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Interaction between soil mineralogy and the application of crop residues on aggregate stability and hydraulic conductivity of the soil

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One of the main goals of modern agriculture is to achieve sustainability by maintaining crop productivity while avoiding soil degradation. Intensive cultivation could lead to a reduction in soil organic matter that could affect the structure stability and hydraulic conductivity of the soil. Moreover, crops extract nutrients from the soil that are taken away from the field when harvested, and as a consequence, the addition of fertilizers to the soil is necessary to maintain crop productivity. One way to deal with these problems is to incorporate crop residues into the soil after harvest. Crop residues are a source of organic matter that could improve soil physical properties, such as aggregate stability and soil hydraulic conductivity. However, this effect could vary according to other soil properties, such as clay content, clay mineralogy, and the presence of other cementing materials in the soil (mainly carbonates and aluminum and iron oxides). In the present work, the interaction between the addition of chickpea crop residues to the soil and clay mineralogy on aggregate stability and saturated hydraulic conductivity were studied. Chickpea plant residues were added at a rate of 0.5% (w/w) to smectitic, kaolinitic, illitic and non-phyllosilicate soils from different regions. The soils without (control) and with chickpea residues were incubated for 0, 3, 7 and 30 days, and the saturated hydraulic conductivity of the soils was measured in columns after each incubation time. The response of hydraulic conductivity to the addition of residues and incubation time was different in the soils with various mineralogies, although in general, the addition of chickpea residues increased the saturated hydraulic conductivity as compared with the control soils. This positive effect of crop residues on hydraulic conductivity was mainly a result of improved aggregate stability and resistance to slaking during wetting.