ON SANDY SOILS – CULTIVATE LAND IN THE SPRING RATHER THAN THE AUTUMN FOR SPRING CROP ESTABLISHMENT

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Description
• Cultivate arable land for spring crops in the spring rather than the autumn.
• Plough out grassland in the spring rather than the autumn.

Rationale, mechanism of action
Cultivation of soils results in mineralisation of organic N and increases the risk of nitrate leaching. The amount of mineralisation is strongly affected by soil temperature, moisture, the N balance under the previous crop, and the amount of time between cultivation and the onset of winter drainage. In the case of grassland, mineralisation will be greater following cultivation of grazed swards than cut swards. Autumn cultivation further increases the risk of nitrate loss because the warm and moist soil conditions at this time of year encourage high rates of mineralisation while, in the absence of an actively growing crop, there is little N uptake. Drainage during the following winter period will then transport the accumulated nitrate out of the soil profile. Cultivation in spring can be better, because bare soil is not exposed over the winter period and an actively growing crop is established soon after cultivation to take up N and provide surface cover. However, limited autumn cultivation can be effective in reducing P and sediment losses on high soil erosion risk fields [1].

Relevance, applicability & potential for targeting
The measure is generally suitable for sandy or loamy soils, but on medium to heavy clay soils delaying cultivation until spring may result in the spring crop being drilled into a drying seedbed. This may have an impact on establishment and yield. For clay soils the main problem is that conditions may be too wet for tillage in spring, and cultivation during a wet spring can result in cloddy soil and soil compaction, with associated soil structural problems. Ploughing is generally never carried out in spring for soils with clay content higher than 20% in the Nordic countries unless the soil is unusually dry. However, by using powerful seedbed preparation machinery (e.g. Väderstad Carrier) it is possible to plough soils with up to 30% clay.
Spring cultivation is applicable where a switch is being made from winter to spring cereal cropping. It is also applicable to grassland systems where grass leys are ploughed under and reseeded, e.g. silage and grazing leys. Nutrient mineralisation is greater following cultivation of grazed swards than cut swards. Under Nordic conditions reseeding is seldom practised but grass leys are commonly incorporated into the crop rotation, usually under-sown with a spring cereal and grazed after cutting of hay or silage in the following year/s. Grass leys are often ploughed out in late autumn, with only limited N mineralisation and subsequent leaching as a result. On the other hand, freezing-out of the P in plant cells, and thus enhanced potential for increased P losses, is a risk for grass crops under Nordic winter climatic conditions [2].
Delaying soil cultivation until spring can be introduced and targeted locally.

Effectiveness, including certainty
Nitrogen: Delaying tillage until spring has been estimated to result in a moderate reduction in nitrate leaching in the UK, Denmark and southern Sweden and a smaller reduction in more central areas of the Nordic countries [3].

Phosphorus: The effect is dependent on both soil type and soil moisture conditions at the time of tillage. Research results from a silty soil in Sweden [4] clearly indicate the advantages of not tilling this particular soil during autumn and are in agreement with findings from southern Norway [5]. Delaying tillage until spring has been shown to greatly reduce P losses from high to medium erosion risk arable fields (50-75%), whereas changes in soil tillage on low erosion risk fields reduced the erosion losses but increased P losses in lysimeter studies in Norway [6]. In the UK, delaying tillage until spring was theoretically estimated to reduce soil P losses by 50% on a clay loam and 70% on a sandy loam soil [7]. In Denmark, delaying tillage until spring on erosion-risk areas has been suggested to have high relevance in reducing nutrient losses [7,8].

Time frame
The effect of reduced tillage on erosion risk can be expected in the short term. The effects of reduced tillage on soil structure and improved infiltration may however, take some more time (3-5 years).

Environmental side-effects
Delaying cultivation until the spring can increase weed problems and enhance herbicide use. In addition, cultivating in spring under wet conditions can damage clay soil structure, reduce water infiltration and increase surface runoff. Crop residues left on the soil surface can act as a P source and increase the loss of dissolved reactive P. This form of P has a higher ecological impact than particulate-bound P due to its higher bioavailability.
Other problems may follow if fewer winter cereals are grown. Repeated spring cereals have been demonstrated to be associated with higher N leaching than varied crop rotations [9].

Administrative handling and control
Delaying soil cultivation until spring must be adopted locally but is easy to handle administratively. Since 1992 reduced autumn tillage has been targeted in Norway by giving subsidies for no-till in autumn targeted to areas of high erosion risk [5]. In southern Sweden it has been practised and subsidised for several years, with the aim of reducing N leaching from sandy and loamy soils.

Costs: Investment, labour
On some soils crop yields may decrease. In a factorial field experiment from 1963 to 1984 on a clay soil in Norway, autumn ploughing gave significantly higher yields (on average 420 kg ha^{-1}) than spring ploughing. The seedbed in spring was finer in the autumn-ploughed soil because of the effects of freezing and thawing [10]. Furthermore, the time available for tillage and sowing may be short in spring and create a time-conflict for farmers.

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