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Exogenous Application of 24-Epibrassinolide Confers Saline Stress and Improves Photosynthetic Capacity, Antioxidant Defense, Mineral Uptake, and Yield in Maize

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Abstract: Salinity is one of the major environmental stresses threatening crop production, the natural ecosystem, global food security, and the socioeconomic health of humans. Thus, the development of eco-friendly strategies to mitigate saline stress and/or enhance crop tolerance is an important issue worldwide. Therefore, this study was conducted during the summer of 2022 to investigate the potential of 24-Epibrassinolide (EBL) for mitigating saline stress and improving photosynthetic capacity, antioxidant defense systems, mineral uptake, and yield in maize (*Zea mays* L.) grown under a controlled hydroponic system. Three saline stress levels—S1 (control/no added NaCl), S2 (60 mM NaCl), and S3 (120 mM NaCl)—were continuously applied with nutrient solution, whereas exogenous EBL (i.e., control, 0.1 µM and 0.2 µM) was applied as exogenous application three times (i.e., 40, 55, 70 days after sowing). The experiment was designed as a split-plot in a randomized complete block design (RCBD) in which saline stress was the main factor and EBL treatment was the sub-factor. Results showed that saline stress significantly affected plant growth, physiological performance, biochemistry, antioxidant activity, and yield attributes. However, the exogenous application of EBL at 0.2 µM significantly mitigated the salt stress and thus improved plant performance even under 120 mM NaCl saline stress. For instance, as compared to untreated plants (control), 0.2 µM EBL application improved plant height (+18%), biomass (+19%), SPAD (+32%), Fv/Fm (+28%), rate of photosynthesis (+11%), carboxylation efficiency (+6%), superoxide dismutase (SOD +14%), catalase (CAT +18%), ascorbate peroxidase (APX +20%), K^+ (+24%), 100-grain weight (+11%), and grain yield (+47%) of maize grown under salt stress. Additionally, it resulted in a 23% reduction in Na^+ accumulation in leaves and a 25% reduction in for Na^+/K^+ ratio under saline stress as compared to control. Furthermore, the Pearson's correlation and principal component analysis (PCA) highlighted the significance of exogenous EBL as saline stress mitigator in maize. Overall, our results indicated the protective effects of EBL application to the alleviation of saline stress in crop plants. However, further exploration of its mechanism of action and crop-specific response is suggested prior to commercial use in agriculture.

Keywords: 24-epibrassinolide; exogenous EBL; saline stress; mitigator; maize

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