

eip-agri
AGRICULTURE & INNOVATION

Soil organic matter matters

Investing in soil quality for long-term benefits



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European
Commission



Soil organic matter content is key for a healthy and high-quality soil. This brochure highlights methods to improve soil organic matter content which can help ensure adequate soil functionality and soil fertility. It also offers a number of solutions for common soil challenges, which are especially critical in Mediterranean regions. To take ideas on soil quality and soil health further, this brochure also suggests topics for potential Operational Group projects (funded through the European rural development programmes).

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This brochure has been produced within the framework of the European Innovation Partnership 'Agricultural Productivity and Sustainability' (EIP-AGRI), which was launched by the European Commission to promote innovation in the agricultural and forestry sectors and to better connect research and practice. In 2014-2015 the EIP-AGRI Focus Groups on 'Soil Organic Matter content in Mediterranean regions' (SOM) and 'Soil-borne diseases' (SBD) each brought together 20 experts with different backgrounds (scientists, farmers and advisers).

Their aim was to propose solutions for securing soil functionality and soil fertility, and for improving soil organic matter content in the Mediterranean region in a cost-effective way. The soil-borne diseases Focus Group also proposed recommendations on how good soil health can suppress soil-borne diseases. This brochure follows up on the [SOM final report](#) and the [SBD final report](#), in which the Focus Groups presented their conclusions. All Focus Group results can be found online via www.eip-agri.eu.



The importance of soil organic matter in a healthy soil

Soil organic matter is the organic component of soil. It consists of organic material from plants and animals, and material that has been converted by microorganisms in the soil at different stages of decomposition. Soil organic matter has direct benefits for agricultural and forestry production. Healthy soils with stable levels of soil organic matter are also better equipped to prevent and fight soil-borne diseases. Soil organic matter plays a vital part in enhancing soil fertility and quality, on three levels:



CHEMICAL: Soil organic matter significantly improves the soil's capacity to store and supply essential nutrients (such as nitrogen, phosphorus, potassium, calcium and magnesium), and to retain toxic elements. It allows the soil to cope with changes in soil acidity, and helps soil minerals to decompose faster.



PHYSICAL: Soil organic matter improves soil structure. This ultimately helps to control soil erosion and improves water infiltration and water holding capacity, giving plant roots and soil organisms better living conditions.

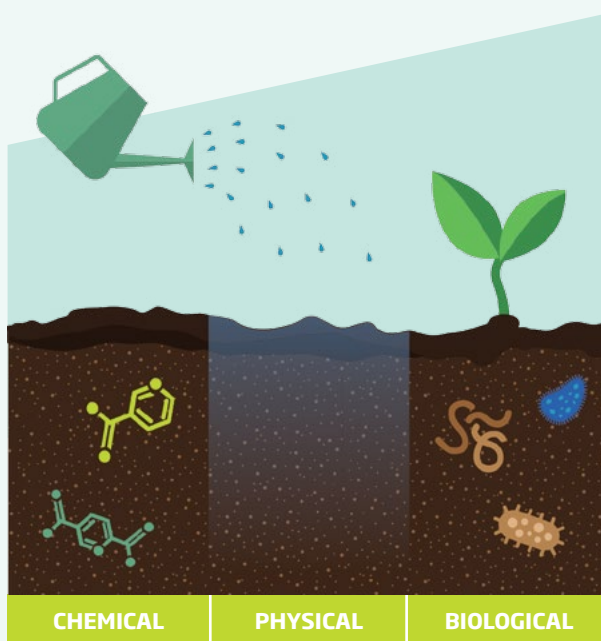


BIOLOGICAL: Soil organic matter is a primary source of carbon (C) which gives energy and nutrients to soil organisms. This supports soil functionality because it improves the activity of microorganisms in the soil and it can enhance biodiversity. Capturing carbon in the soil also lowers emissions of CO₂ to the atmosphere, and this mitigates climate change.

