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Overexpression of transcription factor genes improves tolerance to drought stress in transgenic *Populus* × *euramericana*

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As renewable resources, trees are playing an important role in the maintenance and protection of the ecological environment. But with the current worsening biotic and abiotic stress conditions, their yield, quality and productivity of forest trees has been severely affected. Consequently, it has become the hot topic to cultivate new resistant variety of forest tree with resistant, improve arid, semi-arid and saline wasteland to promote the development and utilization of land resources and improve environmental resources. ABA Response Element Binding Protein *(ckAREB)* is from *Caragana korshinskii*, a perennial woody succulent xerophyte that is one of the most drought tolerant plant species identified till date. Jasmonic Acid Ethylene-Responsive Element *(JERF36)* comes from tomato, which plays dual roles in response to biotic and abiotic stresses in plants. In this study, we constructed a plant expression vector with two resistance transcription factor genes and transferred into *Populus* × *euramericana* cl. 'Lingfeng 2'. In total we obtained 12 transgenic plants expressing double genes *(JERF-ckAREB)*, 6 transgenic plants expressing *ckAREB*, 28 transgenic plants expressing *JERF36*. Simulated drought stress assays induced by PEG6000 demonstrated that transgenic plant with ckAREB *(GA51)* had an increased ability to tolerate drought than non-transgenic plant as evidenced by a higher maximum photochemical activity of Photosystem II (PSII) (Fv/Fm), Relative Water Content (RWC) and proline content (187.56% significantly higher than non-transgene plant). Furthermore, leaf tissue of GA51 accumulated less Malondialdehyde (MDA) and both Superoxide Dismutase (SOD) and Peroxidase (POD) activities were elevated in GA51. Transgenic plant with double genes *(JERF-ckAREB)* (GAJ39) had an increased ability to tolerate high drought than transgenic plants with single gene *(JERF or ckAREB)*. For exemple, the chlorophyll content and proline content of GAJ39 were higher (13.8% and 17.05%) than transgenic lines expressing JERF36 (LJ6) respectively. At the same time, leaf tissue of GAJ39 accumulated MDA 42.84% lower than LJ6. On other hand, the content of proline, activity of SOD and POD were 32.62%, 12.21% and 84.76% singnificant higher than transgenic lines expressing ckAREB (GA49) respectively. Result of assays ion flow of Na^+, K^+ and H^+ of transgenic poplar roots by non-invasive micro-measurement techniques (scanning ion-selective microelectrode technique show that, compared with non-transgenic plants, Na^+ and H^+ of transgenic lines (LAJ12, LAJ29) expressing double genes efflux and K^+ influx significantly. Na^+, K^+ of transgenic lines (GA49, GA51) expressing ckAREB efflux and H^+ influx significanrly under simulated drought stress. This indicates that the proton pump activity of transgenic plants was stronger than the non-transgenic lines and transgenic lines expressing double genes were stronger than transgenic lines expressing single genes under drought stress. Above all, overexpression of transcription factors *JERF36* and *ckAREB* can improve both the tolerance to drought stress transgenic poplars and the resistance of transgenic lines expressing two transcription factors were much higher than which expressing one transcription factors.

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