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Management Effects on Soil Quality of the Geary Soil Series in Thayer County, Nebraska

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Abstract

- CGIAR[1] reports that around 40% of global crop yield variability is explained by climate. While global food consumption is expected to soar in 2050, the impact of climate change accounts for approximately 5% decrease in crop productivity.
- FAO[2] estimates a 60% increase in global food demand by 2050, with global population reaching 9.8 billions[3]. Sustainable soil management was also noted to boost agricultural food production by 58%. [2]
- The evaluation of the impact of different management practices on dynamic soil properties was conducted on Geary silty clay loam, 3 to 7 %, eroded soils, which are mainly used for crop production and pasture in east-central Nebraska and central Kansas.
- To restore and/or preserve soil health, it is critical for future agronomists to understand potential impacts of different management practices on soil quality indicators at a global scale. For example, farmers in Rwanda undergo high pressure to produce more to feed the growing population, and to achieve this goal they need to rely on up-to-date, easy-to-interpret soil quality data to inform their agronomic practices.

Objectives

- Project objective: Analyze soil samples from Geary soil in Thayer Co. and compare affects on dynamic soil properties related to:
  - Differences in management – no cover crops vs. cover crops vs rangeland
  - Differences in temporal change – compare 2015 to 2019
- Overarching objective: Identify management practices that improve or maintain soil quality, specifically related to the dynamic soil properties.

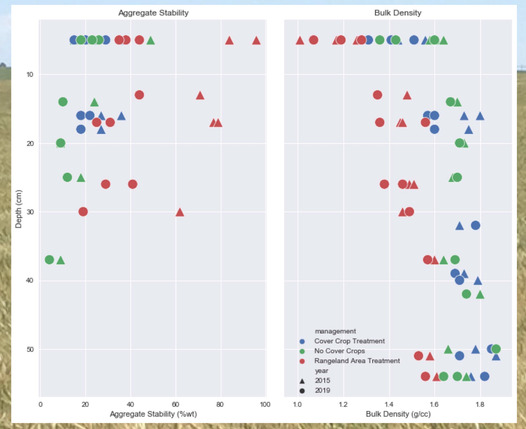
Methods

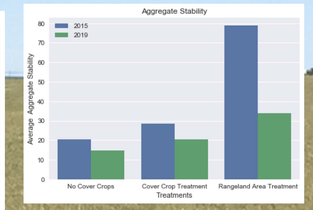
- 36 samples from 3 sites, each under different management, in Thayer County by Nebraska State Soil Scientist.
- Half of samples collected in 2015, and half in 2019.
- Analyzed samples for dynamic soil properties such as total carbon & nitrogen, particulate organic matter carbon & nitrogen, beta-glucosidase enzymes, aggregate stability, bulk density
- Followed standard analysis protocols developed and published in Kellogg Soil Survey Laboratory Methods Manual, version 5.0[4]

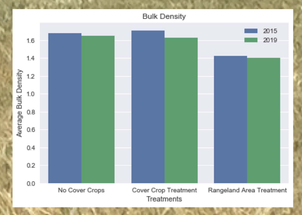
Project Sample Sites Locations, Thayer Co. Nebraska (courtesy of Aaron Hird)

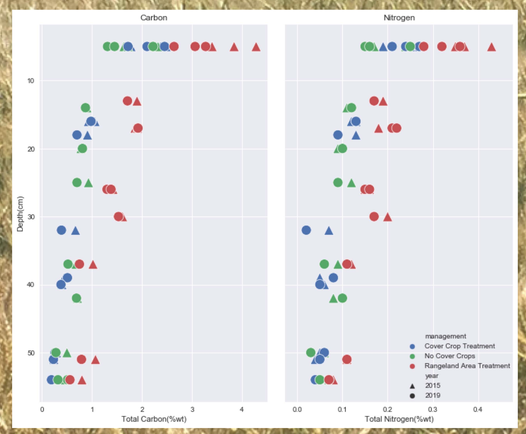
Sample collection at cover crop site, with Neil Dominy, Nebraska State Soil Scientist, USDA-NRCS (courtesy of Aaron Hird)

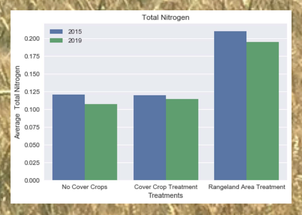
Soil sampling at rangeland site with Casey Latta, USDA-NRCS soil scientist (courtesy of Aaron Hird)

