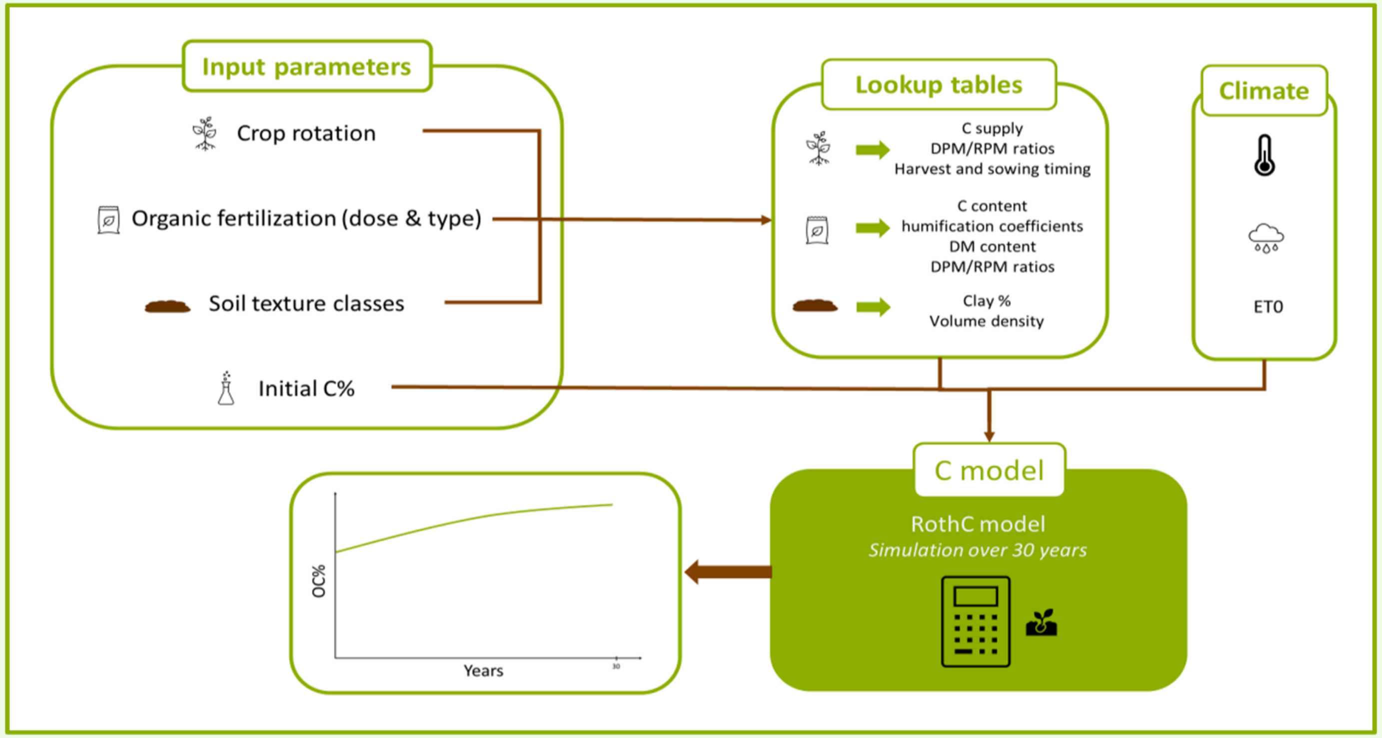
Sensitivity analysis of a Roth-C based model

BeSOCC model

- **Roth-C based** model to calculate the overturn of SOC in agricultural fields calibrated for Flanders



- **Sensitivity analysis**: How do the parameters impact the outcome of the model?
  - Updates BeSOCC model + high uncertainty input parameters used for simulation on Flanders' arable fields

  → Need for sensitivity analysis

Methodology

Selection of parameters

Selection of analysis methods

Global sensitivity analysis

Selection of scenarios

Annual Science Day, 10-14/06/2024 Vilnius (LT)

Soil health challenges and farmers adaptation strategies: transition pathways in Türkiye and the European Union

Francesco Galioto, Francesca Varia, Giovanni Dara Guccione, Sabina Asins, Javier Renovell, Akin Un, Tali Monis, Monika Vilkiene, Ieva Mockeviciene, Raimonds Kasparinskis, Baiba Dirnena, Alessandra Vaccaro, Laura Viganò

EJP SOIL
European Joint Programme

EJP SOIL has received funding from the European Union's Horizon 2020 research and innovation programme: Grant agreement No 862695

Synthetic overview

Key messages

A farmers' survey in 5 study regions involving 70 farmers, was conducted to investigate soil-related challenges addressing dominant agricultural systems (**A**).

A DEA techniques was develped to assess the farm scale at which observed farms reveal the highest soil-healt performances and to classify farmers (**B**).

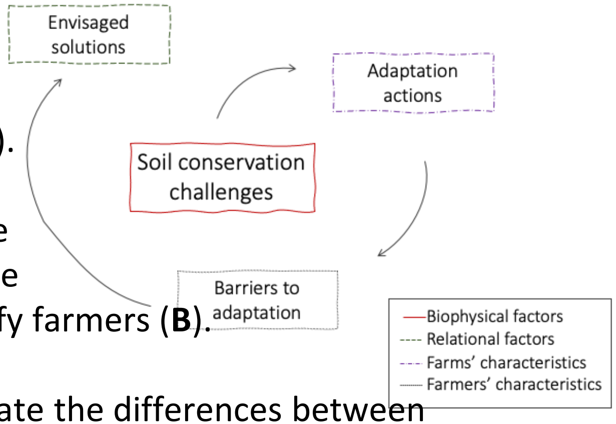
A fisher exact test was conducted to investigate the differences between farms' size classess (**C**).

The results of this work reveal farms at the optimal scale for dealing with soil-related challenges are more sensitive to landscape and pollution issues than others.

But optimal scale tends to prevail in an area like Türkiye, which lacks a system of rules and incentives to promote sustainable use of agricultural resources compared to the other study regions. **The why this happens will be explored during the poster session!**

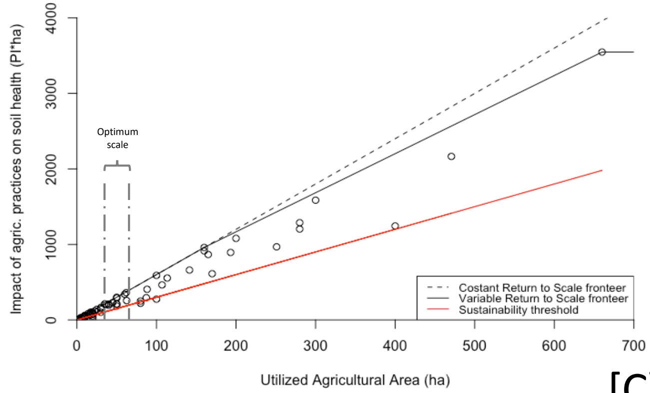
Methodology

[A
]

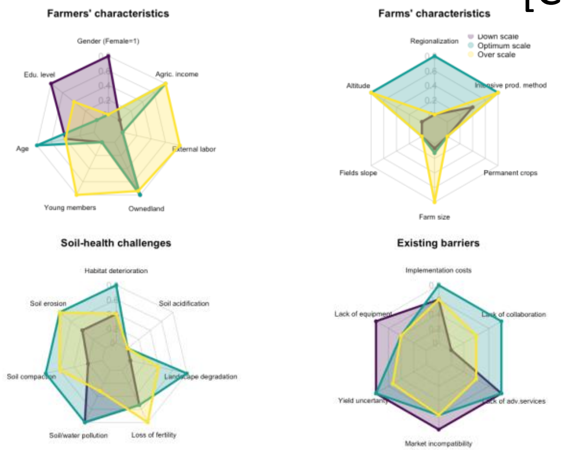


Results

[B]

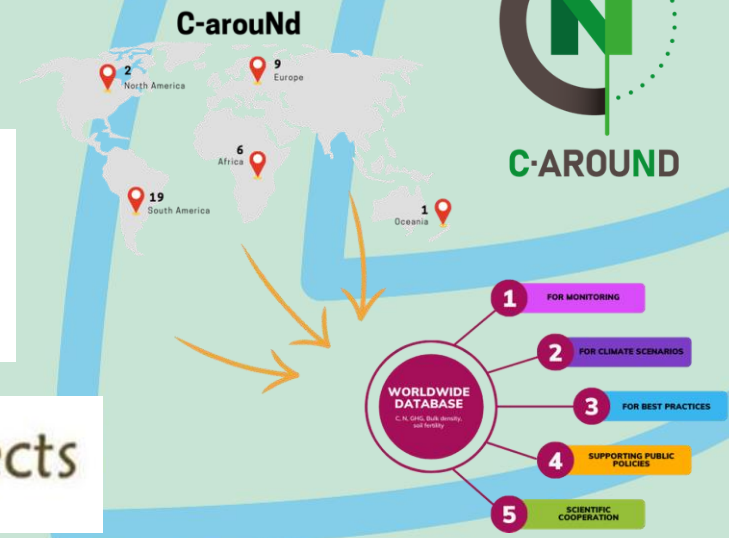


[C]



Long-term impact of anaerobic digestion of dairy cattle slurry on grass-clover yields and soil properties

Rittl Tatiana F., Pommeresche R., Johansen A., Steinshamn H., Riley H. and Løes A.K.



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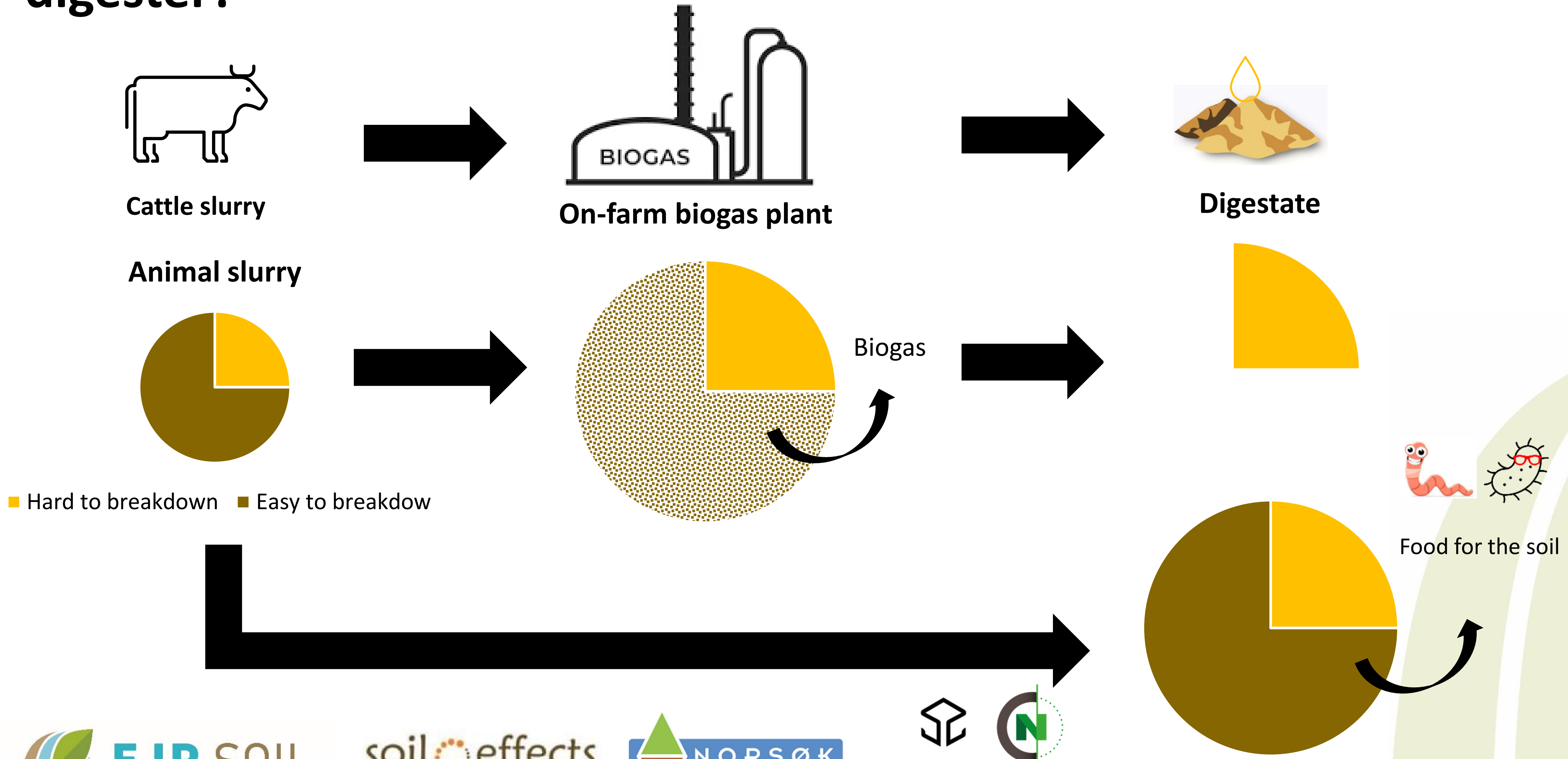
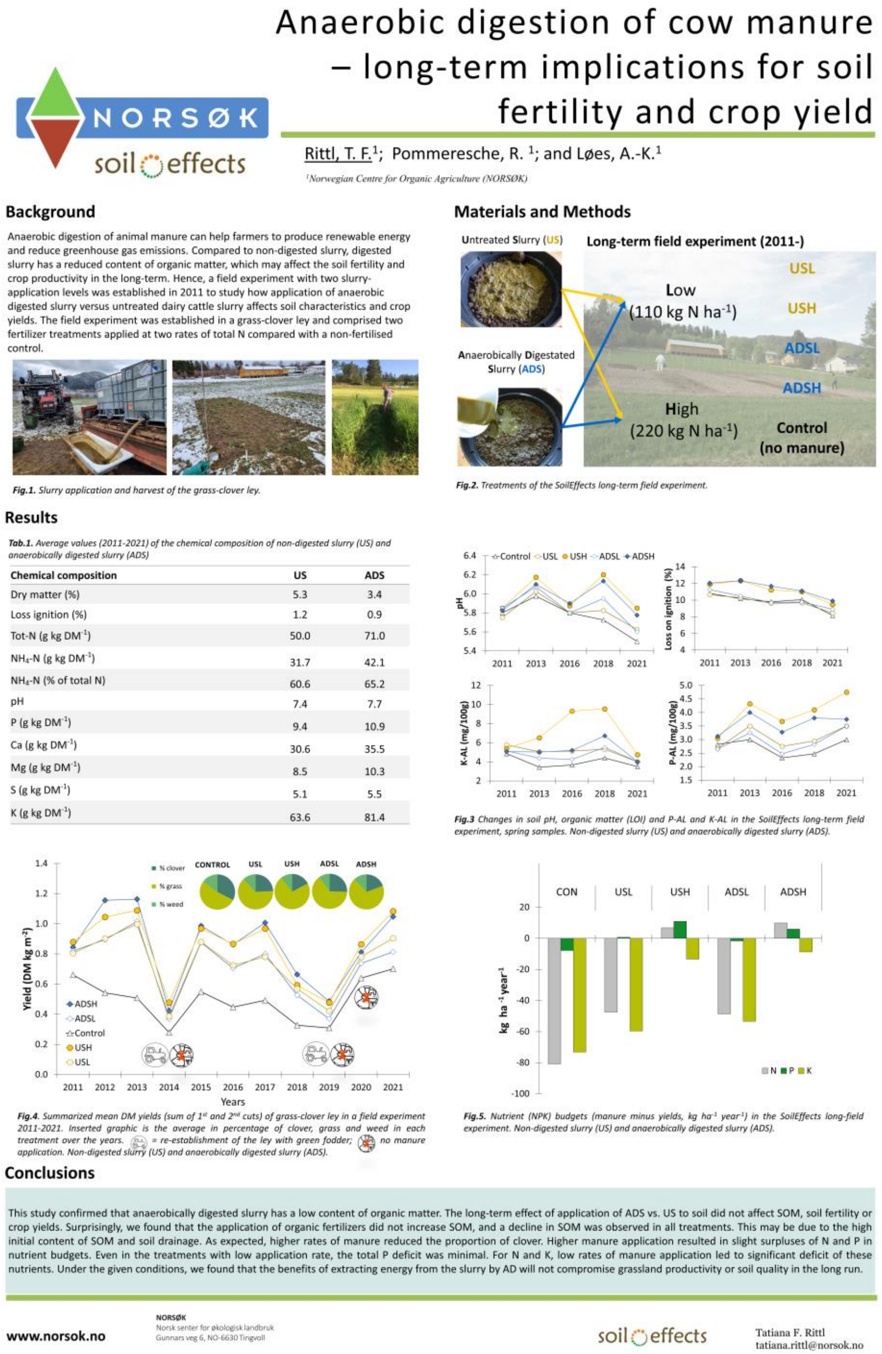
What happens to the soil if the farmer puts the manure in a biogas digester?



EJP SOIL European Joint Programme
soil effects
NORSØK Norwegian Centre for Organic Agriculture
NIBIO
C·AROUND

SoilEffects experiment: 2011-



Anaerobic digestion of cow manure – long-term implications for soil fertility and crop yield

Rittl, T. F.[1]; Pommeresche, R. [1]; and Løes, A.-K.[1]

[1]Norwegian Centre for Organic Agriculture (NORSØK)

Background

Anaerobic digestion of animal manure can help farmers to produce renewable energy and reduce greenhouse gas emissions. Compared to non-digested slurry, digested slurry has a reduced content of organic matter, which may affect the soil fertility and crop productivity in the long-term. Hence, a field experiment with two slurry-application levels was established in 2011 to study how application of anaerobic digested slurry versus untreated dairy cattle slurry affects soil characteristics and crop yields. The field experiment was established in a grass-clover ley and comprised two fertilizer treatments applied at two rates of total N compared with a non-fertilised control.

Fig.1. Slurry application and harvest of the grass-clover ley.

Materials and Methods

Fig.2. Treatments of the SoilEffects long-term field experiment.

Results

Tab.1. Average values (2011-2021) of the chemical composition of non-digested slurry (US) and anaerobically digested slurry (ADS)

Chemical composition	US	ADS
Dry matter (%)	5.3	3.4
Loss ignition (%)	1.2	0.9
Tot-N (g kg DM^{-1})	50.0	71.0
NH_4-N (g kg DM^{-1})	31.7	42.1
NH_4-N (% of total N)	60.6	65.2
pH	7.4	7.7
P (g kg DM^{-1})	9.4	10.9
Ca (g kg DM^{-1})	30.6	35.5
Mg (g kg DM^{-1})	8.5	10.3
S (g kg DM^{-1})	5.1	5.5
K (g kg DM^{-1})	63.6	81.4

Fig.3 Changes in soil pH, organic matter (LOI) and P-AL and K-AL in the SoilEffects long-term field experiment, spring samples. Non-digested slurry (US) and anaerobically digested slurry (ADS).

Fig.4. Summarized mean DM yields (sum of 1st and 2nd cuts) of grass-clover ley in a field experiment 2011-2021. Inserted graphic is the average in percentage of clover, grass and weed in each treatment over the years. = re-establishment of the ley with green fodder; no manure application. Non-digested slurry (US) and anaerobically digested slurry (ADS).

Fig.5. Nutrient (NPK) budgets (manure minus yields, kg ha^{-1} $year^{-1}$) in the SoilEffects long-field experiment. Non-digested slurry (US) and anaerobically digested slurry (ADS).

Conclusions

This study confirmed that anaerobically digested slurry has a low content of organic matter. The long-term effect of application of ADS vs. US to soil did not affect SOM, soil fertility or crop yields. Surprisingly, we found that the application of organic fertilizers did not increase SOM, and a decline in SOM was observed in all treatments. This may be due to the high initial content of SOM and soil drainage. As expected, higher rates of manure reduced the proportion of clover. Higher manure application resulted in slight surpluses of N and P in nutrient budgets. Even in the treatments with low application rate, the total P deficit was minimal. For N and K, low rates of manure application led to significant deficit of these nutrients. Under the given conditions, we found that the benefits of extracting energy from the slurry by AD will not compromise grassland productivity or soil quality in the long run.