Challenges specifically linked to Mediterranean regions

In 2002, the European Commission identified declining soil organic matter content as one of the most serious causes of soil degradation, especially in southern Europe. Mediterranean climates tend to have higher soil temperatures and suffer more from drought and heavy rain.

This can speed up the decomposition of soil organic matter and causes loss of soil nutrients. Coarse landscapes, certain land uses (such as vineyards), and soils that are not completely covered by vegetation are more prone to erosion, which also leads to loss of soil organic matter.





Solutions to improve soil organic matter

Improving organic matter on the farm

Farmers can take measures to avoid carbon loss through decomposition, leaching via ground water, and erosion. They can also improve soil organic matter content on the farm by adding carbon inputs. This can be plant or animal waste produced on the farm, or organic material from outside the farm. Soil organic matter can also be increased through reduced and no-tillage practices, by selecting crops that produce more diverse organic residues, and by applying crop rotations. Keeping the soil covered for a longer period of time, for instance with green manures (cover crops that are incorporated into the soil) can also improve organic matter content. The biological quality of soils may also be improved by inoculating the soil with beneficial microorganisms or by using 'bioeffectors' which stimulate biological activities in the soil.

► Digging for innovative solutions

The EIP-AGRI Focus Group on Soil organic matter content listed different techniques for improving soil organic matter, specifically in Mediterranean soils. Read and download all results on the EIP-AGRI website: <https://ec.europa.eu/eip/agriculture/en/content/soil-organic-matter-content-mediterranean-regions>



Stimulating soil quality and soil health for long-term benefits

To improve soil fertility, farmers often focus on the soil's chemical elements and the use of chemical fertilisers. However, improving soil fertility may not always be relevant as an ultimate goal. In many wine-growing areas, for instance, the best quality wines are produced from vineyards growing in poorly fertile soils.

If the purpose is to increase carbon in the soil (C sequestration), then practices that favour a slow decomposition rate of soil organic matter are the most effective. However, a slow or reduced decomposition rate may restrict the supply of nutrients to crops. The best solution may be to ensure a stable level of soil organic matter, with yield-related and financial benefits in the long run, and advantages for soil health and disease prevention as well.



► A soil health strategy for disease prevention

Soil-borne diseases can more easily be prevented and suppressed by developing a soil health strategy at farm level. The EIP-AGRI Focus Group on integrated pest management (IPM) for soil-borne diseases made suggestions for tackling diseases, for practical research and for improving the cost-benefit ratio of IPM methods, such as:

- Cover crops and green manures can stimulate microbial activity and help fight soil-borne diseases in the soil.
- By incorporating certain Brassica species (notably mustards) into the soil, gases are released that can help to suppress soil-borne diseases.
- Several studies have shown that using compost can help suppress pests and diseases.

Read all results from this Focus Group: <https://ec.europa.eu/eip/agriculture/en/content/ipm-practices-soil-borne-diseases-suppression-vegetables-and-arable-crops>

Decision support tools

Before deciding which methods to apply when managing the soil, every farmer needs to consider which soil benefits he or she wants. Soil functions and ecosystem services – such as nutrient cycling, filtering water quality, physical soil stability, supporting biodiversity and soil microbial resources – are all influenced by the amount and quality of soil organic matter. A number of decision support tools can help farmers decide which strategy is best for their own soils:

► DEMETER: hands-on support tool for soil and water quality

The EU LIFE project 'DEMETER' developed a hands-on decision support tool for farmers to track the evolution of organic matter and nutrients in their soils. The tool is freely available online and gives farmers a report based on parcel-specific input. It was developed in cooperation with farmers, farm advisers and scientists. The tool is currently aimed at Dutch and Belgian farmers (language, soil types, climate), but steps are being taken to translate the webtool into English.

- <https://www.vlm.be/nl/projecten/Europeseprojecten/Demeter/InEnglish/Paginas/default.aspx>

► Support tools for better soil quality

- The Catch-C project collected 81 innovative practices at farm level from across Europe that can improve soil quality and farm productivity, and at the same time mitigate climate change. Examples are reduced tillage, applying organic inputs (such as compost), crop rotation, cultivating green manures, and using of low-impact machinery.

