Impact of Land Management on Soil Quality

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Introduction

With agriculture being a major portion of the United States land-use and as the global population continues to rise, soil quality will increasing become an issue of importance as the demand for food security proceeds with the growing population. Our food security greatly relies on the ability of our soils to support agricultural systems. Managing land in a way that promotes a ideal soil quality is key in agricultural, aquatic and terrestrial systems. This renewable resource is one we must not neglect for the generations to come greatly rely on how we cautiously utilize this valuable commodity. With soil degradation becoming a more pressing issue, scholars have begun researching the effect of different land management types on soil quality.

With the current push for alternative fuels, research has been done to see the effect of bioenergy crops on the soil. As stated in a 1999 study at the University of Rostock in Germany, “the introduction of new crops into agriculture also requires a corresponding assessment of their effects on agricultural ecosystems”(Beuch 1999). When establishing new species into our crop production, we have to be aware of what positive or negative affects they may ensue on the system. Studies have been done on perennial biograsses, like swithgrass and *miscanthus*, and have shown benefits to the soil after the establishment of such crops.

A 2006 study in Ireland investigated the ability of a perennial biograss crop, *miscanthus giganteus (MxG)*, to sequester carbon and increase soil organic matter. The study found that the 15 year-old plot of MxG did in fact increase the soil organic carbon by fourteen percent. This means that the crop has the potential for carbon sequestration as a carbon mitigation option, but further studies need to be done to see if this is a lasting effect on the soil (Clinfton 2007).

Objectives

The general objective of this study was to observe the impact of continuous corn, continuous soybean, perennial biograsses, grass waterway and forests on soil quality through physical, chemical and biological indicators. Specifically, all tests outlined in the Natural Resources Conservation Service Soil Quality Kit Guide were completed in accordance to how they are detailed with the exception for water aggregate stability which was performed in the University of Illinois Urbana-Champaign labs with an wet sieving apparatus. These tests include respiration, infiltration, electrical conductivity, pH, temperature, nitrate content, slake test, bulk density, physical observation and water aggregate stability. In addition to the tests, moisture content, soil organic matter and texture analysis were performed on each of the five management types. From the found data, a quantitative soil quality index was calculated on all five management sytems. Overall, the hypothesis for this study was that the least disruptive management type will lead to the highest soil quality.

Method

A total of eleven tests were performed on the five different management types, and, at each management type, there were three sampling areas for a total of fifteen sampling areas. All of these sampling areas were located in close proximity to each other at a location called the Kerley Farm which is diagramed in the photo below.

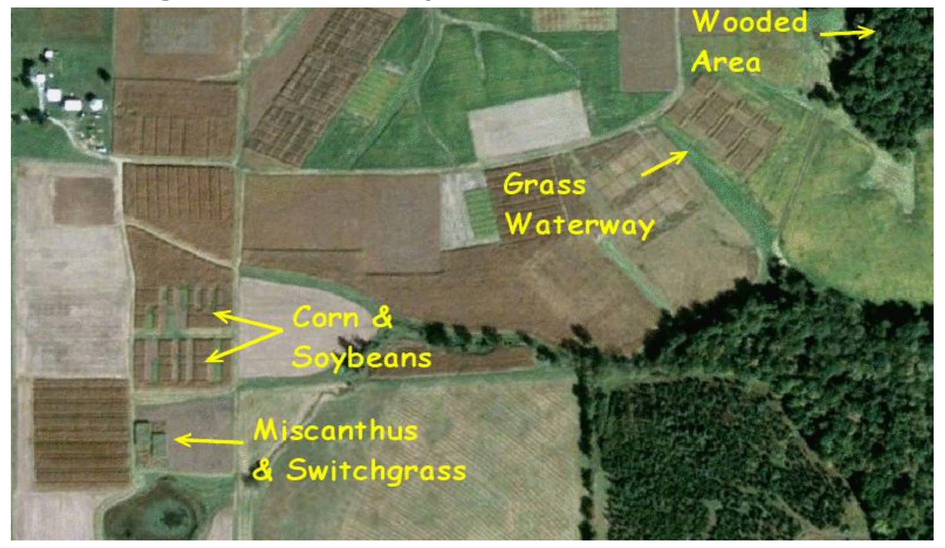

Figure 1: Aerial photo of Kerley Farm where all five management types are located.