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Norsk senter for økologisk landbruk
Gunnars veg 6, NO-6630 Tingvoll

soil effects

Tatiana F. Rittl
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soil effects

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C-AROUND

Fertilizer quality of anaerobic digestate produced from marine residual resources (CIRCULIZER)

Rittl T. F.[1], Lied J. G.[2], Aker M.[2], Kvande I.[1], Brod E.[3], Lyng K.-A.[4]

[1]Norwegian Centre for Organic Agriculture (NORSØK); [2]Norwegian Agricultural Extension Service (NLR);

[3]Norwegian Institute of Bioeconomy Research (NIBIO); [4]Norwegian Institute for Sustainability Research (NORSUS)

EJP SOIL has received funding from the European Union's Horizon 2020 research and innovation programme: Grant agreement No 862695

On-farm biogas plant

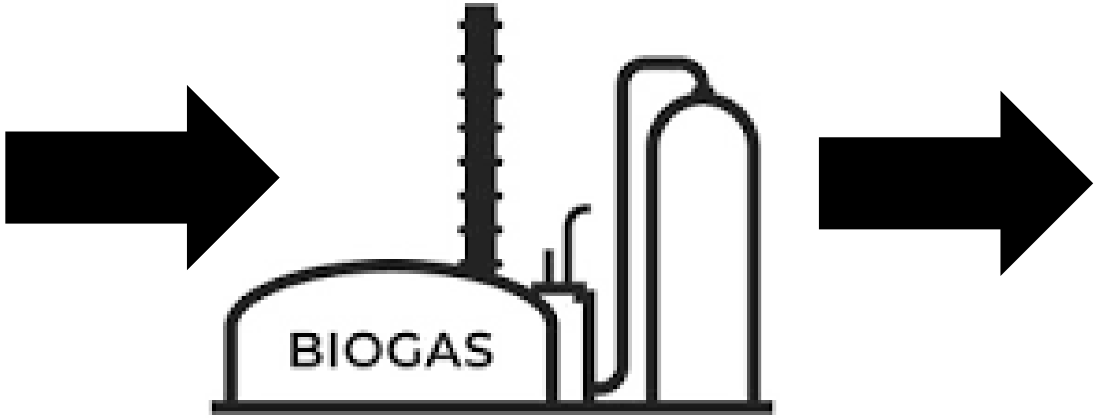

Foto sources: NORSØK (above); NOFIMA (below)

- **What are the potential impacts on the quality of digestate when incorporating increasing proportions of new marine residual resources?**

- **How do these changes affect its suitability for agricultural use?**

NORSØK

Fertilizer quality of anaerobic digestate produced from marine residual resources (CIRCULIZER)

Rittl T. F.[1], Lied J. G.[2], Aker M.[2], Kvande I.[1], Brod E.[3], Lyng K.-A.[4]

[1]Norwegian Centre for Organic Agriculture (NORSØK); [2]Norwegian Agricultural Extension Service (NLR); [3]Norwegian Institute of Bioeconomy Research (NIBIO); [4]Norwegian Institute for Sustainability Research (NORSUS)

Background

Circulizer project aims to improve the circularity between the blue and green sector, by increasing the knowledge of the use of marine residues (i.e. fish sludge and fish silage) for biogas production and its effects on the fertilizer quality (digestate) and environment.

While the quality of digestate from food waste and animal manure has been extensively studied, the impact of incorporating increasing proportions of new marine residual resources remains to be investigated. **Circulizer** will run lab and field scale experiments where the biogas process performance and digestate quality will be assessed.

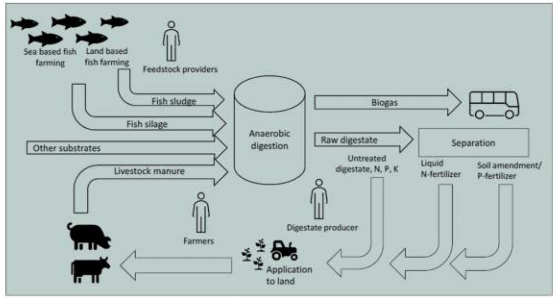

Fig.1. *Value chain for digestate production, including relevant actors. Source: NORSUS*

On-farm biogas plant, fertilizer quality and newly started experiments

On-farm biogas production plant & digestate separator

Fig.2. *On-farm biogas and separator. Source: Svanem biogas and J.G.Leid*

Experiment I : Vestland

Fig.3. *Field experiment established in 2024. Source: Aker M.*

Fertilizer quality

Parameters	Units	Animal + fish slurry		
		Undi-gestate	Di-gestate	Liq. fraction digestate
Dry matter (DM)	%	6,4	5,0	3,7
Total nitrogen	kg/ton	3,9	3,8	3,6
NH_4-N	kg/ton	1,9	2,0	2,0
Phosphorous (P)	kg/ton	0,7	0,6	0,6
Potassium (K)	kg/ton	3,5	3,7	3,0
Cadmiun (Cd)	mg/kg DM	0,2	0,3	0,3
Zink (Zn)	mg/kg DM	190	240	300

Experiment II : Møre og Romsdal

Fig.4. *Field experiment established in 2024 Source: J.G.Lied*

Expected outcomes

(i) Enhancing the green transition and circularity of Norwegian food production by recycling valuable nutrients from fish production for agricultural use; (ii) Ensuring environmental safety by addressing concerns related to heavy metals and organic pollutants; (iii) Increasing the utilization of marine residual resources for biogas production; (iv) Supporting the growth of the fish farming industry in Norway by improving waste treatment and recycling options for unavoidable residual resources, thereby facilitating increased fish production and nutrient recycling.

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NIBIO NORSUS

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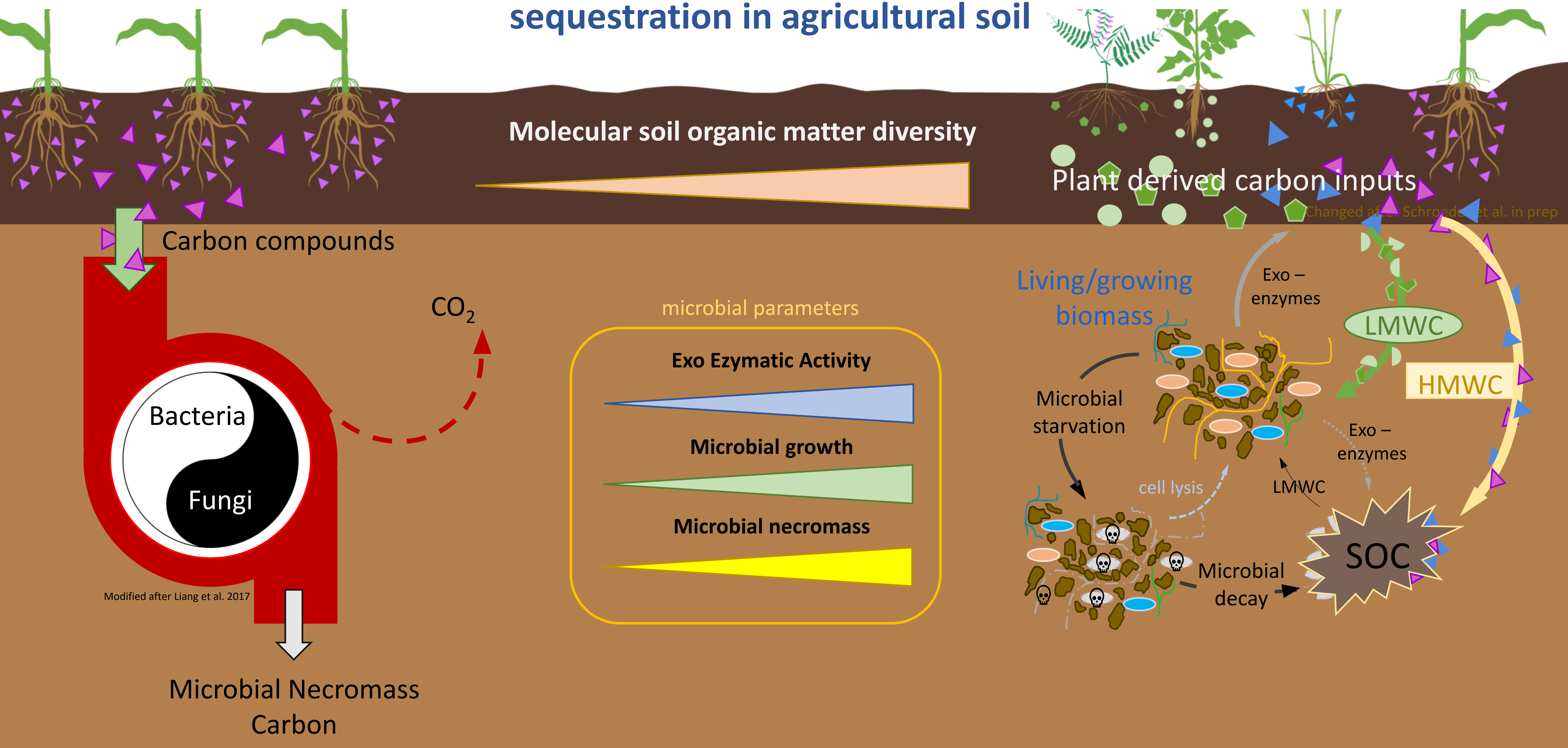
NORSØK Norwegian Centre for Organic Agriculture

NIBIO

NORSUS

Cover crop diversification alters microbial life-death cycle and enhances microbial carbon sequestration in agricultural soil



LMWC = Low molecular weight compounds
HMWC = High molecular weight compounds

ASTAVIT :
A fast, easy and cost-effective new method for soil stability measurement

Wengler Julien, Cottenot Lionel, Saby Nicolas and Lacoste Marine — INRAE, France

AGGREGATE
STABILITY
ASSESMENT THROUGH
VIDEO
TESTING

Current reference

« Le Bissonnais » ISO method

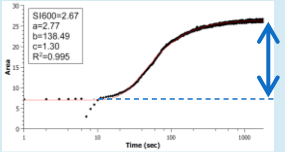
- Time and labor intensive
- 48h drying delay
- Uses ethanol (→ risk management)
- Repeatability issues

WHAT ?

ONE SOIL ⇨ ASTAVIT

96 aggregates 3-5 mm sieved

Immersion in water



Calculation

New aggregate stability index ς_{∞}

±10% consistency between experiments

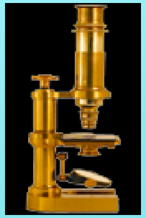
HOW ?

3D printing

\+

Video recording

\+



ImageJ

Image processing

Can we measure the persistence of organic carbon in soil?

Johanna Maria Zenner[1], Jeroen H.T. Zethof[1], Tatiana F. Rittl[2], Klaus Schützenmeister[1], Hermann F. Jungkunst[1]

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- 2 Norwegian Center for Organic Agriculture (NORSØK), Tingvoll, Norway

Contact: johanna.zenner@rptu.de

The DeliSoil Project
- Delivering safe, sustainable, tailored & socially accepted soil improvers from circular food production processes for boosting soil health

Palojärvi Ansa[1]*, Martínez-Avila Oscar Mauricio[2], Bevivino Annamaria[3], Hermann Ludwig[4], Salo Tapio[1], Smol Marzena[5], Cardillo Pamela[6], and the whole DeliSoil consortium

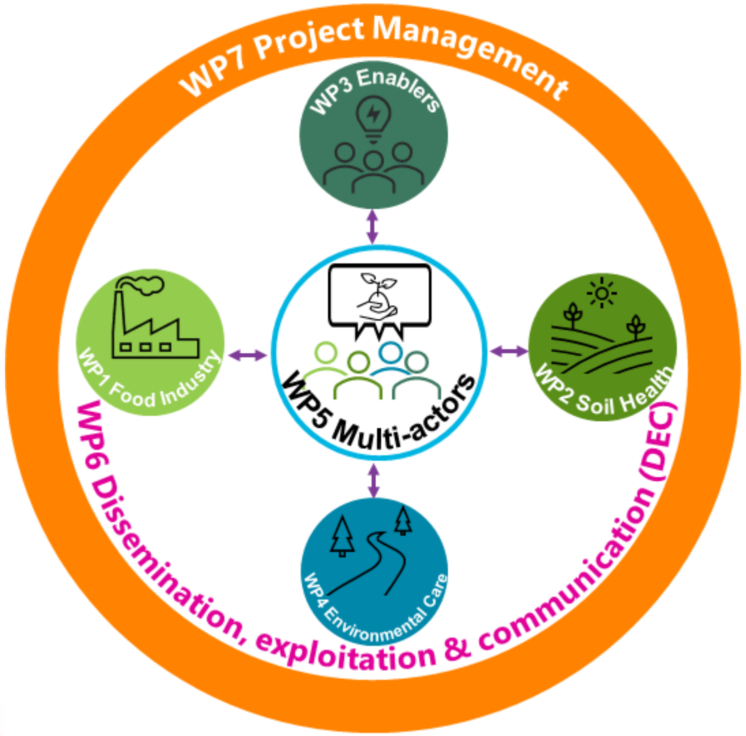
[1]Natural Resources Institute Finland (LUKE), Finland, [2]UVic-UCC, Spain; [3]ENEA, Italy; [4]PROMAN, Austria; [5]MEERI, Poland; [6]ERINN, Ireland

EJP SOIL
European Joint Programme

EJP SOIL has received funding from the European Union's Horizon 2020 research and innovation programme: Grant agreement No 862695

DeliSoil project and WPs

- The EU Mission Soil funded DeliSoil project (2023-2027, 7 milj. EUR).
- DeliSoil is supporting the EU Mission ‘A Soil Deal for Europe’.



Project objectives

- **Valorise nutrients and organic matter in food processing side-streams** as tailored soil improvers, developing innovative solutions for regionally important food industries.
- **Establish five regional Living Labs and five Lighthouses** for food value chain actors to co-create innovations for healthy soils.
- **Identify technological, financial, legislative and social barriers and enablers** in support of these goals.
- **Establish an evaluation framework** of actions and strategies for improved soil health.
- **Raise public awareness of soil health** and, in particular, of the safety and potential of circular solutions.

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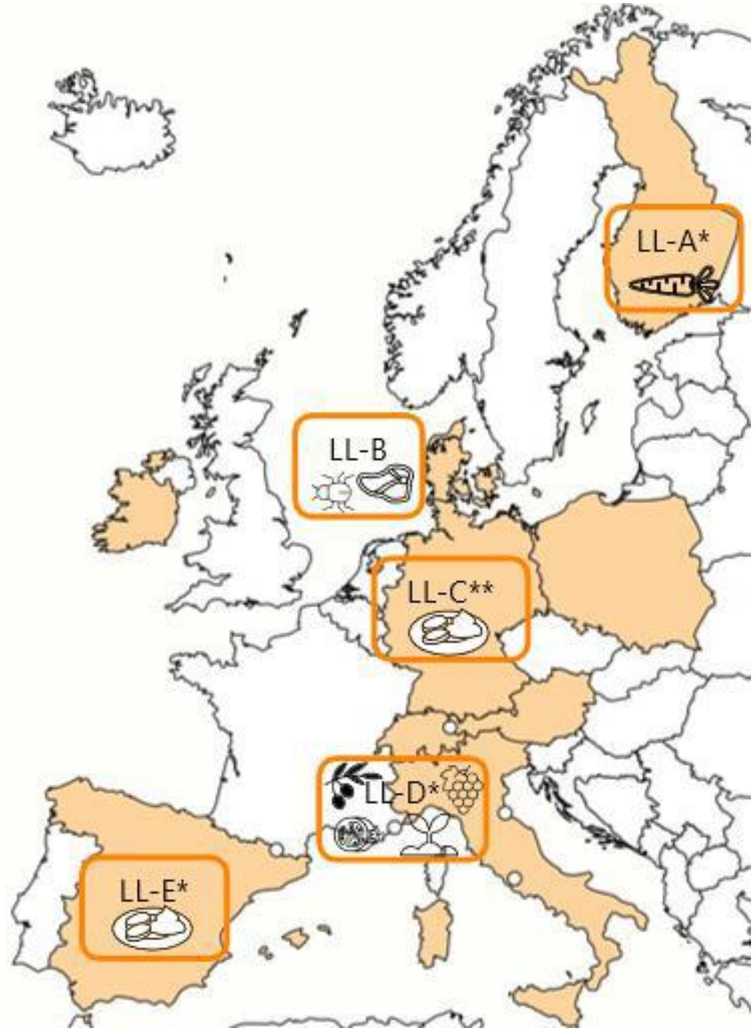
Living Labs and Lighthouses of the whole Food Value Chain



- Food industry uses raw materials to produce products for consumers.
- The side streams are processed with different technologies and used as soil improvers or other fertilizer products without risks to environment in safe food production to boost soil health.

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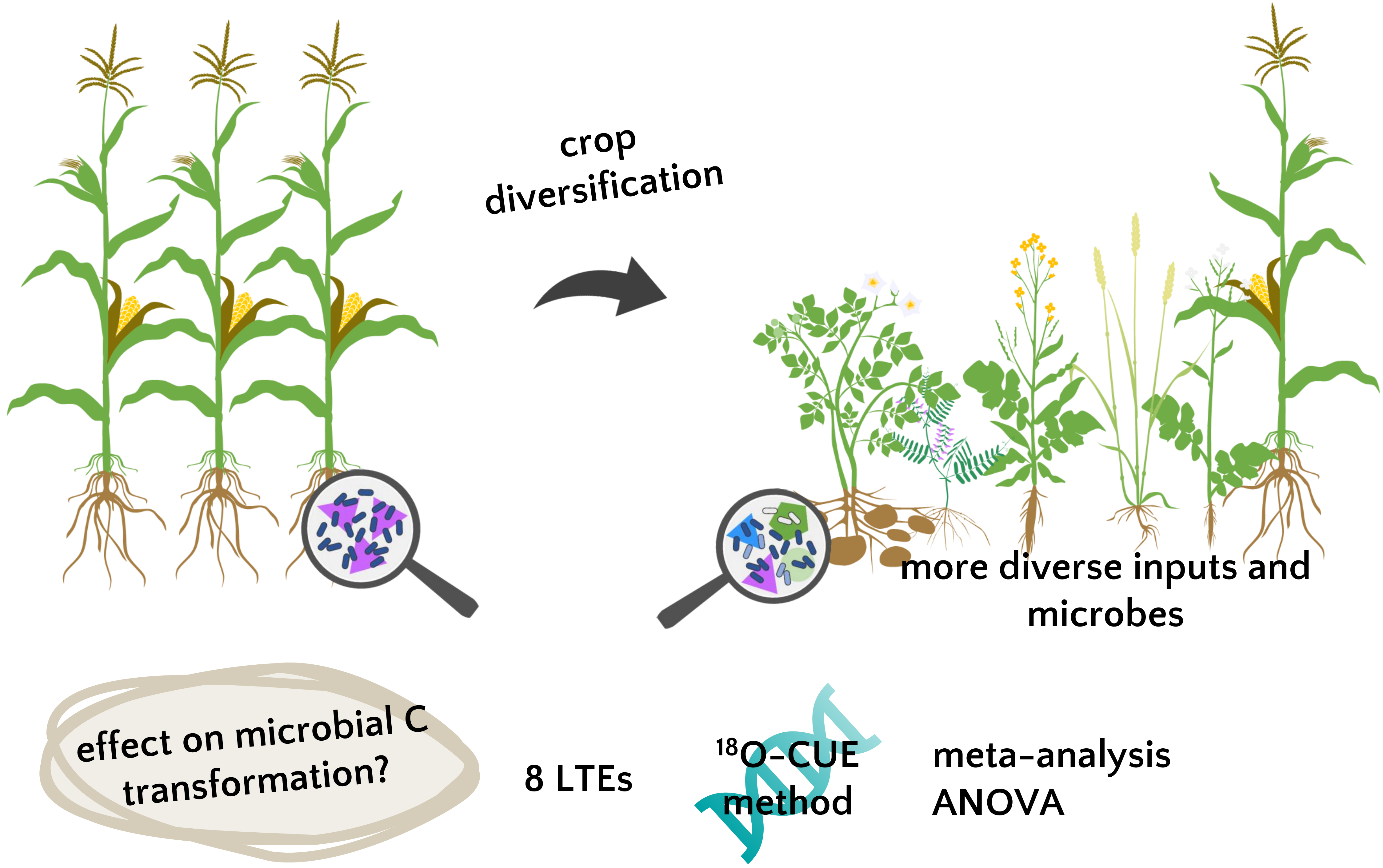
crop diversification
more diverse inputs and microbes
effect on microbial C transformation?
8 LTEs
^{18}O-CUE method
meta-analysis
ANOVA

The effect of crop diversification and season on microbial carbon use efficiency across a European gradient

Schroeder Julia[1*], König Alexander[2], Bölscher Tobias[3], Poeplau Christopher[1], Meurer Katharina H.E.[4], Toleikienė Monika[5], Hanegraaf Marjoleine[6], Meisner Annelein[6], Hakl Josef[7], Keiblinger Katharina M.[2], Chabbi Abad[8], Suhadolc Marjetka[9], Inselsbacher Erich[2], Knicker Heike[10], and Hermann Anke M.[4]

