BRAM

Project title: Functional-structural modelling of bud burst patterns in rosebush: integration of the role of sugars and hormones.

Acronym: BRAM (BRAnching Modelling)

Project duration: 36 months – Start date: 01/11/2016 End date: 31/10/2019.

Key-words: Bud, Branching, Regulation networks, Dynamical systems, Functional-structural plant modelling, Sugars, Hormones.

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Total cost of the project: 118 k€ (Do not include salaries others than those of the people hired for the project: PhD or post-doc)
Financial support from « Objectif Végétal »: 22 k€. The project benefits from an INRA scholarship.

Summary:

To minimize the impact of agriculture on environment, resource supply should be tightly adjusted to production goals. Computer models predicting plant growth response to environment are powerful tools to optimize resource supply according to plant needs, especially within controlled environments (greenhouses…). Developing such tools implies a better understanding of branching regulation at the plant scale because it is an important variable of plant plasticity that determines productivity and the visual quality of ornamental plants.

The project aims, for the first time, at building a comprehensive model accounting for the role of sugars, together with hormones, in the regulation of bud burst patterns along rosebush primary axis under contrasted light environments. On the contrary to hormones, sugars are a very recently identified player in apical dominance and its mode of action is not known yet. As photosynthetically-derived nutrients, sugars are internal players that have the potential to mediate a part of environmental effects. We propose to develop a new model to understand environmental regulation of branching, calibrated for simple rosebush plants under different light environments. Such model will be defined in a generic way to be adapted easily to other economically important species. It will also open new prospects to understand branching behavior of adult plants, and later, to apprehend the complexity of urban environment and its effect on plant architecture.

The methodology will consist in implementing physiological processes common to different species in a computer functional-structural model. We have recently developed a model at the bud scale that simulates bud burst response to both sucrose and hormones. This bud model will be integrated in a plant architecture to simulate bud burst patterns at the scale of the plant. For that, we will couple the bud model with simulation of spatial and temporal dynamics of hormones and sugars within plant architecture. This involves the use of existing models of sugar and hormone dynamics, and requires physiological and molecular experiments to gain knowledge about how sugars interact with hormonal network. Such a multidisciplinary approach will be achieved through a consortium between biologist experts in the physiological regulation of bud outgrowth (ARCH-E) and computer scientists with strong expertize in modelling of plant morphogenesis (Inria Virtual Plants).