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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 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 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.

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Key words: bio-geochemical cycles of N and P, ecological intensification, legume crops, phosphorus use efficiency, phytate, symbiotic N_2 fixation.