Importance of The Arboretum's Victoria Woods as a reference point to study soil organic carbon sequestration and soil health

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Part of our research program is the investigation of soil organic carbon (SOC) sequestration and soil health in different land-use systems including agricultural fields, and herbaceous biomass crop fields (e.g. switchgrass and Miscanthus). As an undisturbed old growth forest, the Victoria Woods woodlot in The Arboretum serves as an ideal reference point to predict the maximum SOC sequestration potential associated with these other land-uses. Data from the Victoria Woods, along with baseline SOC data from an agriculture field at the Guelph Turfgrass Institute (GTI) were used to assess SOC gains associated with fields that were converted to perennial biomass crops in 2009. In the context of soil health, earthworm numbers were quantified in all three land-use systems (Figure 1).

Figure 1. Sowthini Vijayakumar (PhD student) assessing earthworm populations in the Victoria Woods woodlot at The Arboretum.

The results of our research show that SOC stock is highest in woodlots (an un-disturbed forest ecosystem), followed by switchgrass and Miscanthus fields (a perennial grass ecosystem), and lowest in annual agriculture systems (Figure 2).

The increase in SOC stock since 2009, was 10.4 Mg C/ha under switchgrass and 7.5 Mg C/ha under Miscanthus compared to SOC stock quantified in an agricultural system in 2016. This shows that biomass crops (perennial grasses) have the ability to accumulate more SOC in soil compared to agricultural crops, and may have the potential to reach the levels of SOC found in undisturbed systems such as the Arboretum woodlot. Given that these land-use systems have the

same soil type, the conversion to perennial grasses could mobilize close to 230 tonnes of atmospheric carbon dioxide as SOC in a hectare of land. Adoption of Best Management Practices (BMPs), such as residue inputs, no-till, manure application, cover crops, etc., can also contribute to enhance SOC levels in agricultural systems.

