

A rainfall simulation study on P removal in buffer zones amended with Fe and Ca compounds

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Although vegetated buffer zones (BZs) along water courses decrease total losses of sediment and phosphorus (P) from field surface runoff, they appear ineffective in reducing dissolved reactive phosphorus (DRP) losses from boreal clayey soils. After soil freezing and thawing in spring, DRP losses can be considerable and they may even increase on BZs. To improve DRP retention, we added Fe and Ca containing compounds to the surface of BZs: gypsum ($\text{CaSO}_4 \times 2\text{H}_2\text{O}$), Fe-gypsum, ground calcium carbonate (CaCO_3) or granulated ferric sulphate (Ferix-3).

Altogether 40 undisturbed surface soil columns (depth 7 cm, $\text{Ø}=24$ cm) were cored from two BZ sites located on clay soils at Jokioinen and Pöytyä, SW Finland, in November 2008. Phosphorus status in surface soil (0–2 cm) measured by the method of NH_4 -acetate acetic acid was 'fair' (6.4 mg L^{-1}) and 'excessive' (47 mg L^{-1}) in Jokioinen and Pöytyä, respectively. Gypsum (6 t ha^{-1}), Fe-gypsum (8.5 t ha^{-1}), CaCO_3 (3.3 t ha^{-1}) or Ferix-3 (0.67 t ha^{-1}) was spread on surface of four replicate soil samples, whereas eight samples served as untreated controls. Simulated rainfall (5 mm h^{-1}) was applied indoors to presaturated samples. After that, the soil samples were frozen (1–2 months), thawed (20 h, $+6^\circ\text{C}$) and a second simulated rainfall was applied. A third rainfall was given after yet another freeze-thaw cycle. During each rainfall simulation, surface runoff was collected and analysed for DRP, total P (TP) and suspended solids.

Freezing and thawing increased the DRP concentration of control treatment up to 13-fold. For the samples treated with Fe and Ca compounds, the removal efficiency for DRP was increased in the order: gypsum < CaCO_3 < Ferix-3 < Fe-gypsum. Both Ferix-3 and Fe-gypsum retained 74–85% of DRP and 47–64% of TP, whereas gypsum and CaCO_3 were not effective in the retention. Ferix-3 also retained 45% of suspended solids from surface runoff of Pöytyä soil columns.