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[2] *University of Natural Resources and Applied Life Sciences, Department of Forest and Soil Sciences, Institute of Soil Research, Vienna, Austria*
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[4] *Department of Soil & Environment, Swedish University of Agricultural Sciences - SLU, Uppsala, Sweden*
[5] *Lithuanian Research Centre for Agriculture and Forestry, Akademija, Lithuania*
[6] *Wageningen University & Research, Wageningen Plant Research, Wageningen, Netherlands*
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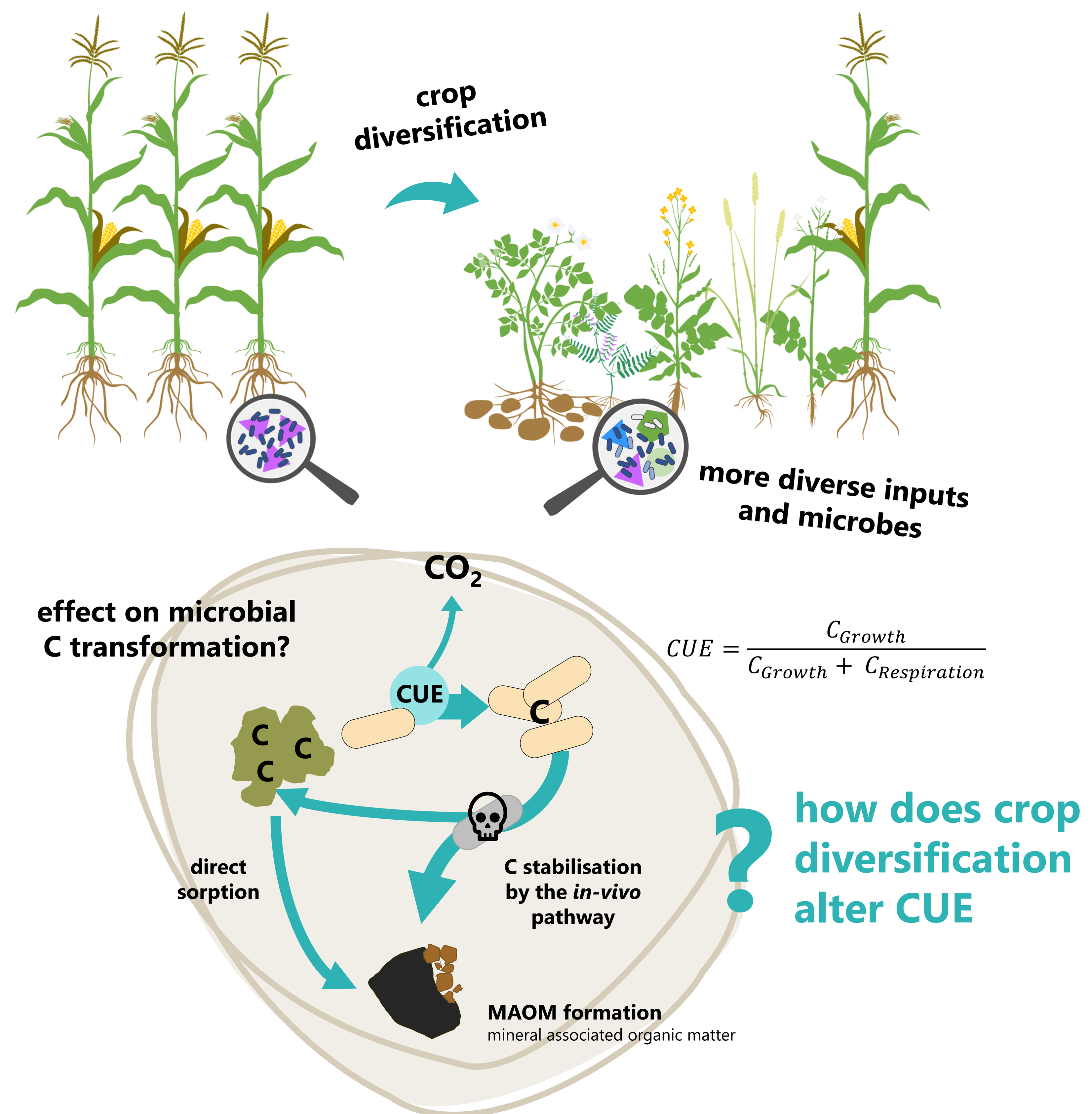
[8] *INRAE Centre de Recherche Nouvelle-Aquitaine-Poitiers, Unité de Recherche Pluridisciplinaire Prairies & Plantes Fourragères, Lusignan, France*
[9] *University of Ljubljana, Biotechnical Faculty, Ljubljana, Slovenia*
[10] *Instituto de la Grasa (IG-CSIC), Sevilla, Spain*

background



$$CUE = \frac{C_{Growth}}{C_{Growth} + C_{Respiration}}$$

? how does crop diversification alter CUE

set-up

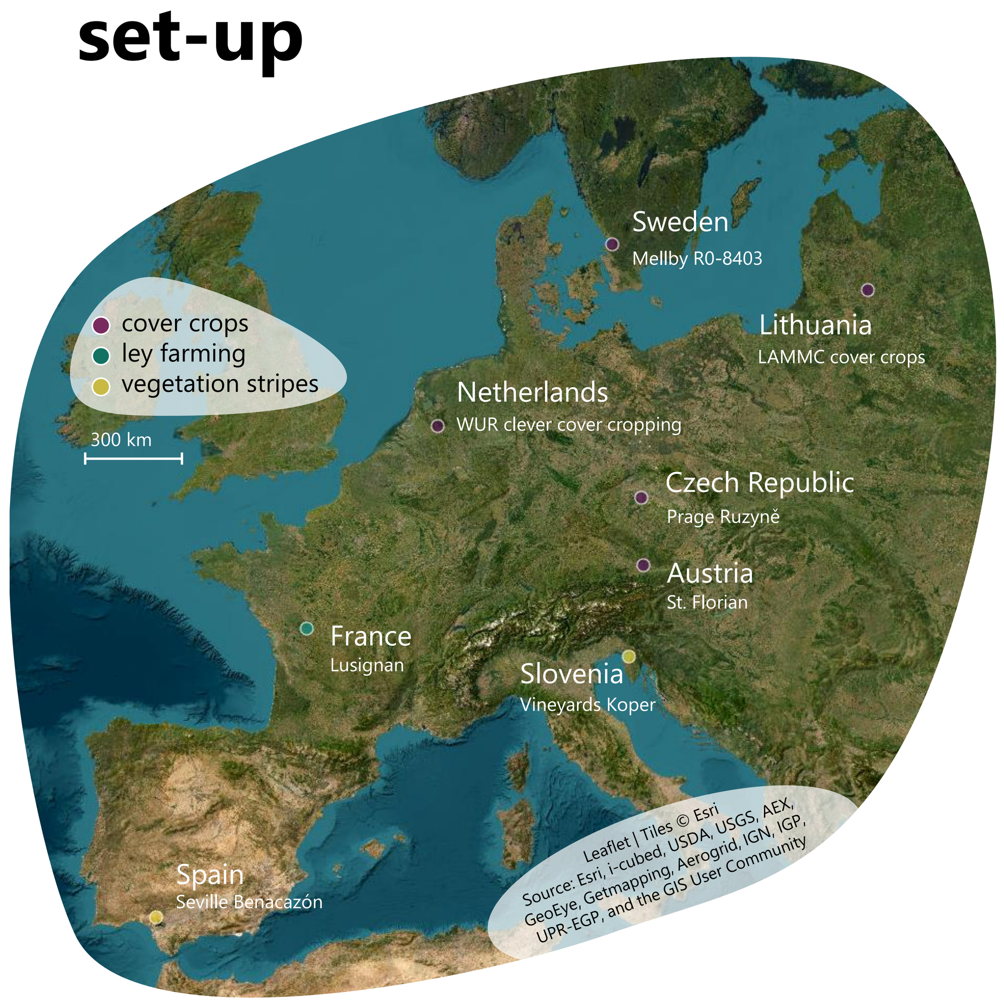
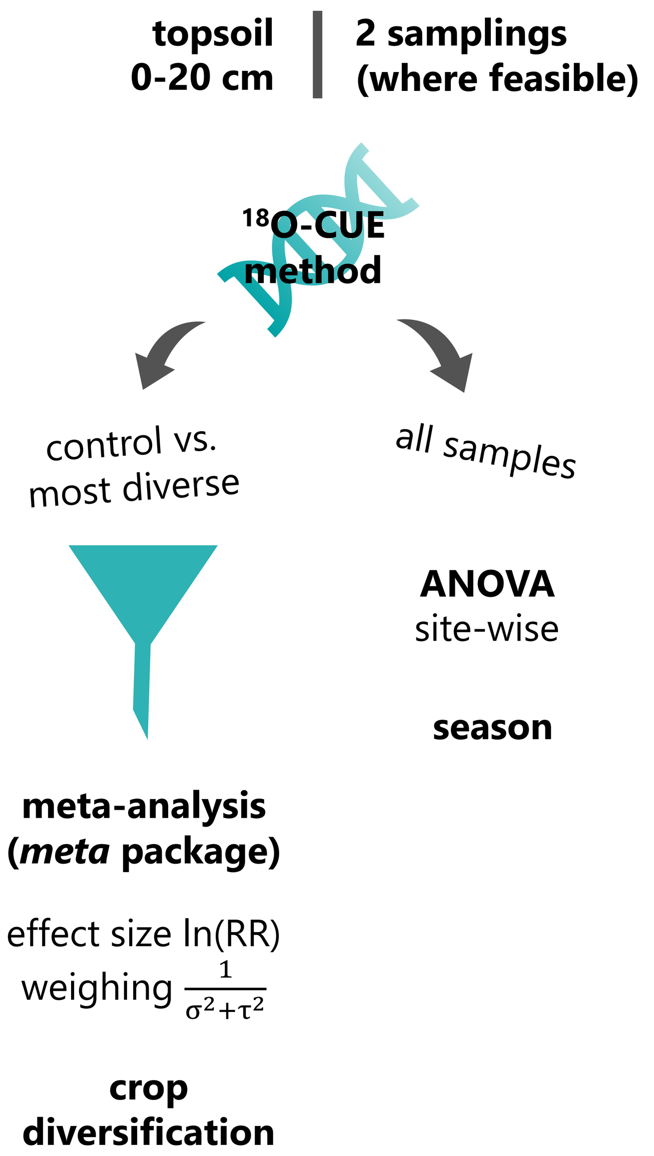


Figure 1 Sampling sites. The selected long-term field experiments along the pan-European pedo-climatic gradient cover different measures, i.e. cover crops, ley farming, and vegetation stripes representative for crop diversification across Europe.



season

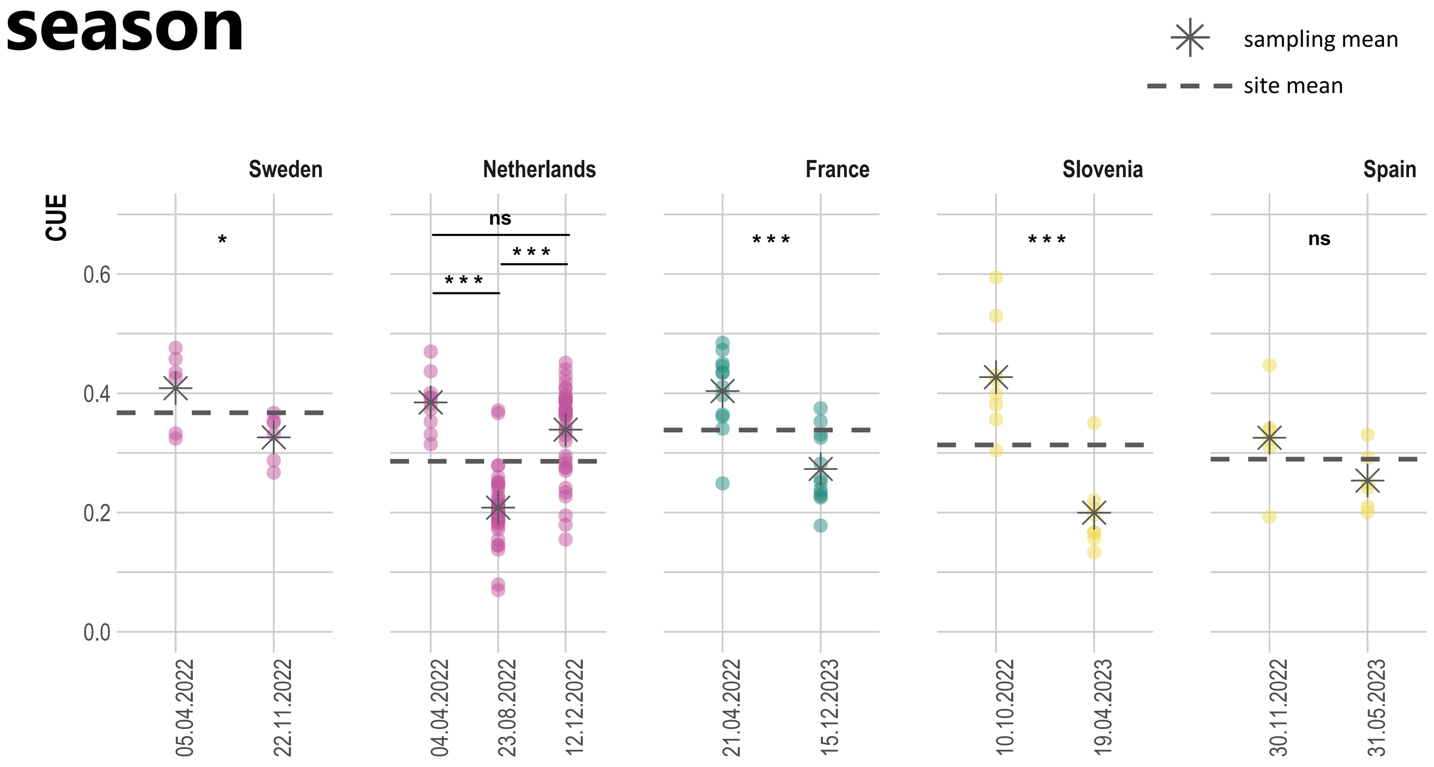


Figure 3 Effect of season on microbial carbon use efficiency (CUE). ANOVA revealed CUE differed significantly between samplings (except Spain). Differences between samplings exceeded differences between sites.

! CUE varies with sampling

which samplings to compare?

? seasonality effect

crop diversification

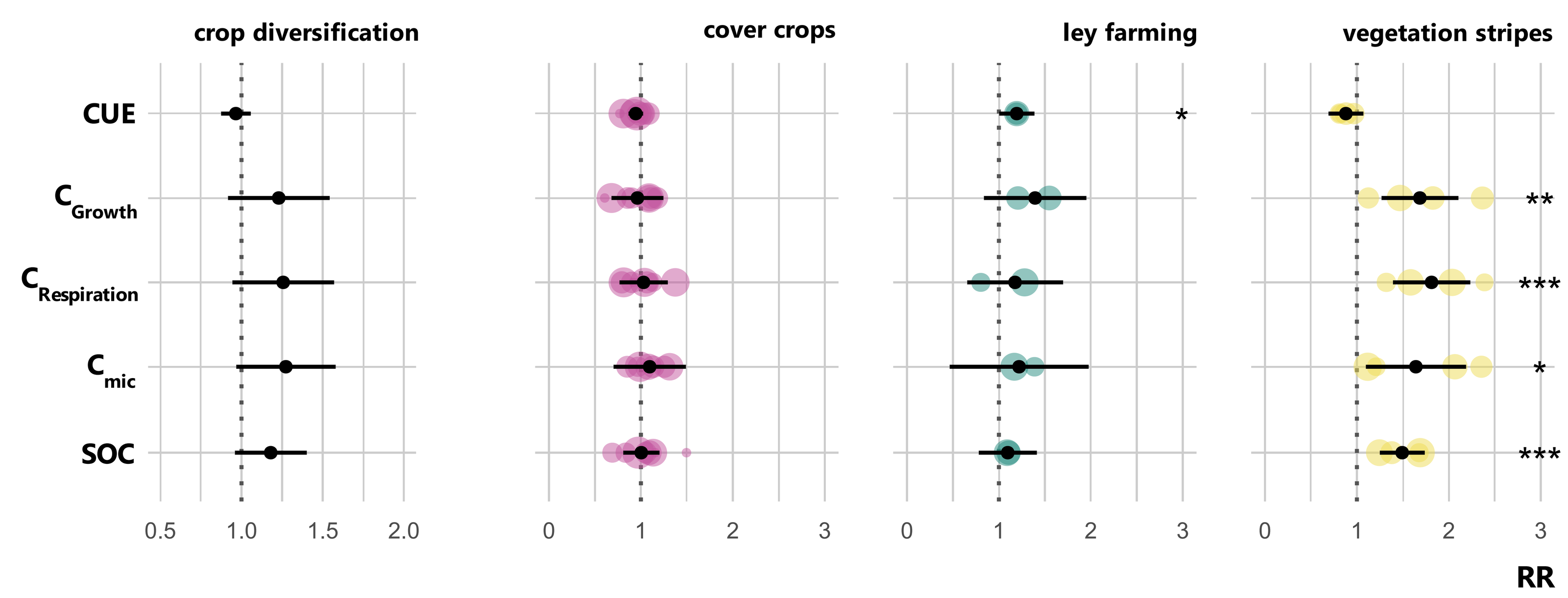


Figure 2 Results of the meta-analysis. Overall and measure-specific effect sizes of crop diversification on microbial carbon use efficiency (CUE), respiration ($C_{Respiration}$), growth (C_{Growth}), biomass C (C_{mic}) as well as soil organic carbon (SOC). There was no significant general effect of crop diversification on microbial C transformation.

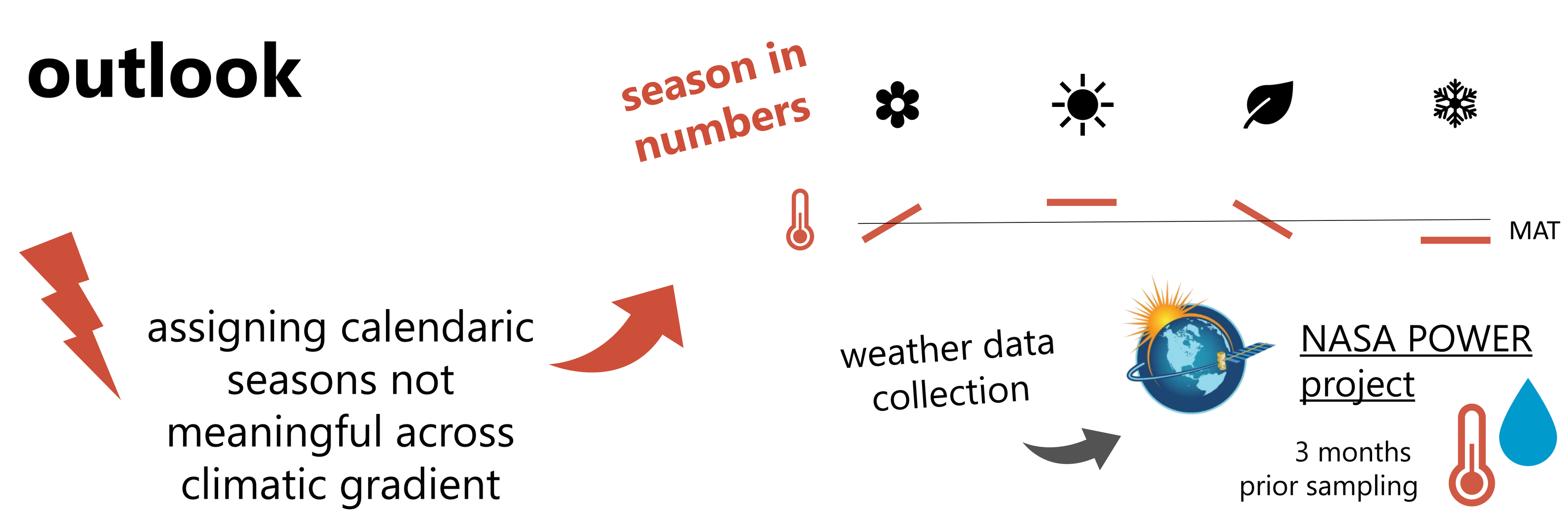
! no general effect on microbial CUE

Table 1 Test statistics of meta-analysis. Overall high heterogeneity between observations. Only for CUE the effect sizes across studies are homogenous (i.e. no effect). Overall heterogeneity is partly explained by different effect sizes between diversification measures.

	τ^2	I^2	p_Q	$p_{subgroup}$
CUE	0.009	34 %	0.114	0.036
$C_{Respiration}$	0.152	90 %	< 0.001	0.008
C_{Growth}	0.155	89 %	< 0.001	0.015
C_{mic}	0.154	88 %	< 0.001	0.276
SOC	0.07	83 %	< 0.001	0.008

overall variability in the effect sizes (I^2) · variance between observations (τ^2) · p-value for heterogeneity test (p_Q) · p-value for subgroup differences ($p_{subgroup}$)

outlook



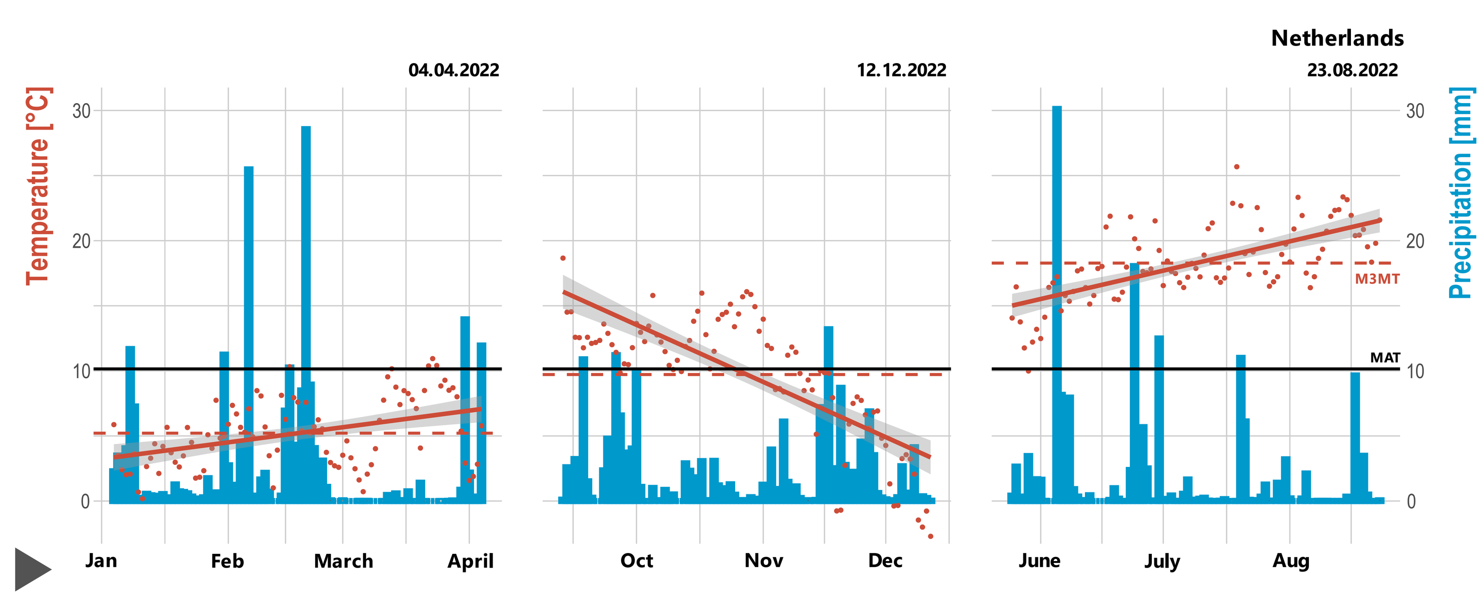


Figure 4 Season in numbers (example Netherlands). Mean daily temperature was plotted over 3-months prior sampling. The fitted slope and the distance of the 3-months mean temperature (M3MT) to the mean annual temperature (MAT) were retrieved to serve as seasonal predictors of CUE. Water availability was expressed as cumulative precipitation over 3-months.

