SoilCare
SOILCARE FOR PROFITABLE AND SUSTAINABLE CROP PRODUCTION IN EUROPE

NEWSLETTER ISSUE #8

Testing and promoting the adoption of soil-improving cropping systems across Europe

August 2021

Welcome to our FINAL SoilCare newsletter!

We've come to the end of our five-and-a-half-year study, SoilCare, which has explored the potential of soil-improving cropping systems (SICS) for increasing soil quality and sustainability, while maintaining profitability of crop production in Europe. We have some very exciting results to present in this final newsletter, deriving from our 27 experiments alongside sociocultural, economic, and policy analysis.

I'd like to thank the European Union for funding the project via the Horizon 2020 programme. Thanks also to the SoilCare partners and stakeholders for making this project possible. This isn't the end - keep your eyes peeled for further dissemination and resources we'll be producing during the final month of our project, and even after the end of the project. Resources will remain accessible on our website for the next 5 years.

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Soilcare-project.eu

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Find out which SICS may reduce costs and input requirements in this final newsletter!

Keep up to date with SoilCare by following us across social media!

www.soilcare-project.eu

The SoilCare project is funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No. 677407.

FINAL RESULTS: SOIL-IMPROVING CROPS AS POTENTIAL SICS

Several SoilCare experiments explored the efficacy of soil-improving crops for improving soil quality. Experiments in France, Norway, Germany, Greece, Denmark, and Portugal explored the potential of cover crops, whilst France, Greece, and the UK explored the potential of early sown wheat, different crops, and deep-rooting grass leys as SICS, respectively. Read more about the results of these experiments here.

Cover crops as SICS

In **France**, seeding a buckwheat cover crop on the row in maize did not make any significant differences to most soil parameters, aside from saturated conductivity, which was higher under the cover crops. A longer-term study is needed to explore the impacts of cover crops on erosion and compaction.

Cover crops growing in Brittany, France

The cover crop experiment in **Greece,** however, found that a vetch cover crop grown within a vineyard resulted in significant reductions in soil erosion, with cover crops increasing soil stability. In addition, water movement and soil aeration was slightly improved under cover cropping. In conclusion, vetch cover crops offer an inexpensive way of reducing soil erosion.

Leguminous undersown cover crops growing in Denmark

In **Norway**, poor weather conditions led to poor yields both with and without cover crops. Regardless, an Alfafa cover crop established a strong root system and appears useful for alleviating soil compaction. It may, however, be expensive to grow.

Cover crops in Portugal

Meanwhile, in **Germany**, it was found that cover crops may be useful for suppressing weeds, thus reducing the need to apply pesticides, such as Glyphosate. Crop yields and quality were unaffected by treatment, indicating that despite a higher weed infestation under cover cropping without Glyphosate use, yields are not reduced. In addition, earthworm numbers rose in response to cover cropping, indicating that they may result in long-term improvements in soil health and structure.

Earthworm living amongst cover crops in Greece

The **Danish** experiment found that leguminous cover crops can maintain or improve several soil properties whilst reducing the yield gaps between organic and conventional production. These findings are particularly relevant under organic arable systems where nutrient availability may be somewhat limited.

In **Portugal**, however, the use of leguminous cover crops used as green manure did not significantly improve soil quality in the two years of the study. They did, however, provide other agro-ecological services, including biomass production and reductions in nutrient leaching.

Cover crop trial in Germany

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FINAL RESULTS: SOIL-IMPROVING CROPS AS POTENTIAL SICS (CONTINUED)

Early sown wheat as a SICS

The second SoilCare experiment conducted in **France** involved sowing wheat in August, earlier than is conventional, to determine whether this could reduce soil erosion. It was found that this may reduce erosion as water stable aggregates increased as a result. In addition, soil organic carbon levels rose as a result of this SICS. However, it appears that this approach may only be realistic under specific climatic conditions due to the risk of increased weed infestation. It was also found that early sown wheat was not economically viable. However, companion cropping and altered sowing rates may offer an affordable alternative.

Early-sown wheat in France exhibiting N deficiency and weed infestation

Changing crop types as a SICS

Oranges, a major crop in **Greece**, are no longer financially viable due to market competition. Despite several extreme rainfall events during the study period which affected the trials, this experiment found that avocados are more profitable and are capable of maintaining soil quality. High soil organic carbon levels were found for both crops, with avocado trees resulting in higher levels, likely due to the reduced need for inputs. In addition, weed infestation levels were 10% less in the avocado plots than in orange plots.

