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Soil Physical Properties under a Long-Term System Trial Comparing Organic and Conventional Management in India

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Abstract

Agricultural systems with deteriorating carbon stocks lead to unstable soil structure in India. Especially in 'black cotton soils' the stability of aggregates and pores is critical for soil fertility due to a high slaking risk. Therefore, a higher input of biomass resulting in higher soil organic carbon (SOC) is advocated e.g. by biodynamic and organic farming. Higher SOC in turn influences soil physical parameters. This study analysed whether organic farming leads to (i) lower bulk density, (ii) higher surface area of cracks, (iii) higher infiltration, and (iv) lower erosion during rain compared to conventional farming. Various structural properties of the soil were determined in field plots of a long-term trial, which were 7 years under four farming systems: biodynamic, organic, conventional, and conventional farming with Bt cotton. The long-term experiment follows a two-year crop rotation comprising cotton-soybean-wheat. While the conventional systems receive mainly mineral fertilisers, the biodynamic and organic systems are fertilised with fresh and composted organic manures. To analyse soil structure bulk density was determined by core method, crack volume by image analysis, infiltration with double ring infiltrometers, and surface runoff by simulated rain. Preliminary results showed that the bulk density under wheat was similar in all systems after irrigation but was 5 % higher in the conventional than in the organic systems 28 days after irrigation. Image analysis of cracks is in progress. The linear regression slope of water infiltration rate (logarithmized time) increased 8 times from irrigation to 39 days later. Then, in unsaturated state the conventional systems showed a 25 % higher infiltration slope under wheat. However, in the furrows of the cotton crop the organic systems showed a 73 % higher infiltration slope. The surface runoff of a simulated rain event (100 mm h^{-1}) ranged from 3.5 to 8.5 mm with a soil content of 113 to 219 g m^{-2}, but showed no significant differences between treatments. This study suggests a higher impact of organic farming on bulk density and infiltration when soil is in unsaturated and shrunk state. Further results, the possibilities of assessing physical soil parameters in the field, and their contribution towards sustaining soil fertility will be discussed.

Keywords: Bulk density, longterm experiment, organic farming, soil structure, Vertisol

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