Sucrose interacts with auxin in the burst of axillary buds

Jessica Bertheloot, François Barbier, Frédéric Boudon, Maria Dolores Perez-Garcia, Thomas Péron, Christine Beveridge, Christophe Godin, Soulaiman Sakr

Sucrose interacts with auxin in the burst of axillary buds

Jessica Bertheloot[(1)], François Barbier[(2,5)], Frédéric Boudon[(3,4)], Maria-Dolores Perez-Garcia[(2)], Thomas Péron[(1)], Christine Beveridge[(5)], Christophe Godin[(4)], Soulaiman Sakr[(2)]

[(1)]INRA, UMR IRHS, Angers, France
[(2)]Agrocampus-Ouest, UMR IRHS, Angers, France
[(3)] CIRAD, UMR AGAP, Montpellier, France
[(4)]Inria Virtual Plants team joint with CIRAD and INRA, Montpellier, France
[(5)]The University of Queensland, St. Lucia, Australia

Research focus. Branching is an important process for productivity (number of productive branches) and for visual quality of ornamental plants (branches spatial arrangement). But branching behaviour is difficult to predict due to the lack of knowledge on the all mechanisms regulating the plasticity of the burst of axillary buds. Auxin has an inhibitory action on bud burst and interacts with cytokinins (CKs) and strigolactones (SLs) [1]. Our study focuses on understanding and modelling how a newly-identified player, sugars [2,3], interact with the hormonal network to control bud burst.

Methods. Experiments consisted in cultivating nodal stem segments of rosebush *in vitro* with different sucrose and auxin levels, and in quantifying bud elongation, CK level, and the expression of genes involve in SL biosynthesis and signalling. From these data, we designed and calibrated a computational model accounting for sucrose modulation of bud inhibition by auxin.

Results. We observed that increasing sucrose level decreased the inhibition of bud elongation by auxin, so that buds fed with high sucrose level were less inhibited by a given amount of auxin than those fed with low sucrose level. In accordance with literature, auxin repressed CKs and stimulated the expression of SLs biosynthesis genes. We demonstrate that the main effect of sucrose was to repress SL signalling. The model developed from these results reproduced the combined action of sucrose and auxin on bud burst. We validated it for its capacity to predict the effect of external CK supply for different sucrose levels.

Conclusions. Our study proposes for the first time a physiological model of the effect of sucrose on bud regulation by auxin at the scale of the bud. Initially observed for rosebush, our results were also validated in pea, demonstrating model genericity. Next step is to understand the role of sugars, together with hormones, in the spatio-temporal regulation of bud burst at the scale of the plant. For that, we will use the computational tool, by coupling our bud model to models simulating sugar and hormone fluxes within a plant architecture.

[1] Rameau, C., Bertheloot, J., Leduc, N., Andrieu, B., Foucher, F., and Sakr, S. (2015). Multiple pathways regulate shoot branching. *Frontiers in plant science* 5. doi: 10.3389/fpls.2014.00741.

[2] Barbier, F., Peron, T., Lecerf, M., Perez-Garcia, M.D., Barriere, Q., Rolcik, J., Boutet-Mercey, S., Citerne, S., Lemoine, R., Porcheron, B., Roman, H., Leduc, N., Le Gourrierec, J., Bertheloot, J., and Sakr, S. (2015a). Sucrose is an early modulator of the key hormonal mechanisms controlling bud outgrowth in Rosa hybrida. *Journal of Experimental Botany* 66**,** 2569-2582. doi: 10.1093/jxb/erv047.

[3] Mason, M.G., Ross, J.J., Babst, B.A., Wienclaw, B.N., and Beveridge, C.A. (2014). Sugar demand, not auxin, is the initial regulator of apical dominance. *Proceedings of the National Academy of Sciences of the United States of America* 111**,** 6092-6097. doi: 10.1073/pnas.1322045111.

Corresponding author: J. Bertheloot, +33 (0)2 41 22 56 32, jessica.bertheloot@angers.inra.fr