Oranges growing in Greece

Grass leys growing at the UK study site

Researchers measuring water infiltration rates

Deep-rooting grass leys as a SICS

Soil compaction can contribute to reducing flood risk, a threat faced by the **United Kingdom**. It was found that deep-rooting grass leys performed no better than a rye/clover mix for alleviating compaction in a sheep-grazed field, with soil organic carbon, infiltration rates, and penetration resistance relatively unchanged by this SICS. Previous compaction may, however, have prevented the leys from establishing deep roots. In an area of ungrazed/unharvested grass leys, the deep-rooting grasses produced significantly higher root volume at depth than the control. This finding provides evidence that reducing grazing densities can improve the rooting-depth of grass leys with the potential to increase water infiltration. A longer-term study was recommended by stakeholders to determine whether deep-rooting grass leys may have a more profound impact over a wider study period.

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FINAL RESULTS: EXPERIMENTS ON FERTILISATION/AMENDMENTS

SoilCare experiments using different fertilisation/amendment techniques as SICS were conducted in Poland, Switzerland, Belgium, and Portugal.

Organic amendments as SICS

Our **Polish** study site undertook experiments to determine whether liming and manure applications (alongside cover crops) offer a suitable SICS for increasing soil organic matter and overall soil quality. It was found that yields and plant heights were higher where all three treatments are used simultaneously. However, the economic costs of this treatment outweigh the yield benefits due to an increase in production costs. Longer-term research is, therefore, needed to see whether this becomes economically viable in the long term.

Field research taking place in Poland

In **Switzerland,** meanwhile, researchers used the 'CULTAN' method (underfoot fertilisation after controlled uptake of long-term ammonium nutrition) to explore whether this could increase organic matter levels in the soil without resulting in nutrient leaching. It was found that despite more efficient nutrient assimilation and higher yields, this SICS is unsustainable as a result of the increased production costs due to a need for specialised machinery. This approach does, however, result in a reduced workload for farmers.

Using the CULTAN technique to apply organic amendments in Switzerland

Crop production in **Belgium** is being threatened by low soil organic matter levels, soil erosion, and compaction. In response, several organic amendments were tested, including compost, woodchips, and pig manure. It was found that applying woodchips was highly successful for increasing water infiltration rates and that they are likely to increase soil organic carbon content in the long-term. As a result of this project, the policy surrounding the use of woodchips in Belgium has changed.

Woodchips being applied in Beglium

Urban sewage sludge as a SICS

In **Portugal**, an experiment was conducted to explore whether the application of urban sewage sludge could improve soil organic matter levels. It was found that this is a successful way of rapidly increasing soil fertility. It is, however, vital that the sludge being applied is monitored for nutrient content to ensure this SICS does not result in pollution due to excess leaching.

Spreading urban sewage sludge in Portugal

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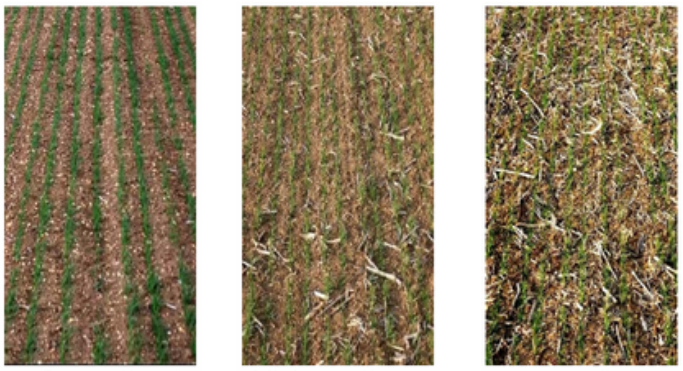
FINAL RESULTS: EXPERIMENTS ON SOIL CULTIVATION AS SICS

SoilCare experiments using different tillage practices took place in the Czech Republic, Belgium, Greece, and Italy. These experiments all explored the potential of minimum tillage for increasing soil quality.

Minimum tillage as a SICS

In the **Czech Republic**, a study was undertaken to explore the effect of tillage and fertilisation practices on soil quality and crop yields. It was found that both minimum and zero tillage led to increased soil organic carbon levels, reduced erosion, and more stable crop yields.



