French-Chinese cooperation on plant salt stress

The response of natural Arabidopsis accessions to salt stress - A French-Chinese initiative

ABSTRACT

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 upregulation. 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 downregulates 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.

Keywords : Plant, Operation, Abiotic stress, Gene expression, Arabidopsis (species), root

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PERSPECTIVES

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.