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Effect of nitrogen form, pH and plant species in the mobilization and acquisition of P from a recycled phosphorus fertilizer

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Abstract: World phosphorus resources are limited. Therefore recycling of phosphorus from waste materials is important, and struvite (MgNH4PO46H2O) is a common precipitate recovered from waste water treatments or during anaerobic digestion of manure. Our approach is to evaluate how mobilization of phosphorus may differ when two different species (narrow–leaved Lupin and Maize) are grown in an acidic or alkaline sand with phosphorus added as either struvite or as superphosphate. Nitrogen was applied as ammonium or nitrate as an important factor that could affect phosphorus availability by changing soil pH. The parameters to evaluate the mobilization of phosphorus from struvite were phosphorus uptake, phosphorus present in the soil and comparison of plant performance within the different treatments. Lupines are capable of symbiotically fixing atmospheric nitrogen, as well as to release phosphate-mobilizing carboxylates. These two traits make lupines good candidates forstudying nutrient mobilization in the rhizosphere. In order to observe if citrate (mimicking root exudates) was able to make the P from the struvite more available compared with water, our study also included a flushing experiment with citrate in columns filled with two different sands of acidic and alkaline pH mixed with struvite. We predict that lupine growing on alkaline sand will have better access to phosphorus in struvite (than on acidic sand) due to its ability to acidify the rhizosphere via exudation of carboxylates. Thus we expect lupine to have higher biomass when growing on alkaline sand with an ammonium supply.

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