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Biochars improve soil water retention, aggregates stability and porosity in a rainfed cropland

Chong Ma and Genxing Pan

Nanjing Agriculture University, Resource and Environment Science Institute, Soil Science, China (machong0204@163.com)

Biochars used as a soil amendment can improve soil physical structure and chemical properties. A two-year field experiment was conducted to assess whether a higher porosity and stability of soil aggregates with higher water retention would be developed by biochar amendment in a rainfed cropland located in the Northern region of China. The results show that the application of maize biochar significantly enhanced water content by 3.7% relative to the control treatment. The application of maize biochar increased MWD of soil aggregates, implying that the biochar increased the aggregates stability. We use the scanning electron microscope (SEM) to visualize the aggregates morphology, the results show that after biochar inputting, micro-aggregates (53-250μm) were more loosely assembled by mineral particles and of more rough surfaces compared with control. Aggregates' nano-structure under biochar amendment were measured by nuclear magnetic resonance cryoporometry(NMRC), the results show that there were significant differences in total porosity and size distribution of nano-pores among the tested soil aggregates. Total porosity was 0.519cm3 g-1 in macro-aggregates and 0.178cm3 g-1 in micro-aggregates. For size distribution of nano-pores, a bimodal distribution was characteristic for the macro-aggregates, respectively between 1.7$\sim$ 2.5nm and 50$\sim$100nm in pore diameter. For aggregates from a single soil, nano-pores within micro-aggregates were largely concentrated in diameter range of 1.6$\sim$2.5 nm, while those within macro-aggregates was distributed in a range both of 1.7$\sim$5nm and of 50$\sim$250nm. This supported micro-aggregates within the macro-aggregates. Overall, results indicate that biochar can improve water retention, aggregate stability and aggregate porosity of a rainfed cropland. Further research should be done on the differences between soil organic matter distribution within aggregates with and without biochar amendment. This would help improve our understanding of three-dimensional arrangement of SOC within soil aggregates.