

Improving Organic Matter in Soil - Contributing to Productivity

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Background

Soil organic carbon (SOC), or more generally soil organic matter (SOM), contributes to soil quality which in turn is strongly linked to sustainability of agriculture production systems.

SOM has many functions:

- Improves soil structure (tilth) and buffering capacity.
- Increases erosion resistance.
- Aids air and water movement.
- Influences pesticide efficacy and decomposition processes.
- Increases water and nutrient storage.
- Facilitates nutrient cycling.
- Important plant nutrient source.
- Energy source for micro-organisms.
- Greenhouse gas (GHG) source and sink.

Loss of soil organic carbon and nitrogen

Cultivation of grasslands and forest lands in the Canadian Prairies has resulted in a substantial decline in SOC and soil organic nitrogen (SON) from pre-settlement levels.

The rate and quantity of loss is affected by:

- Number of years under cultivation
- Summer fallow
- Climate
- Soil type
- Slope position

SOM (3 – 10% in Canadian Prairie soils) Composition

- 1-10% Plant Residues
- 10-40% Detritus
- Humus 40-60%

Increasing Soil Reserves

- Cultivated soils can have 16 – 60% less SOC than undisturbed native prairie soils.

- This is equivalent to 4 – 51 tonnes C per hectare, suggesting there is substantial room for increasing SOC reserves in annual cropping systems. Increasing SOC can increase productivity with the environmental co-benefit of removing CO₂ from the atmosphere.

Increasing SOC

- Reducing tillage to minimum or no tillage.
- Retaining straw in field instead burning or removal.
- Annual application of N, P, or other nutrients.
- Balanced fertilizer management – addressing all deficient nutrients including sulfur (S).
- Manure application – better long-term SOC improvement (direct and indirect benefits) than using mineral fertilizers.
- Manure + mineral fertilizers more effective than either used alone –particularly effective on eroded soils.
- Continuous cropping (annual crops or mixed annual/perennial) – i.e., no summer fallow.
- Land conversion from annual cropping system to perennial cover.

Note: There are upper limits to the amount of SOC that can be stored as a result of changes to management practices.

Conclusions

- Reducing summer fallow frequency and adopting no-till may be the most effective techniques to increase storage of organic C in soil as long as crop residues are returned to soil and nutrient deficiencies in crops are addressed. Adding organic amendments (e.g., manure) can greatly enhance these effects.
- Benefits include increased sustainable crop productivity (improved soil quality and nutrient supplying power), while reducing the potential for environmental damage by GHG emissions.

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