Visual differences between cultivation practices in the Czech Republic

The cultivation experiment in **Belgium** explored whether reduced tillage could reduce soil erosion and compaction in maize fields. It was found that adopting strip tillage lacked practicability due to issues with implementing it. In addition, there were potentially negative ecological impacts caused by the treatment due to an increased need to apply pesticides. Results did, however, vary depending on weather conditions.

Study site plots in Belgium

In **Greece**, different tillage practices were trialled in an olive grove. It was found that intensive tillage resulted in increased soil erosion and had adverse effects on the rooting system of the trees. In addition, the biological health of the soils was greatly improved by adopting no-till; for example, earthworm counts were considerably higher in these soils.

A tilled plot in Greece

Conservation tillage was adopted on arable fields in **Italy** to determine whether this would increase soil organic matter levels and reduce compaction. It was found that no-tillage resulted in increased susceptibility to environmental conditions and thus a higher risk of crop failure. Earthworm counts, however, benefitted from the treatment. In addition, production costs may be reduced by no-tillage after a few years. Further, longer-term research is needed to explore this further.

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FINAL RESULTS: EXPERIMENTS ON ALLEVIATING SOIL COMPACTION

SoilCare experiments using approaches for alleviating soil compaction included study sites in the UK, Italy and Sweden.

In the **United Kingdom**, direct drilling (no-till), ploughing, and low-disturbance subsoiling were tested for see whether reduced tillage could alleviate compaction. It was found that where compaction levels are already high, direct drilling is inappropriate and results in yield penalties. Ploughing was, however, found to reduce earthworm numbers. It was concluded that soil compaction must be alleviated before direct drilling can be used.

Alongside adopting different tillage practices to alleviate soil compaction, the **Italian** study site also trialled the use of tillage radish for alleviating soil compaction. Tillage radish is deep-rooting, thus creates root channels deep in the soil. It can be assumed that these channels likely reduce soil compaction. It was, however, found that growing tillage radish did not have any clear impact on compaction. Therefore, a longer-term trial may be needed to determine whether tillage radish may result in benefits after sustained usage.

Deep-rooting tillage radish grown in Italy to alleviate soil compaction.

Meanwhile, in **Sweden**, mechanical loosening both with and without the incorporation of organic matter was trialled to determine whether this would reduce soil compaction in the subsoil. It was, however, found that subsoiling only affected the top few centimetres below the topsoil, potentially as the subsoiling was not carried out deeply enough. In addition, incorporating straw also did not result in compaction alleviation. However, these treatments did have a positive effect on root growth and depth. There is a need for longer-term study to explore whether subsoil loosening may result in compaction alleviation over time.

Sub tiller machinery used in Sweden for alleviating soil compaction

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SOILCARE FINAL POLICY REPORTS AND SUMMARIES

SoilCare has produced a policy report and summary for each of the 16 countries that had a study site. You can access them here.

OVERALL POLICY FINDINGS

When combined, the overall policy recommendations of the SoilCare project indicate that there is a need for:

- A dedicated soil policy and associated targets
- Policy coherence
- Better monitoring and enforcement
- Improved education, advice, and awareness
- Rewarding farmers for the benefits they provide to society
- More flexibility in economic instruments
- A reduction in administrative burdens

You can read the SoilCare policy recommendations in detail here.

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SOILCARE FINAL CONFERENCE: JUNE 2021

What are Soil-improving cropping systems (SICS)? What can SICS achieve? What tools has SoilCare developed to help policy-makers in their decision-making about the implementation of soil-improving practices? What are the barriers to the uptake of soil-improving practices and how can we improve policies both at the EU and national level to secure their delivery? These questions were the focus of the final conference of the SoilCare project that took place in a virtual setting (Crowdcast) on 24th June 2021.

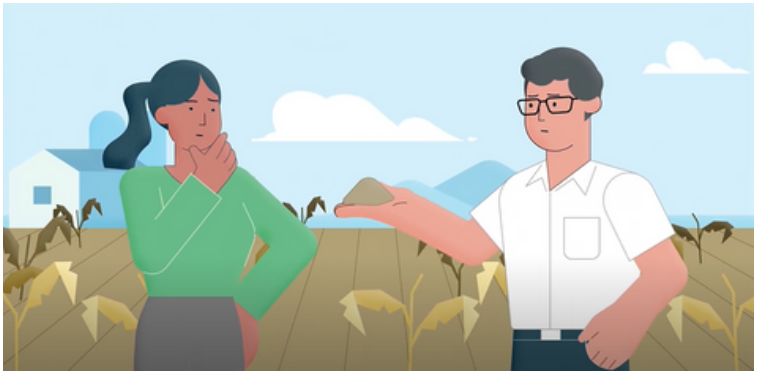
The conference brought together more than 150 policymakers, farmers, farmer representatives, advisors, SMEs, NGOs, members of the public, and researchers from 34 countries worldwide .

