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SOIL ORGANIC MATTER

This factsheet contains complementary information to the Best4Soil video on Soil Organic Matter

INTRODUCTION

Soil consists of different materials. Even if the main fraction is mineral, the organic matter in soil plays a critical role in the functions of a healthy soil. The main functions (Schulte et al.,2014) in soil, such as primary productivity, water purification and regulation, carbon sequestration and regulation, biodiversity and nutrient cycling are all highly dependent on soil organic matter (SOM). The organic fraction in soil consists of approximately 58% carbon, which was mostly removed from the atmosphere through the photosynthetic activity of plants. Therefore, the level of SOM is not only critical for the soil and the farmer, but also for climate, environment and society as a whole. Depending on the type of soil, most organic matter levels in arable and vegetable production are between 1 to 6% of total soil mass. Even with such a small proportion, soil organic matter has a huge impact on most physical, chemical and biological characteristics of the soil.

SOM IMPACT ON PHYSICAL, CHEMICAL AND BIOLOGICAL CHARACTERISTICS

Physical impact

If soil organic matter is raised in soil, the impact on physical characteristics is significant. Aggregate stability (fig. 1), and therefore water infiltration, water holding capacity as well as air and water distribution are all increased. A reduction in crusting and better pore spacing also result from increased SOM levels and can be monitored easily.

Chemical impact

Increased cation exchange capacity and therefore higher nutrient dynamics can be measured, if the organic matter in soil is increased. Plants and farmers benefit from higher total nutrient levels and faster nutrient mobilization for plant availability.

Fig. 1: Soil aggregate stability of two sandy loam soils with 7% SOM (left side) and 2% SOM (right side).

Biological impact:

Soil organic matter is not only a habitat for soil microorganisms and even larger organisms in soil, but it is also a food for them. The higher the level of SOM is, the more diverse and abundant life in the soil is. This not only results in more dynamic mobilization of nutrients for the plants, but also in better competition against soil borne diseases and therefore increases soil health.

In general, soil organic matter plays a critical role in making soils more resilient, that is the capacity of the soil to deal with negative effects from outside (e.g.: drought, harsh temperatures, compaction, pesticide pressure, ...).

HOW TO PROTECT EXISTING ORGANIC MATTER IN SOIL

Protecting soil organic matter is therefore critical for each farmer and grower. The main methods to maintain SOM levels is to reduce tillage, avoid the possibility of erosion and to reincorporate crop residues (fig. 2). Tillage particularly plays a critical role, because it opens the

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soil. Microbes react to the higher availability of oxygen and consume some of the soil organic matter, which results in carbon dioxide release. Soil carbon dioxide is the most important plant nutrient (photosynthesis!), but increased levels at this point do not help and are lost to the atmosphere.

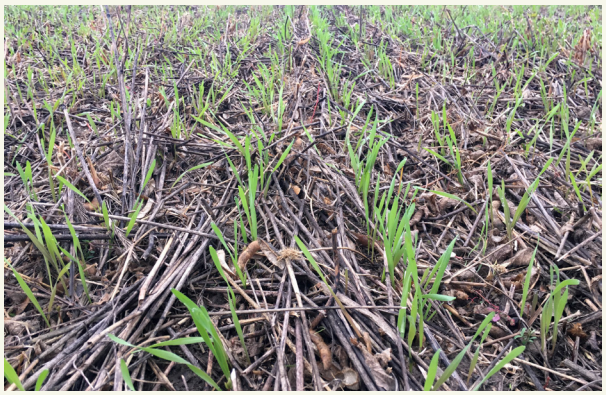

Fig. 2: reduced tillage and crop residues help to fight the loss of soil organic matter.

METHODS TO INCREASE SOIL ORGANIC MATTER IN SOIL

Because some SOM is always lost through farming activity, increasing levels is not only possible, but also necessary. There are several methods to do the job:

Crop rotation

Growing a diverse range of crops with spring and autumn seeding dates provide all year coverage of soil and therefore balance SOM levels.

Cover crop and green manures

In between cash crops, cover crops and green manures are used not to deliver a crop for the farmer, but a benefit for the soil. These plants are not harvested but incorporated back into the soil and therefore raise SOM levels (fig. 3).

Fig. 3: Earthworms feed on crop residues therefore increase soil organic matter.

Perennial crops

Perennial crops are often used in crop rotations by organic and livestock farmers. Clover, lucerne (alfalfa) and clover-grass mixes are perfect crops for increasing soil organic matter for two reasons. They sequester a lot of carbon all year round and also, these fields are not tilled when the crops are present.

Composts, manures, organic fertilizers and soil amendments

Growing SOM on the field is one opportunity, applying carbon through compost and other organic resources is another opportunity to increase SOM.

Biochar

Biochar application, often in a mix with compost or manures is a rather new method to raise SOM in soil. Biochar is charcoal produced from organic residues through pyrolysis. It is rich in carbon and used in soils also, where it stays intact for centuries.

Livestock for mob grazing[2]

Another method, which is gaining more and more attraction again is mob grazing (fig. 4). Animals in high population densities are used to graze, trample and leave plants on the ground. This method mimics large buffalo and antelope herds, which helped to create fertile soil in the prairie.

Fig. 4: Cattle grazing on a grass-clover ley grassland.

[1] EIP-AGRI Focus Group Moving from source to sink in arable farming: Final report https://ec.europa.eu/eip/agriculture/en/publications/eip-agri-focus-group-moving-source-sink-arable

[2] EIP-AGRI Focus Group Grazing for carbon: Final report https://ec.europa.eu/eip/agriculture/en/publications/eip-agri-focus-group-grazing-carbon-final-report

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Additional information on organic matter are published as an EIP-AGRI minipaper:

https://ec.europa.eu/eip/agriculture/sites/agri-eip/files/2_eip_sbd_mp_organic_matter_compost_final.pdf

References

Schulte et al, 2014, Functional land management: A framework for managing soil-based ecosystem services for the sustainable intensification of agriculture, IN: Environmental Science and Policy, Volume 38, April 2014, page 45-58, https://doi.org/10.1016/j.envsci.2013.10.002

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