Postdoctoral position available in Marseille (IUSTI Laboratory), France

Long-distance signalling in plants: Do hydraulic pressure pulses induce growing responses?

Plants display mechanical-induced morphological responses, called thigmomorphogenesis, in order to respond and acclimate to mechanical loadings like the deformation due to the wind. A fascinating feature of this response is that it is not only local but also nonlocal: bending a stem or a branch induces a rapid arrest of the growth far away the stimulated area, suggesting a distance signalling across the whole system. The origin and nature of this long distance communication is still not understood and remains a major scientific challenge for understanding the growth modulation in plants.

Recently, it has been proposed that this signal could be purely mechanical and could involve pressure pulses generated by the coupling between mechanics and hydraulics within the vascular plant network (Lopez et al, 2014). Using a biomimetic approach, we have understood the physical mechanism of generation of such hydraulic pulses in both artificial and natural tree branches (Louf et al, in preparation). However, two key questions remain open: (1) Is this physical mechanism restricted to woody plants or universal across the plant kingdom? (2) Do these hydraulic pulses act as a new long-distance communication mechanism in plants?

This post-doctoral position aims at addressing these questions to solve the last “missing chain“ of the hydraulic pulse hypothesis, i.e. to establish the link between the hydraulic pressure pulse and the physiological response of the plant. In the first part of the project, the applicant will extend the study of hydraulic pulse generation to soft green plants, by performing experiments with the model plant Arabidopisis. A dedicated micro-fluidic pressure probe system will be developed to monitor the pressure and flow rate in the vascular system of the plant in response to a bending stimulus. In the second part, the applicant will develop a novel experimental device that will be able to generate transient and controlled hydraulic pulses in growing plants while accurately monitoring their growth (using 3D kinematics and imaging techniques). Collaborations with biophysicists and molecular biologists at the PIAF laboratory (INRA, Clermont-Ferrand) will be organized to transfer these results from small plants to small trees (poplars) and study their molecular and physiological responses.

This interdisciplinary project, combining physics and biology, is supported by the ANR (the French National Research Agency, project ARTIS) and the ERC (European Research Council, project PLANTMOVE). A minimum of two-year funding is available (about 50 k€ per year depending on experience). The candidate should be an experimentalist with good general knowledge in fluid/solid mechanics and a strong taste for plant biology and interdisciplinary works. Expertise in biomechanics/biophysics/micro-fluidics/soft matter physics will be an asset.

Contacts:

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