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Efficacy of struvite as a phosphorus source for alfalfa in organic cropping systems

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Soil phosphorus (P) deficiency is common in organic cropping systems in which access to manure or other suitable P sources is limited. Insufficient P supply may be particularly detrimental to crop yields in systems relying on biological nitrogen fixation by legumes. High-purity struvite (magnesium ammonium phosphate hexahydrate) recovered from wastewater is gaining attention as a potential P source for organic crops, but little is known about the soil-crop dynamics associated with struvite application to legumes in organic cropping systems. Our objective was to assess the effect of struvite application on alfalfa productivity, P uptake, and apparent fertilizer recovery efficiency in soils with low soil test P (STP) under both field and controlled conditions. A field experiment was conducted in Manitoba, Canada (clay soil, pH 8, Olsen-P 2-3 mg kg⁻¹), in which an existing alfalfa-grass forage stand was amended with differential rates of granular struvite and monitored over three growing seasons. A complementary pot experiment compared alfalfa response to differing rates of struvite application, relative to a soluble P fertilizer (monoammonium phosphate, MAP), in two low-STP but otherwise contrasting soils (clay texture, pH 8.0, organic matter 5.6%, Olsen-P 6 mg kg⁻¹; sandy loam texture, pH 7.1, organic matter 3.2%, Olsen-P 10 mg kg⁻¹). Struvite application increased forage shoot biomass yield and P concentration in the field experiment, with larger yield gains relative to the control in the second and third growing seasons. Apparent fertilizer P recovery was 26-27% over three growing seasons, regardless of struvite application rate. In the pot experiment, alfalfa yield was similar for plants fertilized with struvite or MAP but differed with soil type. Overall, our results indicate that struvite is an effective P source for organically grown alfalfa and can help to alleviate P deficiency in organic cropping systems.