THÜNEN
EJP SOIL EnergyLink

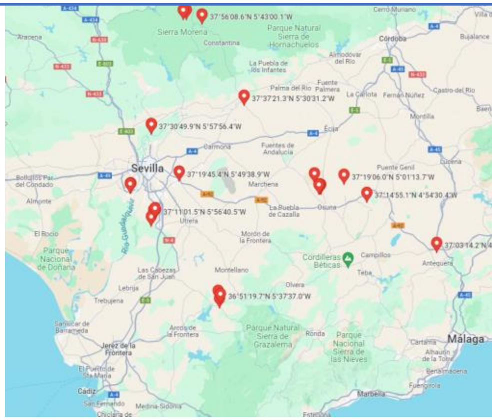
UNVEILING SOIL PROPERTIES FROM FTIR SPECTRA

López-Núñez Rafael[1], Cobos-Sabater Joaquín[2], Cayuela-Sánchez José A.[3], Almendros-Martín Gonzalo[4]

[1]INSTITUTO DE RECURSOS NATURALES Y AGROBIOLOGÍA DE SEVILLA (IRNAS-CSIC), [2]ESTACIÓN BIOLÓGICA DE DOÑANA (EBD-CSIC), [3]INSTITUTO DE LA GRASA (IG-CSIC), [4]MUSEO NACIONAL DE CIENCIAS NATURALES (MNCN-CSIC),
rafael.lopez@csic.es

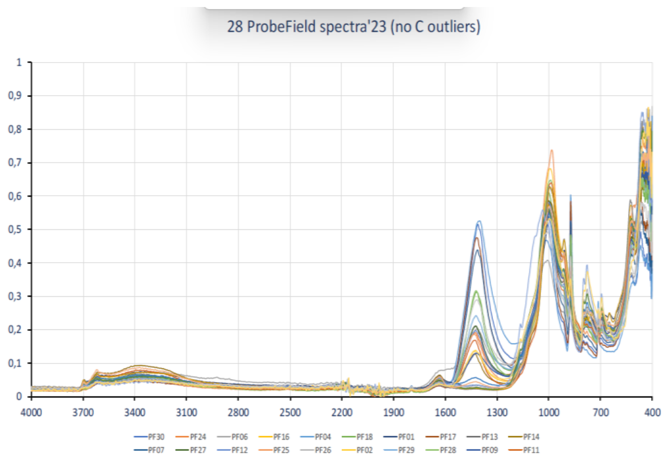
- The EJP Soil ProbeField project (A novel protocol for robust in-field monitoring of carbon stock and soil fertility based on proximal sensors and existing soil spectral libraries) proposes innovative techniques for determining SOC stocks and other relevant properties to the health of EU soils.
- This study aims to predict soil properties (calcium carbonate, sand, silt, clay, available-P, and available-K contents) using partial least squares regression (PLS) models and identify significant spectral bands for predicting soil physicochemical properties.

28 samples, 0-15 cm, of agricultural soils in southwestern Spain

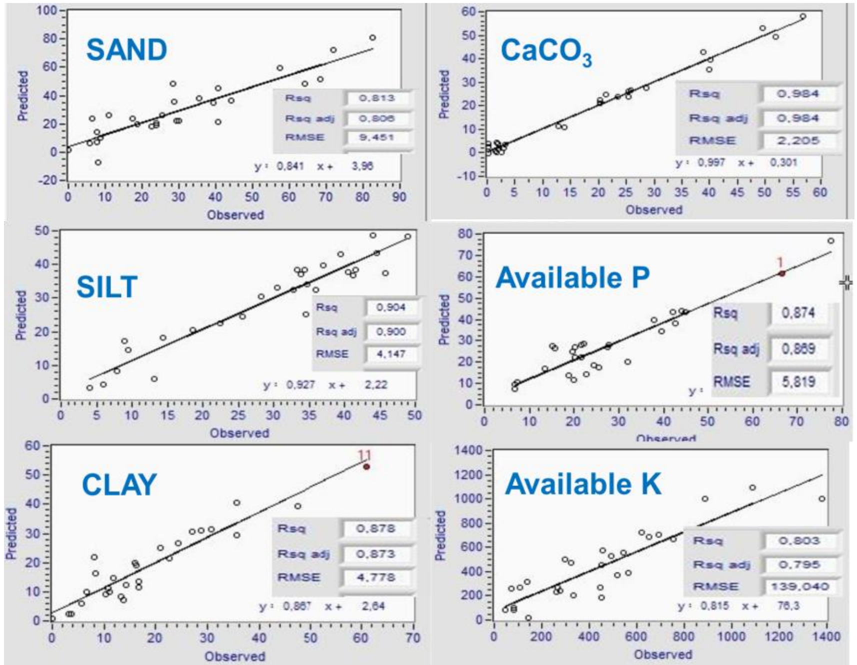


Soil properties determined using conventional laboratory techniques and Fourier transformed infrared (FTIR) spectrum were recorded (range of 4000–400 cm^{-1})

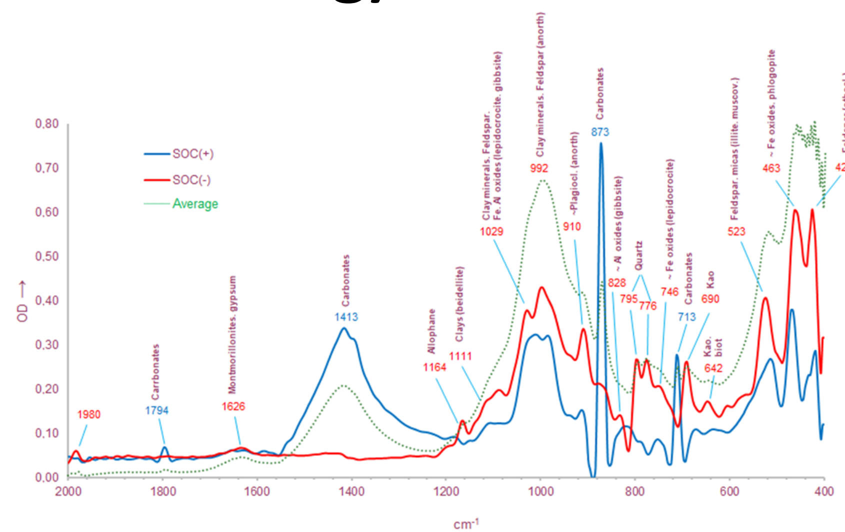
Pretreatment of spectral data: mean centering and MSC (Multiplicative Scattering Correction)



- **Partial least square regression (PLS) with spectral points as independent variables and soil properties values as dependent ones.**
- **Root mean square error (RMSE) and Akaike information criterion (AIC) to select the model with the minimum number of latent variables (LVs), avoiding overfitted spurious models**



- **EXCELLENT predictions with 19 LV (without overfitting)**



Tentative assignments of the major soil minerals are shown above the main peaks of the scaled subtracted spectra. Dotted line: original (average) spectrum: Red numbers: bands attributed to minerals that predominate in the C-depleted soils; blue numbers: bands that predominate in soils with high C content.

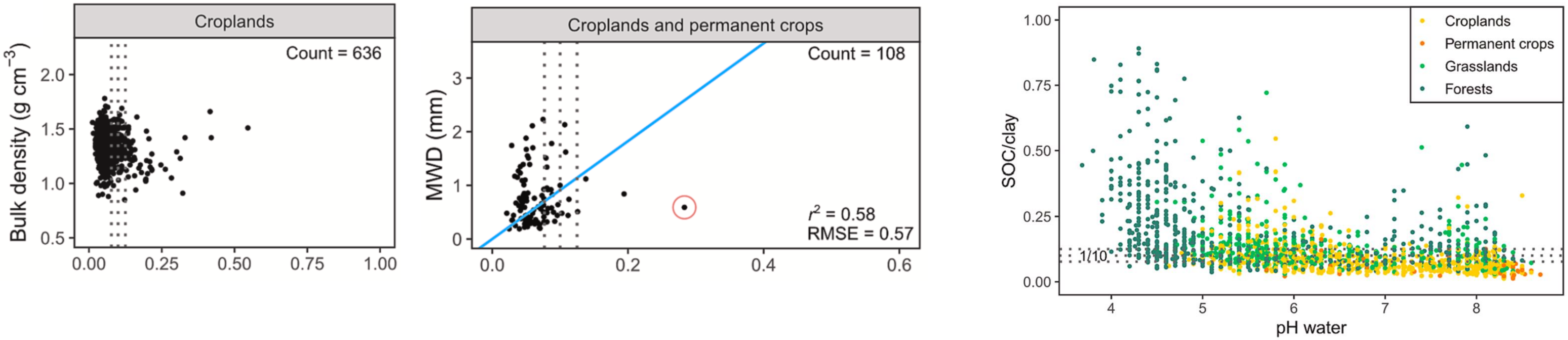
The latent variables include information on the various components of the soil (calcite, silicates, clays, oxides), that is, we can assign the spectral bands to the various minerals

Key message to stakeholders: Powerful, fast soil spectroscopy laboratories coming soon

Relevance of the organic carbon to clay ratio as a national soil health indicator

E. Rabot[1], N.P.A. Saby[1], M.P. Martin[1], P. Barré[2], C. Chenu[3], I. Cousin[1], D. Arrouays[1], D. Angers[4], A. Bispo[1]
1- INRAE Orléans, France, 2- CNRS Paris, France, 3- INRAE Palaiseau, France, 4-AAC Canada.

→ Evaluation at the national scale in diverse pedoclimatic contexts in France
Dataset: the French Soil Quality Monitoring Network (RMQS)



SOC/clay:

→ poorly correlated with soil structure attributes
→ biased, as dependent on soil type

=> Limited relevance as a soil health indicator

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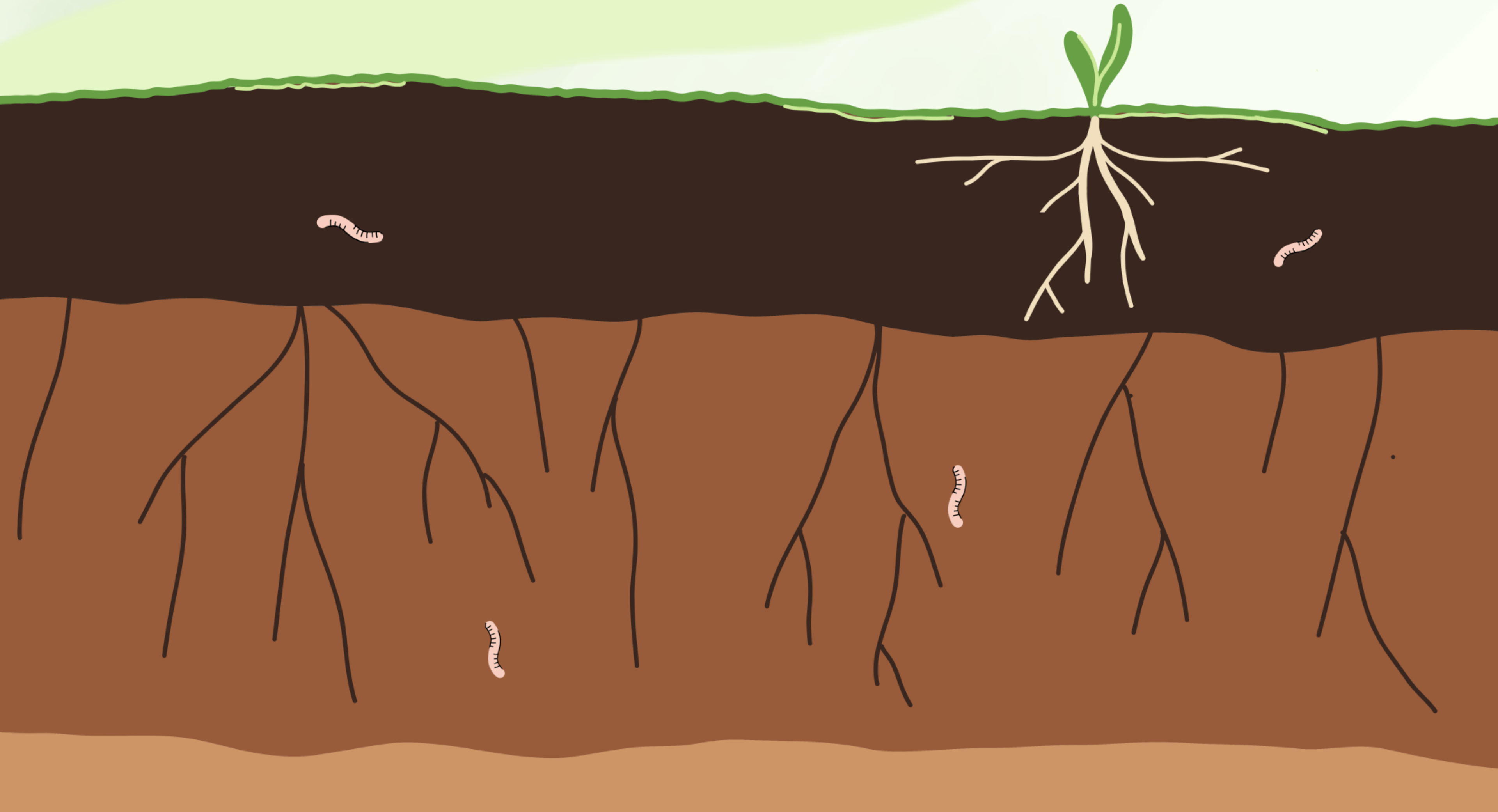
Rabot et al. 2024. Geoderma. https://doi.org/10.1016/j.geoderma.2024.116829

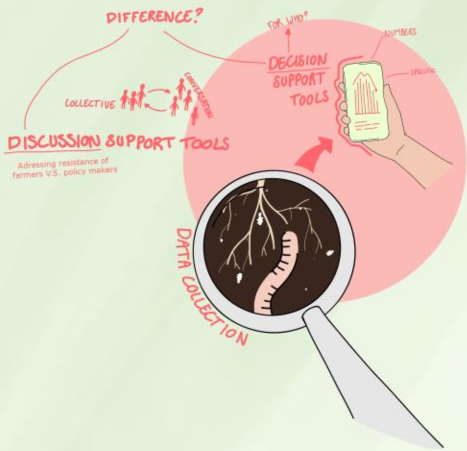
inspiring discussion

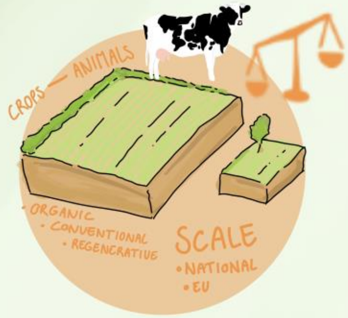
Decision support tools for soil health in living labs

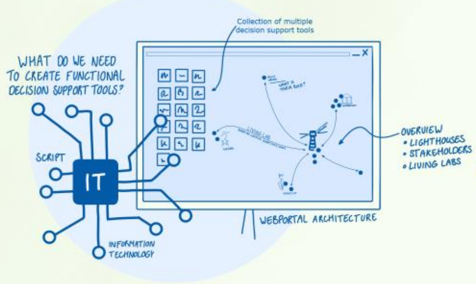


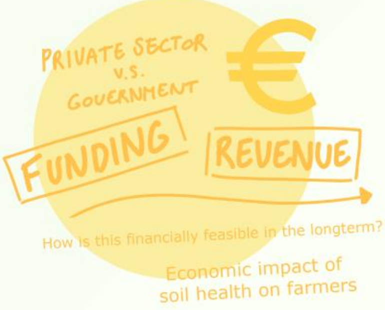
inspiring discussion

Decision support tools for soil health in living labs









inspiring discussion

Decision support tools for soil health in living labs

GREEN DEAL

Aims for 100 living labs and lighthouses
by the year 2030 for soil health

Effects of Anaerobic Digestates and Biochar Amendments on Soil Health, Greenhouse Gas Emissions, and Microbial Communities: A Mesocosm Study

Pastorelli Roberta[1], Rocchi Filippo[2], Tempio Elina[2], Laaksonen Ilmari[2], Becagli Claudia[1] and Lagomarsino Alessandra[1,*]

[1] *Research Centre for Agriculture and Environment, Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria (CREA-AA), Firenze, Italy*

[2] *Natural Resources Institute Finland (Luke), Production Systems, Finland*

** Presenting author: alessandra.lagomarsino@crea.gov.it*

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EJP SOIL has received funding from the European Union's Horizon 2020 research and innovation programme: Grant agreement No 862695

30 mesocosms (1000 cm^3 polyethylene jars equipped with a gas-tight cap with two in-out valves)

- 500 g soil (loam texture) with digestate and biochar combinations:
  - 2 manure-based digestates
  - Biochar (from digested sewage sludge and waste wood) at 2 and 10%:

Contr – Dig1 – Dig2 – Bio2% - Bio10% - Dig1+bio2% - Dig2+bio2% - Dig1+bio10% - Dig2+bio10%

- Measurements of CO_2, CH_4 and N_2O at 1, 2, 4, 6, 8, 11, 15, and 22 days of incubation (Gasmet FTIR analyzer)
- Germination Index
- Microbial community structure

