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Surface runoff, subsurface drainflow and soil erosion as affected by tillage in a clayey Finnish soil

Keywords Clay, drainage water, grass, hydrology, physical properties of soil, ploughing, reduced tillage, soil erosion, soil macroporosity, stubble, stubble cultivation, surface runoff,

Abstract

Conservation tillage practices were tested against autumn mouldboard ploughing for differences in physical properties of soil, surface runoff, subsurface drainflow and soil erosion. The study (1991 -2001) was performed on a gently (2%) sloping clayey soil of southern Finland, with two replicates of the tillage treatments on 0.5 ha plots. The annual shares of surface runoff of the total flow (surface runoff + subsurface drainflow) were 8–42% for ploughing (depth 20–23 cm), 36–66% for shallow autumn stubble cultivation (depth 5–8 cm) and 36–82% for soil left untilled over winter. Surface runoff increased with decrease in the tillage intensity, and in line with the values of depressional water storage, macroporosity and saturated hydraulic conductivity. Erodibility of this gently sloping soil was at highest after autumn and spring tillage operations and decreased with time. Shallow autumn tillage produced erosion as high as mouldboard ploughing (407–1700 kg ha⁻¹yr⁻¹), but 48% and 12% lower erosion levels were measured from plots left untilled in autumn, covered by grass or barley residues, respectively. Eroded soil particles moved relatively freely to the subsurface drains, which carried 37–94% of the annual soil losses from the field. The study shows that even on the relatively flat clayey soils typical for southern Finland, tillage has a great influence on soil losses. The frequency of tillage needs to be reduced rather than the depth of tillage on clayey soils with poor water conductivity and structural stability if soil loss is to be diminished by conservation tillage.

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