Missed the conference? You can watch all sessions on our YouTube channel!

The SoilCare project is funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No. 677407.

NEW SOILCARE VIDEOS: EXPLAINING SICS AND EXPLORING OUR RESULTS

Click on the images below to watch!



Animated explainer video: What are 'SICS'?

Not sure what we mean by 'soil-improving cropping systems' (SICS)? This two-minute explainer video sets out what 'SICS' are by sharing illustrative examples from our case study sites in Spain and Belgium.

Spanish study site: Smart irrigation, compost and cover crops as a SICS

In this short video, Rafael Alonso gives an overview of the SICS used in his organic olive groves and explains why increasing soil quality is so important.

UK study site: A farmers' perspective on SICS and the importance of soil quality

Phil Jarvis, previous head of farming at the Game and Wildlife Conservation Trust gives an overview of why SICS are important for improving soil quality.

SOILCARE SPECIAL ISSUE IN LAND

land

an Open Access Journal by MDPI

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SoilCare is leading a special issue in *land*, an open access journal. The issue will be entitled: 'Soil Improving Cropping Systems for Sustainable and Profitable Farming in Europe'. The deadline for article submissions is 15th December 2021.

Access the special issue here.

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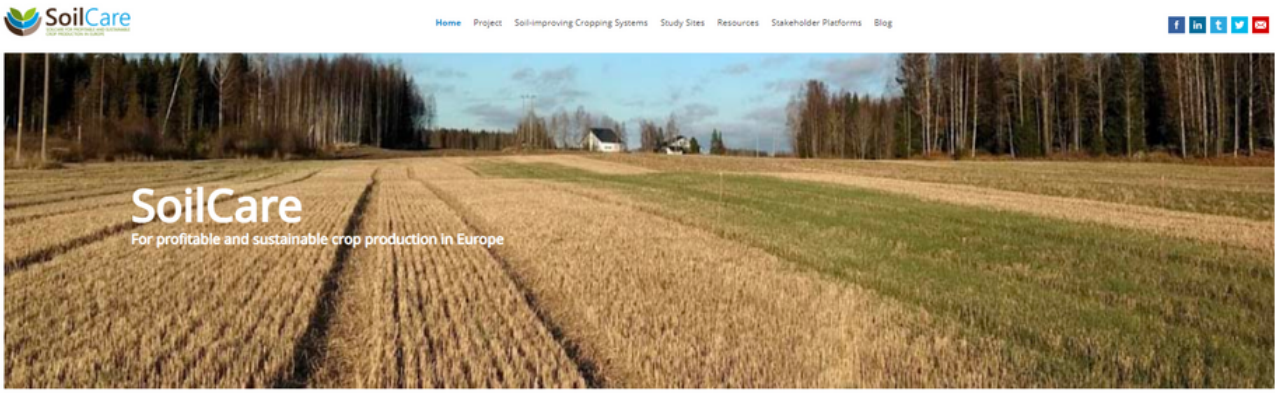
WHAT NEXT FOR SOILCARE?

The SoilCare website is not going away. The site will be maintained for the next 5 years. During this time, all the SoilCare findings and resources will be available for download.



You can also read our key final deliverables here:

D2.1 Review report of Soil-improving cropping systems - Full Report

D4.1 Final version of assessment methodology - Executive Summary

D5.1 Database with monitoring data - Executive Summary

D5.2 Report on demonstration activities in Study Sites

D5.3 Report on monitoring results and analysis

D7.1 Inventory of opportunities and bottlenecks in policy to facilitate the adoption of soil-improving techniques

D7.2 Report on the selection of good policy alternatives at EU and study site level accompanied by an analysis of their performance on multiple criteria

T8.2 Review of soil advice

RECENT SOILCARE PUBLICATIONS

S. E. Hannula, D. P. Di Lonardo, B. T. Christensen, F.V. Crotty, A. Elsen, P.J. Erp, E.M. Hansen, G. H. Rubæk, M. Tits, Z. Toth, A. J. Termorshuizen. 2021. Inconsistent effects of agricultural practices on soil fungal communities across twelve European long-term experiments. European Journal of Soil Science 2021;1–22. DOI: 10.1111/ejss.13090

