phenolic compounds are a diverse group of secondary metabolites that have been shown to possess strong antioxidant properties. Studies have shown that exogenous application of phenolic compounds can improve plant growth and yield under salinity stress (Aghdam et al., 2019; Hassanein et al., 2020). Glutathione is a tripeptide that plays a critical role in plant defense against oxidative stress. Studies have shown that exogenous application of GSH can improve plant growth and yield under salinity stress (Hasanuzzaman et al., 2018; Ibrahim et al., 2019).

Soil amendments such as gypsum, vermiculite, and zeolite have been used to improve soil structure and reduce salt concentration. These amendments increase soil water holding capacity and reduce the accumulation of toxic ions in the root zone (Sairam and Tyagi, 2004).

Adding organic matter to soil can improve its fertility and water-holding capacity, as well as increase the activity of beneficial microorganisms. Studies have shown that organic matter amendments can improve soil properties and plant growth under salinity stress (Kumar et al., 2018; Saqib et al., 2019).

Gypsum is a commonly used soil amendment for managing saline soils. It can improve soil structure and reduce soil sodium levels, which can improve plant growth and yield. Studies have shown that gypsum amendments can improve soil properties and plant growth under salinity stress (Khan et al., 2017; Hussain et al., 2019). Biochar is a carbon-rich material produced from the pyrolysis of biomass. It has been shown to improve soil fertility and water-holding capacity, as well as reduce soil salinity. Studies have shown that biochar amendments can improve soil properties and plant growth under salinity stress (Mia et al., 2017; Xu et al., 2020).Compost is a rich source of organic matter and nutrients that can improve soil fertility and structure, as well as increase the activity of beneficial microorganisms. Studies have shown that compost amendments can improve soil properties and plant growth under salinity stress (Jafarzadeh-Haghighi et al., 2018; Cui et al., 2019).

Several irrigation methods, such as drip irrigation and sprinkler irrigation, have been used to reduce salt concentration in the soil. These methods supply water directly to the root zone, reducing salt accumulation in the soil surface (Zhang et al., 2014)

Drip irrigation IN this method, water is applied directly to the root zone of plants through emitters. Drip irrigation can reduce water loss due to evaporation and minimize soil salinization by applying water uniformly and gradually. Studies have shown that drip irrigation can improve crop yield and water-use efficiency under saline conditions (Ahmed et al., 2019; Ibrahim et al., 2020). Sprinkler irrigation involves applying water to the soil surface through overhead sprinklers. This method can help reduce soil salinity by washing salt away from the root zone, but may also increase soil erosion and water loss due to evaporation. Studies have shown that sprinkler irrigation can improve crop yield and water-use efficiency under saline conditions (Zhao et al., 2018; Al-Fraihat et al., 2021).

Subsurface irrigation In this method, water is applied below the soil surface through buried drip tapes or porous pipes. Subsurface irrigation can help reduce soil salinity by minimizing water loss due to evaporation and reducing salt accumulation on the soil surface. Studies have shown that subsurface irrigation can improve crop yield and water-use efficiency under saline conditions (Al-Ashkar et al., 2018; Mahmoudi et al., 2021).Furrow irrigation involves applying water to the soil surface in shallow trenches between crop rows. This method can help reduce soil salinity by promoting leaching of salts from the root zone, but may also result in uneven distribution of water and increased soil erosion. Studies have shown that furrow irrigation can improve crop yield and water-use efficiency under saline conditions (Abdul-Wahab et al., 2018; Islam et al., 2020).

Use of halophytes are salt-tolerant plants that can grow in saline soil. The use of halophytes in salt-affected areas can improve soil quality and reduce soil salinity (Khan et al., 2015).Halophytes are plants that are able to grow in saline soils or waters, which are inhospitable for most other plant species. The use of halophytes is a promising strategy for the remediation of saline soils and for the production of food and other useful products in saline environments. Here are some details on the use of halophytes with references and citations:

Saline agriculture using halophytes. Halophytes can be cultivated in saline soils or waters and used for the production of food, fodder, biofuels, and other products. This approach is known as "saline agriculture" and has been gaining attention as a sustainable solution for the utilization of saline lands. Halophytes can also be used for phytoremediation of saline soils and waters contaminated with heavy metals and other pollutants. (Munns and Tester, 2008)

Halophyte cultivation and breeding The cultivation and breeding of halophytes for various purposes requires a better understanding of their physiological, biochemical, and molecular mechanisms of salt tolerance. Several studies have focused on the identification of salt-tolerant halophytes and the characterization of their salt tolerance mechanisms. (Katschnig et al., 2018; Munns et al., 2020).Salt-tolerant crops:The use of halophytes as a source of salt tolerance genes for the genetic improvement of crops has also been explored. Several genes and mechanisms involved in salt tolerance in halophytes have been identified and transferred to crop plants, resulting in improved salt tolerance and yield under saline conditions. (Wang et al., 2016; Flowers and Colmer, 2015)