Soil Properties and Potassium Availability in Various Crop Management Practices in Kentucky

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Introduction

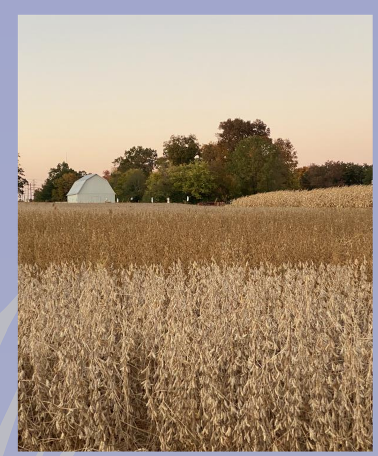
One of the most important factors regarding soil and plant health is nutrient availability and soil fertility. Soil fertility is the ability of a soil to grow plants by providing the essential nutrients plants need to grow (FAO, 2022). There are different factors that play a vital role in soil fertility such as soil organic matter (SOM) and soil water (SWHC) (Queensland 2022). Various land management practices can have major effects on soil fertility, as some forms of management includes different methods of tilling and different crop rotations. Various crop rotations result in differing amounts of residue. Residue is one of the main sources of soil organic matter which aids in the formation of soil organic carbon. Soil organic carbon levels directly impact the stability or tilth of a soil, soil organic carbon also aids in drainage and aeration, this also affects the nutrient holding capacity. (Corning etal., 2016). Another major component that relates to both the levels of soil organic matter content and soil fertility levels is bulk density. Bulk density is described as the ratio between the mass and volume of a sample in relation to pore volume (Chalise et al.,2019). Bulk density is important in determining soil compaction. If bulk density is higher than 1.6 g/cm^3, it may begin to restrict root growth or water infiltration. In Kentucky potassium is very important in regards to nutrient uptake and ATP production in plants. ATP is one of the main controllers of nutrient transport and metabolism (V. De Col, et al. 2017). Potassium use efficiency is usually low, but it varies depending upon the different soil types in different areas. (Meyer, 2020). Previous studies indicated that soil compaction, water content, organic matter content, and aeration levels influence the availability and the uptake of potassium by crops. Therefore the objective of this research was to determine the impact of land use management in Murray, KY on bulk density, soil water retention, soil organic matter, and available potassium. The results will be beneficial to agronomists and producers across the Midwest in order to better understand the impacts of crop management practices on selected soil properties and the fertility of potassium.

Study Site

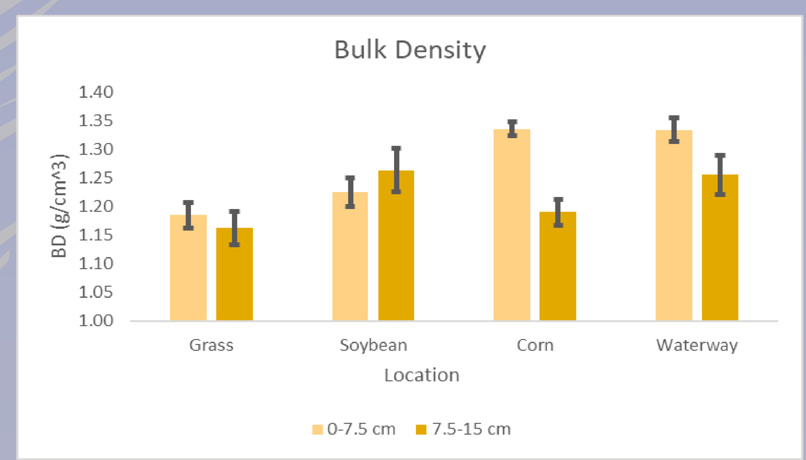
All four of the sites that the samples were collected from a corn plot, soybean plot, grass patch and waterway, at the Pullen Farm in Murray, KY (Calloway County). This research farm is conveniently located just off campus (36.6060°N, 88.3299°W). The major soil series for these sites include Calloway Silt Loam (20.7%), Grenada Silt Loam (53.1%), and Enville-Falaya Complex (26.2%). In total, the area that was covered for the sample collection was approximately 8 acres.

