TEMPORAL VARIABILITY OF SOIL CARBON AND NITROGEN IN SEMI-ARID SOIL ON THE TEXAS HIGH PLAINS

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Abstract

Soil organic C (SOC) is fundamental for soil health because it plays a key role in nutrient cycling and soil erosion and is the primary component of soil organic matter (SOM) (Follett et al., 1987; Nelson and Sommers, 1996). In the semi-arid Texas High Plains, where soil erosion by wind is an important environmental concern, conservation management practices like no-tillage and cover cropping can increase SOC and subsequently enhance soil health; however, this process may take several decades (Lucas and Weil, 2012; Bronson et al., 2004). Previous research in soil health management of semi-arid cotton cropping systems is limited and previous studies have not examined the temporal variability of SOC. Potassium permanganate oxidizable C (POX-C) is a fraction of SOC which is considered the most mineralizable by microbes and therefore can serve as an indicator of short-term soil health dynamics (Weil et al., 2003). With a national focus on environmental sustainability it is important to regionally develop and standardize soil health parameters for semi-arid cotton cropping systemsm.

The objective of this research was to determine the effects of no-tillage and cover crop use on temporal variability of C and N pools within a semi-arid cropping system. Research was conducted at the Agricultural Complex for Advanced Research and Extension Systems in Lamesa, TX. The soil at the research location is classified as an Amarillo series (fine-loamy, mixed, superactive, thermic Aridic Paleustalfs). The experimental design was a randomized complete block with three replications of treatments included conventional tillage fallow during winter (CT), no-tillage with a rye (*Secale cereal* L.) cover (NTR), and no-tillage with mixed species cover (NTM). No-tillage and rye cover were implemented in the conservation management plots in 1998. In 2014, the NTR plots were split to include a mixed species cover including rye, hairy vetch (*Vicia villosa* Roth), winter pea (*Pinsum sativum* L.), and radish (*Raphanus sativus* L.). Soil samples were collected monthly and evaluated for SOC, POX-C and inorganic N (N_{inorg}) calculated as nitrate-N (NO_3^--N) plus ammonium-N (NH_4^+-N).

Preliminary results indicate temporal variability of C is more dynamic than previously reported and continued investigation is necessary. Soil organic C and POX-C fluctuate throughout the growing season with changes likely corresponding to plant rhizodeposition. Results indicate SOC and POX-C were generally greater in the NTR and NTM treatments compared to CT. Additionally, SOC and POX-C levels were greatest in periods with active root growth compared to periods of colder temperatures with less active root growth. Significant differences in N_{inorg} between treatments was not determined, but N_{inorg} was variable throughout the study period and likely correspond to microbial immobilization and mineralization. Cover crops appear to be immobilizing N during decomposition, limiting N availability for the cotton cash crop. Further investigation will attempt to quantify the contribution of rhizodeposition to temporal changes of SOC, N_{inorg}, enhanced microbial activity.

References

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