A study on the effect of compaction on transport properties of soil gas and water I: Relative gas diffusivity, air permeability, and saturated hydraulic conductivity

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Abstract	Operation of farm machinery in agricultural fields is the main cause of soil compaction, which may have detrimental effects on soil gas and water transport. However, application of organic matter (OM) reduces the adverse effects of compaction and improves transport properties of soil gases and water. To date, experimental data on the effect of compaction on those transport properties and its relationship to the presence of applied OM remains scarce. The effect of compaction on relative gas diffusivity (D-p/D-0)(100) and air permeability (k(a100)) at a soil matric suction of -100 cm H2O (soil pF 2.0), and saturated hydraulic conductivity (k(s)) were investigated using disturbed soil sample taken from 0-15 cm layer mixed with rice husk, rice straw, compost, sawdust, and wood bark at a rate of 20% of the soil volume. The common compaction caused by farm machinery in agricultural fields was simulated in the laboratory using a static compression load of 150, 225, and 300 kPa. The effect of compaction on total porosity (f) and air content at soil pF 2.0 (epsilon(100)) was also examined. Compaction reduced f, e(100), (D-p/D-0)(100), k(a100), and k(s), with the more pronounced significant difference between 150 and 300 kPa compactions. The decrease in (D-p/D-0)(100) was likely attributable to a reduced air content, and the decrease in k(a100) and k(s), was likely attributable to a reduced volume of macropores, as indicated by reduced epsilon(100) values. Compared with the control, addition of sawdust and wood bark seemed to have the most positive effect on (D-p/D-0)(100), k(a100), and k(s) in term of resistance to compaction, while rice straw had the opposite effect. The presence of OM was likely to block the soil pores and increase capillary water in the bottle-neck, leading to lower values of (D-p/D-0)(100) and k(a100) for a given value of epsilon(100) ("blockage effect"). These pores blocked by OM, however, seemed to allow the water to flow through the soil matric ("ceramic filter effect"). Further studies on the prolonged application of OM at field scale, taking into account the decomposition process, should be conducted. (C) 2014 Elsevier B.V. All rights reserved.
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