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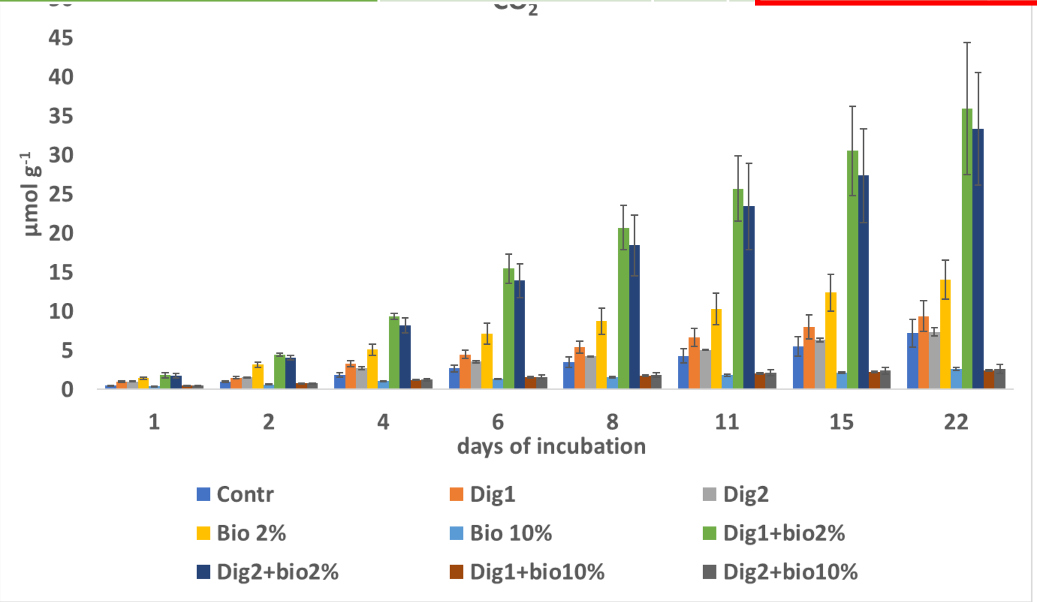
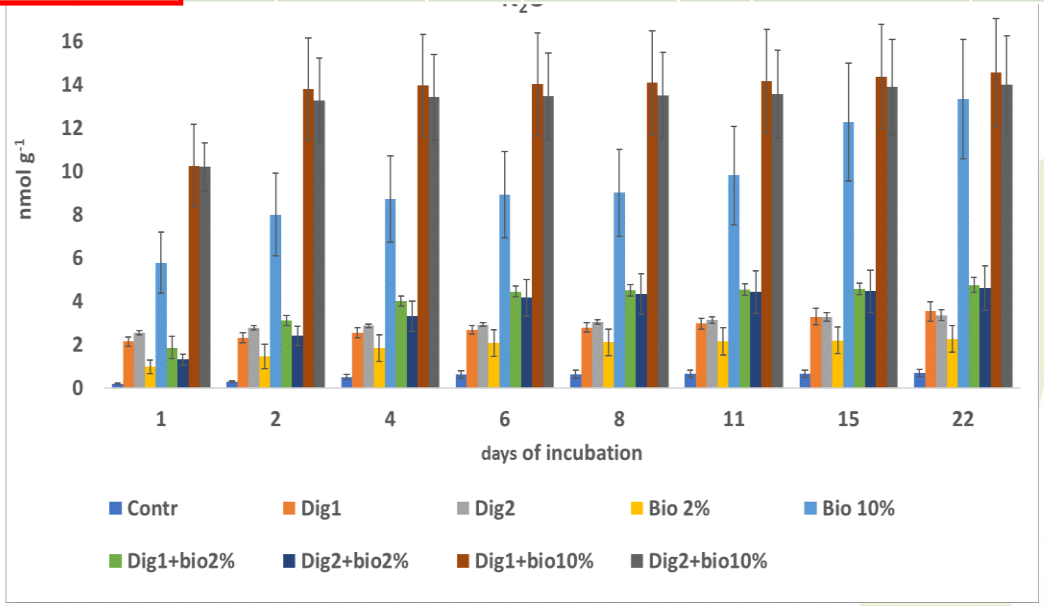
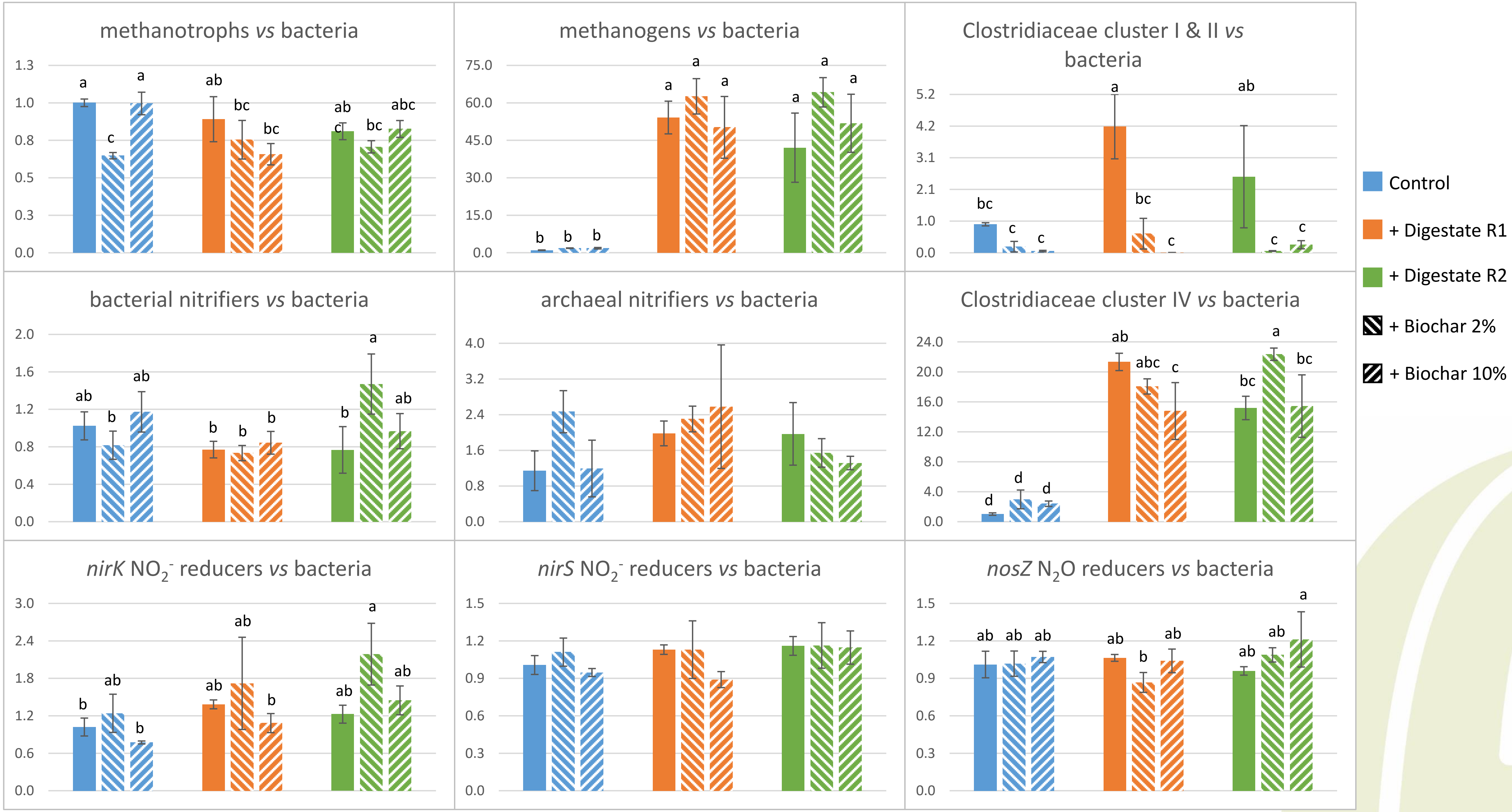
Treatment	TC (%)		TOC (%)		TN (%)		C/N		pH		EC (dS/m)	
Control	1.45	b	0.69	d	0.11	e	13.4	a	7.91	ab	30.9	c
Dig1	1.50	b	0.78	d	0.13	de	11.9	bc	8.00	a	28.5	c
Dig2	1.59	b	0.79	cd	0.14	cde	11.5	c	7.93	ab	26.9	c
Bio2%	1.90	b	1.31	Bcd	0.15	bcd	12.3	abc	7.87	bc	27.1	d
Bio10%	4.89	a	4.24	A	0.38	a	12.9	ab	7.81)	cd	49.3	a
Dig1+bio2%	2.15	b	1.47	bc	0.17	bc	12.4	abc	7.93	ab	29.6	c
Dig2+bio2%	2.15	b	1.63	b	0.18	b	11.7	c	7.94	ab	34.1	c
Dig1+bio10%	4.31	a	3.68	a	0.34	a	12.7	abc	7.78	d	61.6	b
Dig2+bio10%	4.46	a	3.92	a	0.34	a	13.3	a	7.82	cd	61.7	b







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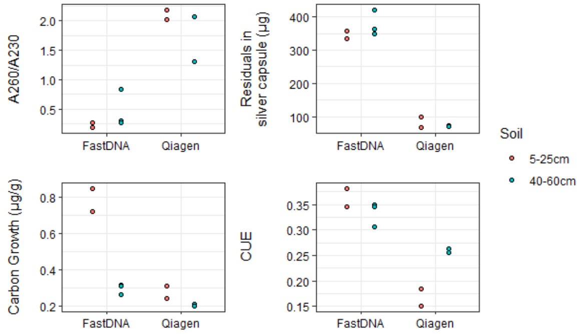
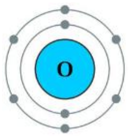
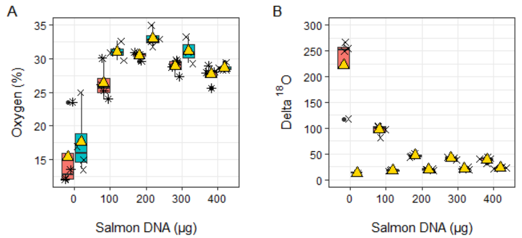
A guideline for appropriate estimates of carbon use efficiency with the ^{18}O method

POTENTIAL ISSUES		EXPLORING SOLUTIONS
Impurities in DNA extractions	→	Find the ideal extraction kit
Not enough oxygen in the sample	→	Oxygen Spyke test
Several equations in bibliography	→	Equation revission







$$A^{18}_{DNA} = \frac{(O_{salmon} + O_{DNA}) * A^{18}_{total} - O_{salmon} * A^{18}_{salmon}}{O_{DNA}}$$

$$\frac{DNA_{prod}}{DNA_T} = turnover$$

$$C_{growth} = Microbial\ C * turnover * t^{-1}$$

$$CUE = \frac{C_{growth}}{C_{growth} + C_{resp}}$$

Soil carbon sequestration: insights from different farming practices

Kauer Karin, Astover Alar, Liina Talgre

www.emu.ee
Eesti Maaülikool
Estonian University of Life Sciences

Aim:
Compare the impact of conventional (mineral N fertilization) and organic farming (cover crops with/without manure) on soil organic carbon (SOC) dynamics over ten years (2008–2018).

MM:
- Long-term experiment (started in 2008, ongoing)
- Size-fractionation was used to separate soil into particulate organic matter (POM) and mineral-associated organic matter (MAOM)

Results:
- Over 10 years, SOC concentration significantly increased only with cover crops and manure
- POM-C and MAOM-C concentrations increased in all treatments, but organic farming led to greater increases
- POM-C/MAOM-C ratio was highest in organic treatments, indicating organic farming promotes SOC accumulation
- SOC stock related to POM fraction was lower in conventional systems compared to organic systems

Experimental site

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Biological activation and N enrichment as tool to optimize biochar-based fertilizers

Vandecasteele Bart[1], Castejón-del Pino Raúl[2], Cayuela María L.[2], Sánchez-Monedero Miguel A.[2]
[1]ILVO, Belgium
[2]CEBAS-CSIC, Spain
bart.vandecasteele@ilvo.vlaanderen.be

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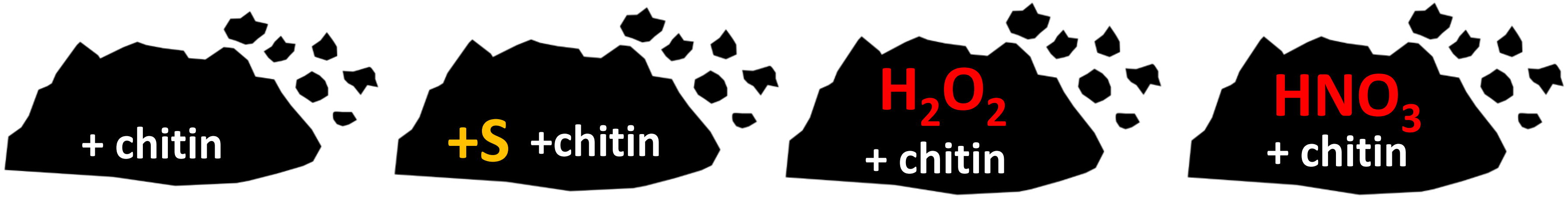


Chemical versus biological activation of biochars to produce biochar-based fertilizers (source of stable C and slow N release)

Mode of action: microbiological
Effect: chemical

Mode of action: microbiological
Effect: chemical

Microbial activation of biochar?

Microbial activity:

Elemental S: change in pH, EC and sulphates

Chitin: mineral N release (but mineral N can be immobilized again)

Microbial interaction:

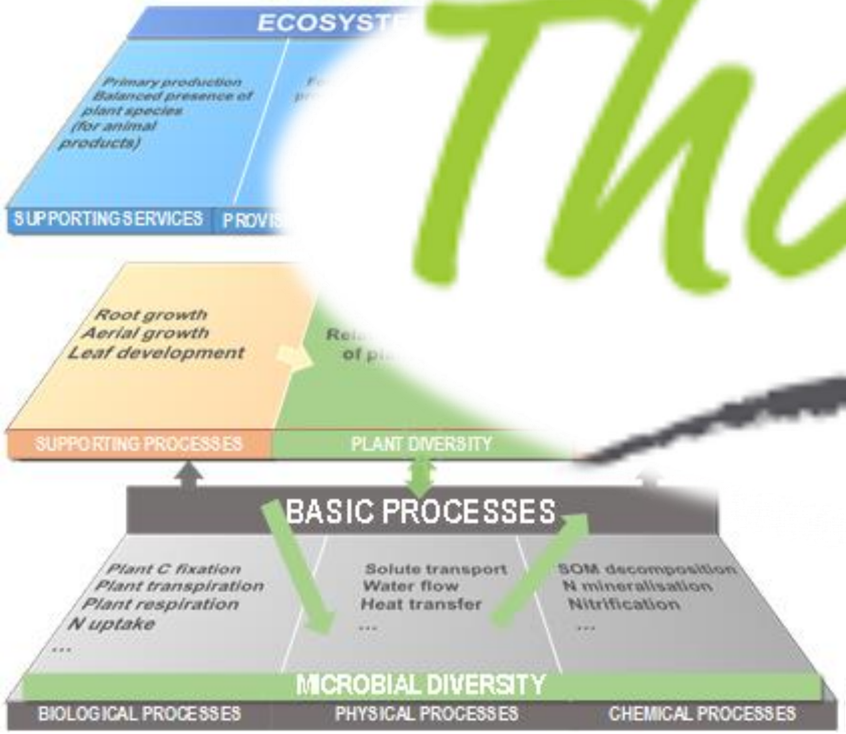
Chitin: only N mineralization in presence of S

S: faster pH decrease when chitin is present

Integrated modelling of microbial-plant interactions in multi-species agroecosystems: the

Interactions between plant and soil microbial diversity are essential for regulating C ... cycling in agroecosystems.

MODIMIV develops integrated, explicit and dynamic simulators of ... multi-species vegetation covers (e.g. grassland ... N fluxes while synchronising



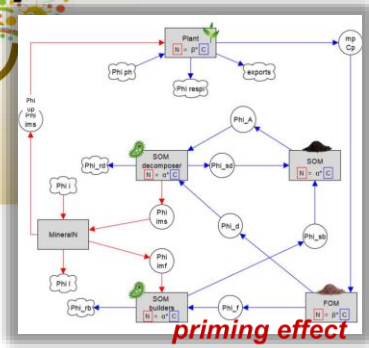
Fontaine et al., 2024, Global Change Biology

gianni.bellocchi@inrae.fr

Varying C-N ratios
Nutrient recycling
Root growth and exudates, …

$$\lambda_{W,S} = \frac{1}{1 + f_N/\sigma_C \cdot d\sigma_C/dF_N}$$

SYMPHONY



Perveen et al., 2014, Global Change Biology

EJP SOIL AGROECOseqC

UREP INRAE EMMAH BIOSEFAIR crea LIEC

G. Bellocchi[1], L. Adam[1], G. Alvarez[2], A. Bérard[3], J. Bloor[1], M. Carozzi[4], D. Cavalli[5], A. Cébron[6], S. Fontaine[1], R. Martin[1], A. Rodriguez[7], D. Warren Raffa[8], A. Trinchera[8]

[1]INRAE-UREP, [2]VetAgro Sup, [3]INRAE-EMMAH, [4]INRAE-SADAPT, [5]CREA-ZA, [6]CNRS-LIEC, [7]INRAE-UR ... [8]CREA-AA

A simple profile-scale model of soil organic matter turnover accounting for physical protection and priming: model description and sensitivity analysis

Elsa Coucheney, Anke Herrmann and Nicholas Jarvis

Department of Soil and Environment

Swedish University of Agricultural Sciences

750 07 Uppsala, Sweden

SLU

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MaxRootC: WP6

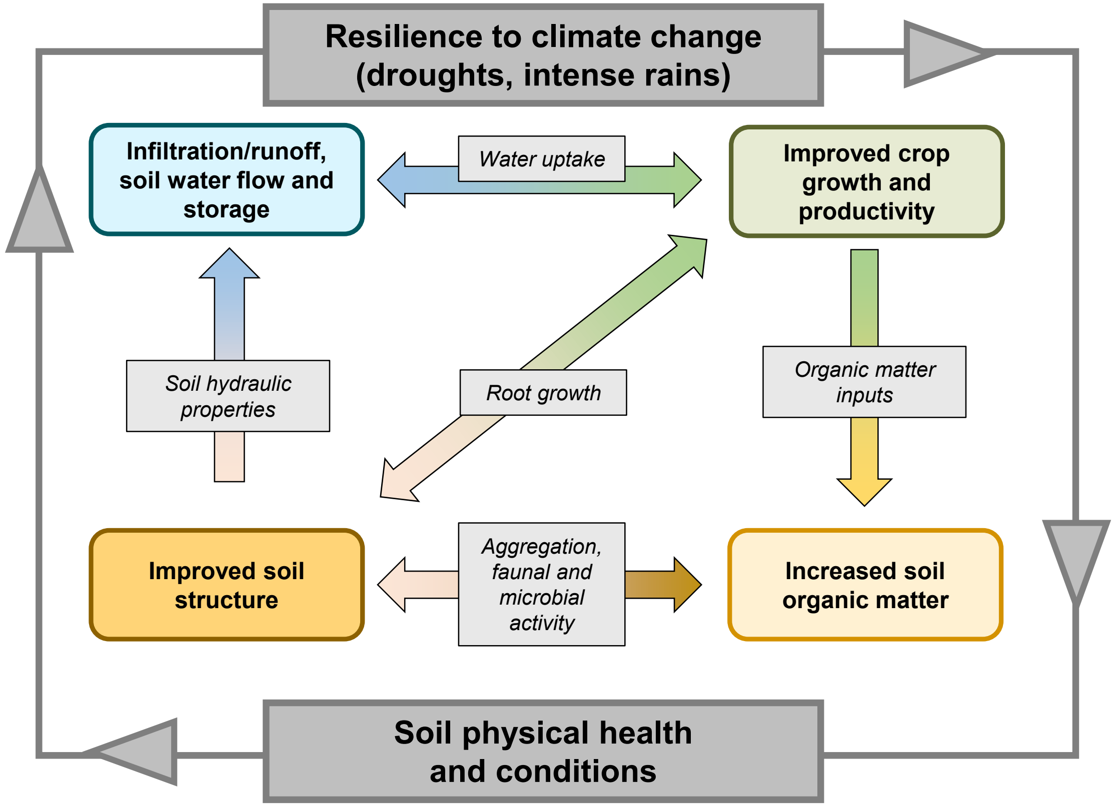
Task 6.2.3

A sensitivity analysis …. to explore which processes matter most for …. soil C dynamics in contrasting soil types (e.g. structured clays soils vs. sandy soils)

What is most important?

…… OM inputs (total), partitioning between roots and shoots, microbial carbon use efficiency and priming, soil structure, tillage intensity, root depth and distribution?

*USSF (**U**ppsala model of **S**oil **S**tructure and **F**unction)*



Schematic: Tino Colombi, Nick Jarvis

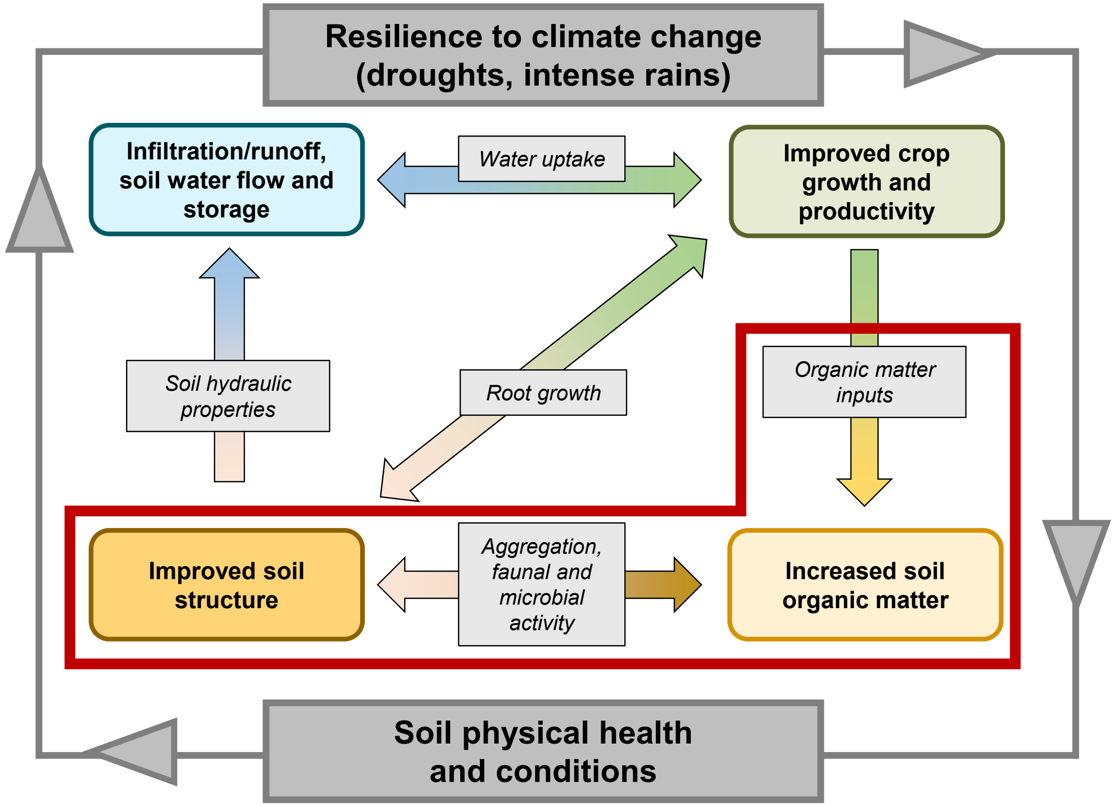
Strengths

- Feedbacks between soil and crop properly represented, including the effects of soil structure dynamics

Limitations

- Slow to run (5-10 minutes per year)
- Complex (100+ parameters)

*ICBM-P⁴ (**P**hysical **P**rotection and **P**riming in a soil **P**rofile)*

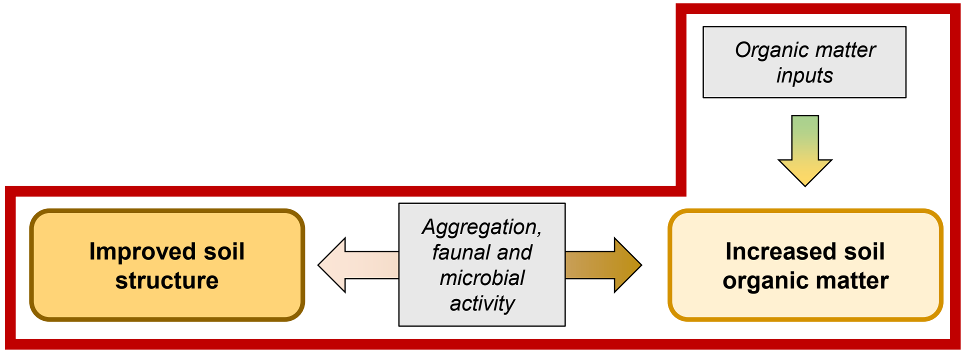


Schematic: Tino Colombi, Nick Jarvis

Advantages

- Fast (seconds)
- Simple (15 parameters)
- Solved analytically for steady-state stocks

*ICBM-P⁴ (**P**hysical **P**rotection and **P**riming in a soil **P**rofile)*



Advantages

- Fast (seconds)
- Simple (15 parameters)
- Solved analytically for steady-state stocks

…. but soil-plant feedbacks mediated via soil hydrological processes are lost …

Please see our poster in session C1 for an overview of the ICBM-P^4 model and the results of a sensitivity analysis and ”reality-check” ….