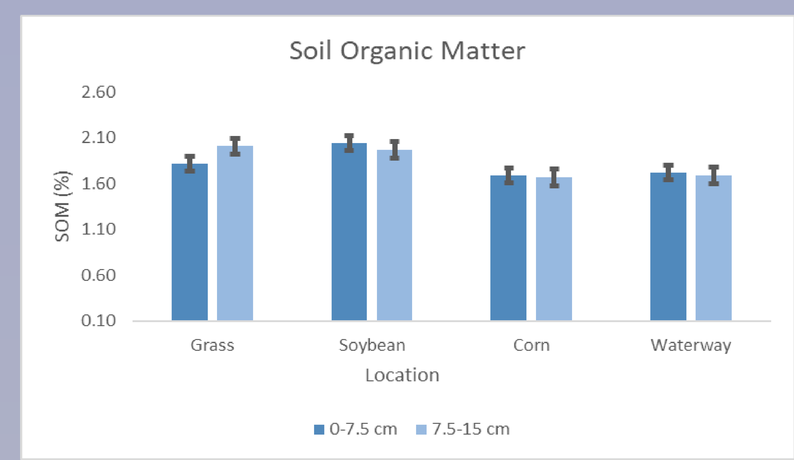
Methods

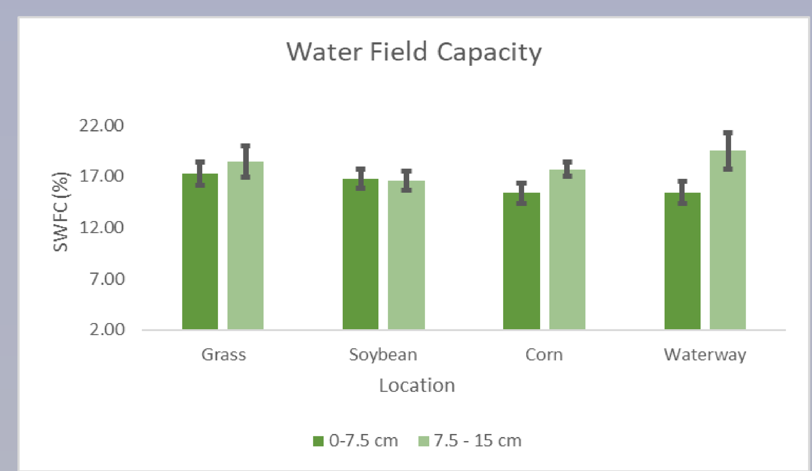
The undisturbed soil cores that were collected were from the uppermost layer of the soil profile in the topsoil (depth of 0-7.5 cm) and the subsoil just beneath the topsoil (depth of 15-21 cm) from four different sites. These sites were two row crop plots (corn and soybean),a grass patch and a waterway. Fields were between 0.5 and 1 hectare in size. Four randomly selected undisturbed cores per site were analyzed to determine water holding capacity (WHC), soil water field capacity (WFC), total porosity, and bulk density (BD). We had 32 core samples in total to test these qualities. Soil WHC, total porosity, soil WFC and BD were determined using the core method by the NRCS (2008) guidelines. Once the core samples were analyzed in the lab, the soil was removed from each core and treated as disturbed samples. From each core about 10g of soil sample was collected and analyzed to measure soil organic matter (SOM). The remaining soil from each core was then combined based on the depth and location. These samples were mixed to represent a composite sample. These 8 sample bags were then sent to the lab for testing available potassium (K+) per location.

