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## Structure liming and omitting ploughing as measures to reduce agricultural nutrient loading to surface waters

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**H**igh losses of soil and total phosphorus (TP) have been shown to occur from tine-cultivated and mouldboard-ploughed soils in clay soil areas, especially from soils with a weak soil structure in Scandinavia. Structure liming with burnt lime (CaO) causes an immediate reaction between CaO and clay. Adding CaO at a rate of 5 t ha<sup>-1</sup> to a marine clay soil south of Stockholm doubled aggregate stability, expressed as readily dispersed clay (RDC). A two-year plot experiment at the same site revealed a clear reduction in TP leaching via tile drains, mainly in the form of particulate phosphorus (PP), after structure liming at the same rate. Overall, TP leaching declined significantly from 0.22 to 0.085 kg t<sup>-1</sup> year<sup>-1</sup> related to harvested amount of barley. Omitting ploughing and only cultivating in autumn did not decrease TP losses, but reduced nitrate-nitrogen (NO<sub>3</sub>-N) losses at the site in the second year.

Omitting ploughing in autumn and continuous crop cover are generally used to control soil erosion. In one example, estimated particulate P (PP) losses from a tile-drained, heavy clay soil in SW Sweden were 2 kg ha<sup>-1</sup> in wet winters, but undersown green manure or undisturbed stubble reduced these losses by on average 42% over 4 years. In Norway, ploughing and shallow cultivation of sloping fields in spring instead of ploughing in autumn has been shown to reduce particle transport by up to 89% on soils with very high erodibility. Particle erosion from clay soils has been estimated to be reduced by 79% by direct drilling in spring compared with autumn ploughing. However, the results regarding the effect of reduced tillage during autumn on losses of dissolved reactive P (DRP) are contradictory, indicating that erosion control measures should be further evaluated for fields with a low erosion risk.