Phosphorus requirement for symbiotic N2 fixation: a major challenge for sustainable agro-ecosystems
Jean-Jacques Drevon, Josiane Abadie, Laurie Amenc, Adnane Bargaz, Odile Domergue, Mohamed Lazali, Catherine Pernot

To cite this version:

HAL Id: hal-02739325
https://hal.inrae.fr/hal-02739325
Submitted on 2 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers. L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
PHOSPHORUS REQUIREMENT FOR SYMBIOTIC N₂ FIXATION: A MAJOR CHALLENGE FOR SUSTAINABLE AGRO-ECOSYSTEMS

J.J. Drevon¹, J. Abadie¹, L. Amenc¹, A. Bargaz², O. Dommergue³, M. Lazali⁴ & C. Pernot¹

¹- INRA Ecologie Fonctionnelle & Biogéochimie des Sols & Agroécosystèmes, 1 Place Viala, F34060, Montpellier, France.
²- Swedish University of Agricultural Sciences, Department of Biosystems and Technology, PO Box 103, SE-230 53 Alnarp, Sweden.
³- Laboratoire des Symbioses Tropicales et Méditerranéennes, Campus International de Baillarguet, 34398 Montpellier Cedex 5, France.
⁴- Université de Khemis Miliana, Route Theniet El Had, Soufay 44225 Ain Defla, Algérie.

Email: drevonjj@supagro.inra.fr

Low phosphorus availability in about 40% of the world’s arable land limits crop yield, most particularly for leguminous crops when their growth depends upon symbiotic N₂-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 BPP-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 N₂-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 FABATROPI MED federative project of Agropolis Montpellier.
References