Potassium alleviates over-reduction of the photosynthetic electron transport chain and helps to maintain integrity of the photosynthetic apparatus under salt-stress

Huihui Zhang[1], Yanhui Che[1], Dayong Fan[2], Tongtong Yao[1], Zihan Wang[1], Hongbo Zhang[1], Guangyu Sun[1], and WahSoon Chow[3]

[1]Northeast Forestry University
[2]Beijing Forestry University College of Forestry
[3]Australian National University

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Abstract

Potassium ions enhances photosynthetic tolerance to salt stress. We hypothesized that potassium ions, by minimizing the trans-thylakoid proton diffusion potential difference, can alleviate an over-reduced photosynthetic electron transport chain and maintain the integrity of the photosynthetic apparatus. This study investigated the effects of exogenous potassium on the transcription level and activity of proteins related to the photosynthetic electron-transport chain of tobacco seedlings under salt stress. Salt stress retarded the growth of seedlings, and caused potassium ion outflow from the chloroplast. It also lowered qP (indicator of the oxidation state of Q_A), Y_{PSII} (average photochemical yield of PSII) while increasing Y_{NO+NF} (non-regulatory energy dissipation), accompanied by reduced expression of most light-harvesting, energy-conversion, and electron-transport genes. Interestingly, Lincomycin (a D1 protein-synthesis inhibitor) significantly diminished the alleviation effect of exogenous potassium on salt stress. We attribute the comprehensive NaCl-induced down-regulation of transcription and photosynthetic activities to ROS-induced retrograde signalling. There probably exists at least two types of ROS-induced retrograde signalling, distinguished by their sensitivity to Lincomycin. Exogenous potassium appears to exert its primary effect by ameliorating the trans-thylakoid proton diffusion potential difference caused by salt stress, thereby alleviating over-reduction of the photosynthetic electron transport chain, and maintaining the integrity of photosynthetic proteins.

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