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LIGHT REGULATES ASCORBATE IN PLANTS: AN INTEGRATED VIEW ON PHYSIOLOGY AND BIOCHEMISTRY

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Highlights

- ASC levels in plant tissue increases at higher irradiance levels due to stimulation of the primary (D-Man/L-Gal) biosynthetic pathway.
- The primary biosynthetic pathway accounts for the majority of ASC found in plants. Other biosynthetic pathways possibly contribute to the ASC pool only in genetically modified plants.
- Respiration, photosynthesis and carbohydrate availability are regulatory cues for ASC in plants.
- Respiration and photosynthesis potentially interact in light regulation of ASC via carbohydrates.

Abstract

L-ascorbate (vitamin C, ASC) is an antioxidant that is essential for the proper function not only of plants but also animals. Light is a major regulatory factor for ASC levels in plants. In this paper, we review the regulation of ASC by light and the involved biochemical and physiological processes. Several biochemical pathways for ASC biosynthesis have been proposed to exist in plants. We aim to determine the contribution of these biochemical pathways on ASC levels and, locate the steps of them that are affected by light. From biochemical and genetic studies only evidence for ASC biosynthesis occurring via the D-mannose/L-galactose biosynthetic pathway was found. Alternative pathways might account for ASC biosynthesis only in transgenic plants. Apart from biosynthesis, recycling and turnover of ASC might affect the size of the ASC pool. Light regulation of ASC levels in plants occurs primarily via effects on biosynthesis. In addition, light affects ASC homeostasis and translocation within the plant. Light regulation of ASC has been studied for individual physiological processes without taking into account possible interactions. By establishing the physiological network behind light regulation of ASC for both leaves and fruit, we developed a novel hypothesis on interactions between the physiological processes that regulate ASC. We conclude that respiration and photosynthesis interact in light regulation of ASC biosynthesis via carbohydrate availability.

Keywords: ascorbate; vitamin C; light regulation; vitamin C biochemistry; vitamin C physiology