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 increase in 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 comprehensive understanding 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 switchgrass 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 biogress 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 (Clifton 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 the weekly tests being performed as a carbon mitigation option, but further studies need to be done to see if this is a lasting effect on the soil. Seven of these eleven tests were performed once a week over an eight week 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.

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.

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 4: Graphical representation of Soil Organic Matter in all five management types. Figure 5: Graphical representation of Water Aggregate Stability in all five management types. Figure 6: Graphical representation of pH in all five management types. Figure 7: Graphical representation of bulk density with the red line representing the maximum ideal bulk density for a soil type which was observed in this study. Figure 8: Graphical representation of nitrate in all five management types measured over an eight week period. Figure 9: Graphical representation of soil quality index.

Results
A 2006 study in Ireland investigated the ability of a perennial biogress 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. Hopefully, this data can help assist a land owner in deciding in the future to help provide usable land for future generations.

Conclusion
This study suggests different management systems have different affects on the soil quality and that a measurable 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 biogress 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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References

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

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

Figure 3: Depiction of how the weekly nitrate tests were performed in the lab at the U of I Champaign for providing infrastructure on the Soil Organic Matter Level of Arable Soils.

Figure 4: Graphical representation of Soil Organic Matter in all five management types. Figure 5: Graphical representation of Water Aggregate Stability in all five management types. Figure 6: Graphical representation of pH in all five management types. Figure 7: Graphical representation of bulk density with the red line representing the maximum ideal bulk density for a soil type which was observed in this study. Figure 8: Graphical representation of nitrate in all five management types measured over an eight week period. Figure 9: Graphical representation of soil quality index.

Figure 10: The photo to the left is a representation of the corn 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.

Figure 12: The photo in the center is a representation of the soybean management type used in this study.

Figure 13: The photo to the left is a depiction of how the weekly respiration tests were performed in the lab at the U of I Champaign for providing infrastructure on the Soil Organic Matter Level of Arable Soils.