



Mecano

Mechanobiological responses of roots to obstacles

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Summary

Context —

The root system although hidden, plays several fundamental roles for the tree fitness and the ecosystem functioning. Bad rooting due to hard layers or soil compaction hampers stress resistance and may have significant economic impacts. In this context, it is crucial to understand the limitations to root growth in soils. At a fine scale, soil is physically heterogeneous and the growing root has to cope with obstacles of various size and rigidity. The mechanical stress of the obstacle on the root then induces biological regulations that can be qualified as mechanobiological responses.

Objectives —

The overall aim of the Mecano project is to understand the dynamics of the biophysical regulations and their underlying molecular pathways that help the root to overcome obstacles in soils.

Approaches —

The poplar adventitious root is nearly insensitive to gravity. We will take advantage of this property to avoid the interference of gravitropism with the developmental response to a mechanical stimulus. By using an experimental set-up designed to impede root growth by a frontal force while monitoring both root growth and the resisting force, we will study the dynamics of growth variations in response to different durations of root blockage and following the release of the mechanical stress. We will complete this growth analysis by determining the kinetics of two biophysical traits involved in cell expansion, the osmotic potential and the cell wall extensibility. The experimental approach will be completed by a modelling one, tempting to predict the long term dynamics of growth. At last, a transcriptomic approach will seek the molecular responses induced by the mechanical stress, without interference with gravitropic responses.

Expected results and impacts —

By gathering physiological, biomechanical and transcriptomic approaches, this work will improve our understanding of the root growth regulation in hard soils.