

The sugar signalling metabolite trehalose 6-phosphate is a key signal in regulating plant development

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Abstract

Shoot and root branching are regulated by a complex network of phytohormone and sugar-related pathways. Trehalose 6-phosphate (Tre6P) is a sucrose-specific signalling metabolite that has been implicated in the broad regulation of primary metabolism as well as developmental processes. Expressing tagged forms of TREHALOSE-6-PHOSPHATE SYNTHASE1 (TPS1), the main Tre6P-synthesizing enzyme in arabidopsis, revealed that Tre6P synthesis occurs predominantly in the vasculature and meristematic tissues. The vascular expression of TPS1 ideally places Tre6P at the interface between source and sink and at a highly strategic site for systemic signalling of sucrose status. To test this potential of Tre6P as a hormone-like signal, we investigated the impact of localized changes in Tre6P levels in dormant axillary buds and found that lowering Tre6P strongly inhibited bud growth. We further found that changing Tre6P levels in the vasculature modulated flowering and shoot branching, and also had an effect on root size and architecture. Combinatorial mutant analyses, metabolic profiling and RNA sequencing approaches revealed multiple connections between Tre6P and other nutrient and phytohormone signalling pathways, especially strigolactones, allowing us to place Tre6P signalling in the network of hormonal regulation of plant development.