Phosphorus requirement for symbiotic N2 fixation: a major challenge for sustainable agro-ecosystems

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PHOSPHORUS REQUIREMENT FOR SYMBIOTIC N_2 FIXATION: A MAJOR CHALLENGE FOR SUSTAINABLE AGRO-ECOSYSTEMS

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Low phophorus availability in about 40% of the world's arable land limits crop yield, most particularly for leguminous crops when their growth depends upon symbiotic N_2-fixation (SNF). Therefore, our work aims to increase the phosphorus use efficiency (PUE) for SNF, and its contribution to a more effective coupling between the P and N bio-geochemical cycles. *Myo*-inositol hexakisphosphate (phytate) constitutes the main source of organic P in soils, but is unavailable to plants. Phytases are the only phosphatases able to hydrolyse phytate efficiently into inorganic Pi, thus increasing P bio-availability for plants. In this work we show by *in situ* RT-PCR, the expression of a purple acid phytase within the inner-cortex of *Phaseolus vulgaris* root-nodule (Lazali et al., 2014). Also histidine acid- and β-propeller- phytases (HAP and BPP) were found among legume-nodulating rhizobia with major expression in nodule infected-cells. Moreover, phosphoenol pyruvate phosphatase (Bargaz et al. 2012) and trehalose 6P phosphatase (Bargaz et al. 2013) were discovered in nodules with puzzling localization. The nodular expression of all these genes and the enzymatic activity of their products increased significantly under P-deficiency. They varied among recombinant inbred lines of *P. vulgaris* that were shown to contrast in their PUE for SNF. It is concluded that the differential expression of bacterial and plant phosphatase-genes in nodules offers a new understanding of the N_2-fixing legume physiology and its specific P requirements. The potential of these phosphatase-genes as molecular markers for adaptation of legume crops in low-P soils and their contribution to a virtuous cycle of P and N fertility will be addressed in relation with the interdisciplinary research strategy of the FABATROPIMED federative project of Agropolis Montpellier.

References

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