Geophysical Research Abstracts, Vol. 7, 02621, 2005
SRef-ID: 1607-7962/gra/EGU05-A-02621

Soil porosity and water infiltration as influenced by tillage method

J. Lipiec (1), J. Kus (2), A. Slowinska-Jurkiewicz (3), A. Nosalewicz (1)

(1) Institute of Agrophysics, Polish Academy of Sciences, Doświadczalna 4, 20-290 Lublin, Poland, (2) Institute of Soil Science and Plant Cultivation, Czartoryskich 8, 24-100 PuŁ awy, Poland, (3) University of Agriculture, Institute of Soil Science and Environmental Management, 20-068 Lublin, Kr. Leszczyńskiego 7, Poland (Lipiec@demeter.ipan.lublin.pl)

1 Introduction

The significant function of soil is transmission of water that directly affects plant productivity and environment. Infiltration of water increases water storage in soil profile and groundwater recharge and reduces erosion. Infiltrability of soil depends on pore size distribution that is largely influenced by tillage. In this study we assessed the effect of long term use of various tillage systems on pore size distribution, areal porosity and hydraulically active porosity and infiltration of brown alluvial soil.

2 Materials and methods

The experiment was carried out on brown alluvial soil with particles $<$0.02 mm content 48%, w/w and organic matter content 2.3%, w/w in plough layer. Four treatments, with four replicates arranged in a randomized block design, were as follows: (1) loosening to depth of 20 cm (CT); (2) loosening to 20 cm every 6 years and 5 cm in the remaining years (S/CT); (3) shallow loosening to 5 cm each year (S); (4) sowing to the uncultivated soil (No-till) in microplot experiment. The operations were applied during 18 years under before planting. Core samples of 100 cm^3 volume were taken to find the soil water characteristics that was used further to calculate pore size distribution. Areal porosity was determined under CT and No-till using resin- impregnated soil sections (8x9x2 cm) in the horizontal and vertical planes for two depths within plough layer. Measurements of infiltration of water into the soil was determined by the double ring infiltrometer, with a 215 mm diameter inner and 300 mm diameter outer cylinder. To analyse the water-conducting pores (preferential flow) methylene blue solution was infiltrated from the soil surface on delimited areas. Afterwards, soil cores were taken with steel cylinders from the depth 0-200 mm and sectioned horizontally at 2 cm depth intervals. Photographs of each section were used to determine methylene blue stained porosity.

3 Results and discussion

The tillage treatments significantly affected pore size distribution. CT had greater percentage of pore volume for larger pore diameter ($>$100 μm) and lower pore volume of smaller pores ($<$ 6 μm) compared to all other tillage treatments. The percentage of pores 6 to 30 μm, retaining plant-easily available water, was significantly lower in SCT compared to all other treatments. Mean values of areal porosity were greater in CT than NT in both horizontal and vertical planes. The differences were relatively greater in the horizontal than the vertical plane. The percentage of the stained (flow active) pores was highest in CT and lowest in S throughout the plough layer. The stained porosity as a function of depth could be well described by logarithmic equations in all treatments. The infiltration rate was highest under CT and successively decreased under S, No-till and S/CT. Initial and cumulative infiltration rates indicate higher capability of CT pore system to increase amount of water infiltrating before reaching steady state infiltration. Initial and cumulative infiltration rates most closely correlated with stained porosity in top layer (0-6 cm).

4 Conclusion

The results indicate that pore system of conventionally tilled with higher contribution of large pores compared to No-till and reduced tillage treatments enhanced infiltration and water storage capability.