Phosphorus use efficiency in symbiotic N2 fixation for coupling bio-geochemical cycles in agrosystems with legumes
Jean-Jacques Drevon, Laurie Amenc, Adnane Bargaz, Thierry Becquer, Didier Blavet, Frédéric Gérard, Odile Domergue, Mohamed Lazali, Mainassara Zaman-Allah

To cite this version:
Jean-Jacques Drevon, Laurie Amenc, Adnane Bargaz, Thierry Becquer, Didier Blavet, et al.. Phosphorus use efficiency in symbiotic N2 fixation for coupling bio-geochemical cycles in agrosystems with legumes. 3. Climate Smart Agriculture, Mar 2015, Montpellier, France. 227 p. hal-02741501

HAL Id: hal-02741501
https://hal.inrae.fr/hal-02741501
Submitted on 3 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 use efficiency in symbiotic N$_2$ fixation for coupling bio-geochemical cycles in agrosystems with legumes

J.J. Drevon$^1$, L. Amenc$^1$, A. Bargaz$^2$, T Becquer$^1$, D Blavet$^1$, F. Gérard$^1$, O. Dommergue$^3$, M. Lazali$^4$ & M. ZamanAllah$^5$

$^1$ICIRAD-INRA-IRD-SupAgro Ecologie Fonctionnelle & Biogéochimie des Sols & des Agroécosystèmes, 1 Place Viala, F34060, Montpellier, France. *drevonjj@supagro.inra.fr
$^2$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.
$^5$CIMMYT, Southern Africa Regional Office, Peg Mazowe Road MP163, Mt Pleasant, Harare, Zimbabwe.

Fewer chemical inputs, as fertilizers or control of diseases, becomes of paramount importance for the safety and impact on the environment of agricultural production of food. This implies new requirements with regard to the selection of legume-crop varieties for grain cropping systems. 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 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 in agriculture and forestry. 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 soil-P bio-availability for plants. In this work we demonstrate the existence of phytases, both histidine acid and beta-propeller, among rhizobia nodulating legume spp, and show their expression within nodule infected-cells. Plant phytase-gene expression was also found in nodules, and shown by in situ RT-PCR, to increase significantly under P-deficiency, and to vary among recombinant inbred lines of Phaseolus vulgaris that are contrasting in their PUE for SNF. A subsequent virtuous cycle of P and N fertility will be addressed in relation with the objective of the interdisciplinary research strategy of FABATROPIMED. The overall objective is to increase the benefit of grain-legumes for cereal systems and the environment by promoting the interaction between soil micro-organisms for plants to acquire and use N and P most efficiently. The field activities include a participatory approach with farmers in reference agroecosystems offering a wide range of agroclimatical and socioecological situations.

This work is supported by the Great Federative Project FABATROPIMED of Agropolis Fondation under the reference ID 1001-009.

Key words: bio-geochemical cycles of N and P, ecological intensification, legume crops, phosphorus use efficiency, phytate, symbiotic N$_2$ fixation.