Nutrient cycling in native systems and agroecosystems in well and poorly drained soils

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Abstract

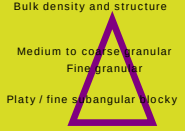
Long-term plots (44 yr) under no till (NT) and plow till (PT) and different crop rotations (continuous corn, corn-soybean and corn-oats-hay) in well and poorly drained sites are sampled on a decadal basis to track the changes induced on major soil nutrient dynamics and soil physicochemical properties. A pit sampling was included to ascertain macro and micromorphological changes in the topsoil, considering also woods and grassed areas. Cultivation modified structure development with a strong stable structure found under grass followed by NT and then PT. Bulk density was related to the degree of structure development (or degradation) with the greatest values for PT in the topsoil. The C pool in the topsoil was greater in Wooster under NT than for PT, almost similar for both treatments in Hoytville. Grassed and wooded areas have higher organic C stocks with higher levels in the poorly drained site. Long-term maintenance of NT, compared to PT, led to an accumulation of organic matter and a sustained ability to support high grain yields in the soil with highest susceptibility to erosion (Wooster), suggesting that NT management can sustain or even enhance soil quality in this site.

Rationale and Objectives

The Triplett - van Doren plots, that include the longest continuously maintained NT plots in the world provide a unique opportunity to investigate the long-term impact of tillage combined with crop sequences on soil properties and on nutrient cycling in soils of contrasting drainage classes. This setting could be especially useful to shed light in the still not completely understood effects of no till on soil properties and plant production.

Our objectives are:

- **Describe the main morphological and physico-chemical changes as a result of continuous application of no till and conventional till,compared to forest and grass ecosystems**
- **Link these changes to soil nutrient stock evolution and dynamics and plant production**



A. Characterization of four soil ecosystems

Woods

Grass

Pits

Continuous Corn No till

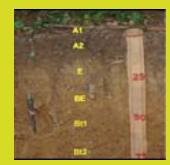
Continuous Corn Plow till

Poorly drained site

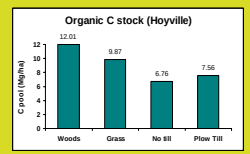
Hoytville

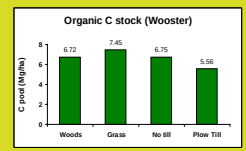
Well drained site

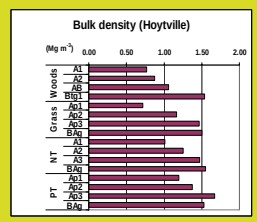
Wooster

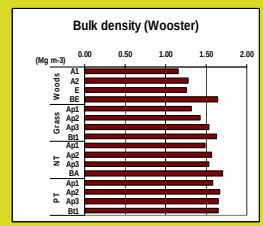


Lab physicochemical analysis
Mineralogy
Micromorphology







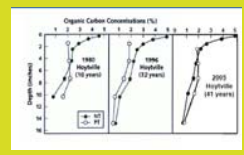


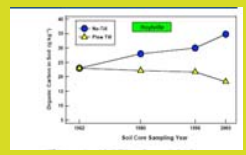
B. Evolution of nutrient stocks in four decades

(Continuous corn, no-till and plow till)

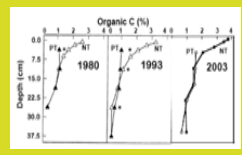
Decadal soil sampling + lab analysis

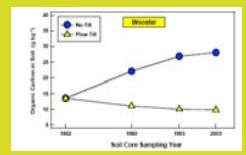
Organic C (Hoytville)





Organic C (Wooster)





Conclusions

- Soil profile changes under continuous no-tillage show the development of a better defined and strong structure, leading to lower bulk density values.
- Biological mixing due primarily to deep burrowing earthworms in NT, preserved root channels and the absence of disruption of aggregates could contribute also to more porosity and lower bulk densities.
- These combined factors have helped to an increased concentration of C in the surface layers of the NT soil profile as compared to the PT soil profile. The depth of C accumulation after 44 years extends about 50 cm. However, analyzed as C stock, NT is significantly superior to PT just in the well drained site (Wooster).
- Continuous, long-term NT management can sustain or even enhance crop yields and soil quality as compared to long-term PT management.

Acknowledgements

This poster is dedicated in honor of Dr. G.B. Triplett and Dr. D.M. Van Doren who were no-tillage pioneers and established the tillage and rotation plots in Ohio. Many other people have contributed to the care and helped in data collection during the years the plots have been in existence and their contributions are acknowledged.

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