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Leaching of some agricultural chemicals in relation to pore structure and preferential flow

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Leaching of agricultural chemicals is largely influenced by pore size distribution (PSD) and pore continuity influencing transmission and retention soil functions. Macropores may encourage preferential flow paths for rapid movement of water and chemicals into deeper layers of soil and groundwater, bypassing much of the soil matrix. This flow often occurs in no-till or grassed soil with open on the surface and continuous with depth earthworm channels and may also occur in ploughed soil with stable structure preserving macropore network. Leaching losses depend also on sorption properties of macropore material and reactivity of the agricultural chemicals. The macropore functions are interrelated with other pores. Understanding the relations between the PSD and leaching of chemicals is important in developing management options that minimize the leaching and contamination of the environment and water. In this study we examined pore structure and leaching of some agricultural chemicals in tilled and orchard silt loam soil. These management systems were selected to have a range of pore structure.

The experiment was performed on an Orthic Luvisol developed from loess. The experimental objects included: (CT) conventionally tilled field with main tillage operations including pre-plow (10 cm) + harrowing, mouldboard ploughing (20 cm) and crop rotation including selected cereals, root crops and papilionaceous crops, (OR) 35 year-old apple orchard with a permanent sward that was mown in the inter-rows during growing season. The chemicals included: nitrogen in nitrate and ammonium forms, phosphate and atrazine. To determine leaching of the chemicals soil columns of undisturbed structure were taken with steel cylinders of 21.5 cm diameter and 20 cm height from the depth of 0-20 cm. Before surface application of the chemicals, the columns were pre-wetted with water in order to obtain field water capacity and

then subjected to watering at an amount of 30 mm. Leachates from the columns were analyzed for concentration of the chemicals applied. We used the same soil columns to analyze the areal porosity, number of pores and water-conducting pores (stained by Brillant blue during the infiltration) in sections at 2 cm depth intervals. Comparison of the pore characteristics between the depths indicate a greater continuity of the pores under OR than CT soil. In general cumulative leaching of nitrogen in nitrate form, phosphate and atrazine was greater and that of nitrogen in ammonium form was lower beneath the CT than OR columns. The rate of leaching at comparable time was faster in OR than CT soil due to a greater percolation rate in the former.