NATIONAL AGRICULTURAL
AND FOOD CENTRE

Dynamics of Soil Organic Carbon Stocks on Arable Land under Varied Soil Management and Climate Scenarios: Insights from Long-term Experiments in Eastern Slovak Lowland

Barančíková Gabriela, Koco Štefan, Halas Ján, Takáč Jozef,
Makovníková Jarmila and Šoltysová Božena

- Long-term experiments (LTE) – modelling of soil organic carbon (SOC) stock by RothC model
- Validation of the RothC model according data of LTE – good fit between modelled and measured data
- Tracking changes of SOC stock in long time period
- 2 Climate scenarios:
  - RCP 2.6 – prediction of lower temperature (T),
  - RCP 8.5 – prediction of higher temperature
- 4 Management scenarios – BAU, application of manure, changes in crop rotation, no post-harvested residues
- RothC model predicts:
  - Higher T - lower SOC stock
  - Crop rotation without leave of post-harvested residues – decrease of SOC stock
  - Application of manure and mainly incorporation of clover grass to crop rotation – increase of SOC stock

Impacts of biochar on nitrous oxide emissions and ammonia volatilisation in wheat and maize cropping systems

Ferdinand Hartmann, Heide Spiegel, Barbara Kitzler, Eugenio Díaz-Pinés, Rebecca Hood-Nowotny*

*presenting author

EJP SOIL
European Joint Programme

EJP SOIL has received funding from the European Union's Horizon 2020 research and innovation programme: Grant agreement No 862695

Biochar as a soil amendment to reduce N_2O and NH_3

- Fertilizer application in agricultural systems are responsible for the majority of anthropogenic N_2O and NH_3 emissions.

- Severe negative impacts on the environment:
  - →Greenhouse gas effect (N_2O)
  - →Ozone depletion (N_2O)
  - →Formation of fine particulate matter $PM_{2.5}$ (NH_3)
  - →Eutrophication of aquatic and terrestrial ecosystems (NH_3)
  - →Soil acidification (NH_3)

- Biochar as a soil amendment to reduce N_2O and NH_3 emissions

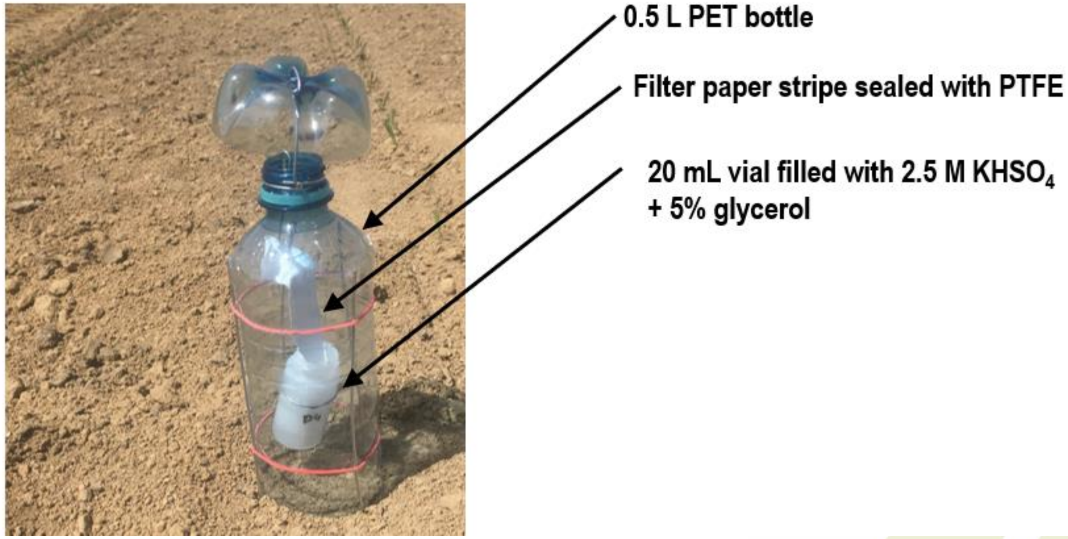
Simple and efficient methods to measure N_2O and NH_3 in the field

N_2O

Closed static chamber

- Incubation for 20 min
- Sampling of 200 mL
- Analysis with laser technology

NH_3



Semi-open static chamber

- Incubation for 7 days
- NH_3 is trapped with an acid-immersed filter paper stripe covered with PTFE

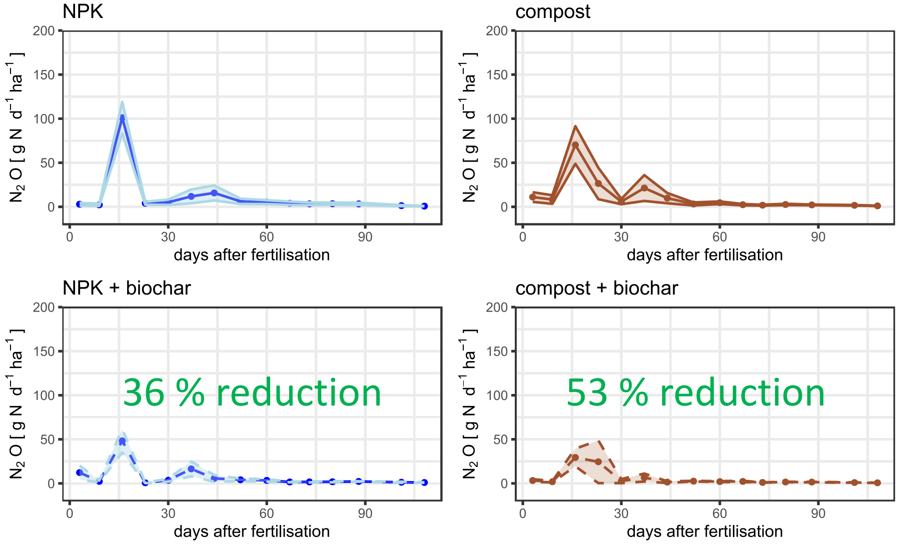
BOKU Institute of Soil Research

EJP SOIL European Joint Programme

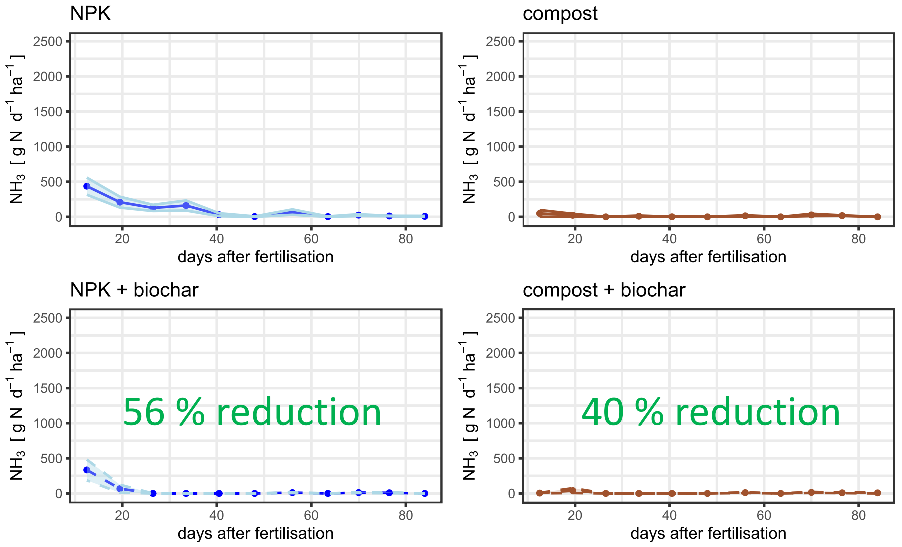
Results from a Field Experiment

- Biochar substantially decreases N_2O emissions and NH_3 volatilisation
- There are several mechanisms reported which can reduce N_2O emissions; in our case we pose, that the **immobilisation of NO_3^-/NH_4^+** and an **increased $N_2O \rightarrow N_2$ rate** are responsible.
- **NH_3 volatilisation** was reduced by the N immobilisation effect of biochar, which outweighs an acceleration of NH_3 volatilisation induced by a pH increase.
- Biochar **as a suitable soil amendment to reduce N_2O and NH_3 emissions** in fertilised agricultural systems.

N_2O



NH_3



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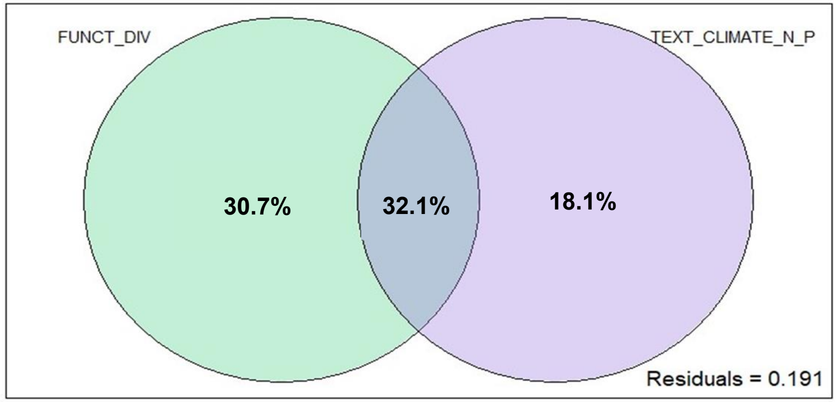
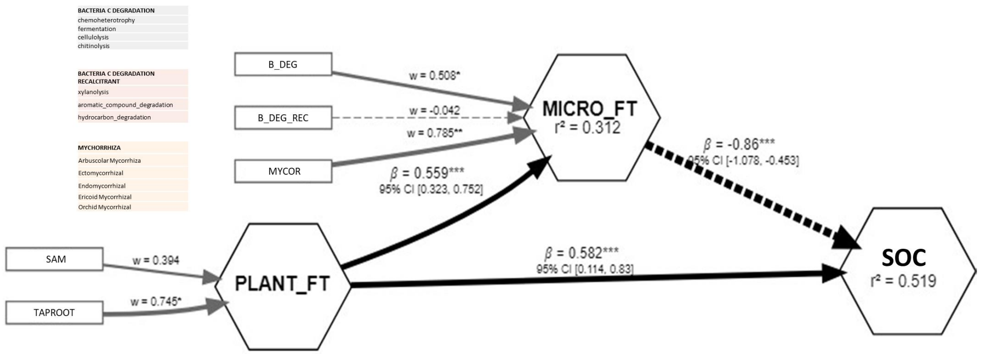
Trying to answer burning questions on functional diversity and soil carbon that keep awake agroecologists overnight

EJP SOIL AGROECOseqC

1. Is functional diversity relevant in explaining the variation of soil carbon in agricultural fields?

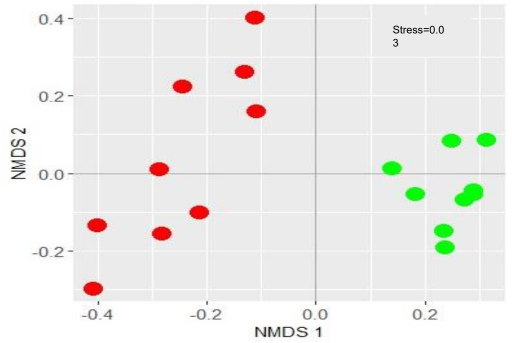


2. Given the complexity of the functional microbial groups and plants' traits, how do they interact in the context of SOC dynamics?

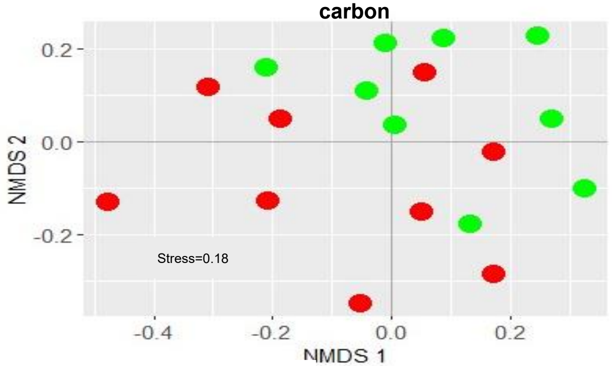


3. Do farming practices affects plants and microbial functional groups?

Non-metric multidimensional scaling on the effect of farm practice on plant functional traits

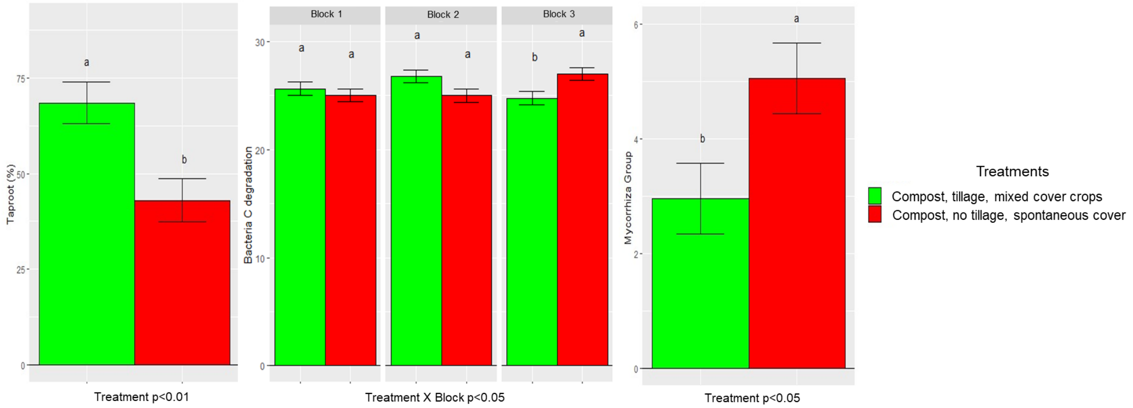


Non-metric multidimensional scaling on the effect of farm practices on microbial functional groups related to soil carbon



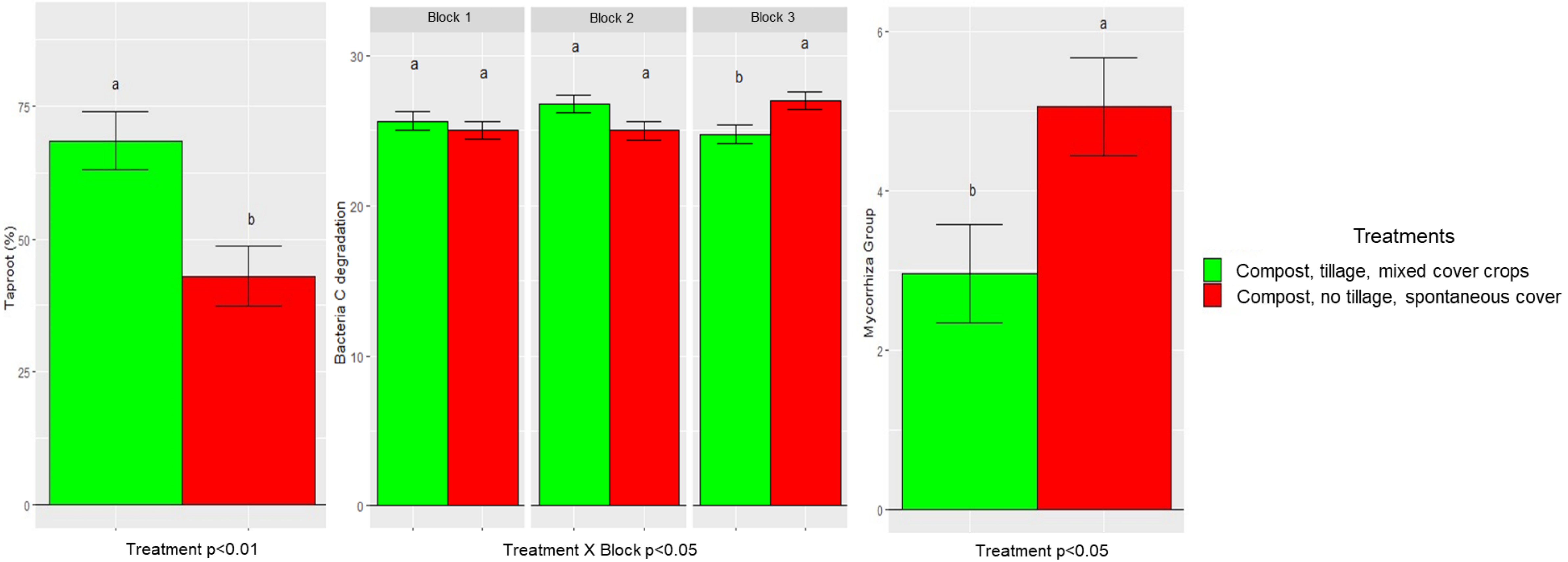
Compost, tillage, mixed cover crops
Compost, no tillage, spontaneous cover

4. What impact does farm management have on plant and microbial functional groups relevant to soil organic carbon dynamics?



Trying to answer burning questions on functional diversity and soil carbon that keep awake agroecologists overnight

4. What impact does farm management have on plant and microbial functional groups relevant to soil organic carbon dynamics?



Effects of different crop management options on SOC stocks and deriving emission factors- the CARBOSEQ approach based on European LTEs

CARBOSEQ ILVO EJP SOIL European Joint Programme

EJP SOIL has received funding from the European Union's Horizon 2020 research and innovation programme: Grant agreement No 862695

LITHUANIAN RESEARCH CENTRE FOR AGRICULTURE AND FORESTRY

The impact of cover crop roots in soil carbon input across a European gradient

Toleikienė Monika[1*], Hood- Nowotny Rebecca[2], Spiegel Heide[3], Rasmussen Jim[4], Hakl Josef[5]

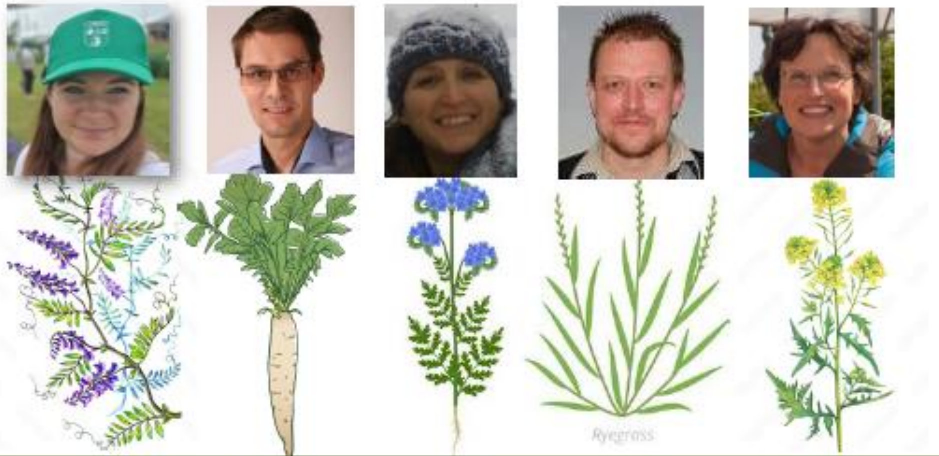
[1] *Lithuanian Research Centre for Agriculture and Forestry, Akademija, Lithuania*

[2] *University of Natural Resources and Applied Life Sciences, Vienna, Austria*

[3] *Austrian Agency for Health and Food Safety, Vienna, Austria*

[4] *Aarhus University, Tjele, Denmark*

[5] *Czech University of Life Sciences, Prague, Czech Republic*



WHY COVER CROPS?

- Cover crops have been identified a key component for achieving both soil health and carbon sequestration in EU Soil Mission goals.
- Currently they are cultivated on about 10% of the arable land area in Europe with large differences across regions, presenting ample opportunities for expansion.
- Increasing the mass and depth of cover crop roots could be a pioneering option for breeding for carbon inputs.
- Establishing an effective management for increasing below ground carbon inputs requires information on root quantities, location, and longevity as well as information on the impacts on following crops.
- Currently there is scant data on cover crop root carbon inputs across Europe and even less data on how inputs such as rhizodeposition and turnover contribute to increasing soil organic carbon stocks.

