SATURATED HYDRAULIC CONDUCTIVITY AND BIOPOROSITY OF TWO ARABLE CLAY SOILS IN RELATION TO SUBSURFACE LOCATION

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Abstract

Effective drainage and lowering of ground water table level are expected to be important for formation of soil structure in clay soils. The effect of subsurface drain location on soil saturated hydraulic conductivity (K_{sat}) and bioporosity was examined in two clay soils in Jokioinen, in southern part of Finland. The fields were drained in 1930s or in 1950s, and they were redrained in 1980s.

In 2002, soils were sampled at 15 locations on each fields. At each location, samples were taken at two points: (A) above the drain, and (M) midway between two drains. Soil K_{sat} and bioporosity were determined down to the depth of 0.5 m. K_{satf} of soil layer of 0.3–0.6 m was determined on field.

The spatial variation of soil properties was large both in topsoil and subsoil. The differences in mean K_{sat} and dry bulk density measured in laboratory were small in relation to drain location. On both fields, only the number of root channels at 0.5 m depth was great above the drain than at midway between two drains. On both fields, the number of earthworm burrows and earthworms was small.

Even though the drain location did not affect consistently measured soil properties, it seems advisable to take notice of the subdrain positions when designing field experiments and when studying the variation of soil properties.

Field-1 in spring 2004

Field-2 in spring 2003

Clay (< 0.002 mm) content

Field-1: 0.34–0.92 g g^{-1}

Field-2: 0.58–0.91 g g^{-1}

Materials and methods

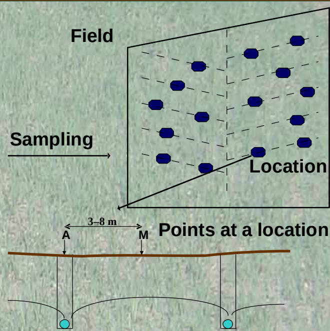
Fields: very fine Typic Cryaquept (Field-1, subsurface drained 1950s, redrained 1987), Umbric/Histic Cryaquept (Field-2, subsurface drained 1930s, redrained 1986).

Measurements 15 years after redrainage:

On field: Saturated hydraulic conductivity (K_{satf}, reversible auger-hole) at 0.3–0.6 m.

Sampling: 15 locations per field, two measurement points (A and M) at each location.

In laboratory: Saturated hydraulic conductivity (constant head method), dry bulk density and number of cylindrical pores (> 2 mm earthworm burrows, < 2 mm root channels) were determined down to the depth of 0.5 m. Diameter of sample 0.15 m.

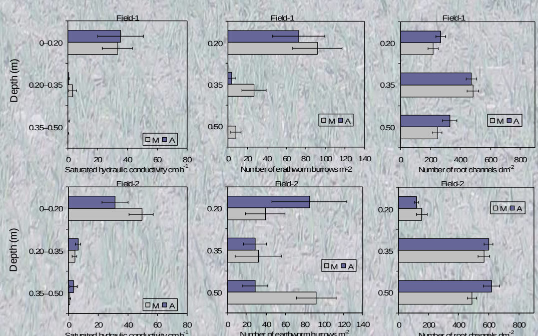


Results

The differences in mean K_{sat} and dry bulk density measured in laboratory were usually small in relation to drain location. On the Field-1, the K_{satf} was 2.8 ± 1.8 cm h^{-1} (mean ± SE) above the drain and 0.3 ± 0.1 cm h^{-1} between the drains. On the Field-2, the differences in K_{satf} were, however, small (A: 0.1 ± 0.05, M:0.09 ± 0.05 cm h^{-1}).

On both fields, the median number of root channels at the depth of 0.5 m was greater above the drain than between the drains.

The number of earthworm burrows of both fields was small, less than 100 burrows m^{-2}. Also the number of earthworms was small, less than 50 earthworms m^{-2}. The burrows were found more often midway between the drains than above them. We assume that these pores were mainly old root channels.



Mean K_{sat} of soil (laboratory measurement) and mean number of cylindrical pores diameter ≥ 2 mm (earthworm burrows) and diameter < 2 mm (root channels) above the drain (A) and midway between the drains (M). Line ± SE.

Depth (m)	Mean dry bulk density ± SE (Mg m^{-3})			
	Field-1		Field-2	
	A	M	A	M
0–0.20	1.04 ± 0.03	1.02 ± 0.03	0.95 ± 0.02	0.92 ± 0.03
0.20–0.35	1.28 ± 0.04	1.32 ± 0.03	1.21 ± 0.03	1.19 ± 0.02
0.35–0.50	-	-	1.25 ± 0.03	1.27 ± 0.03

Conclusions

On both soils, only the number of root channels at 0.5 m depth was larger above the drain than at midway between two drains. The physical properties of Field-2 were better than those of Field-1.

Even though the drain location did not affect consistently measured soil properties, it seems advisable to take notice of the subdrain positions when designing field experiments and when studying the variation of soil properties.

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