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P237

Diversity of arbuscular mycorrhizal fungi and P-solubilising bacteria in rubber tree rhizospheres in Thailand

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Rubber tree (*Hevea brasiliensis*) is a crop of major importance for smallholders in Southern Asia because it produces latex, a substantial source of income for farmers. Rubber tree can grow on very poor soils (sandy soils, low fertility, subject to erosion and leaching of applied fertilizers), which are unsuitable for other commonly cultivated cash crops. It covers 2.7 million ha across Thailand, but its establishment in areas with very poor soils, especially in Northeast Thailand, represents a major potential for increased production. The important roles of rhizosphere microbial communities in supporting soil fertility and plant nutrition has been widely recognized. In particular, root-interacting P-solubilizing bacteria (PSB) and arbuscular mycorrhizal fungi (AMF) contribute to plant P nutrition by increasing mineral nutrient availability and by enhancing plant nutrient uptake. The diversity of AMF in roots and of PSB in rhizosphere soil was assessed along a chronosequence of rubber tree plantations (3, 6 and 16 year-old) and compared to cassava fields. AMF diversity was assessed by 454 sequencing of SSU 18S rDNA. PSB strains were characterized after culturing on selective media. AMF communities in cassava roots were twice as rich as in rubber tree samples. AMF diversity was not affected by the age of rubber trees, but was related to the soil P content. The improved understanding of the diversity of root- or rhizosphere-associated microbes will contribute to the development of alternative sustainable practices to improve and sustain soil fertility.

P238

The role of plant and bacterial organic anion production in plant access to insoluble organic phosphorus

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The inefficient use of phosphorus (P) in agricultural systems has led to the global depletion of mineral phosphate supplies and surface water pollution. External fertilizer requirements and nutrient loss could be minimized by improving crop access to native soil P. Phytate (IHP) is the dominant organic P compound in most soils and is converted to plant-available orthophosphate (Pi) by plant or microbial phytases. The bioavailability of insoluble IHP may be improved in the presence of low molecular weight organic anions (OAs) from plant or microbial sources. The influence of plant and bacterial OAs on the solubility and bioavailability of IHP was assessed in tobacco (*Nicotiana tabacum*) grown on insoluble P sources (IHP, Pi), which were either sorbed to goethite (Gt) or precipitated with calcium (Ca). Wild-type (WT) tobacco was transformed to over-express *Peniophora lycii* phytase (PHY) and Multidrug-And-Toxic-Compound-Extrusion-type transporters (CIT), leading to increased phytase activity (33-fold) and citrate exudation (2.6-fold), respectively. Consistent with exudate characteristics, PHY plants accessed 4-fold more P from Gt-IHP, whereas CIT plants incorporated 2-fold more shoot P relative to the WT. The PHY plant-line incorporated >20-fold more shoot P compared to other plants grown on Ca-IHP. Transgenic plants inoculated with *Pseudomonas* sp. incorporated >7-fold more P from Ca-IHP, suggesting a synergistic effect of plant exudates and microbial products on plant acquisition of insoluble organic P. A combined strategy of P solubilization and hydrolysis is therefore suggested as a suitable target for improving crop utilization of native soil P.