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Poultry Manure and Its Derived Biochar as a Soil Amendment for Newly Reclaimed Sandy Soils under Arid and Semi-Arid Conditions

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Abstract : Sandy soils under arid and semi-arid conditions are characterized by poor physical and biochemical properties such as low water retention, rapid organic matter decomposition, low nutrients use efficiency, and limited crop productivity. Addition of organic amendments is crucial to develop soil properties and consequently enhance nutrients use efficiency and lessen organic carbon decomposition. Two years field experiments were developed to investigate the feasibility of using poultry manure and its derived biochar integrated with different levels of N fertilizer as a soil amendment for newly reclaimed sandy soils in Western Desert of El-Minia Governorate, Egypt. Results of this research revealed that poultry manure and its derived biochar addition induced pronounced effects on soil moisture content at saturation point, field capacity (FC) and consequently available water. Data showed that application of poultry manure (PM) or PM-derived biochar (PMB) in combination with inorganic N levels had caused significant changes on a range of the investigated sandy soil biochemical properties including pH, EC, mineral N, dissolved organic carbon (DOC), dissolved organic N (DON) and quotient DOC/DON. Overall, the impact of PMB on soil physical properties was detected to be superior than the impact of PM, regardless the inorganic N levels. In addition, the obtained results showed that PM and PM application had the capacity to stimulate vigorous growth, nutritional status, production levels of wheat and sorghum, and to increase soil organic matter content and N uptake and recovery compared to control. By contrast, comparing between PM and PMB at different levels of inorganic N, the obtained results showed higher relative increases in both grain and straw yields of wheat in plots treated with PM than in those treated with PMB. The interesting feature of this research is that the biochar derived from PM increased treated sandy soil organic carbon (SOC) 1.75 times more than soil treated with PM itself at the end of cropping seasons albeit double-applied amount of PM. This was attributed to the higher carbon stability of biochar treated sandy soils increasing soil persistence for carbon decomposition in comparison with PM labile carbon. It could be concluded that organic manures applied to sandy soils under arid and semi-arid conditions are subjected to high decomposition and mineralization rates through crop seasons. Biochar derived from organic wastes considers as a source of stable carbon and could be very hopeful choice for substituting easily decomposable organic manures under arid conditions. Therefore, sustainable agriculture and productivity in newly reclaimed sandy soils desire one high rate addition of biochar derived from organic manures instead of frequent addition of such organic amendments.

Keywords : biochar, dissolved organic carbon, N-uptake, poultry, sandy soil
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