Seven of these eleven tests were performed once a week over an eight period time frame, which include respiration, infiltration, temperature, electrical conductivity, pH, total moisture content and nitrate content. Slake testing, soil organic matter, and water aggregate stability were just performed once and textural analysis will be performed in the fall in the lab at the University of Illinois Urbana-Champaign.

Figure 2: Depiction of how the weekly respiration tests were performed in the perennial biograss.

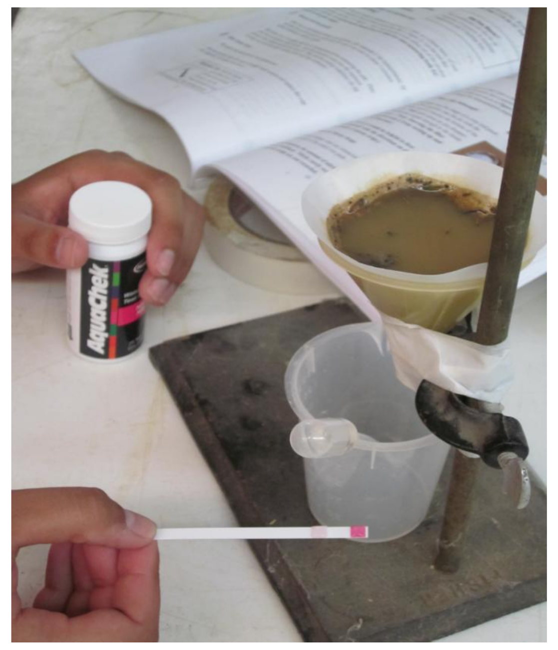

Figure 3: Depiction of how the weekly nitrate tests were performed in the labs at the Dixon Springs Agriculture Center.

References

Beuch, S., B. Boelcke, and L. Belau. "Effect of the Organic Residues of Miscanthus × giganteus on the Soil Organic Matter Level of Arable Soils." *Journal of Agronomy & Crop Science* 184.2 (2000): 111-120. *Academic Search Premier*. EBSCO. Web. 2 Aug. 2011.

CLIFTON-BROWN, JOHN C., JÖERN BREUER, and MICHAEL B. JONES. "Carbon mitigation by the energy crop, Miscanthus." *Global Change Biology* 13.11 (2007): 2296-2307. *Academic Search Premier*. EBSCO. Web. 2 Aug. 2011.

Results

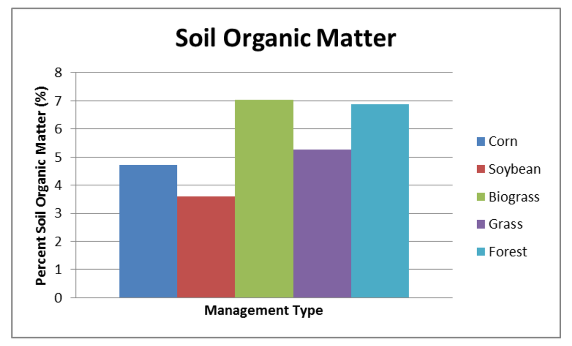

Figure 4: Graphical representation of Soil Organic Matter in all five management types demonstrating that the perennial biograss performed the best.

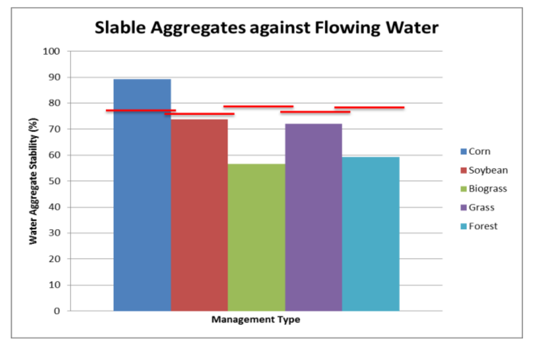

Figure 5: Graphical representation of Water Aggregate Stability in all five management types demonstrating that the continuous corn performed the best.