Magdalena, Giorgia Pertile, Jacek Panek, Agata Gryta, Karolina Oszust, Jerzy Lipiec, Bogusław Usowicz. 2021. Mycobiome Composition and Diversity under the Long-Term Application of Spent Mushroom Substrate and Chicken Manure. Agronomy 11, 410. https://doi.org/10.3390/agronomy11030410

Usowicz, B., Lipiec, J.. 2021. Spatial variability of saturated hydraulic conductivity and its links with other soil properties at the regional scale. Scientific Reports (2021) 11:8293. https://doi.org/10.1038/s41598-021-86862-3

Moritz Hallama, Carola Pekrun, Stefan Pilz, Klaus A. Jarosch, Magdalena Frąc, Marie Uksa, Sven Marhan, Ellen Kandeler. 2021. Interactions between cover crops and soil microorganisms increase phosphorus availability in conservation agriculture. Plant and Soil https://doi.org/10.1007/s11104-021-04897-x

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UPCOMING CONFERENCES

GENEVA Eurosoil 2021

SoilCare will be hosting a 90-minute session during the upcoming Eurosoil conference, where we will present several of the findings of the project.

Royal Geographical Society with IBG

Based on ongoing research exploring the efficacy of advisory services across Europe for delivering soil health-related advice, SoilCare will be presenting a poster at the upcoming RGS-IBG conference.

SoilCare plan to present at the 2021 EU conference on modelling for policy support. We will be presenting on how policy modelling can be used to scope alternative pathways for sustainable and profitable agriculture in Europe. The talk will focus on the participatory techniques used to support the scenarios used for supporting policy within the SoilCare project.

WHAT NEXT FOR OUR SOILCARE PARTNERS?

SPRINT
SUSTAINABLE PLANT PROTECTION TRANSITION

The 5-year SPRINT project, which started in September 2020, is funded by the EU Horizon 2020 research programme and has two key aims: First, to develop a Global Health Risk Assessment toolbox for pesticides to assess the exposure, risks and impacts of pesticide mixtures on human, animal, and ecosystem health. Second, to identify farming practices and policy changes that help farmers rely less on chemical pesticides and transition towards sustainable food production.

SOILGUARD

The objective of SOILGUARD is to stimulate the sustainable use of soil biodiversity in order to protect the multifunctionality of soils and to increase economic, social, and environmental well-being. This will be achieved by collecting strong evidence of the links between soil management, soil biodiversity, soil multifunctionality, and human well-being in bio-geographical regions. This evidence will be obtained through an innovative holistic framework on wellbeing and soil biodiversity. SOILGUARD will assess the status of soil biodiversity and its contribution to the provision and value of soil-mediated ecosystem services (ES) in relation to the threats of land degradation, unsustainable soil management, and climate change.

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SOILCARE PROJECT PARTNERS

The SoilCare project has brought together a transdisciplinary team of 28 different organisations to identify, test and promote the adoption of soil-improving cropping systems across Europe.

PROJECT PARTNERS

Wageningen Environmental Research, The Netherlands
University of Newcastle upon Tyne, United Kingdom
KU Leuven, Belgium
University of Gloucestershire, United Kingdom
University Hohenheim, Germany
Research Institute for Knowledge Systems, The Netherlands
Technical University of Crete, Greece
Joint Research Centre, Italy
University of Bern, Switzerland
Milieu LTD, Belgium
NIBIO, Norway
Bodemkundige Dienst van België, Belgium
Aarhus University, Denmark
Game & Wildlife Conservation Trust, United Kingdom
Teagasc Research Institute, Ireland
AgroCares Research, The Netherlands
Escola Superior Agrária de Coimbra, Portugal
National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection, Romania
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Institute of Agrophysics of the Polish Academy of Sciences, Poland
Wageningen University & Research, The Netherlands
University of Pannonia, Hungary
Swedish University of Agricultural Sciences, Sweden
Agro Intelligence ApS, Denmark
Crop Research Institute, Czech Republic
University of Almeria, Spain
Fédération Régionale des Agrobiologistes de Bretagne, France
Scienceview Media B.V., The Netherlands
Milieu Consulting SPRL, Belgium

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