CFAES

SCHOOL OF ENVIRONMENT AND NATURAL RESOURCES

MASTER THESIS DEFENSE

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Stability of biosolids derived carbon in soils; evidence from a long-term experiment and meta-analysis.

Many decades of research have contributed to the understanding of biosolids and their effects when applied on soil. Improved soil quality indicators such as reduced bulk density, and increased aggregation, water infiltration and nutrient supply have been shown to be positively correlated with biosolid application, often as of the result of increasing soil organic carbon. While it is well known that biosolids increase SOC, the effect on carbon permanence and how abiotic controls such as climate and texture influence biosolid application effect on SOC is less well known. This thesis investigates the effects of biosolid applications specifically on SOC and how. For that objective, this thesis is divided into two separate investigations. The first study examines the impacts of a one-time soil biosolids application experiment, of varying rates up to 300 Mg ha-1, on long term soil carbon stability utilizing a long-term experiment started in 1990 at the Waterman Agricultural and Natural Resource Laboratory in Columbus, Ohio on a Fine, mixed, active, mesic Aeric Epiaqualfs. A size-density-chemical fractionation approach was used to isolate soil organic matter fractions of differing stabilities to determine decadal processes of carbon stabilization or lack thereof. The second approach for elucidating the impact of biosolids application on SOC was a systematic meta-analysis, from over 40 years of peer-reviewed research, that explored the relationships between biosolid application and soil organic carbon, and the applications' influence on SOC with multiple abiotic factors. Eighty-four peer-reviewed articles met data quality and experimental settings to be included in the meta-analysis, which resulted in 347 experimental comparisons; 167 comparisons reported only SOC concentration while 180 reported SOC stock or in which stock could be calculated. The results from the meta-analysis determined there is a 30% increase in SOC concentration and 71% increase in SOC stock when biosolids are applied to the soil and application frequency influences SOC levels more than application amount. Biosolid application amount and frequency, study duration, clay content, and sampling depth all significantly influenced SOC when comparing biosolids applied and control treatments. Examining carbon stabilization in the long-term Waterman Farm Experiment, there was still a significant treatment effect of biosolid application after 28 years. A majority of the increase of SOC with increasing biosolid application rate was found within the most stable carbon fractions, resistant soil organic carbon (rSOC) and the silt + clay (Si + C) fractions, signifying carbon stabilization. Overall bulk SOC, however, rapidly decreased four to 28 years post application. These studies provide insights on the potential of biosolid application for long-term stabilization of carbon in the soil.

FRIDAY, DECEMBER 18, 2020, 1:00 P.M.

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