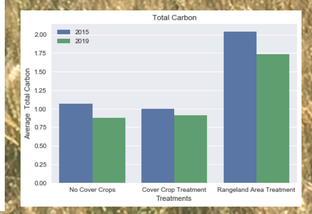


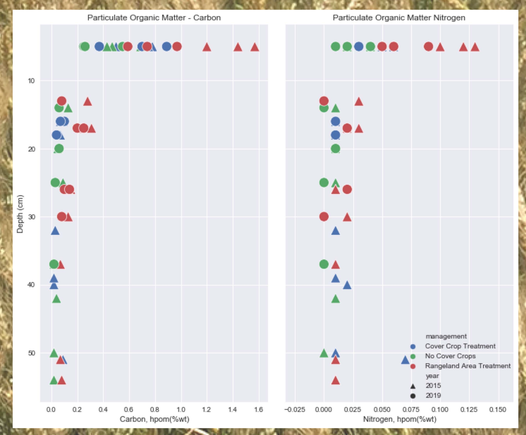


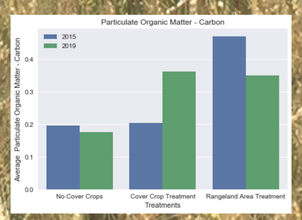


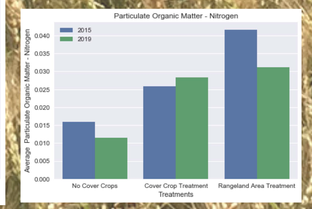


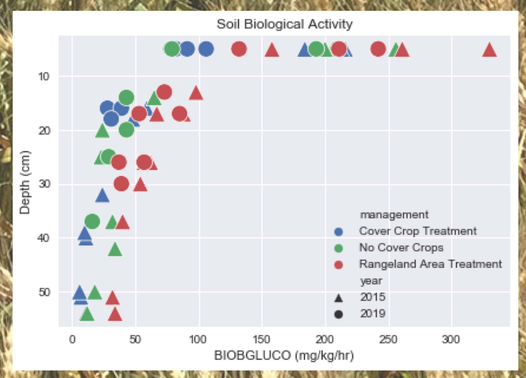


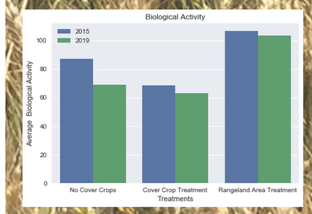












Results & Discussion

- Aggregate stability decreased in all sites from 2015 to 2019
  - significant drop observed in rangeland soil – this was unexpected
  - factors such as erosion, overgrazing, and additional disturbance may have caused the notable decrease
  - suitable aggregate stability for Geary soils is about 75%[4]; all soils except rangeland in 2015 are well below suitable
- Bulk densities in cover-crop and no-cover crop sites are greater than 1.6 which may affect root growth in silty clay loam soils[5]
- Total carbon and nitrogen decreased at all sites from 2015 to 2019, but particulate organic matter, carbon & nitrogen, increased in cover-crop sites.
  - significant decrease in particulate organic matter, carbon & nitrogen, in rangeland area might also have led to a decrease in aggregate stability
    - POM-C&N acts as a glue to hold aggregates together
  - may explain the smaller decrease in biological activity in cover-crop sites compared to no-cover crop between 2015-2019
- With a decrease in stable aggregate and particulate organic matter in rangeland area, we expected a significant decrease in biological activity as well, which was not the case.

Conclusion

- Rangeland is often expected to be a more stable agroecosystem with minimal soil disturbance compared to cultivated areas. The unexpected observation of a decrease in stable aggregates, particularly at the surface, might have been caused by other factors including erosion and overgrazing.
- Overall, this data indicates that soil quality has decreased in all sites between 2015 and 2019.
  - The Geary soil under rangeland management in 2015 was of “good” quality in 2015[4].
- The small number of samples used in the analysis may have introduced errors and skewed data. More data points (samples) would provide a more accurate depiction on the effects of these management practices on dynamic soil properties.
- Recommend an additional study into factors that may have caused a decrease in biological activities in these soils, such as types of cover crops and fertilizers utilized, weather patterns, timing of sampling, etc.

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