

Root for Ever

Root development: to grow or not to grow?

ABSTRACT

Crop root system architecture influences plant development and nutrition. Root initiation and subsequent growth are two key factors impacting the elaboration of this architecture and its adaptation to environmental cues.

Little is known about the mechanisms regulating lateral root growth plasticity in other plant species than Arabidopsis, such as white Lupin

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Project type : AAP

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Flagship project : no

Project leader : Patrick Doumas

Project leader's institution : INRA-INRAE

Project leader's RU : BPMP

Budget allocated : 17000 €

Total budget allocated (including co-financing) : 17000 €

Funding : Labex

GOAL

In the present project, we propose to compare two phenomena, determinate versus indeterminate root growth, in order to develop novel strategies to control root architecture responses. This exploratory work aims at investigating the gene regulatory network regulating lateral root meristem activation and maintenance in two biological systems and using two experimental strategies. On the one hand, transcriptomic kinetics and inference algorithms will be used to infer the gene regulatory network regulating lateral root meristem activation in Arabidopsis. On the other hand, the transcriptome of indeterminate lateral roots versus determinate cluster roots in white Lupin will be compared in order to identify master genes controlling this meristem property. Crossing these two original approaches should lead to the identification of genes involved in the differential fate of lateral root like organs.

ACTION

The main objective of this project is to identify new genes controlling the determinate (white Lupin) versus indeterminate (Arabidopsis) nature of root development :

Identification of the gene regulatory network operating during Arabidopsis lateral root meristem
Transcriptome comparison from RNA-Sequencing (RNA-Seq) analysis of a kinetic approach of root development from cluster roots and from lateral roots of the same plants
Comparison of the outputs of the previous approaches

RESULTS

This project is expected to yield :

- the predicted topology and dynamics of the gene network operating during lateral root activation in Arabidopsis,
- the production of transcriptomic datasets covering lateral root and cluster root development in the crop model white Lupin,
- the identification of candidate genes possibly involved in controlling the determinate or indeterminate root growth behaviour in that species.

This will bring new fundamental knowledge about developmental plasticity and especially, about the adaptation mechanisms of root developmental program to environmental constraints.

PERSPECTIVES

It becomes an essential issue to obtain plants with an enhanced nutrient efficiency and able to grow in challenging environments. In this perspective, our project will give clues to plant breeders to optimize root growth in poor soil allowing the exploitation of new soil surfaces. Furthermore comparing the model plant Arabidopsis and the white Lupin crop is also interesting in the plant breeding perspective. White Lupin has exceptional capacities to exploit poor soils and foraging for phosphate. This specificity needs to be studied in order to exploit and develop new strategies for improving plant nutrition in challenging conditions.