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Which Mechanisms are Involved by Legume-Rhizobia Symbiosis to Increase Its Phosphorus Use Efficiency under Low Phosphorus Level?

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Abstract : Legume species are able to establish a nitrogen fixing symbiosis with soil rhizobia that allows them, when it operates normally, to ensure their necessary nitrogen nutrition. This biological process needs high phosphorus (P) supply and consequently it is limited under low phosphorus availability. To overcome this constraint, legume-rhizobia symbiosis develops many mechanisms to increase P availability in the rhizosphere and also the efficiency of P fertilizers. The objectives of our research works are to understand the physiological and biochemical mechanisms implemented by legume-rhizobia symbiosis to increase its P use efficiency (PUE) in order to select legume genotypes-rhizobia strains combination more performing for BNF under P deficiency. Our studies were carried out on two grain legume species, common bean (Phaseolus vulgaris) and faba bean (Vicia faba) tested in farmers' fields and in experimental station fewer than two soil phosphorus levels. Under field conditions, the P deficiency caused a significant decrease of Plant and nodule biomasses in all of the tested varieties with a difference between them. This P limitation increased the contents of available P in the rhizospheric soils that was positively correlated with the increase of phosphatases activities in the nodules and the rhizospheric soil. Some legume genotypes showed a significant increase of their P use efficiency under P deficiency. The P solubilization test showed that some rhizobia strains isolated from Haouz region presented an important capacity to grow on solid and liquid media with tricalcium phosphate as the only P source and their P solubilizing activity was confirmed by the assay of the released P in the liquid medium. Also, this P solubilizing activity was correlated with medium acidification and the excretion of acid phosphatases and phytases in the medium. Thus, we concluded that medium acidification and excretion of phosphatases in the rhizosphere are the prominent reactions for legume-rhizobia symbiosis to improve its P nutrition.

Keywords : legume, phosphorus deficiency, rhizobia, rhizospheric soil
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