- www.catch-c.eu

- The web application Knowsoil allows users to trace the effects of soil management practices on soil quality, crop productivity and climate impact.

- The 'Guide to better soil structure' from LandIs (Land Information System) gives practical measures to understand and protect good soil structure.

- The N-Toolbox online catalogue provides tips for farmers to optimise Nitrogen cycling and minimise water pollution, for manure storage, livestock diet, grazing, Nitrogen balance, and irrigation.

- PLANET (Planning Land Applications of Nutrients for Efficiency and the environment Tool) is a free tool to assist farmers in complying with Nitrate Vulnerable Zones' regulations in the UK.



Voices from the field

► Filipe Marques farmer in Alentejo (Portugal)

Winner of the Land and Soil Management Award 2015-2016 organised by the European Landowners Organisation

Filipe: "Our challenge is to create soil management opportunities under Mediterranean soil and climate conditions. We try to use smart solutions to reduce the impact of irregular rainfall and high temperatures on soil organic matter content. The biggest enemy for improving soil fertility, we believe, is tillage, which increases organic matter mineralisation and soil erosion. The conservation agriculture system that we've adopted is based on no-tillage, crop rotation, and adding crop residues. We also add cow manure from our own cattle. Soil management is a continuous process that takes time.

By improving soil organic matter content, soil structure, soil fertility and soil biology, we are also enhancing soil functions, resulting in a more efficient soil and higher crop yields year after year.

"Soil organic matter content is key for improving our results and our economic sustainability. Conservation agriculture also has the best environmental benefits." - Filipe Marques -

► Carla Konsten farmer in Italy

Carla: "When we bought our farm in 2005, the soil was low in soil organic matter content because previously only chemical fertilisers had been used. We turned our farm into an organic farm. We use plant organic residue from our olives, fruit and vegetables for composting. Because this compost is poor in nutrients, we also collect manure from horses, sheep, goats and cows from different farms in our village. We mix this manure with our on-farm compost.



The result is clearly visible in our vegetable crops: the soil has a better structure and retains water better, it is full of worms and other soil fauna, and does not dry out as easily. Our plants are healthier, they grow better and we produce more than we did in the first years. Although this solution is quite labour-intensive, soil organic matter management is essential for the growth and health of our plants. Collecting manure from other farms also brings us in close contact with other farmers in our community, allowing us to help each other and exchange experiences."





Inspiration for setting up Operational Groups

By working together, we can achieve more. EIP-AGRI Operational Groups are groups of people with varied expertise who come together to find innovative solutions for agricultural issues. These projects are funded by the rural development programmes in EU countries and regions. By setting up Operational Group projects, farmers, advisers and researchers can join hands to come up with concrete, practical solutions to problems related to soil quality and soil health.

Experts from the EIP-AGRI Focus Groups on soil organic matter and on soil-borne diseases have already listed a number of ideas for Operational Groups. A few examples:



Soil organic matter in mediterranean regions

- ▶ Optimising the use of fertilisers and pesticides in conservation agriculture
- ▶ Diagnostic procedures and recommendations for soil organic matter management
- ▶ Assessment and technical recommendations for conservation agricultural practices in perennial and cover crops
- ▶ Conserving soil organic matter content in bioenergy crop systems



Soil-borne diseases

- ▶ On-farm production of compost and compost quality indicators
- ▶ Recognition of symptoms, developing and testing diagnostic tools together with farmers; developing tools on soil quality management
- ▶ Networking actions to optimise the introduction and use of biological control agents

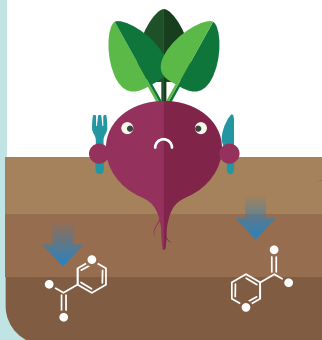
For more ideas for Operational Groups and research needs, have a look at the Focus Group reports:

