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Photosynthetic carbon metabolism in potato leaves under changes in light intensity

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Abstract

© 2016, Pleiades Publishing, Ltd.Photosynthetic assimilation of 14CO2 was examined in leaves of potato (Solanum tuberosum L.) plants that were grown under direct sunlight and then transferred to 50% irradiance for various periods. The rate of 14CO2 assimilation correlated with light intensity: the photosynthetic rate reduced by 52% after 5-day shading and by 70% after 30-min shading. In all shaded and shade-adapted plants, the sucrose/hexose ratio decreased by a factor of 3.5–4.1; furthermore, the radioactivity of glycolate cycle metabolites and the serine/glycine ratio were lowered. In plants shaded for 5 days or 30 min, the radioactivity of aspartate and malate was higher than at continuous high irradiance, especially in plants shaded for 30 min, whereas a sudden illumination of the shaded plants reduced the radioactivity of these substances. We suppose that low irradiance averted the reentry of glycolate path carbon into the Calvin cycle and redirected this carbon source for the production of four-carbon acids that acidified the apoplast. This acidification activated the apoplastic invertase, which enhanced sucrose hydrolysis and hindered the sucrose export from the leaf. Hydrolysis of sucrose promoted the increase in osmolarity of the apoplastic solution, this increase being stronger at close distances to the stomatal pores where water is intensely evaporated. The increase in osmolarity of extracellular medium led to closing of stomata and the suppression of photosynthesis.

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Keywords

invertase, irradiance, photosynthetic carbon metabolism, regulation, Solanum tuberosum, stomata