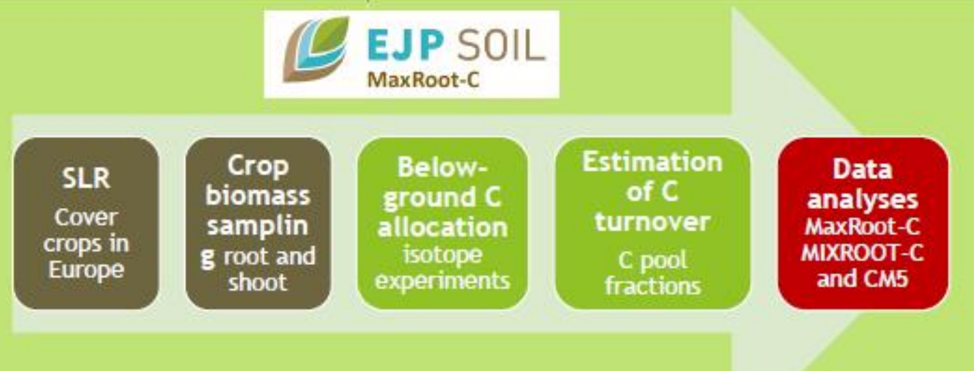
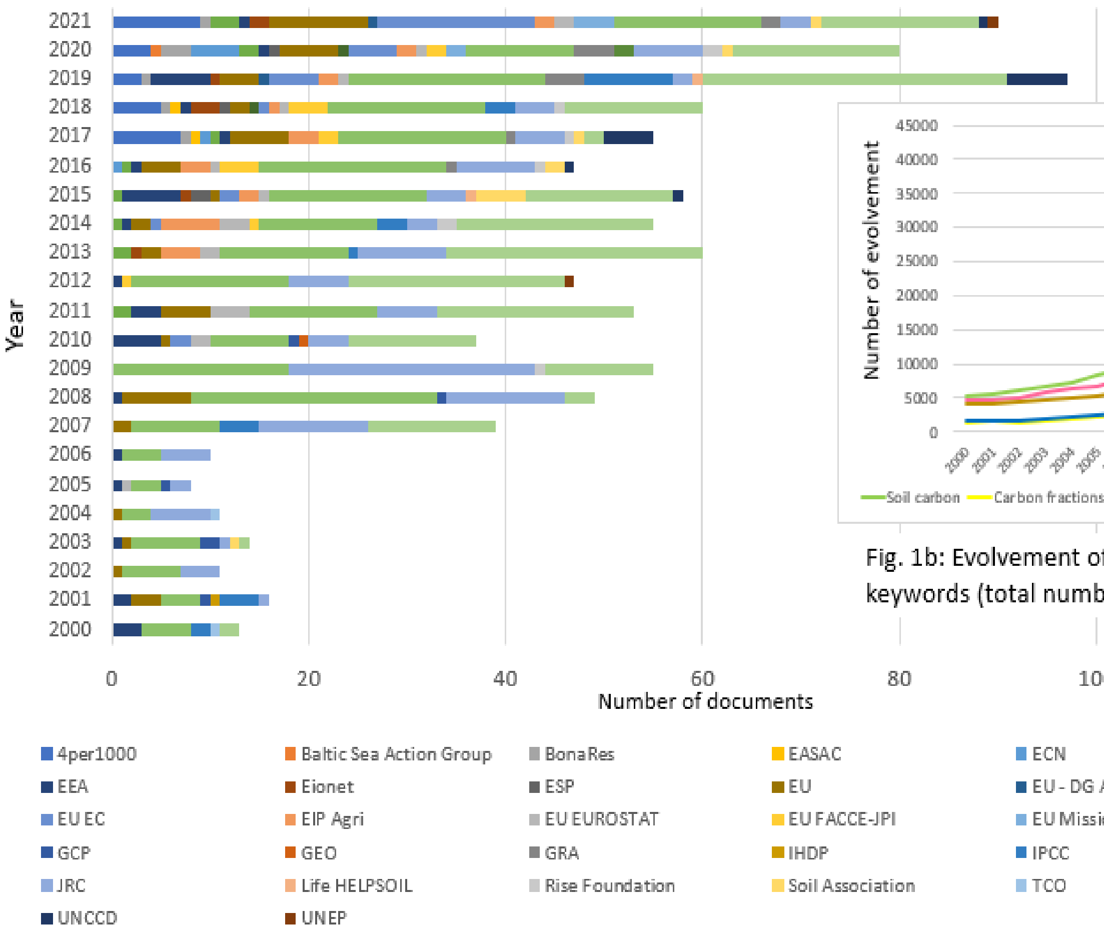


Figure 1. **MaxRoot-C WP 4 Cover crops**

GRAY LITERATURE



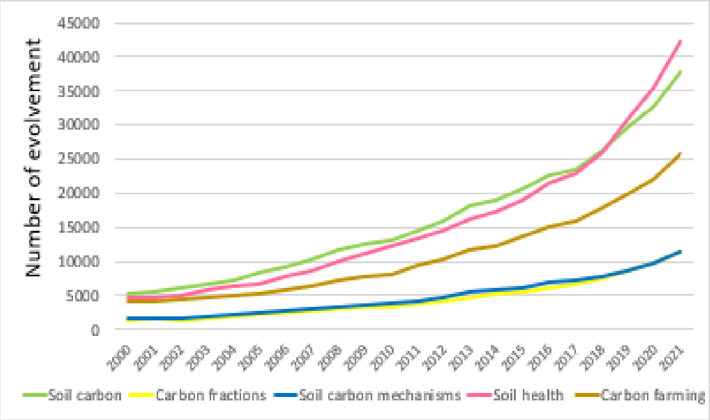
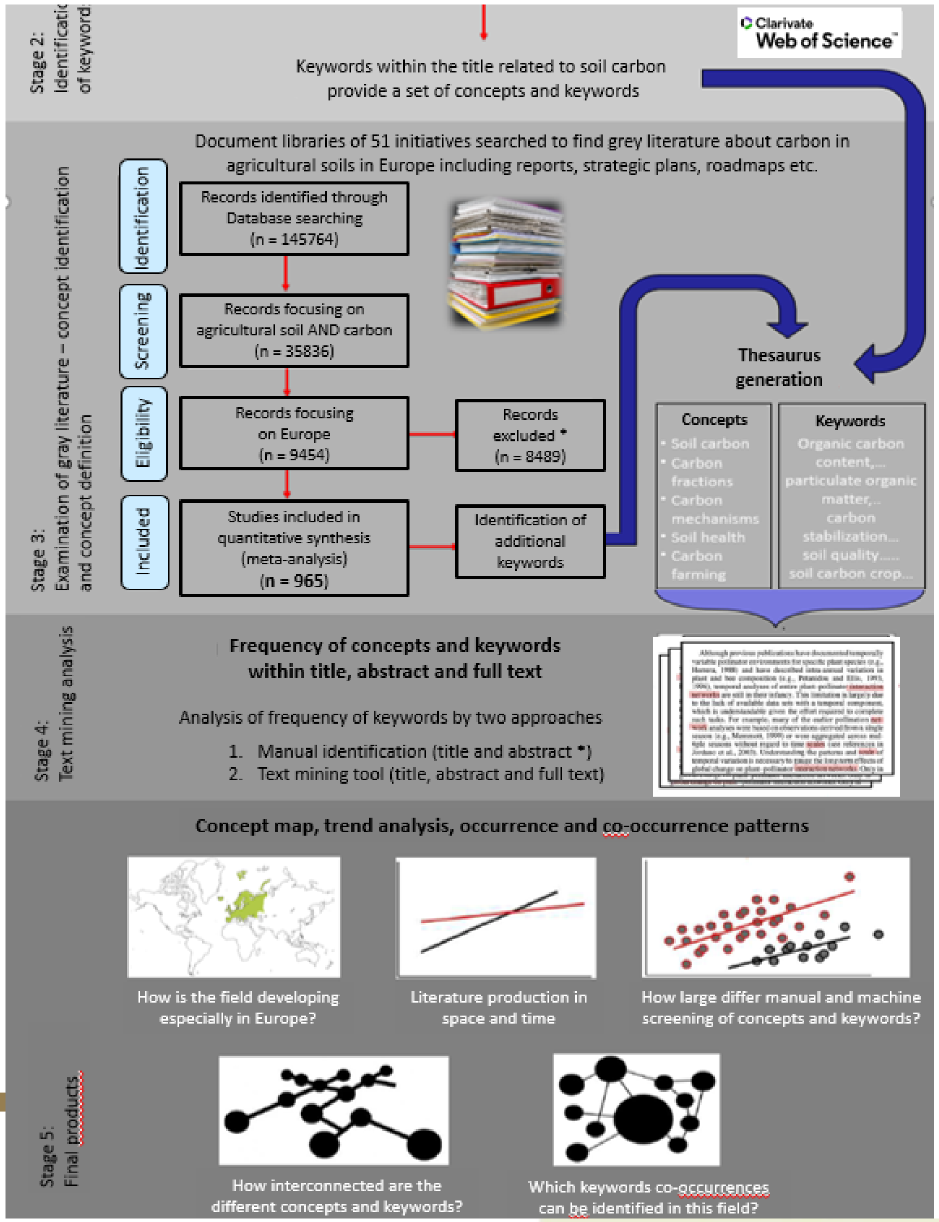


Fig. 1b: Evolvement of the **five concepts** and their associated keywords (total numbers) in WoS from 2000-2021.

Fig. 1a: Number of selected documents per initiative between 2000 and 2021



Shrimp Shells Valorization for Chitosan and Chitosan Nanomaterial Synthesis & Their Applications as Antimicrobial Agents in Agriculture

Hosney Ahmed [1*], Urbonavičius Marius [2], Varnagiris Šarūnas [2], Kundrotaitė Algimanta [1], Drapanauskaite Donata [1], Barčauskaitė Karolina [1]

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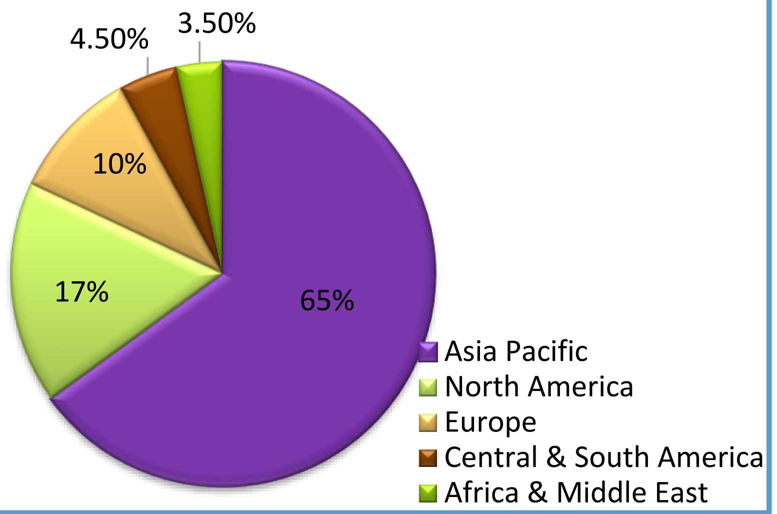
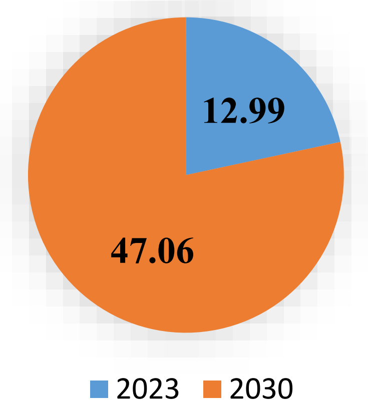
EJP SOIL has received funding from the European Union's Horizon 2020 research and innovation programme: Grant agreement No 862695

INTRODUCTION

Chitosan Market Share by Region

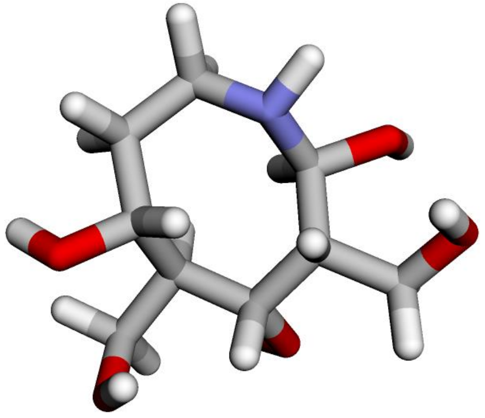


Chitosan Market (Billion USD)

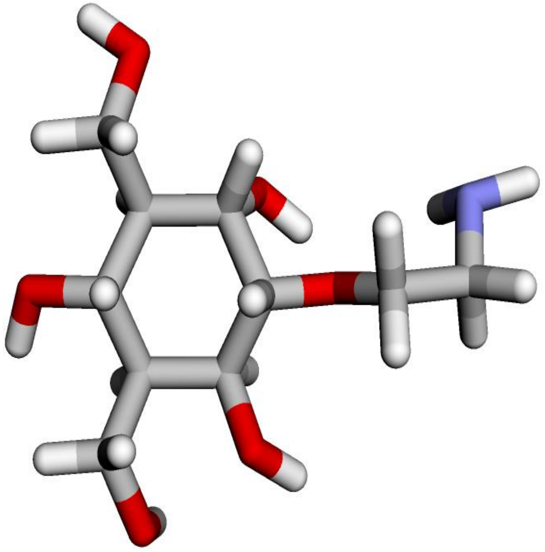


Shrimp

Shrimp Shells



Chitin



Chitosan

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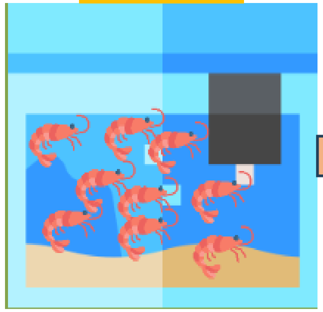
Research Methodology

Shrimp Tank

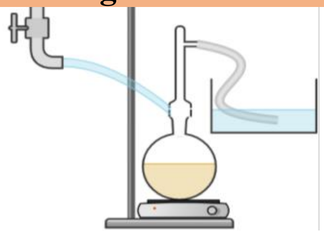


Shrimp Shells

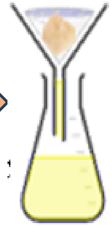
Dried Shells

Pulverized Shells

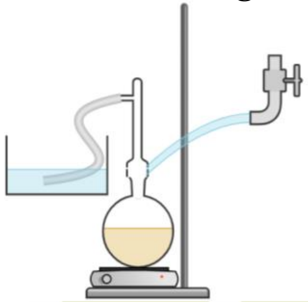
1. DM of shrimp shells using 1%, 2%, 3%, 4%, 5 and 10% mineral and organic acids and stirring for 2hrs.



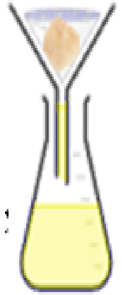
2. Filtration, neutralization to pH ~7 & drying



3. DP of shrimp shells using 4% NaOH and stirring for 2hrs., then soaking for 24 hrs. without stirring

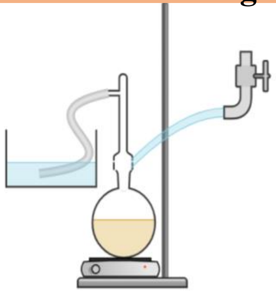


4. Filtration, neutralization to pH ~7 & drying



Chitin

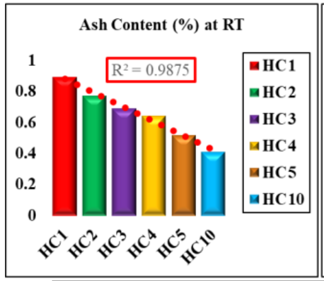
5. DA of shrimp shells using 50% NaOH and stirring for 2hrs., then soaking for 24 hrs. without stirring



6. Filtration, neutralization to pH ~7 & drying

Chitosan

Chitosan Characterization



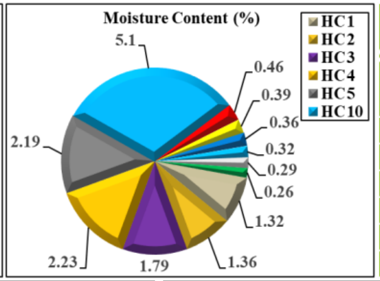
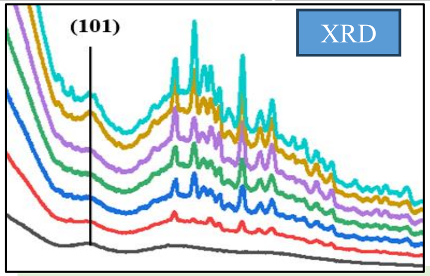
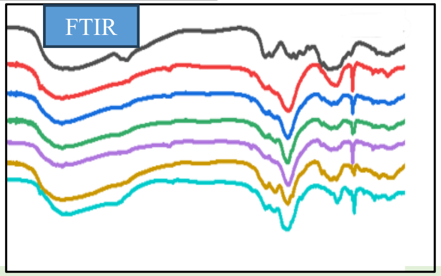


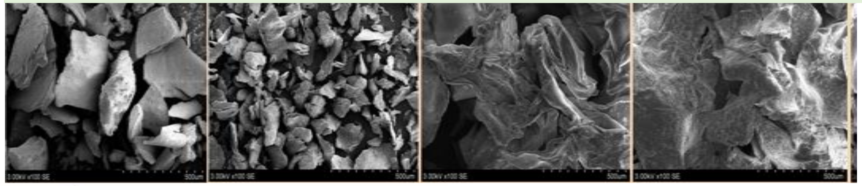
Table 3. Chitosan yield (%) of isolated chitosan samples.

Sample	Hydrochloric Acid Conc.	Temperature (°C)	Chitosan Yield (%)
HC1	1%	RT	51.30±0.02*
HC2	2%	RT	41.90±0.13*
HC3	3%	RT	23.20±0.14*
HC4	4%	RT	18.90±0.19*
HC5	5%	RT	17.50±0.16*
HC10	10%	RT	16.40±0.35*





SEM-EDS



EJP SOIL
European Joint Programme

Regional Assessment of Soil Organic Matter Stability under No-till and Diversified Agricultural Management Practices (WP6 T6.1)

S. Suproniene[1]*, G. Kadziene[1], S. Pranaitiene[1], A. Slepetiene[1], A. Skersiene[1], O.M. Doyeni[1], N. Matelioniene[1], A. Shamshitov[1], O. Auskalniene[1], S. Sanchez-Moreno[2] and A. Trinchera[3]

[1] Lithuanian Research Centre for Agriculture and Forestry (LAMMC), Kedainiai distr., Lithuania
[2] National Institute of Agricultural and Food Research and Technology (INIA-CSIC), Madrid, Spain
[3] Council for Agricultural Research and Economics (CREA), Rome, Italy
**** Presenting author:** skaidre.suproniene@lammc.lt*

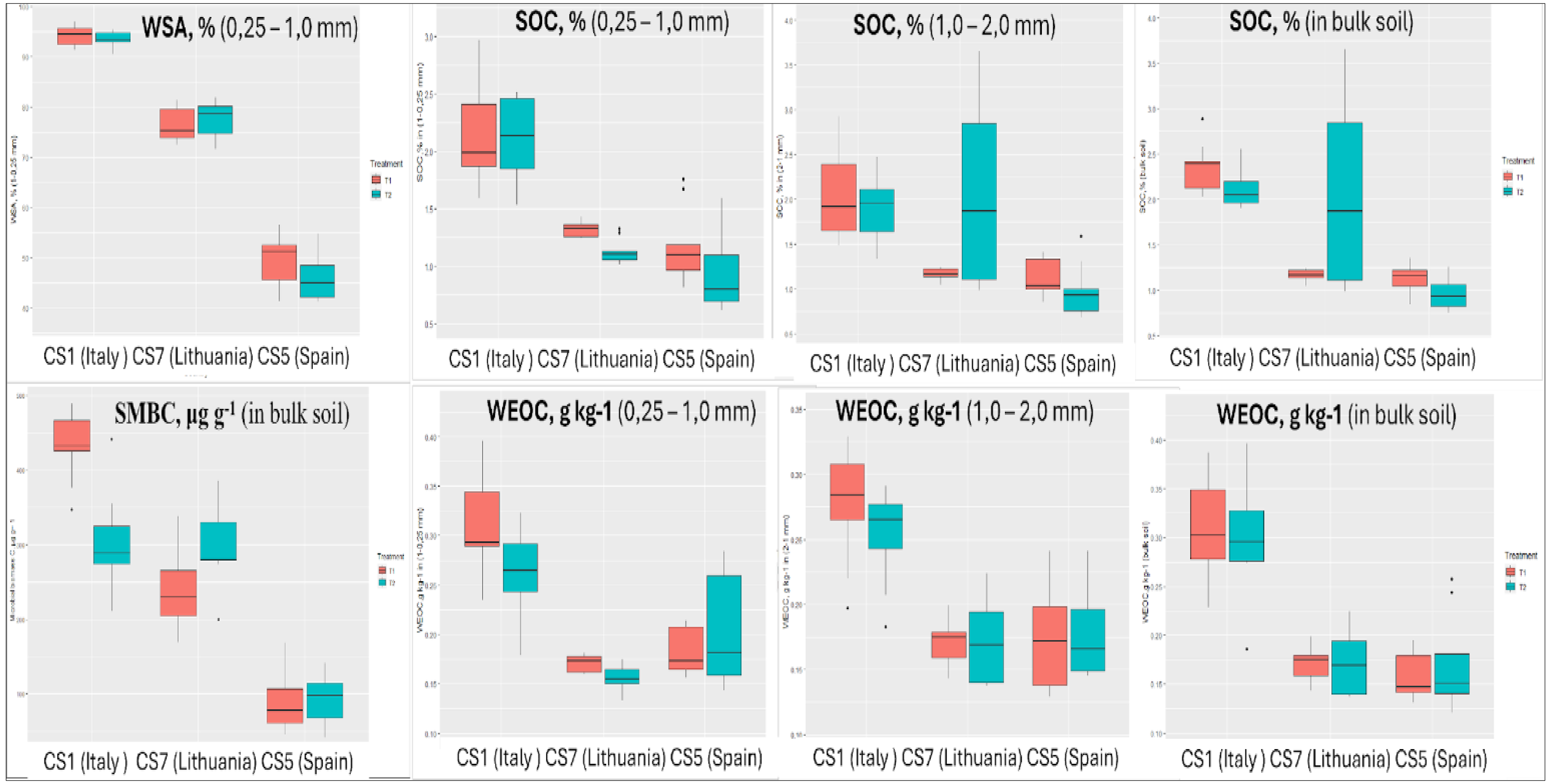
EJP SOIL
AGROECOseqC

EJP SOIL has received funding from the European Union's Horizon 2020 research and innovation programme: Grant agreement No 862695

Core-sites	Codes	Treatments
CS1 – Italy (CREA)	T1	No-till, Spontaneous cover
	T2	Tillage, Wheat + vetch cover crops (CC)
CS5 – Spain (CSIC-INIA)	T1	No-till, monocrop
	T2	No-till, wheat-vetch-barley rotation
CS7 – Lithuania (LAMMC)	T1	No-till, no CC
	T2	No-till, Persian clover CC

Study aim - to validate the established correlation between the water stable aggregates (**WSA**, %), soil organic carbon (**SOC**, %), water extractable carbon **WEOC** (g kg^{-1}), and soil microbial biomass **SMBC** (µg g^{-1}) in bulk soil, fine (0.25-1 mm), and coarse (>1mm) soil aggregates, under diversified agricultural practices across different environmental conditions at experimental sites.

