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Effect of silencing of the apoplastic invertase gene on photosynthesis in tomato

Chikov V., Akhtyamova G., Batasheva S., Mikhailov A., Khamidullina L., Timofeeva O.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2015 Pleiades Publishing, Ltd. Photosynthesis was examined in wild-type tomato plants (Lycopersicon esculentum L., cv. Money-maker) and in the transformants where gene expression of the leaf apoplastic invertase was suppressed by RNA interference (Lin8-RNAi). The influence of genetic transformation on photosynthesis depended on the demand for assimilates by sink organs. Using growth pots with low amount of soil, we found that at the initial growth stage when growth processes were particularly active, photosynthesis in Lin8-RNAi plants was higher than in the wild-type plants. As the reserves of mineral nutrients were gradually exhausted, photosynthesis decreased in both plant groups, but the decrease was more extensive in Lin8-RNAi plant form. Analysis of the distribution of ^{14}C among the photosynthates produced after 3-min period of $^{14}CO2$ assimilation revealed the decreased incorporation of ^{14}C into hexoses in Lin8-RNAi plants and the increased incorporation of ^{14}C into aspartate and products of the glycolate pathway. Supplementing the soil with nitrate nitrogen as a fertilizer enhanced the non-carbohydrate trend of photosynthesis, but this trend was less pronounced in the transformed plants. Simultaneous measurements of CO2-exchange and H2O release revealed an insignificant increase in Lin8-RNAi plants of photosynthetic activity, transpiration, and intraleaf CO2 concentration. However, in 30–50 min after lowering the photon flux density from 1556 to 771 μmol/(m^2 s) photosynthesis was reduced in both genotypes, whereas transpiration was diminished in wild-type plants and increased in the Lin8-RNAi form. It is concluded that the apoplastic invertase regulates photosynthesis through changes in osmolarity of the apoplastic fluid that controls the opening of stomata.

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Keywords

Apoplastic invertase, Irradiance, Lycopersicon esculentum, Nitrogen nutrition, Photosynthesis, Transpiration