PLOUGHING TO REDUCE STRATIFICATION AND SHALLOW MACROPORES

2011 Authors: B. Ulén, M. Bechmann, T. Krogstad

Description
Through tillage, any stored surplus of P in the upper topsoil layer is mixed into deeper layers, thus reducing its effect in creating high P losses via surface runoff. In addition, any macropores in the topsoil are destroyed by the tillage and no longer act as continuous vertical channels for preferential flow down the soil profile.

Rationale, mechanism of action
Applying no tillage limits fertiliser and manure to be mixed into to the soil. This builds a stratified layer of crop nutrients on or near the soil surface. Phosphorus concentrated at the soil surface is vulnerable to extreme rainfall, and runoff events can remove this highly concentrated material from the soil surface. Soil tillage is one way to mix surface soil accumulated P into deeper soil layers and then reduce the P concentration in the topsoil. Soil tillage will also break the continuity of macropores in the topsoil and thus decrease phosphorus transport [1]. If soil tillage operations are not carried out, the macropore flow in certain soils can increase, which in turn often contributes to great P losses into tile drains [2,3].

Applicability
The measure is applicable for some types of silty and clay soils with very high topsoil P concentrations that are prone to surface erosion.

Effectiveness, including certainty.
Nitrogen: Reducing stratification has no positive effect on N leaching but may pose a risk by increasing N mineralisation.
Phosphorus: A weak positive indication of reducing stratification has been demonstrated on a Swedish clay soil [4]. Similarly, a number of studies have shown that P losses are lower in tilled soil compared with undisturbed soil [5]. However, there are also studies showing that soil tillage does not have this effect because of enhanced possibilities for surface soil erosion especially in cold climate and snow melting periods. On areas of high erosion risk, improved soil structure with reduced risk of erosion and P losses is mainly obtained by no till. On areas of low erosion risk, ploughing may create reduced risk of surface P losses by reducing soil P status and plant residues on soil surface and also less macropore transport and hence, reduced risk of P losses.

Time frame
The effect of ploughing to reduce continuous macropores is short term. Long-term tillage reduction and increased crop residues provide the greatest benefit to the soil over time. Up to seven years of continuous management may be required before the full benefits of these practices can be realised.

Environmental side-effects
From US experiments it was concluded that even though the losses of total P were considerably reduced when no soil tillage was performed, the losses of dissolved P were eight-fold higher than after conventional tillage operations [6]. In a Swedish study, this was explained by macropores in the topsoil being created by repeated freezing/thawing and the resultant fracturing of soil aggregates [7].

Relevance, potential for targeting
Reducing stratification must be further investigated and the above-mentioned goal conflict considered before its relevance is evaluated.

Costs: Investment, labour
Reducing stratification means more ploughing, which costs labour and fuel.

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