- ▶ [Focus Group report Soil organic matter](#)
- ▶ [Focus Group report Soil-borne diseases](#)



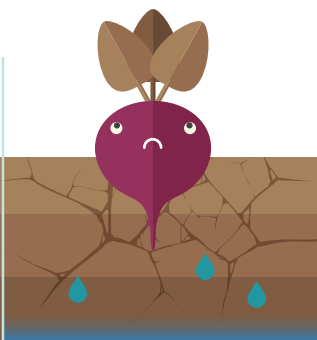
CHALLENGES RELATED TO ORGANIC MATTER IN SOILS

NUTRIENT LOSS



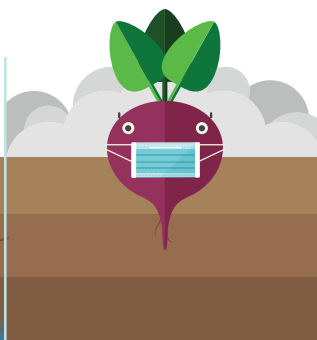
POOR SOIL STRUCTURE

- air and water for plant roots and soil organisms
- water retention

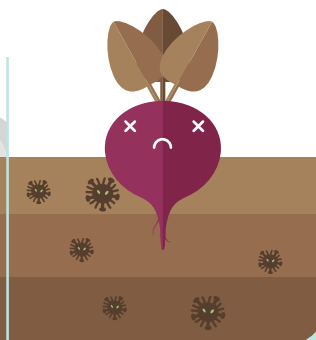


FAST DECOMPOSITION

- CO₂ emissions



SOIL-BORNE DISEASES



SPECIFIC CHALLENGES IN MEDITERRANEAN REGIONS

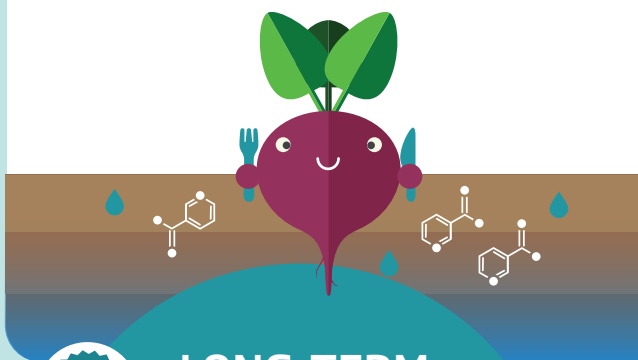
- Loss of soil organic matter (rainfall patterns - soil erosion - drought)
- Low soil organic matter content (soil types)



IMPROVING SOIL ORGANIC MATTER

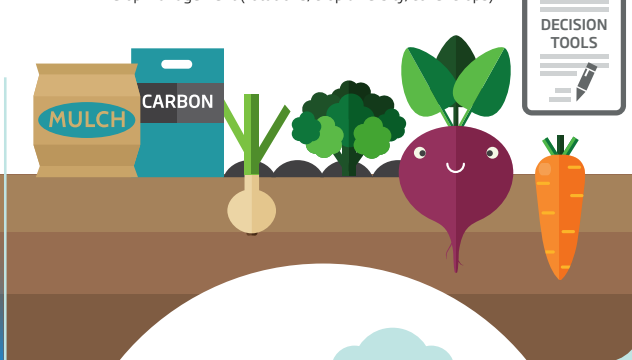
DECREASE LOSS OF ORGANIC MATTER

- Prevent and fight against fast decomposition, leaching and erosion



INCREASE SOIL ORGANIC MATTER CONTENT

- Carbon-rich inputs
- Soil management (reduced or no-tillage, mulching)
- Crop management (rotations, crop diversity, cover crops)



LONG-TERM BENEFITS

- HIGH-QUALITY SOIL
- SOIL HEALTH
- CLIMATE CHANGE BENEFITS
- FINANCIAL & YIELD BENEFITS

