Struvite – Agronomic evaluation of a recycled phosphorus fertilizer

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Phosphorus (P) is an essential and non-substitutable plant nutrient required for high-yield agriculture. However, phosphate ore deposits are finite and increasingly contaminated with cadmium and uranium. The EU is completely dependent on imports of this limited resource, and has therefore classified P as a critical raw material in 2014. Recycling of P from alternative sources like P-rich waste streams (wastewater and sewage sludge) can contribute to substitute some of the imports and meet future demand for P.

One P recycling product from wastewater treatment is struvite ($MgNH_4PO_4 * 6 H_2O$), a hardly water-soluble but fully plant available salt.

The aim is to use the struvite as a fertilizer in agriculture, thus closing nutrient cycles. As part of the BMBF-project 'RePhoR - P-Net', we are investigating the agronomic performance, as well as the nutrient and contaminant (heavy metal and antibiotics) levels of different struvites and struvite-based fertilizers in comparison with conventional P fertilizers. The struvite-based fertilizers used here were developed within the project and include ground pure struvite, pure struvite in pelletized and granular form, as well as struvite blended with a mineral compound fertilizer in pellet form.

In a three-month greenhouse pot trial with *Lolium multiflorum,* ground pure struvite showed a fertilization effect comparable to conventional triplesuperphosphate in two different low-P growth substrate mixtures, independent of soil pH, over all three cuts.

Based on these results, nine large-scale on-farm trials with a duration of one to three years were set up with pelletized and granulated struvite-based fertilizers and the farmers' standard fertilization as a reference. The fertilizers were placed close to the seed during sowing, applying the sowing technique of the respective farmers. In contrast to the greenhouse pot trial, the on-farm trials did not show a clear effect of struvite-based fertilizers on dry matter yield (DMY) of maize/corn and potatoes. Compared to the reference fertilizer, struvite fertilization resulted in significantly higher DMYs on some experimental fields but significantly lower DMYs on others.

These variable results are probably related to different soil pH and soil P levels of the experimental fields. To clarify this, a further greenhouse pot trial with granulated and pelletized struvite fertilizers under defined soil conditions will be carried out in the course of the project.