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Populus euphratica JRL Mediates ABA Response, Ionic and ROS Homeostasis in Arabidopsis under Salt Stress

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Abstract: Sodium chloride (NaCl) induced expression of a jacalin-related mannose-binding lectin (*JRL*) gene in leaves, roots, and callus cultures of *Populus euphratica* (salt-resistant poplar). To explore the mechanism of the *PeJRL* in salinity tolerance, the full length of *PeJRL* was cloned from *P. euphratica* and was transformed into Arabidopsis. PeJRL was localized to the cytoplasm in mesophyll cells. Overexpression of *PeJRL* in Arabidopsis significantly improved the salt tolerance of transgenic plants, in terms of seed germination, root growth, and electrolyte leakage during seedling establishment. Under NaCl stress, transgenic plants retained K^+ and limited the accumulation of Na^+. *PeJRL*-transgenic lines increased Na^+ extrusion, which was associated with the upward regulation of *SOS1*, *AHA1*, and *AHA2* genes encoding plasma membrane Na^+/proton (H^+) antiporter and H^+-pumps. The activated H^+-ATPases in *PeJRL*-overexpressed plants restricted the channel-mediated loss of K^+ that was activated by NaCl-induced depolarization. Under salt stress, *PeJRL*–transgenic Arabidopsis maintained reactive oxygen species (ROS) homeostasis by activating the antioxidant enzymes and reducing the production of O_2^- through downregulation of NADPH oxidases. Of note, the *PeJRL*-transgenic Arabidopsis repressed abscisic acid (ABA) biosynthesis, thus reducing the ABA-elicited ROS production and the oxidative damage during the period of salt stress. A schematic model was proposed to show the mediation of PeJRL on ABA response, and ionic and ROS homeostasis under NaCl stress.

Keywords: jacalin-related lectin; *Populus euphratica*; NaCl; antioxidant enzyme; abscisic acid; K^+/Na^+ homeostasis; non-invasive micro-test technique

1. Introduction

Plants are frequently challenged by various environmental stressors, which inhibit plant growth and crop production. Among these unfavourable environmental factors, salinity presents a serious threat to plant growth and development [1–4]. Salt stress leads to water deficiency and ion toxicity, which cause oxidative damage in plants [5,6]. In addition, high salt alters the expression level of