ABSTRACT

Crop productivity is crucial to meet the food demand of the growing global population. Climate changes and other environmental factors are influencing the seasonal crops, leading to abiotic stress conditions and ultimately impacting crop production and yield. Thus, different studies are being done to improve crop resilience towards environmental stresses such as heat, drought, salinity, etc. This study focuses on an important legume chickpea which is a highly nutritious food. Being a winter legume, at high-temperature conditions chickpea plants experience abiotic stress resulting in reduced crop productivity and yield. To adapt to diverse environments plants have developed adaptative mechanisms, involving many hormones and biomolecules to enhance abiotic stress tolerance. Ethylene is a plant hormone that regulates plant growth and development while playing a crucial role in promoting abiotic stress tolerance in plants.

This study investigates the physiological parameters in ACC and Ethephon-treated ICC-12726 and Genesis-836 chickpea plants. Both chickpea plants were treated with different ACC and ethephon concentrations and the optimal ethylene precursor and concentration were determined by analyzing physiological parameters such as germination percentage, shoot and root length, shoot, and root biomass. The effect of ethylene pretreatment on the growth and heat tolerance of chickpea plants was further investigated through these physiological parameters in combination with key biochemical signatures. The oxidative stress level of chickpea plants under stressed and control conditions was also quantified through TBARS assay, a proxy for lipid peroxidation which measures MDA equivalents. The GABA level of each plant subjected to heat and control conditions was quantified using GABase. Finally, the starch content was measured by using a starch assay.

Both chickpea seeds were pretreated with 0 µM, 10 µM, 50 µM, and 100 µM ACC concentrations and results showed that ACC did not have a significant impact on seed germination and root length in both ICC-12726 and Genesis-826 chickpea plants compared to the controls. In contrast, both chickpeas were pretreated 0 µM, 5 µM, 50 µM, 500 µM, and 1 mM ethephon concentrations and ethephon-pretreated plants exhibited more significant changes in shoot and root length, fresh root, and shoot biomass compared to control plants. According to the results, both ICC-12726 and Genesis-836 chickpea plants showed reduced shoot and root length as ethephon concentration increased. This study has addressed the biochemical responses of chickpea plants subjected to heat stress along with ethephon pretreatment and foliar treatment. Moreover, this study examined the biochemical responses of chickpea plants subjected to heat stress, along with ethephon pretreatment and foliar treatment., overall 5µM ethephon-treated plants under heat stress conditions exhibited higher significance in MDA values compared to those under control conditions. However, ethephon pretreatment did not perform significant changes in MDA levels in both chickpea varieties. Overall the ethephon pretreated both chickpea plants did not show significant changes in GABA level and starch content. In contrast, foliar-treated plants exhibited significant changes in MDA level, and GABA levels compared to ethephon pretreatment. In conclusion, these findings will help to elucidate the role of ethylene in stress signaling pathway in

chickpea plants subjected to heat stress and ultimately these findings and strategies can be utilized to enhance abiotic stress resilience and productivity of chickpea plants subjected to heat stress