Effects of glucose addition on FDA activity and soil hydraulic properties

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Organic matter addition to soil will be a beneficial strategy as it can enhance carbon sequestration in soil and improve soil structure through soil aggregation. However, our understanding on effects of organic matter addition to soil on hydraulic properties has been limited. For example, glucose is known to promote soil aggregation, increasing hydraulic conductivity; however, it could cause biological clogging through increased microbial activity and this could reduce the conductivity. In this study, we examined effects of glucose -liable organic matter- on FDA activity and hydraulic properties. The silt loam soil amended with glucose solution (termed glucose soil; 10mg C g^{-1} soil + 1.25mg N g^{-1} soil) or distilled water (termed control) was incubated at 25℃. After 4, 7, 15 and 33 day incubation, we measured saturated hydraulic conductivity using constant head method and FDA activity. In addition, using 4 and 7 day incubated soils unsaturated conductivity and soil water retention curves were measured by combining simplified evaporation method with dew point method. The functions of soil water retention and hydraulic conductivity curves were determined with van Genuchten and bimodal models. Saturated conductivity for control was significantly higher than that for glucose soil while FDA activity for glucose was significantly higher than that for control on day 4. This negative correlation between the conductivity and FDA activity could be attributed to biological clogging effects. However, this trend was not observed on day 7, 15 and 33. In addition, as the order of the conductivity did not differ between the treatments, for saturated soils, biological clogging effect on the hydraulic conductivity seemed to be small. On the other hand, there was a clear effect of glucose addition on soil water retention curves; the curve for glucose soil showed dual-porosity structure while that for control did not. From their functions, it was suggested that glucose addition increased micro-pore of which diameter is smaller than 10 μm. Since glucose soil with newly formed micro-pore retained water more strongly in the range of 1,000 to 10,000cm than control soil did, unsaturated hydraulic conductivity for glucose soil was lower than that for control. This micro-pore formation can be explained by the association between clay and extracellular polysaccharide substances produced by microbes which was enhanced through glucose addition. In conclusion, in this study it was revealed that glucose addition on the soil enhanced micro-aggregation, but it reduced unsaturated hydraulic conductivity.

Keywords: Soil, FDA activity, Soil water retention characteristics, Hydraulic condcutivity

