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## Tillage systems for the benefit of agriculture and the environment

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# Structure of clay topsoil affected by tillage intensity

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In Finland, the farmers are increasingly interested in reduced tillage and zero tillage. The interest in conservation tillage systems is due to the high cost of fuel and labour with conventional tillage. The effects of the tillage intensity on soil structure are important when soil cultivability and the risk of surface runoff are evaluated. In this study, the effects of tillage intensity on topsoil water holding properties and bioporosity were examined in two field experiments on clay soils. The objective of the study was to investigate the changes in soil structure when ploughing was replaced by less intensive tillage systems.

Field experiments were conducted on a clay soil (0.62 g clay (< 0.002 mm) $g^{-1}$, Vertic Cambisol) and a clay loam soil (0.46 g $g^{-1}$, Eutric Cambisol). Autumn tillage treatments (main plot) were: (P) ploughing to 0.20-0.25 m depth, (S) stubble cultivation (0.10-0.15 m), and (N) zero tillage. Spring tillage and drilling treatments (subplot) were: (A) combined rotary harrowing and drilling, and (B) sowing with direct drill. Both field experiments had four replicates. In the present paper the soil properties were determined from treatments: PA, SA and NC.

The field experiments were established in 2000 (clay soil) and 2001 (clay loam). In autumn 2004, two replicate soil samples (diameter 0.15 m and length 0.20 m) were taken from each plot after harvesting and before autumn tillage. In laboratory, the samples were cut into two subsamples 0-0.05 and 0.05-0.20 m. The macropore size distribution (soil matrix potentials 0, -1, -4 and -10 kPa) and dry bulk density of subsamples was determined. Likewise, the number of earthworm burrows was calculated from the bottom of the subsamples.

On the clay loam soil in 0-0.05 m layer, the average dry bulk density of ploughed soil was greater than that of reduced tilled soils. This was probably due to the higher organic matter content of reduced tilled plots. On the clay soil, the differences in soil dry bulk density were, however, small. In the 0-0.05 m layer, the differences in macropore size distribution were small on both fields. In the layer of 0.05-0.20 m of the clay loam soil, the average macroporosity of direct drilled soil was larger than that of ploughed or stubble cultivated soils. The differences in macropore size distribution were, however, small. The samples were taken after a very rainy growing season (the precipitation sum for May–August 2004 was 349 mm compared to the average of years 1970-2000 252 mm) and the soils stayed wet for long periods during the growing season. It was probable that especially the ploughed soil structure had compacted naturally during the rainy growing seasons which reduced the macroporosity created by ploughing. Even though the differences in the volume of macroporosity were small, there were differences in the origin of macropores. The average number of earthworm burrows was greater in the direct drilled than ploughed or stubble cultivated plots.