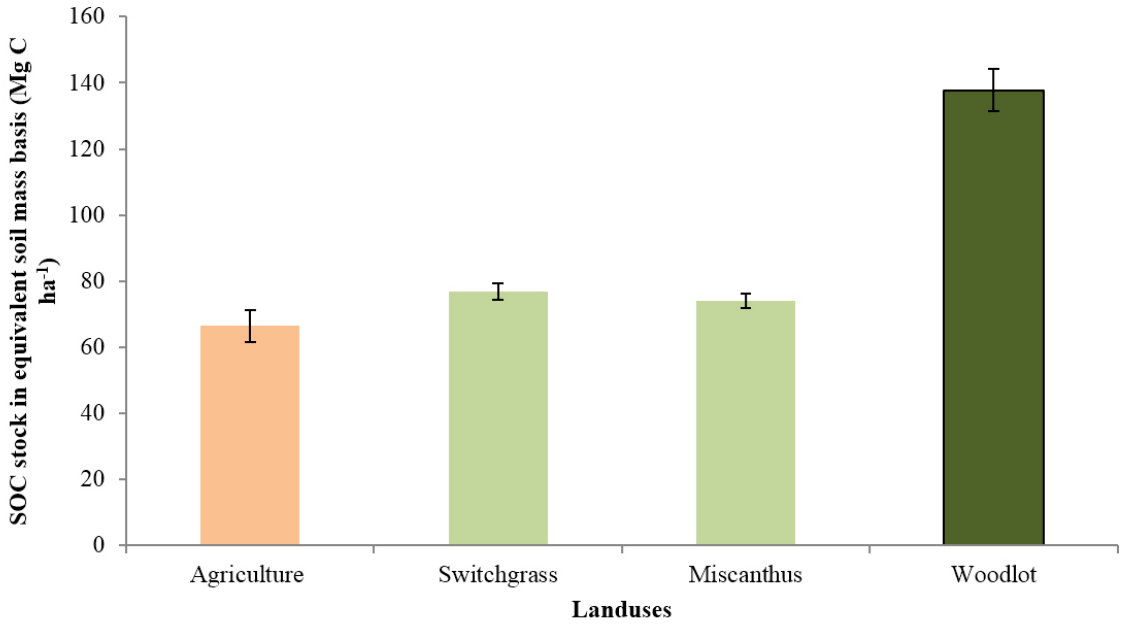

Figure 2. SOC stock (Mg C per hectare) in different land-use systems at the Guelph Turfgrass Institute (GTI) and in the Arboretum in 2016 [Note: switchgrass and Miscanthus fields were established in 2009 by converting a portion of an agricultural field at the GTI].

Earthworm populations at these locations also followed the same pattern as SOC stock: highest in the woodlot (13 individuals/m2), followed by switchgrass (12 individuals/m2) and Miscanthus (8 individuals/m2), and lowest in the agricultural field (7 individuals/m2) (Figure 3). This indicates that increasing SOC levels in the soil may help maintain soil health and fertility.

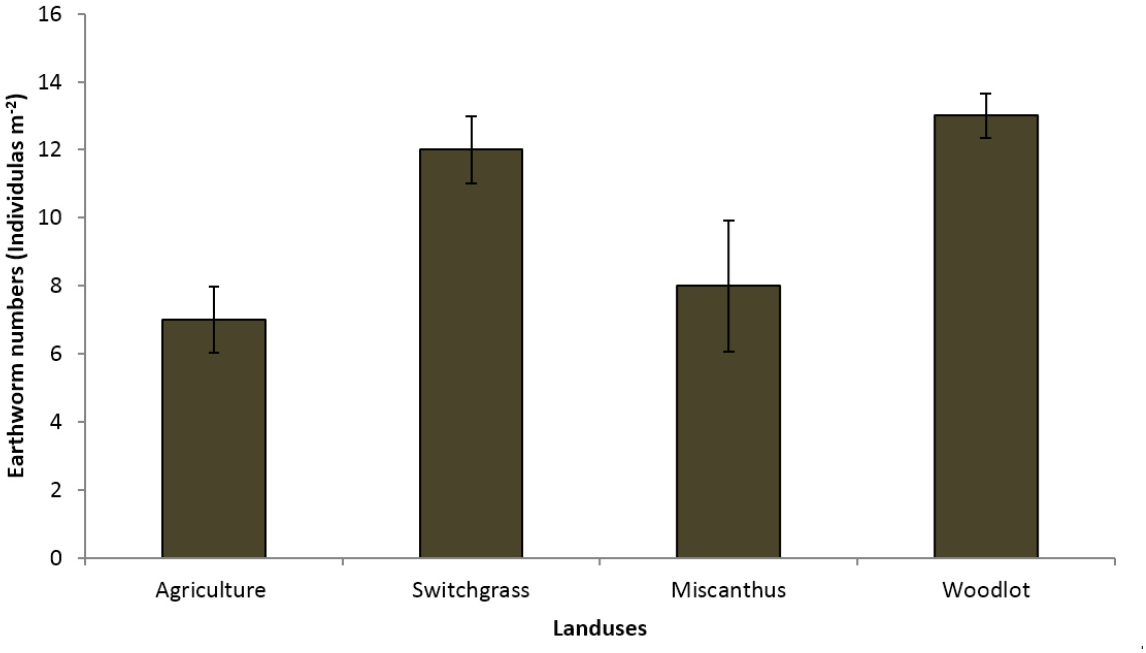

Figure 3. Earthworm populations (individuals per m2) in different land-use systems at the Guelph Turfgrass Institute (GTI) and in the Arboretum woodlot.

In conclusion, our results indicate that retiring low-productive agricultural lands to perennial biomass crops (perennial grasses) and adopting BMPs in agricultural lands have great potential for sequestering carbon, and contribute significantly to Canada's climate change mitigation initiatives, and still maintain healthy and fertile soils.

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