**5. Application and impacts of pristine CQDs and doped CQDs on plant under stress conditions:**

**5.1. Abiotic stresses**

**5.1.1 Salinity**

Plants under salt stress may benefit from the usage of carbon quantum dots and doped CQDs (Mahima Misti Sarkar, Nibedita Pradhan, Rewaj Subba, Puja Saha & Swarnendu Roy, 2022). When exposed to salt stress, CQDs can penetrate the plant and aid in the growth of young seedlings. In seedlings treated with carbon quantum dots under salt stress, proline content buildup can be reduced and the ionic equilibrium can be maintained. Under stressful situations, proline builds up in plants and aids in their protection from harm. It has been demonstrated that CQDs functionalized by proline increase the ability of grapevine plants to withstand salinity stress. Researchers have looked into the use of putrescine-functionalized carbon quantum dots in salt-stressed grapevine plants. In comparison to untreated plants under salt stress, put-CQD treatment dramatically enhanced plant growth, photosynthetic pigments, and lowered Na+/K+ ratio, according to the study's findings. The findings point to put-CQD treatment as a possible tactic for enhancing plant growth and productivity under salt stress. They have been demonstrated to improve germination, growth, chlorophyll content, crop production, and quality, which lessen the negative impacts of salinity. Moreover, CQDs enhance the antioxidant capacities of plants during salt stress, both enzymatic and non-enzymatics. (Mahima Misti Sarkar, Nibedita Pradhan, Rewaj Subba, Puja Saha & Swarnendu Roy, 2022).

Carbon dots such as carbon quantum dots can help plants under salinity stress by maintaining ionic balance, can be employed to promote osmolyte accumulation reducing proline accumulation, improving antioxidant enzyme systems, reducing ROS content, alleviating oxidative damage on cell membranes, increasing photosynthetic pigments and reducing Na+/K+ ratio, enhance hydraulic conductivity, and boost aquaporin expression in root. Because of their improved solubility and durability, doped CDs have been proven to be more effective than prestine CQDs at promoting plant growth under salinity stress. By mitigating the negative impacts of salinity and enhancing germination, growth, chlorophyll content, crop production, and quality, doped carbon dots can benefit plants under salinity stress. During salt stress, carbon dots can enter the plant and increase the formation of new seedlings. Mung bean seeds can be stimulated by heteroatom-free carbon dots to operate as a protective agent, reducing salt stress. It has been demonstrated that magnesium-nitrogen co-doped carbon dots improve plant growth and lessen the oxidative damage brought on by salt stress in tobacco plants. Moreover, due to their capacity to increase crop yields and lessen the impacts of salinity stress on plants, CDs and DCs have potential applications in sustainable agriculture.