NJF Report • Vol 4 • No 3 • Year 2008

Nordic Association of Agricultural Scientists

NJF Seminar 418

New insights into sustainable cultivation methods in agriculture

Piikkiö, Finland, 17-19 September 2008

Nordic Association of Agricultural Scientists

Differences in physical properties of two clay soils

Laura Alakukku[1,2], Antti Ristolainen[2] and Visa Nuutinen[2]
[1] University of Helsinki, Dept. of Agrotechnology, P.O Box 27, FI-00014 University of Helsinki, Finland, laura.alakukku@helsinki.fi
[2] MTT Agrifood Research Finland, Soil and Plant Nutrition, FI-31600 Jokioinen, Finland
antti.ristolainen@mtt.fi, visa.nuutinen@mtt.fi

Finland's most important agricultural region for annual crops is the southern and southwestern part of the country, located between latitudes 60º and 61º N. At this area, mineral soils typically contain more than 0.30 g g^{-1}clay (diameter < 0.002 mm). Clay subsoil characterizes more than 60% of the arable land in south and southwestern Finland.

Soil structure, i.e. porosity and aggregation, markedly affects the crop production, trafficability and workability of arable clays. Macroporosity of heavy clay soils is of crucial importance when considering water and air movement in wet soils. We studied the physical properties of two clay soils (J1 and J2) having relatively similar texture but differing cultivation properties J2 being more sensitive to dry and wet conditions. The clay content of fields was between 0.33−0.82 g g^{-1} in the layer of 0−55 cm. In the topsoil layer of 0−20 cm, the mean organic carbon content of J1 and J2 was 0.031 and 0.049 g g^{-1}, respectively. Both fields were classified as very fine Typic Cryaquept soils.

Undisturbed soil samples (length 60 cm, diameter 15 cm) were taken for analysis of water retention, saturated hydraulic conductivity (K_{sat}) and dry bulk density (BD). Also the number of earthworm burrows (cylindrical pores ≥ 2 mm) was counted. Total of 30 sampling locations from experimental field J1 and 21 locations from field J2 were chosen to determine the spatial variation of soil properties.

The general assumption that the productivity of heavy clay soils is mainly threatened by excessive wetness holds in both fields. Water retention of both fields showed a strong and similar textural dependency, and was also affected by the amount of organic material in soil. According to water retention analyses, in both studied fields with content of clay over 0.30 g g^{-1} the air volume in soil at field capacity was under 0.10 m^3 m^{-3}, often regarded as limiting level for crop growth in cultivated layer. Despite that, field J1 was good yielding even in rainy year when severe soil structural problems were encountered in field J2. The probable reason is the higher number of earthworm burrows in field J1 resulting in high K_{sat} values and good soil aeration. The number of earthworm burrows was high also in subsoil in field J1, which is an indicator of the activity and presence of deep burrowing earthworm *Lumbricus terrestris* L. According to present results, soil water retention of heavy clay soils in both wet and dry ends of pF curve is strongly dependent on soil texture and organic carbon content and therefore use of saturated hydraulic conductivity should be preferred as an indicator of (good) soil structure. Correlations between K_{sat} values and volume of macroporosity weren't strong which emphasized the importance of water flow through continuous earthworm burrows.