OVEREXPRESSION OF RICE OSMYB4 GENE IN APPLE (MALUS PUMILA MILL.) AFFECTS PLANT RESPONSE TO DROUGHT AND COLD STRESSES

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The rice Osmyb4 gene is a putative Myb transcription factor constitutively expressed in rice and strongly induced by cold treatments at 4°C. Overexpression of Osmyb4 gene in Arabidopsis thaliana plants demonstrated a significant increase in cold and freezing tolerance.

In this work, Osmyb4 gene was introduced into the temperate woody species Malus pumila Mill., cv. Greensleeves, clone GS92 under the control of the constitutive CaMV35S promoter by Agrobacterium-mediated genetic transformation. Transgenic plants were studied in order to determine the effects of Osmyb4 expression on chilling and drought tolerance.

Low temperature effects on respiration were studied in vivo in wild-type and transgenic plants. Arrhenius plots show that from 30°C to 12°C, O₂ release decreases linearly for both mature and young leaves of wild-type apple. Below 12°C O₂ release exhibited a rapid decline, whereas in transgenic plants, breaks were observed at 10°C for mature leaves and at 6°C for young leaves. Values for activation energy and the (Q₁₀) factor differed significantly.

Drought tolerance was evaluated by relative water content (RWC) and ion leakage of detached leaves of wild-type and transgenic plants after different periods of treatment. Control plants start with a higher water content than transgenic plants and 6 days of drought (soil water potential at −10 MPa) are enough to produce a 10% reduction of the RWC, whereas in transgenic leaves reduction is significantly lower (0.5%). After 15 days of treatment (soil water potential > -30 Mpa) a 15% reduction of the RWC is detected for control plants, whereas in transgenic leaves no significant reduction is shown.

After 9 days of drought, ion leakage of control leaves doubled from 25% to 50%, whereas for transgenic plants it was about 30%. After 15 days of treatment, control plants showed a 70% of released ions, whereas for transgenic leaves no significant differences are detected, demonstrating a higher membrane stability than control.

Furthermore transgenic plants overexpressing Osmyb4 gene showed under non-stressed conditions higher concentration of soluble sugars and proline than control plants and it is known that a plant strategy that may confer stress tolerance is the accumulation of compatible, low-molecular weight osmolytes, such as sugars and amino acids.

The obtained results suggest that overexpression of Osmyb4 gene might confer an increased tolerance to cold and drought stress conditions in plants reinforcing the hypothesis that Osmyb4 represents a key gene of stress signalling processes.