

ON MEDIUM TO HEAVY SOILS - SHALLOW CULTIVATION IN LATE AUTUMN INSTEAD OF AUTUMN PLOUGHING FOR SPRING CROPS

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Description

For spring crops, use discs or tines to cultivate the soil (shallow cultivation) in late autumn, instead of autumn ploughing. Shallow cultivation maintains organic matter, preserves good soil structure and breaks up any surface crust.

Rationale, mechanism of action

Well-managed soil conditions can improve infiltration and retention of water, thereby reducing P losses. Good soil structure also promotes the efficient use of soil nutrients. Nitrate leaching following shallow cultivation in late autumn is generally lower than after ploughing in early autumn, as there is less time for mineralisation of soil organic matter and plant residues ahead of winter drainage.

Shallow cultivation is practised to decrease surface runoff losses of P in the USA, Canada and many European countries. This improves infiltration and retention of water and thereby decreases P in water. More harvest residue in the upper part of the topsoil increases infiltration and decreases evaporation and soil drying, thus retaining more water in the soil for the following crop.

Relevance, applicability & potential for targeting

Shallow cultivation in the autumn is appropriate on soils with a moderate (<25%) clay content (clays, silty clay loams and clay loams) or other soils where soil structure problems have already been alleviated. These soils require cultivation in the autumn, as there is rarely sufficient time in the spring in temperate and Nordic climates to prepare soils in the spring ahead of crop establishment without compromising seedbed quality and yield. However, using a cultivator on clay soil under wet autumn conditions can be problematic and can make the soil cloddy, resulting in soil compaction with associated soil structural problems, higher runoff volumes and ultimately reduced crop yields [1].

On medium to heavy clay soils, shallow cultivation may result in the spring crop being drilled into a drying seedbed. This can impact on establishment and yield. Thus, late use of the cultivator is associated with a higher risk of reduced crop yields than conventional ploughing [2]. In the Nordic climate, problems can arise since it is usually necessary to incorporate crop residues in order to get clay soil sufficiently warm in spring.

Shallow autumn cultivation can also be unsuitable for soils that are prone to capping, such as silty soils. On soils with poor structure (sandy soils), the method can be quite ineffective. Sandy soils (<18% clay content) are more suited to spring cultivation.

Under dry climate conditions shallow cultivation can limit evaporation, thus retaining water for good crop growth. Under Nordic conditions, where the early summer is dry, field experiments have shown shallow cultivation on clay and silty clay soils to give higher yields than ploughing [3]. There is a theoretical possibility that incorporation of large volumes of straw into a small volume of soil under shallow cultivation may immobilise so much N that crop growth is restricted. This may create a need for more N fertiliser for oilseed rape crops in late summer and early autumn, but is unlikely to be a problem in late autumn.

Effectiveness, including certainty

Nitrogen: In the UK a small reduction in nitrate leaching losses has been estimated following shallow tillage compared with ploughing [4]. Theoretical estimations based on N modelling have also estimated a small to moderate reduction in N leaching for sandy and loamy soils in the south of Sweden [5].

Phosphorus: The effect is dependent on both soil type and soil moisture conditions at the time of tillage. Shallow cultivation was estimated by 'expert weighting' to result in a small reduction in P losses from a clay loam soil in UK [4] compared to ploughing in autumn. The results from a silty soil in Sweden [6] clearly indicated the advantages of not tilling this particular soil in a conventional way during autumn and were in agreement with findings from southern Norway [7].

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. Long-term use of shallow cultivation may be impossible for some types of soils which need to be loosened (through ploughing or ripping) every few years.

Environmental side-effects

By reducing soil erosion natural soil fertility is maintained, thus reducing the need for fertiliser application. However, shallow cultivation may be less effective in reducing weeds compared with conventional ploughing and may thus increase reliance on chemical control measures. Pest and mycotoxins create additional problems. Another possible environmental side-effect associated with shallow cultivation in the long-term is increased dissolved P losses in runoff due to release of P from plant residues on the soil surface [7]. Minimal cultivation has been demonstrated to reduce nitrous oxide emissions in some cases [8]. However, only shallow cultivation may also initially result in poor structural conditions near the surface, resulting in higher soil moisture and higher nitrous oxide emissions compared with ploughed soil [9].

Administrative handling and control

This measure is not appropriate for administrative handling.

Costs: Investment, labour

A modern and efficient cultivator is needed. Switching from ploughing to minimal cultivation saves fuel costs. However, there are also possible increased costs associated with increased pesticide-application, depending on the weed and other pest pressures.

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