PHOTOSYNTHETIC RESPONSE OF TREHALOSE-PRODUCING TOBACCO PLANTS TO ABIOTIC STRESSES

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Transgenic tobacco plants harboring *E. coli* TPS (trehalose-6-phosphate synthase) gene (*ots* A) were generated by leaf disc transformation. Transformants were identified by PCR, Northern hybridization, and trehalose synthesis. Homozygous plants obtained in F2 generation were used to test their physiological and photosynthetic responses to various abiotic stresses with emphasis on dehydration and high temperature. All transgenic plants showed enhanced tolerance against dehydration as shown by maintenance of leaf turgidity and improved retention in fresh weight after polyethylene glycol (PEG)-treatment. Transgenic plants also survived better under salinity and extended period of growth at 40°C~45°C. Furthermore, the germination efficiency was kept higher after exposure to high temperature in transgenic plants. The degree of tolerance was correlated with TPS expression level.

Upon dehydration by PEG-treatment, Pmax of O2 evolution decreased time-dependently in a similar phase in both nontransformants and transgenic plants. However, no significant changes in Chl fluorescence parameters were observed after PEG-treatment in both plants. It appears that trehalose confers transgenic plants improved water retaining ability against dehydration, but without stabilizing their photosynthetic capacity. Water potential was decreased in parallel phase by PEG-treatment in both plants although the initial water potential was higher in all lines of transgenic plants. On the other hand, trehalose-producing plants showed improved ability of holding photosynthetic activity after heat-treatment at 40° ~ 45°C in the dark. Pmax of O2 evolution in transgenic plants declined about 50% after heating at 45°C for 4 h in the dark while it dropped near to zero in wild-type plants. Measurement of CO2 uptake by IRGA produced similar results. Chl fluorescence parameters (Fo and Fv/Fm) also remained more favorable in transgenic plants. After heating, the decrease in Fv/Fm (maximal photochemical efficiency) for transgenic plants was only half of that in wild-type plants. Increase in Fo after heating was much more prominent in wild-type plants. The current results suggest a possible application of trehalose-producing plants for engineering plants resistant to multiple environmental stresses.