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Towards a FSPM of bud outgrowth for rosebush: experimental analysis of sugar effect.

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Highlights: This study provides experimental data on rosebush to extend the auxin-based FSPM model of bud outgrowth to account for sugar roles. The analysis of the relationship between sugar availability and bud outgrowth at both plant and bud scales showed that sugar availability is able to decrease apical dominance by reducing the lag time before bud outgrowth.

Keywords: bud, light, sugar, apical dominance, Rosa hybrida

Outgrowth of axillary buds is a critical process of plant architectural plasticity, by which plants adapt to environment and growing constraints. FSPM based on experimental data is a potential powerful tool to understand bud outgrowth regulation at the plant scale, which involves several internal and external factors (Evers et al., 2011). By including in a FSPM experimentally-described molecular processes, Prusinkiewicz et al. (2009) have demonstrated the role of auxin canalization in regulating bud outgrowth at plant scale. To complete this model, accounting for sugar role is required, since they are critical for bud outgrowth and their availability within plants is sensitive to environment (Henry et al., 2011). Such development requires a preliminary experimental quantification of sugar effect on bud outgrowth.

This study assesses the relationship between bud outgrowth and sugar availability for rosebush primary shoots by experiments at plant and bud scales. In a first experiment, a branching-responsive cultivar was grown in growth chamber under three PAR treatments known to induce contrasted final outgrowth percentage (Demotes-Mainard et al., 2013). Spatio-temporal patterns of different sugar types and of bud outgrowth were quantified. In a second experiment, single-node cuttings were grown *in vitro* to quantify the response of single buds to various sugar supply levels.

In experiment 1, PAR treatments resulted in contrasted sugar spatio-temporal patterns within primary shoots. In particular, the abrupt transfer of plants to high PAR after temporary low PAR resulted in a doubling in total sugar amount available for buds compared to continuous low or high PAR. In all treatments, buds grew out sequentially in the basipetal direction due to apical dominance; but, while the lag time between two successive outgrowths along the shoot was high under both continuous low and high PAR, it was drastically reduced when plants were transferred from low to high PAR. There was thus a positive relationship between sugar availability and the basipetal propagation rate of bud outgrowth along the shoots. In experiment 2, high sugar feeding of single buds was able to alleviate auxin inhibitory effect by increasing outgrowth percentage and/or reducing the lag time before bud outgrowth, depending on sucrose:auxin ratio.

By quantifying that sugar availability is able to decrease apical dominance by reducing the lag time before bud outgrowth, this study provides valuable information to extend the auxin canalization model of Prusinkiewicz et al. (2009) and to build a comprehensive FSPM of branching.

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