PHOSPHORUS IMMOBILIZING AMENDMENTS TO SOIL

2011 authors: W.J. Chardon and J.M. Dorioz

Description

The solubility of phosphorus in the soil is reduced by adding a substrate that contains P sorbing compounds, with the aim of reducing the risk of dissolved P losses.

Rationale, mechanism of action

When the P content of a soil is high this can lead to large losses of dissolved P to surface or ground water. Lowering the solubility of P by adding a substrate that contain a large amount of iron (Fe) or aluminum (Al) compounds will lead to a decrease of the P pools in soil that are most vulnerable to leaching, and decreases the risk of losses of dissolved P. Examples of materials with a high content of Al and/or Fe are red mud, a waste product from the production of Al [1], and biosolids like municipal sewage sludge [2], alum treated poultry litter [3,8], and drinking water treatment residual [4].

In the past, research on the use of Al/Fe-rich compounds started with the aim of increasing the efficiency of P application and reduce P loss from sandy soils in Australia [5] or to reduce P loss from peat soils in Germany [1]. Later, research was done on the possibilities that applied waste products could immobilize soil P and thus reduce yield [6,7], so immobilization was seen as a negative side-effect. More recent research is focused on immobilizing soil P, especially in over-fertilized soils [2,3,8]. The use of Fe/Al-salts has often the purpose of purification, in order to separate solid and liquid fractions, e.g. for municipal water treatment [2], production of drinking water from ground or surface water [4], or separation of liquid and solid fraction of animal manure [9, link to factsheet]. Also, Fe is used for binding volatile and corrosive sulfur compounds that are formed during anaerobic biogas production from animal manure or biomass [10,11]. Since rest products of these processes are often nutrient rich their agricultural use is common in many countries. Although the impact of the application of these rest products on P losses from soils should receive attention, there is reason to believe that, on a short term, in Europe this type of temporarily binding of soil P will not be seen as a sustainable solution.

Applicability

The measure will be most effective when applied on soils with a very high P availability in the top soil. On these soils vegetative mining of P [12] may take a very long period so this option is less applicable. No specific skills or technical equipment is needed, other than for application of solid materials like sludge. Application of Fe/Al-rich material to buffer zones could be investigated.

Effectiveness, including certainty

When transport of dissolved P via runoff or via preferential flow is important on a site, the effectiveness can be high; this can be the case with artificially drained soils or soils with a high ground water table. When transport of particulate P is important erosion control [see link] must also be applied. However, it can be assumed that the bioavailability of eroded particle bound P is also reduced by addition of immobilizing agents; further investigations are needed to evaluate this assumption. When Fe is the main component in the immobilizing material remobilization can occur in surface water under anaerobic conditions.

Time frame

A reduction in mobile P forms can take place within months after application.

Environmental side-effects / pollution swapping

Besides Fe/Al some biosolids can contain large amounts of heavy metals. In that case, plant availability of these metals must be monitored.

Relevance, potential for targeting, administrative handling, control

The option can be relevant for all fields where P status is far above optimal for crop growth, especially when P export due to leaching to ground water or surface water is significant. Control can be done on a decrease in easily extractable P forms.

Costs: investment, labor

No additional labor costs or investments are known other than costs of spreading a material and incorporating it into the soil layer where immobilization is wanted.

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