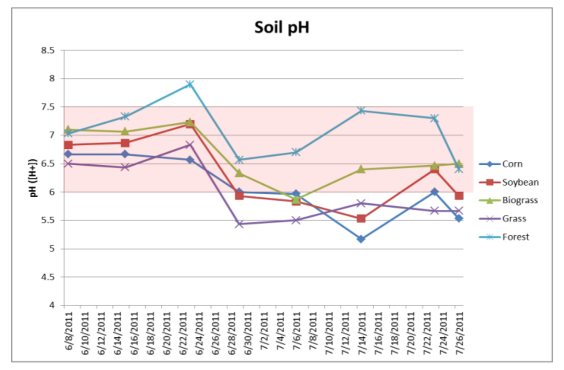

Figure 6: Graphical representation of pH in all five management types with the red shaded area representing the optimal pH range.

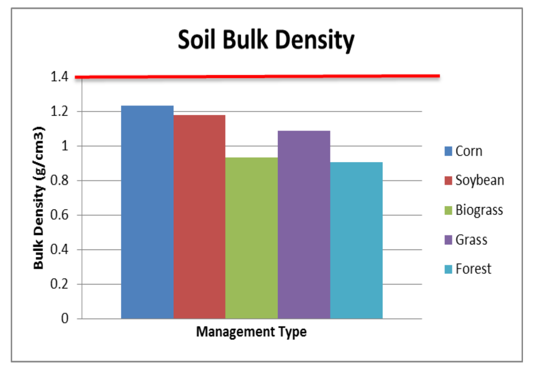

Figure 7: Graphical representation of bulk density with the red line representing the maximum ideal bulk density for a silt loam which was observed in this study.

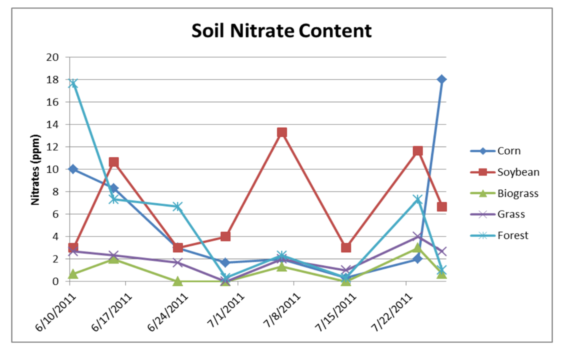

Figure 8: Graphical representation of nitrates in all five management types measured over an eight week period.

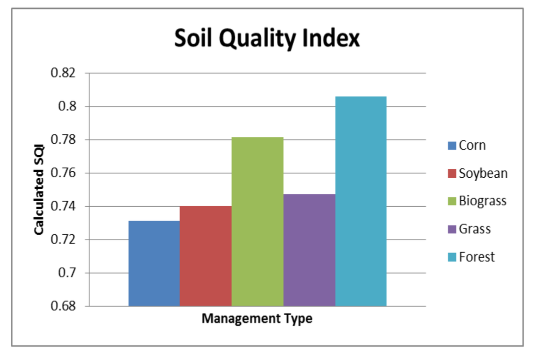

Figure 9: Graphical representation of calculated soil quality index demonstrating that the forest performed the best followed by the perennial biograss.

From the data found in this study, a soil quality index was determined from the five factors shown above. All factors were given equal weights into the index, and each factor's value was calculated by determining how much it ranged from the ideal.

Figure 10: The photo to the left is a representation of the soybean management type used in this study.

Figure 11: The photo to the right is a depiction of the weekly tests being performed in the grass waterway.

Conclusion

This study suggests different management systems have different affects on the soil quality and that a measureable quantitative difference between the systems can be observed. The calculated soil quality index supports the previously stated hypothesis stating that the least disruptive management system will have the highest soil quality number. Evidence from this study shows that perennial biograsses have the potential to alter factors of the soil and benefit soil quality. With further investigations, perennial biograsses could become a viable option as an alternative fuel source and carbon mitigation option.

Impact

Along with the current push for alternative fuels, this project hopes to impact the perennial biograss initiatives in a positive manner to show that these crops are not only viable as a new fuel source but provide benefit to the soil it is established in as well. Soil degradation is a major issue in the agricultural field and must be a problem on the front of a land owners mind when making decisions on their property. Hopefully, this data can help assist a land owner in educated decisions in the future to help provide usable land for future generations.

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