USE OF SOIL STABILISERS

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Description
Soil stabilisers improve soil structure, strengthen soil aggregates and improve water infiltration and can result in reduced P leaching. In addition, calcium and pH are factors that control the chemical mobility of P in terms of precipitation and chemical complexation mechanisms. Therefore P losses via surface run-off and drainage and in both dissolved and particulate form may be reduced after liming. In addition to lime granules, local materials (e.g. waste products from industries) and even sludge from waste water treatment plants may be used as stabilising agents.

Rationale, mechanism of action
The soil must have a structure that can gently absorb rain or snowmelt water rather than allowing rapid flow through the soil and out into the drains. The latter, channel flow, means that large amounts of P are carried out to lakes and streams. In addition P is directly precipitated by the added lime [1,2].
Several forms of calcium phosphate (Ca-P) are also supplied to the soil by common mineral fertilisers. Accumulation of Ca in the soil can also occur as a result of net accumulation from manure [3]. This can increase the exchangeable Ca in soils and thus decrease the release of mineral-bound P [4]. If the manure is rich in Ca, long-term addition can lead to the formation of Ca-P precipitates in the soil [5] and can be followed by formation of secondary P minerals and of calcium-phosphorus complexes. The presence of Ca-P complexes in the fine soil fractions was indicated from a non-calcareous soil that historically had received much pig slurry [6]. However, addition of manure is also succeeded by organic acids known to occur during decomposition of the manure [7] and the addition of organic manure may therefore primarily cause a more direct increase in P availability. The presence of these acids is known to delay the crystallisation and formation of Ca-P complexes and Ca-P minerals [8] but they can form complexes with iron (Fe) and aluminium (Al) and reduce the number of sites for P sorption [9].
Alum sludge is produced in water treatment plants when the raw water is treated with aluminium sulphate to precipitate organic and inorganic material. When sludge is applied to soil, the aluminium has been indicated to decrease the plant available phosphorus in two Swedish soils [9].

Applicability
The liming measure is highly appropriate for acid soils.

Effectiveness, including certainty
Reduced leaching of dissolved reactive P has followed from addition of sludge

Time frame
This measure should be evaluated after a long time, since improving the soil structure and the long-term effects of limed backfilling of drain tiles have not been monitored in field experiments.

Environmental side-effects
With liming increased mineralisation of N and P may become a goal-conflict since this may increase N and P leaching. Sludge addition may increase heavy metals and other harmful elements in the soil. Therefore quality demands are set for sludge applied to arable land.

Relevance, potential for targeting
The measure is locally relevant. Limed back-fills were subsidised in Finland but did not reach the target.

Costs: Investment, labour
Liming generally involves high costs. Transport costs for sludge are high.

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