A study on the effect of compaction on transport properties of soil gas and water. II: Soil pore structure indices

Publons ID	(not set)
Wos ID	WOS:000340698600021
Doi	10.1016/j.still.2014.01.008
Title	A study on the effect of compaction on transport properties of soil gas and water. II: Soil pore structure indices
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Publish Date	NOV 2014
Journal Name	SOIL & TILLAGE RESEARCH
Citation	40
Abstract	Experimental data on the effects of compaction and applied organic matter (OM) on macropore structure indices, more particularly on pore continuity, have yet rarely been documented. In this study, static compaction was simulated in the laboratory at 150, 225, and 300 kPa upon rice husk, rice straw, compost, sawdust, and wood bark-mixed soils and control. Measurements of relative gas diffusivity (D-p/D-0)(100) and air permeability (k(a100)) were conducted at -100 cm H2O soil matric suction after measurement of saturated hydraulic conductivity (k(s)). Corresponding dry bulk density (rho(d)), total porosity (f), and air content (epsilon(100)) values were also determined. Volume of macropores (phi >= 30 mu m) and micropores (phi < 30 mu m) were expressed as volume of air and water at -100 cm H2O soil matric suction, respectively, relative to the volume of soil solid. Specific gas diffusivity (S-D100) and specific air permeability (S-ka100) were calculated as (D-p/D-0)(100)/epsilon(100) and k(a100)/epsilon(100), respectively. Analogous to the S-D100 and S-ka100, specific hydraulic conductivity (S-ks) was defined as k(s)/epsilon(100). The results showed that compaction significantly increased rho(d), which was followed by a reduction in f and the mixed OM resulted in a significantly lower rho(d) and higher f than the control. The volume of macropores was reduced by compaction whereas the volume of micropores remained unaffected, for which the mixed OM tended to result in a higher volume of macropores than the control. Compaction resulted in more tortuous macropores for gas diffusion (lower S-D100) and less continuous macropores for gas convection (lower S-ka100) for which a significant difference was more pronounced between the 300 and 150 kPa compactions. Compaction also resulted in fewer continuous macropores for water movement as indicated by lower S-ks. The mixed OM was likely to result in a lower S-D100, but except for rice straw tended to result in a higher S-ka100 than the control. In addition, the mixed OM also seemed to result in a higher S-ks than the control. Of the OM-mixed soils, the decrease in (D-p/D-0)(100) and k(a100) was more sensitive to compaction (i.e., decrease in epsilon(100)) than that of the control whereas the decrease in k(s) acted conversely. Discussion of the measured (D-p/D-0)(100), k(a100), and k(s) is presented in the companion paper. (C) 2014 Elsevier B.V. All rights reserved.
Publish Type	Journal
Publish Year	2014
Page Begin	180
Page End	187
Issn	0167-1987
Eissn	1879-3444
Url	https://www.webofscience.com/wos/woscc/full-record/WOS:000340698600021
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