Year of CfP: 2008

Project No 0802-005 Completed

Project title: Response of natural *Arabidopsis* accessions to salt stress – A French/Chinese initiative

Unit managing the project: BPMP, Plant Molecular Physiology and Biochemistry (Montpellier SupAgro, INRA, CNRS, UMII)

Project leader: Christophe Maurel (maurel(a)supagro.inra.fr)

Country involved in the project: China

Sub-thematic axis: IPB-1 (Integrative Plant Biology 1: *Genetics and genomics, plant breeding, ecophysiology*)

Objectives:

Environmental constraints (and water stress in particular) represent major limitations for crop production worldwide. In particular, these constraints manifest their effects by harming plant water status. Understanding molecular mechanisms that are involved in water stress perception and signaling and eventually trigger adjustments of plant water relations is a scientific challenge of prime importance.

The aim of this project is to explore the use of a recently identified natural accession of *Arabidopsis thaliana*, as a unique material to identify master regulators of plant responses to water stress. This approach is based on the atypical regulation of root hydraulic conductivity exhibited by this accession in response to salt stress. The genetics of this trait and transcriptomic responses of the accession of interest will be investigated.

This project will be conducted in collaboration between the BPMP unit in Montpellier and a Chinese group working at the Shanghai Institute for Biological Sciences. These two groups share a common interest for the study of stress responses in *Arabidopsis*. Two Chinese scientists will visit the Montpellier unit: a senior scientist for one week, and a post-doctoral student for nine (9) months.

Action carried-out and results obtained:

SCIENTIFIC PROGRAMME: Previous studies on 13 natural accessions of Arabidopsis have revealed a marked variability of the water transport properties (i.e. hydraulic architecture) of the roots of these plants. In this project, we have combined molecular and biophysical approaches to characterize the response to salt stress of the roots of 5 of these accessions. Measurements of the root hydraulic conductivity (Lpr) by means of a pressure chamber technique revealed that this parameter shows a typical inhibition in response to salt in all accessions, except in one (Y) which shows a unique Lpr up regulation. To refine these analyses, we have measured the hydraulic conductivity of root cortical cells (Lpcell) using a cell pressure probe. These measurements turned out to be very difficult in salt stress conditions, because the cell turgor is then very low. Nevertheless, we were able to show that salt stress down regulates cell water transport in 3 of the 5 investigated accessions. The accession Y, and another one (Z), did not show any Lpcell reduction. This cell assay points to a novel aspect of the natural variability of salt stress responses in *Arabidopis*. Our analyses indicate however that the whole root and cell levels do not reveal similar variability profiles. This discrepancy may be explained by differences in root suberisation that were also observed among accessions. To search for molecular markers of root hydraulics in normal and stress conditions, the expression in roots of 17 aquaporin genes was also characterized by quantitative RT-PCR. The regulation of these genes in response to salt stress was not different between the 5 accessions of interest. By contrast, a study in 13 accessions grown in standard conditions revealed that 2 aquaporin genes can be taken as relevant markers of the , Lpr. In

conclusion, our set of physiological and molecular data reveals a high diversity of hydraulic strategies in the roots of Arabidopsis plants grown in standard or salt stress conditions. The aquaporins but also certain anatomical and morphological characteristics of the root contribute to this diversity of functional adaptations.

COOPERATION INITIATIVES: The junior scientist (Dr Guowei LI) started his stay in France on December 1st, 2008. After 9 months devoted to the present project, he now continues his stay in our laboratory within the frame of an ANR project. The senior scientist (Dr Weining Sun) stayed in Montpellier from May 24 to May 31, 2009. She delivered a seminar and visited 5 local laboratories. The French group leader (C. Maurel) traveled to China to attend the international InterDrought III congress (http://www.interdrought.org/index.jsp) and visited the partner laboratory in Shanghai at this occasion.

Publications:

Moira Sutka, Gwowei Li, Julie Boudet, Yann Boursiac, Patrick Doumas, Christophe Maurel (Mar 2011) Natural variation of root hydraulics in *Arabidopsis* grown in normal and salt-stressed conditions. Plant Physiol. 155(3):1264-1276.

Prospects for the future:

This work has led to a very precise description of root hydraulics in Arabidopsis. In particular, it revealed a marked natural variability of this function. We could not confirm the idea that the previously identified Y accession could be a unique material for studying the response of plants to salt stress, as only Lpr but neither Lpcell nor aquaporin gene regulation showed an atypical regulation. By contrast, the identification of gene markers for Lpr, in combination with an increased throughput of Lpr measurements, pave the way to exploring water transport in the Arabidopsis root by quantitative genetics. The present project also reinforced the cooperation with our partner laboratory in Shanghai and allowed to recruit valuable collaborators for other projects in our laboratory.

Total Agropolis Fondation funding: € 37,358 (salary of a Chinese Junior scientist for 9 months, travel expenses for 2 scientists between France and China)

Funding categorie(s): Agropolis Fondation visiting fellowship, Agropolis Fondation small grants (support for exploratory, risky and innovative projects)

Project duration: 23 September 2008 – 22 September 2009

Keywords: *Arabidopsis* – salt stress – water stress – transcriptomics