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Green manuring influence on soil water retention

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Soil-plant-atmosphere models that compute water fluxes in soil using the Richards' equation require information on the soil water-retention curve. In these models the retention curve characteristics, whether estimated on the basis of measurements or by means of pedotransfer functions, are usually considered to be constant in time, for a given soil type. In real systems the soil hydrological properties are subject to the influence of climatic and management factors. The incorporation of fresh organic matter modifies soil functional properties. When incorporated into the soil, organic matter undergoes microbe-induced changes, driven by soil structural and micro-environmental factors. As different kinds of organic matter may be added to the soil for agro-environmental purposes, our hypothesis is that they may differently affect both the soil water retention values and their temporal changes.

We report here the results of a laboratory experiment carried out within the framework of a research project aimed at improving the estimate of parameters describing the soil water retention curve. The goal of this experiment was to compare the water retention of two soils belonging to contrasting textural classes (a loam and a silty-clay), added with different kinds of green manure (GM), with that of non-manured controls. Water retention of the green-manured soils was also measured at subsequent time intervals after GM incorporation.

Green manure was obtained from fresh plant tissues of wheat (*Triticum aestivum* L.), pea (*Pisum sativum* L.) and radish (*Raphanus sativus* L.), harvested before or at flowering. Dry soil samples (600 g), sieved at 5 mm, were put in 1-L beakers, adequately re-moistened and thoroughly mixed with fresh chopped GM plant tissues (30 g dry matter kg^{-1} dry soil). The beakers were left at room temperature, and periodically supplemented with adequate amounts of water to a soil water content equal to 75% of the plant available water, throughout the experiment period. Water retention was measured just after green manuring, and at 2, 4 and 6 months after GM incorporation, on air-dried and 2-mm sieved soil samples using the Richards' apparatus, at –33 and –1500 kPa.

Immediately after GM incorporation, the water retention of the soil added with radish was higher than in the control, for both soils and water potentials, whereas the incorporation of peas or wheat produced contrasting effects, also due to the variability in the response within treatments. In the green manured soils the water retention increased in the months following incorporation, especially with radish as GM. The maximum water retention values were observed 60 days after GM incorporation, at –33 kPa, whereas a water retention increase was still observed in the following months, at –1500 kPa. This water retention increase was more pronounced in the loam soil, at – 33 kPa, and in the silty clay soil, at –1500 kPa. In particular, at –33 kPa water potential, the water retention of the loam soil 60 days after the radish incorporation had increased from 20.8 to 28.6% (as percentage of soil dry weight). Water retention changes for varying GM types and elapsing times after GM incorporation may be attributed to different GM composition and decomposition products.

On the basis of these results we conclude that the water-retention parameter values may vary depending on the nature of the organic matter added to soil, and on the time elapsed after its incorporation. It may be useful to take into account this variability in order to improve the simulation performances of hydrological models.