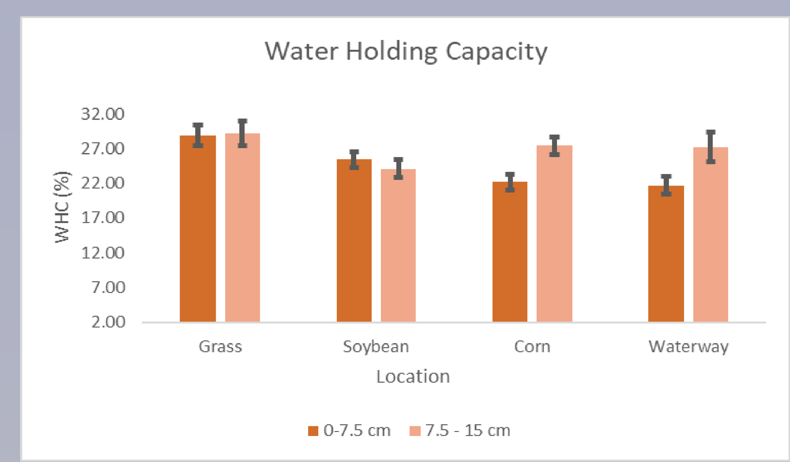


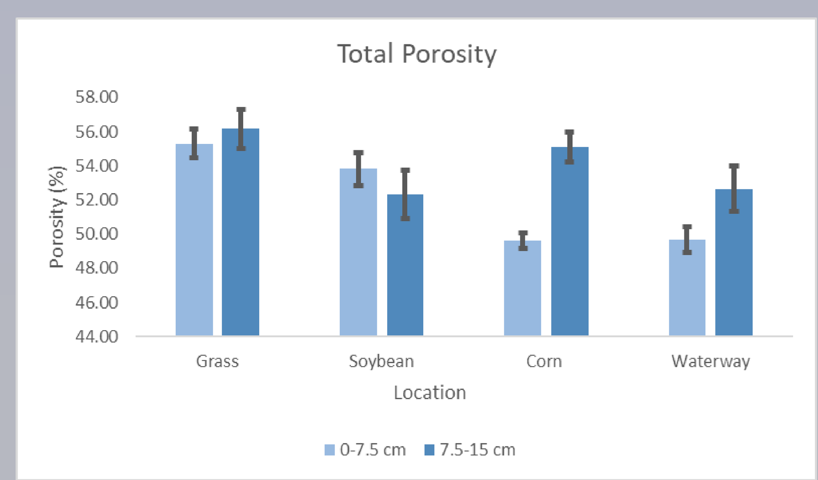
Results

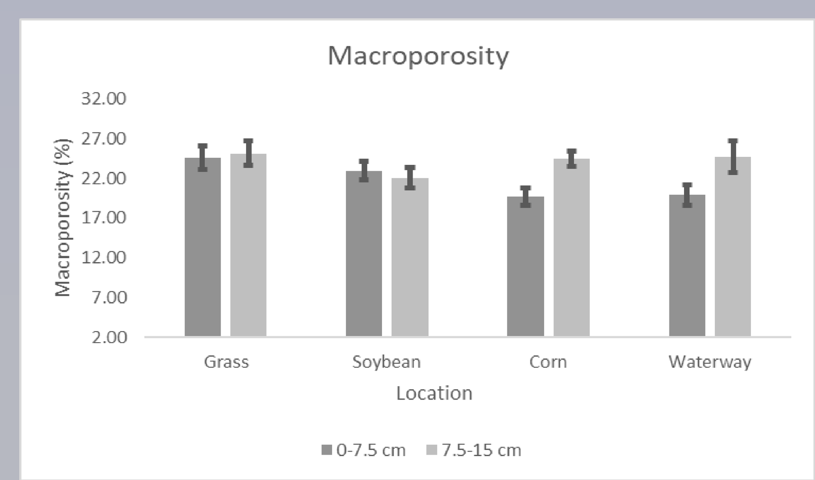


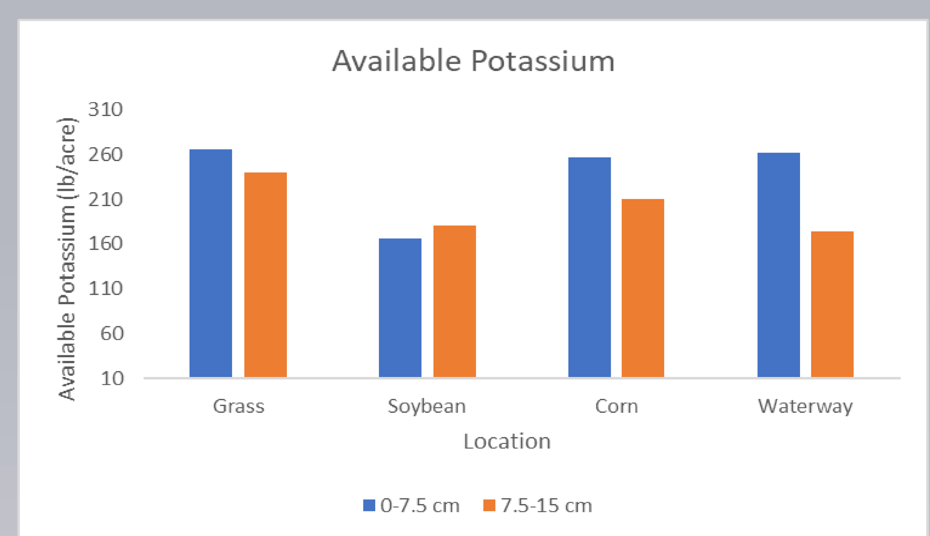












Conclusions

- Generally, the physical indicators are more sensitive to management practices in the topsoil (depth 0-7.5cm) compared to subsoil (depth 15-21 cm). However potassium availability was more dynamic in both depths.
- The grassed area provided the lowest bulk density (BD) 1.15 g/cm^3, due to great root volume. The corn field had the greatest soil compaction as indicated by the bulk density (BD) of 1.35 g/cm^3.
- In the topsoil (0-7.5cm), there was a noticeable effect of land management practices on bulk density (BD). The no-till system (soybean field) and undisturbed area (grass) had a BD of 1.22 g/cm^3 and 1.18 g/cm^3, respectively. These had a much lower BD compared to the conventional till system (corn) and the idle vegetation (waterway) with both having a BD of 1.33 g/cm^3 and 1.34 g/cm^3, respectively.
- Soil Water Holding Capacity (SWHC) in the grassed area was high at around 29.82% while the waterway had a SWHC of 27.22%. This indicates that soil under grass had more ability to hold water compared to the waterway side.
- Potassium levels were noticeably higher in the first 0-7.5 cm of the soil profile. With the most noticeable difference being located in the waterway. The level of potassium in the topsoil (0-7.5 cm) and the subsoil (7.5-15 cm) of the waterway was 262 lb./acre and 174 lb./acre, respectively.
- The findings suggest that soil management practices in Pullen Farm influenced soil organic matter, soil compaction/bulk density, soil water holding capacity, and macroporosity. It seems the available potassium was dynamic throughout the farm the lowest was found in the soybean field at 160 lb/A.

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