

DOI: 10.5586/asbp.3583

Publication history

Received: 2018-01-25

Accepted: 2018-05-12

Published: 2018-06-29

Handling editor

Grzegorz Jackowski, Faculty
of Biology, Adam Mickiewicz
University in Poznań, Poland

Funding

This article has received
financial support from the
Polish Ministry of Science
and Higher Education under
subsidy for maintaining the
research potential of the Faculty
of Biology and Chemistry,
University of Białystok.

Competing interests

No competing interests have
been declared.

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Citation

Ciereszko I. Regulatory roles
of sugars in plant growth and
development. *Acta Soc Bot Pol.*
2018;87(2):3583. [https://doi.
org/10.5586/asbp.3583](https://doi.org/10.5586/asbp.3583)

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REVIEW

Regulatory roles of sugars in plant growth and development

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* Email: icier@uwb.edu.pl**Abstract**

In recent years, several studies have focused on the factors and mechanisms that regulate plant growth and development, as well as the functioning of signaling pathways in plant cells, unraveling the involvement of sugars in the processes regulating such growth and development. Saccharides play an important role in the life of plants: they are structural and storage substances, respiratory substrates, and intermediate metabolites of many biochemical processes. Sucrose is the major transport form of assimilates in plants. Sugars can also play an important role in the defense reactions of plants. However, it has been shown that glucose, sucrose, or trehalose-6-phosphate (Tre6P) can regulate a number of growth and metabolic processes, acting independently of the basal functions; they can also act as signaling molecules. Changes in the concentration, qualitative composition, and transport of sugars occur continuously in plant tissues, during the day and night, as well as during subsequent developmental stages. Plants have developed an efficient system of perception and transmission of signals induced by lower or higher sugar availability. Changes in their concentration affect cell division, germination, vegetative growth, flowering, and aging processes, often independently of the metabolic functions. Currently, the mechanisms of growth regulation in plants, dependent on the access to sugars, are being increasingly recognized. The plant growth stimulating system includes hexokinase (as a glucose sensor), trehalose-6-phosphate, and TOR protein kinase; the lack of Tre6P or TOR kinase inhibits the growth of plants and their transition to the generative phase. It is believed that the plant growth inhibition system consists of SnRK1 protein kinases and C/S1 bZIP transcription factors. The signal transduction routes induced by sugars interact with other pathways in plant tissues (for example, hormonal pathways) creating a complex communication and signaling network in plants that precisely controls plant growth and development.

Keywords

glucose; receptor; SnRK; sucrose; sugar signaling; TOR; Tre6P

Introduction

The growth and development of plants is regulated by various factors at different levels. Much research has been recently devoted to deciphering the mechanisms of growth, developmental regulation, and interactions between different signaling pathways in plant cells [1–8]. One of the most interesting aspects has been the demonstration of the regulatory function of sugars – molecules known for a long time to be involved in basal cell metabolism, and which are substrates or products of numerous chemical reactions.

The saccharides in plant tissues are primarily produced from triose-phosphates formed during photosynthesis occurring in leaves. Sucrose and starch, the final products of photosynthesis, can be temporarily stored in leaves, but most of the sucrose pool is transported to the acceptor tissues that do not produce this sugar [9–11]. The

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