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Interconnectivity of Macropores and Subsurface Drains: Impact on BTCs

Recent research indicates immediate breakthrough of solutes and pesticides in subsurface drainage by extraordinarily efficient transport through directly connected macropores. Macropores created by earthworm burrows allows water and solute to transfer directly to subsurface drains. Laboratory experiments are commonly utilized for investigating this effect of macropore flow on contaminant transport. In this study, the interrelationship between macropores and subsurface drains was investigated by conducting infiltration experiments in a laboratory column (28 cm by 50 cm rectangular cross-section with length of 90 cm) with an artificial macropore directly connected and spaced at varying distances away from the subsurface drain. The goal of this study is to develop relationships relating soil, macropore and subsurface drain properties to the probability of direct connection. A novel design of the experimental setup allowed the buried length of the macropore to be varied from the subsurface drain to the surface without unpacking/disturbing the soil column. Furthermore, this research varied the spatial position of the macropore laterally away from the longitudinal axis of the drain to investigate a relationship between direct connectivity and macropore location. Experiments are completed for each macropore length changing from zero (no macropore effect) to 80 cm (surface connected macropore) with 15 cm increments. Breakthrough curves were plotted for both matrix and macropore flow at the outlet. This procedure was completed using clay loam soil for the bulk density of 1.6 g/cm^3. For each experiment 1 cm ponded water was maintained at the soil surface. The movement of the wave front of the infiltrated water down the column was observed with the pencil size tensiometers mounted on the side of the column at various depths. It was observed that the longer the buried macropore length (i.e., as the macropore approached the soil surface), the more rapid response at the drain outlet. Breakthrough times with the surface connected macropore decreased significantly compared to buried macropores.

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