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Heterologous Expression of the DREB Transcription Factor *AhDREB* in *Populus tomentosa* Carrière Confers Tolerance to Salt without Growth Reduction under Greenhouse Conditions

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Abstract: The DREB transcription factors regulate multiple stress response genes, and are therefore useful for molecular plant breeding. *AhDREB*, a stress-inducible gene, was isolated from *Atriplex hortensis* L. and introduced into *Populus tomentosa* Carrière under the control of the CaMV35S promoter. Under salt stress, the chlorophyll content and net photosynthetic rate were higher in transgenic lines than in the wild type (WT). Moreover, the rate of electrolyte penetration (REC) was lower in the transgenic lines. Additional analyses revealed that the *AhDREB* transgenic plants generally displayed lower malondialdehyde (MDA) activity but higher superoxide dismutase (SOD) and peroxidase (POD) activities and proline content than the WT under salt stress. RNA sequencing indicated that *AhDREB* could enhance tolerance to salt by activating various downstream genes in the transgenic plants. Furthermore, no growth inhibition was detected in transgenic plants expressing *AhDREB* driven by the constitutive CaMV35S promoter. The transcriptome showed 165 and 52 differentially expressed genes in transgenic plants under stress and non-stress conditions, respectively, among which no significant metabolic pathway was enriched and no unintended effects have yet been identified. Together, these results suggest that *AhDREB* may be a good candidate gene for increasing salt tolerance in transgenic poplar breeding.

Keywords: *Populus tomentosa*; *AhDREB*; salt; unintended effects; photosynthesis; antioxidant defense system

1. Introduction

Populus tomentosa Carr. (*P. tomentosa*) is native to China, where it is mainly distributed in 10 provinces in the northern part of the country. *P. tomentosa* exhibits many desirable characteristics, such as broad adaptability, a short rotation time, and rapid growth, which make it an important pulp material and afforestation tree species [1]. Given that *P. tomentosa* does not grow well on saline soils, which cover a large area of China, the application and distribution of *P. tomentosa* are seriously