ABSTRACT

Plants are sessile organisms and experience various abiotic stresses during their life span and try to adapt to environmental stresses by manipulating their physiological, biochemical, cellular and molecular mechanisms. Salinity is one of the important abiotic stress which affects the metabolism and growth of the plant cells which lead to serious damage to crop productivity. Autophagy and Programmed Cell Death are also two important mechanisms and involved during different stress conditions in various organism including yeast, animals and plants. Different genes are involved to regulate autophagy and PCD pathways however their role during saline stress has less explored. It has been reported that different biostimulants including Panchagavya (PG), signaling molecules such as Salicylic Acid (SA) and Jasmonic Acid (JA) improve plant growth and metabolism in plants under various biotic and abiotic stresses. The role of autophagy and PCD during saline stress in rice seedlings are explored. The efficacy of PG, PG1, SA and JA was also studied to alleviate the saline stress in rice seedlings. The role of these biostimulant on modification of autophagy and PCD pathways under saline stress also studied. The role of an autophagy inhibitor Chloroquine (CQ) during saline stress in rice seedlings was analyzed to find whether autophagy is critical for plant to survive under saline stress. Further, novel compounds from biostimulant PG was isolated, characterized and tested their efficacy at morphological, biochemical and molecular level during saline stress in rice seedlings. The autophagy (ATG) proteins were designed with the help of bioinformatic tools and docked with different ligand molecules. The results of study showed that the saline stress greatly influenced and negatively affected the plant growth, biochemical, cellular and molecular attributes in rice seedlings. The saline stress decreased the growth of plants, reduced photosynthetic pigments and protein content. The accumulation of reactive oxygen species and increased activity of antioxidant enzymes including catalase, peroxidase superoxide dismutase was observed that correlated ROS production in rice seedlings. Antioxidant enzyme activities also positively correlated the expression of antioxidant genes including CAT1, Mn-SOD and GPX. Nuclear fragmentation is one of the hallmarks feature of PCD
and fragmented nuclei in leaf cell of rice seedlings was observed under saline stress. Furthermore, expression of genes encoding BI-1, MAPK-1, WRKY53 and autophagy genes was studied in seedlings grown under saline stress. The effect of PG, PG1, SA and JA to alleviate the saline stress either alone or in combination with NaCl showed the significant enhancement of growth, physiological, biochemical, cellular and molecular characteristics in rice seedlings grown under saline stress. These components reduce the accumulation of ROS by acting as a potential scavenger and activated the antioxidant, MAPK1, WRKY53 and ATG genes to help the plants to tolerate the saline stress. The study imparts our understanding on salinity and suggested that PCD and autophagy are co-regulated mechanisms and these mechanisms are critical for plants to cope up with saline stress. The addition of biostimulants, autophagy inhibitors and signalling molecule demonstrated the critical players involved during saline stress.