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A phenotyping procedure for imaging root hairs on whole root system reveals responses to nutrient availability and to inoculation with PGPR-like bacteria

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Introduction

Breeding new cultivars allowing to reduce the ecological costs of conventional agriculture, including fertilization and irrigation, is a major objective of the research in plant sciences [1]. Root hairs at the root-soil interface provide a major contribution to nutrient and water uptake [2]. Different methodologies for root architecture phenotyping have been described in the literature and implemented on different platforms at the international level [3]. However, these methodologies generally do not take into account the development of root hair zones at the root surface, in particular because of the small size of root hairs, which makes them difficult to distinguish.

Our objectives are:
- To develop a methodology for phenotyping root development and elongation of root hairs.
- To investigate the effect of abiotic (water and nutrient availability) and biotic (inoculation with bacterial strains) treatments on wheat (cv. Oued Zenati) root hair development.

The methodologies developed

A- Root hair phenotyping system (Rhizobox-like system)
B- A developed program to analyse root surface area

The developed methodology allows for instance to reveal root hair developmental responses to low N inoculated versus low N non inoculated conditions. The results obtained indicate that Bradyrhizobium japonicum ORS285 strain can interact with the wheat cultivar (Oued Zenati) by increasing the root hair surface area.

Wheat root and root hair response to low N with or without inoculation with PGPR-like bacteria

C- Root area analysed per distance and depth using ACR program

D- Root and root hair surface area analysed using winRHIZO™ software

Conclusion and perspectives

Such analyses pave the way to screenings of collections of microorganisms (PGPR) in different abiotic conditions (nutrient availability) and to comparisons between wheat genotypes recapitulating wheat domestication in term of root and root hair responses to abiotic stress and efficient interaction with PGPR bacteria.

References: