



Best Management Practices

ADDING ORGANIC AMENDMENTS

The amount of organic matter strongly influences the health, productivity, and resilience of cropland soils. Building and maintaining the level of organic matter in your soil offers many benefits.

Higher soil organic matter improves a soil's physical properties, such as water retention, permeability, water infiltration, drainage, aeration and structure. Ultimately it provides a better growing environment for crop roots.

One of the most effective ways to build and maintain levels of your soil's organic matter is by adding suitable organic amendments.

This factsheet describes the nature and function of soil organic matter, sources of organic amendments, and best management practices (BMPs) for adding organic amendments to soil.

THE ROLE OF HEALTHY SOIL IN A CHANGING CLIMATE

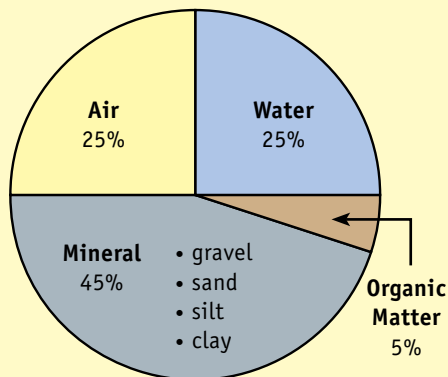
Agriculture and climate are directly linked – anything that has a significant effect on our climate will influence farm production. Greenhouse gas (GHG) emissions and climate change are global concerns, and agriculture can be part of the solution.

BMPs that improve soil health can also help lower GHG emissions, reduce phosphorus loss from fields to surface water, and improve resilience to drought or excessively wet conditions. Healthy soil – an essential component of a healthy environment – is the foundation upon which a sustainable agriculture production system is built.

Soil Organic Matter



Topsoil that is severely depleted of organic matter is light-coloured and prone to all forms of degradation – most notably, crusting, compaction and erosion by water and wind.

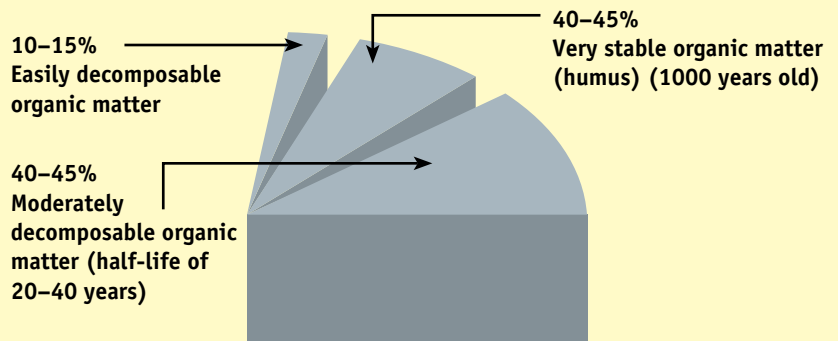


Soil has mineral and organic components. In ideal growth conditions, topsoil is half-solids (mineral and organic fractions) and half-space, where soil pores contain moisture and air for plant and soil organisms to breathe.

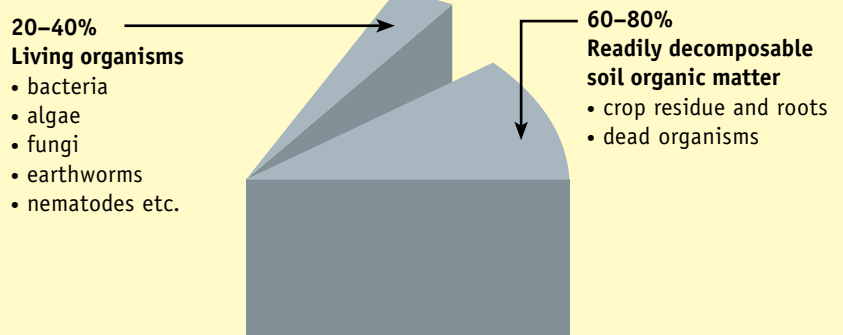


By improving soil health and conditions, soil organic matter provides a better growth environment for crop roots.

ORGANIC MATTER



EASILY DECOMPOSABLE ORGANIC MATTER



Soil organic matter is carbon-rich soil material that includes decomposing plant, animal and microbial residue. Live soil organisms and plant roots are part of the carbon pool in soil but are not considered soil organic matter until they die and begin to decay.

About 40 to 45% of the soil organic matter is very stable and resists decomposition.

Another 40 to 45% is moderately stable. This portion is protected or held within soil clods and on clay particles, and is very important to soil fertility – accounting for 40 to 50% of nutrients released each year.

The remaining 10 to 15% is composed of living and dead organisms, and decomposes easily.

Soil organic matter can come from:

- living plants such as forages, pasture crops, cover crops and plow-downs – root biomass, shoot growth
- dead plants – crop residue
- animals – manure and composted manure
- off-farm organic sources such as sewage biosolids, composted leaves, food processing wastes, char, paper biosolids, used cooking oil, etc.

WHAT HAPPENS TO ORGANIC MATTER IN THE SOIL

Soil microbes produce and add to the soil a glue-like substance known as polysaccharides as organic matter and added soil organic amendments decompose.

Polysaccharides are complex sugars that bind soil and organic matter particles together into aggregates. Well-aggregated topsoil is often referred to as having a crumbly structure. Aggregation makes for better infiltration, water retention, and aeration.

Soils with ideal aggregation are more stable and resilient and therefore more resistant to compaction. Compaction can reduce crop yields by as much as 50%.



HOW MUCH IS ENOUGH?

Cropland seedbed soil organic matter levels usually range from 1 to 5%. The ideal or target level is mostly dependent on soil type or surface soil texture. To be considered healthy, higher levels of organic matter are required for surface layers of clay or fine-textured soils.

TOPSOIL ORGANIC MATTER LEVELS BY TEXTURE

SURFACE SOIL TEXTURE	LOW LEVEL %	MODERATELY LOW %	MODERATELY HIGH %	HIGH %
Sandy Soils	<1.1%	1.2-2.0%	2.1-3.0%	3.1%+
Sandy Loams	<1.5%	1.6-2.5%	2.6-3.5%	3.6%+
Loams	<2.0%	2.1-3.0%	3.1-4.0%	4.1%+
Clay Loams	<2.5%	2.6-3.5%	3.6-4.5%	4.6%+
Clay Soils	<2.5%	2.6-3.5%	3.6-4.5%	4.6%+

It takes a long time to build up organic matter in the soil. In some soils, an increase of only 1% may be accrued after a decade or more of soil building. However, the benefits of this increase are most often realized long before they're measured.

Organic Amendments



The importance of soil organic matter can't be overstated. Adding organic amendment matter has many benefits:

- improved soil structure and tilth
- improved aeration
- improved soil moisture features
 - increased infiltration rates, percolation rates and higher water-holding capacity
- added nutrients and improved nutrient cycling
- improved soil life
- reduced levels of greenhouse gas emissions and a sink for carbon.

FACTORS TO CONSIDER WHEN CHOOSING A SOIL AMENDMENT

There are at least four factors to consider:

- the impact on soil health and long-term organic matter levels
- soil texture (coarseness or fineness of the soil)
- soil nutrient, pH and salt levels
- salt content, nutrient levels, organic matter content and pH of the amendment.

Healthy soils emit fewer greenhouse gases such as carbon dioxide and methane. Adding soil organic matter helps to move carbon out of the atmosphere and into the soil.

BMPs for Adding Organic Soil Amendments

MANURE AND SEWAGE BIOSOLIDS

Manure and biosolids come in a range of forms and can have a wide range of nutrient and carbon levels. For example, adding 20 tonnes/ac/yr of solid cattle manure will increase the organic matter level of a loamy soil by 1% in approximately 10 years. It would take about 25 years to make the same increase if liquid hog manure was applied at a rate of 3000 gal/ac (33 m³/ha) every year. Application of manure and sewage biosolids using BMPs will ensure the effectiveness of adding organic matter to the soil and will help meet crop nutrient requirements.



Wayne Cunningham farms 500 acres near Georgetown, northwest of Toronto. He rotates three crops – corn, soybeans and winter wheat – on his light, sandy, relatively dry soil, and realized he needed organic matter. With the shift from mixed farming to cash crops, manure was no longer available within a reasonable distance.

Cunningham says he views compost as a replacement for manure. “Analysis shows it’s very similar in nutrient content. If I was sitting next to a chicken or pig farm I wouldn’t need it. But I don’t have manure.”



Using compost along with minimal tillage is part of his effort to rebuild his soil.

“I farm to build my soil. You only get out of it what you put back into it. Worm activity is extreme now. There are literally thousands of worms. Water retention and soil tilth are better. The soil smells better. Short-term, I’m not going to get a big result. The next generation will, if they keep farming this land.”

COMPOST

There are several types of compost materials from on-farm and off-farm sources that are suitable for application on cropland. Most compost contains less than 1% each of nitrogen, phosphorus and potassium, so application rates can easily exceed 10–20 tonnes/acre for the first application. Adding 20 tonnes/ac/yr of composted leaf and yard waste from urban centres can increase the organic matter level of a loamy soil by approximately 1% in 15 years.



CROP RESIDUE



Some organic carbon is added to soil by leaving soils protected with the top-growth residue from the previous crop. However, crop residues are more effective as soil cover than as a means to increase soil organic matter.

FORAGES + PASTURE

Soil quality improves drastically when a suite of BMPs is used to increase soil organic matter, such as forage based rotations or long-term pasture plus intensive pasture and grazing management with manure additions.



PLOWDOWNS / GREEN MANURE CROPS

Careful incorporation of legumes after full bloom will maximize top-growth, nitrogen fixation and organic matter additions, while minimizing soil moisture depletion.



COVER CROPS

A number of vegetable producers are growing a summer cover crop (such as sorghum-Sudan grass) to increase soil organic matter. While this may involve taking a field out of production for a season, an early vegetable crop can be grown and followed with a summer cover crop.



CROP ROTATION

Recent research findings on cropping systems and soil organic matter levels attribute higher gains on soils with cereals in the rotation – regardless of tillage system.



Castleton area farmer Scott Mabury has been adding organic amendments regularly over the past 10 years.

“The farm had been rented, so not a lot of work was done on the sandy loam soil. It was ‘challenged’. From the beginning, I wanted to improve it, particularly the organic matter and tilth.”

Scott used paper sludge and leaf/yard-based compost and has seen a dramatic decrease in soil erosion and an increase in soil organic matter of half a percent, from about 2.5 to 3%. In terms of crop

production, though, he says “It’s a no-brainer. If you put compost on, you get bigger yields.”

OFF-FARM SOURCES

A variety of other organic materials can be applied to soil to increase soil organic matter levels. Knowing the dry matter content and nutrient content of the material will help calculate application rates and provide an indication of how much organic matter and nutrients are being added.



For more information

ONTARIO MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS

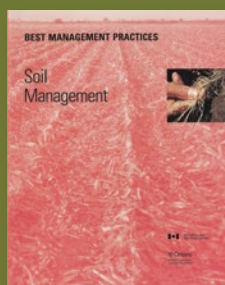
Many sources of supplementary information are available.

Below are some suggestions to get you started. Most can be found online at ontario.ca/omafra or ordered through ServiceOntario.

- Publication 811, *Agronomy Guide for Field Crops*
- Publication 611, *Soil Fertility Handbook*

Best Management Practices Series

- *Application of Municipal Sewage Biosolids to Cropland*
- *Buffer Strips*
- *Controlling Soil Erosion on the Farm*
- *Cropland Drainage*
- *Establishing Tree Cover*
- *Field Crop Production*
- *Managing Crop Nutrients*
- *Nutrient Management Planning*
- *Soil Management*



Environmental Farm Plan (4th ed.) and EFP Infosheets

- #15, *Soil Management*
- #16, *Managing Nutrients in Growing Crops*
- #17, *Use and Management of Manure*

- #18, *Horticultural Production*
- #19, *Field Crop Production*

Inquiries to the Ontario Ministry of Agriculture, Food and Rural Affairs

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