Results



Indicators (soil fraction)	SMBC, µg g^{-1} (bulk soil)	SOC, % (1 – 2 mm)	WEOC, g kg^{-1} (1 – 2 mm)	SOC, % (0,25 – 1 mm)	WEOC, g kg^{-1} (0,25 – 1 mm)	SOC, % (bulk soil)	WEOC, g kg^{-1} (bulk soil)
WSA, % (0,25 – 1 mm)	0.87**l	0.566**l	0.613**l	0.733**l	0.495**l	0.654**l	0.694**l
SMBC, µg g^{-1} (bulk soil)		0.570**l	0.595**l	0.638**l	0.508**l	0.666**l	0.622**l
SOC, % (1 – 2 mm)			0.454**l	0.556**l	0.318*l	0.906**l	0.451**l
WEOC, g kg^{-1} (1 – 2 mm)				0.808**l	0.796**l	0.545**l	0.806**l
SOC, % (0,25 – 1 mm)					0.749**l	0.555**l	0.831**l
WEOC, g kg^{-1} (0,25 – 1mm)						0.412**l	0.731**l
SOC, % (bulk soil)							0.596**l

Takehome message!

- The relationship between soil aggregate stability, microbial activity, and carbon cycling has been discovered across a variety of environmental conditions and agricultural practices.
- The strong correlations observed among WSA, SMBC, WEOC and SOC highlight the pivotal role of soil structure and microbial activity in regulating soil carbon processes.
- Integrated agricultural management strategies are essential for improving soil carbon dynamics in response to these findings.

A stocktaking of European long-term field experiments dealing with the application of External Organic Matter (EOM)

EJPSOIL – EOM4SOIL project

Simon Sail[1*], Hélène Van Der Smissen[1**], Brieuc Hardy[1], Sabine Houot[2], Bruno Huyghebaert[1]

[1] *Walloon Agricultural Research Centre (CRA-W), Department of sustainability, Systems & Prospective – Soil, Water & Integrated Crop Production, Gembloux, Belgium*

[2] *French National Institute for Agriculture, Food, and Environment (INRAE), Paris, France*

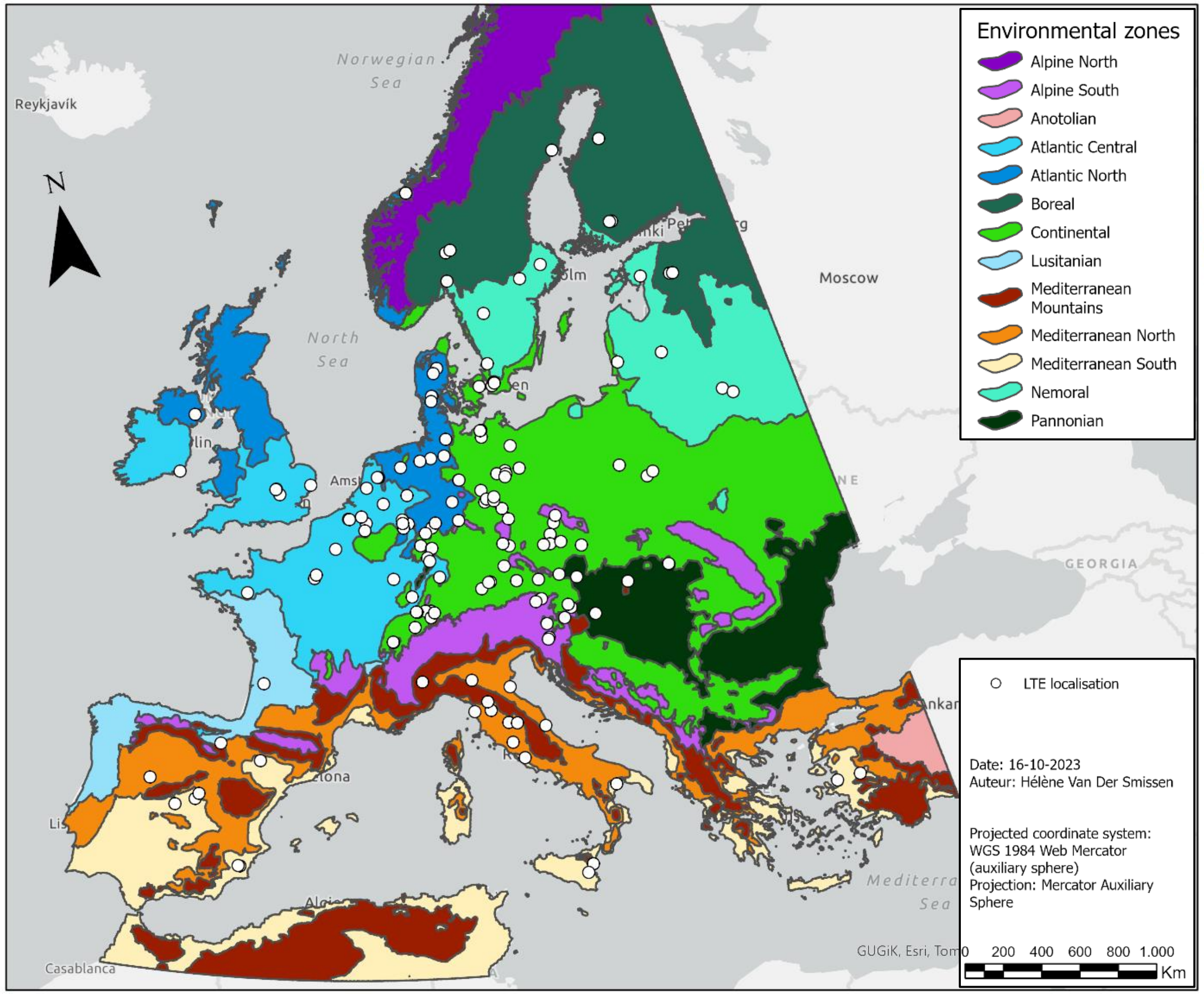
* *Presenting author: s.sail@cra.wallonie.be*

** *Corresponding author: h.vandersmissen@cra.wallonie.be*

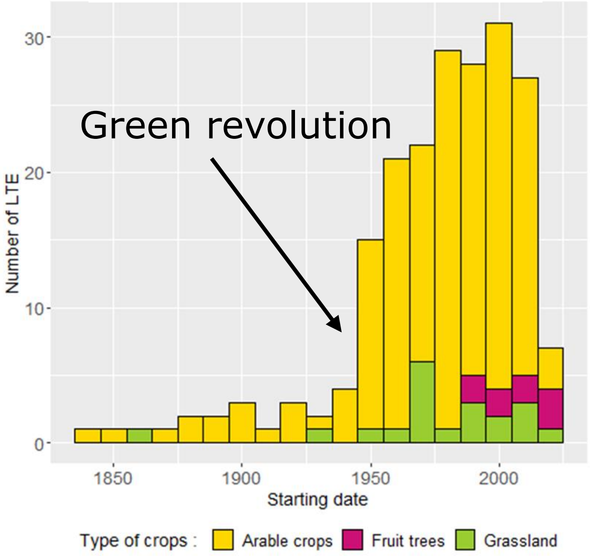
EJP SOIL
European Joint Programme

EJP SOIL has received funding from the European Union's Horizon 2020 research and innovation programme: Grant agreement No 862695

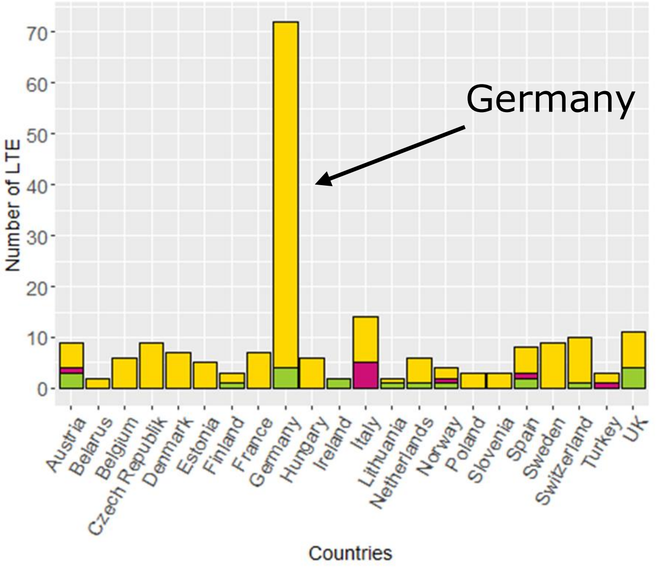
201 European long-term field experiments dealing with organic fertilisation



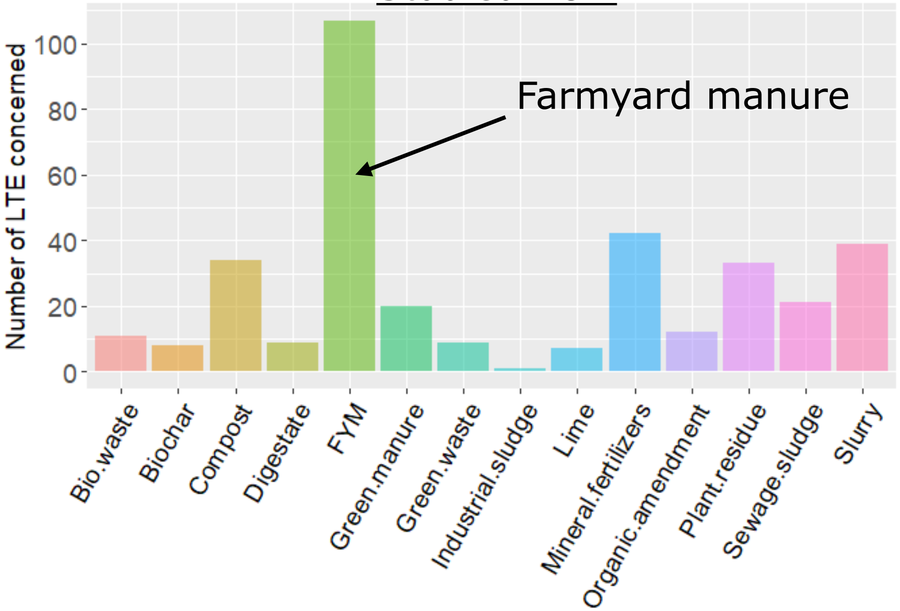
Starting date



Countries



Studied EOM



Guidelines to improve the use and sharing of LTE data

Richness and shortcomings of experiments

EJP SOIL
European Joint Programme

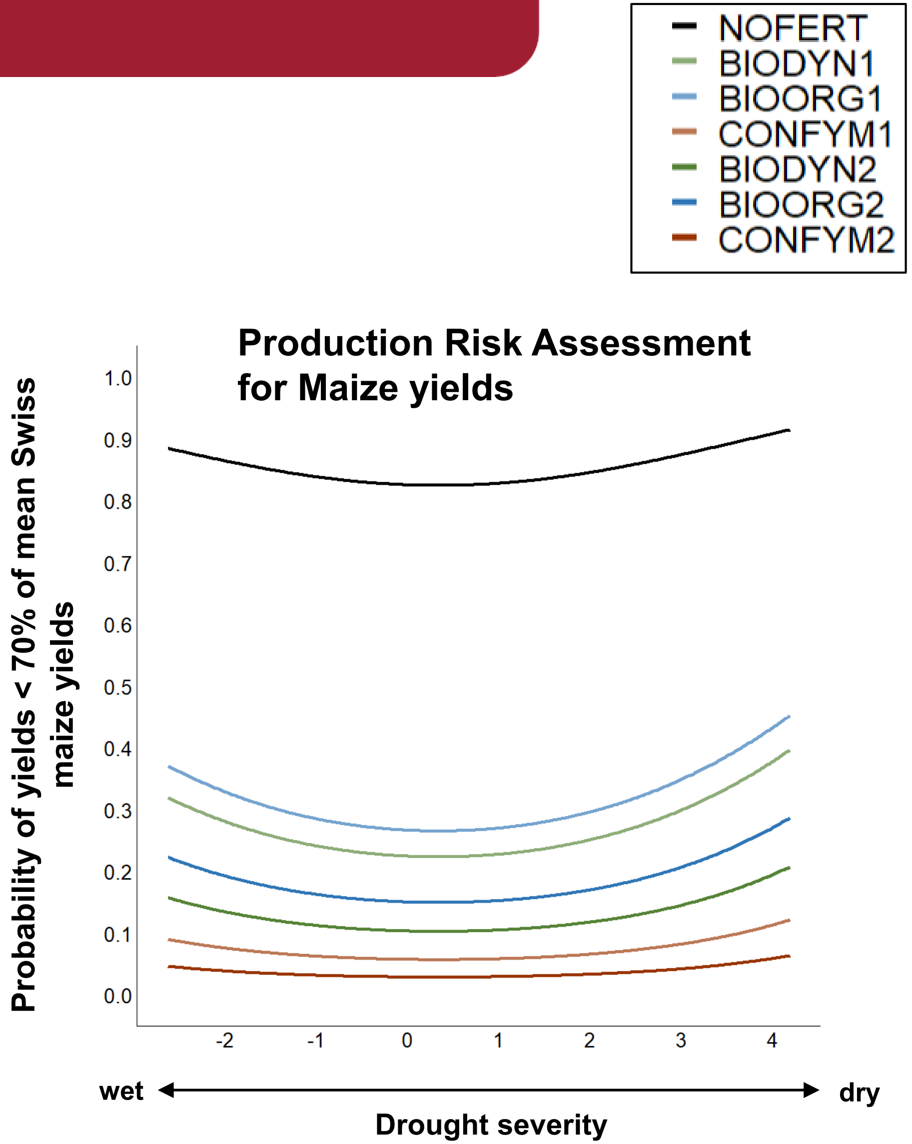
Soil-, management-, and climate-related drivers of yield stability in organic and conventional framing systems

Klaus A. Jarosch et al.

Which **farming systems** are more/less **resilient** against **climate extremes**?

The **DOK-experiment** (CH) compares conventional (CONFYM), organic (BIOORG) and bio-dynamic (BIODYN) farming systems since 45 years. We evaluated the effect of climate variations on yields of Maize, Winter Wheat, Potatoes and Soybean.

Conventional farming systems have **more stable yields** during **adverse climate conditions.**



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Agroscope

EJP SOIL ARTEMIS

Simon Hofer, Juliane Hirte, Mayer Jochen, Klaus A. Jarosch
klaus.jarosch@agroscope.admin.ch

A REVIEW ON MICROPLASTICS IN EUROPEAN SOIL: OCCURRENCE, SOURCES, ANALYTICAL METHODS, AND POTENTIAL ECOLOGICAL RISK

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Lithuanian Research Centre for Agriculture and Forestry, Instituto al. 1, Akademija, 58344 Lithuania

skaiste.dreskiniene@lammc.lt

There is a lack of information on the regional release of microplastics to agricultural soils, no clear classification of factors affecting the concentration of microplastics in soil, and no observations of possible effects on the environment in the target regions.

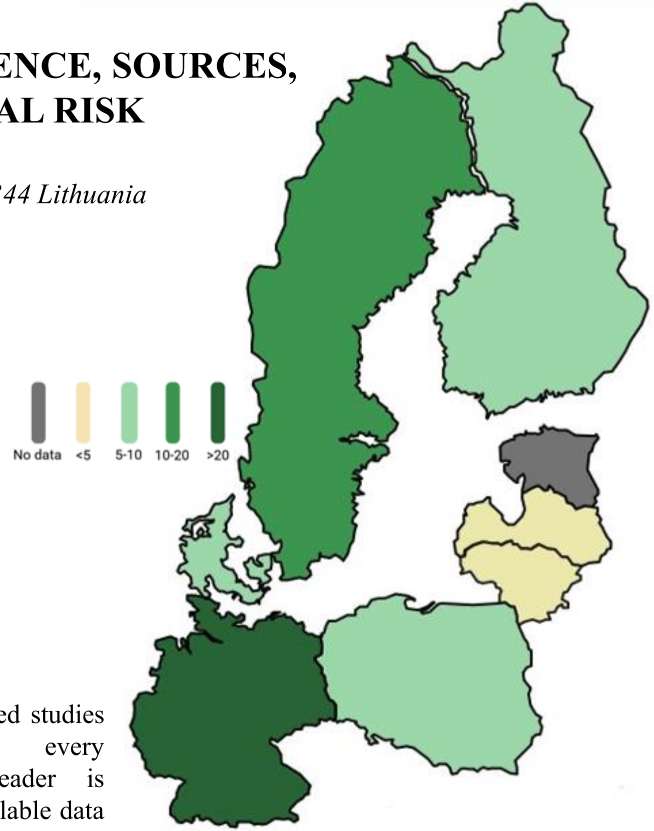


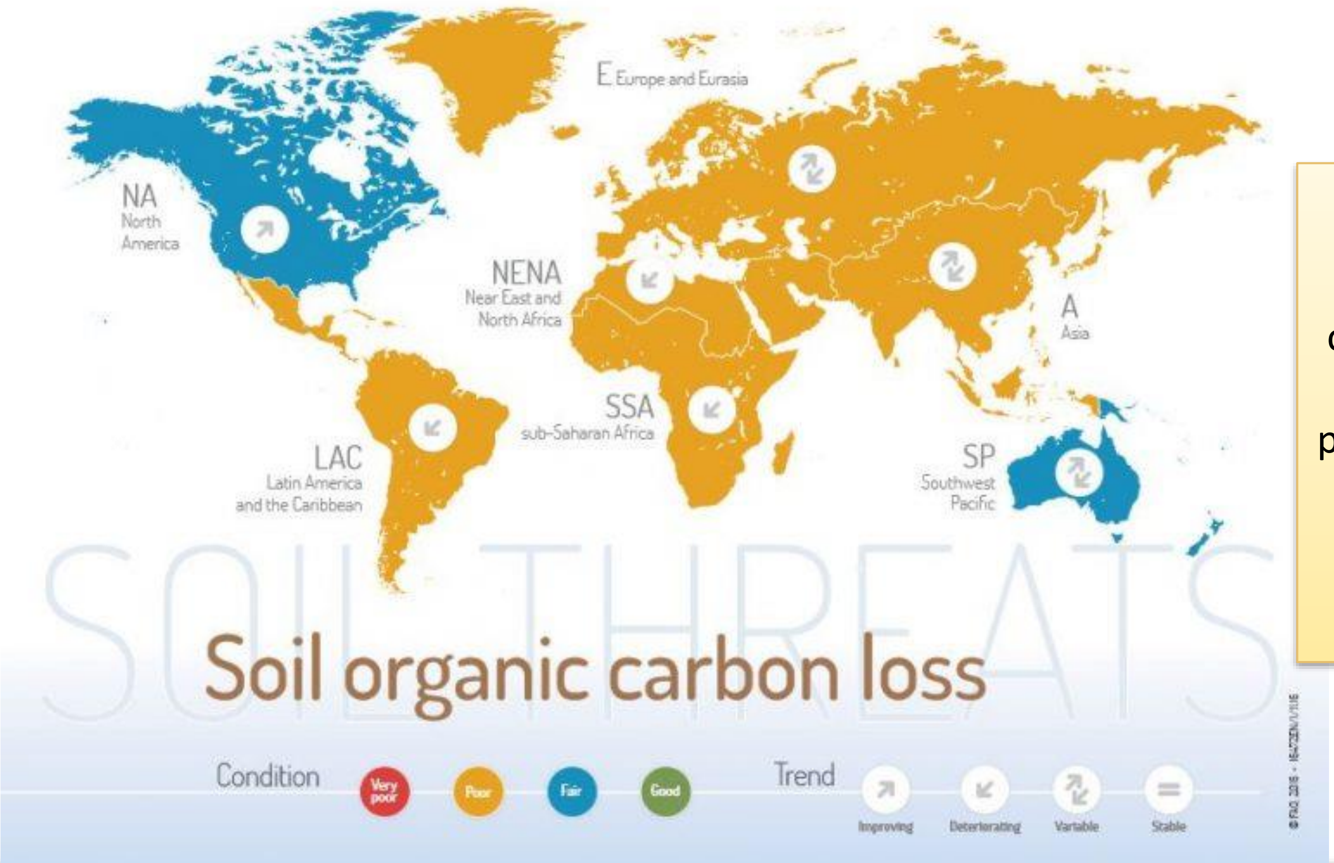
Figure 1. Published studies amount in every country. The leader is Germany. No available data was found about research done in Estonia.

Effect of anthropogenic soil management for increasing soil organic carbon status in Lithuanian acid soil

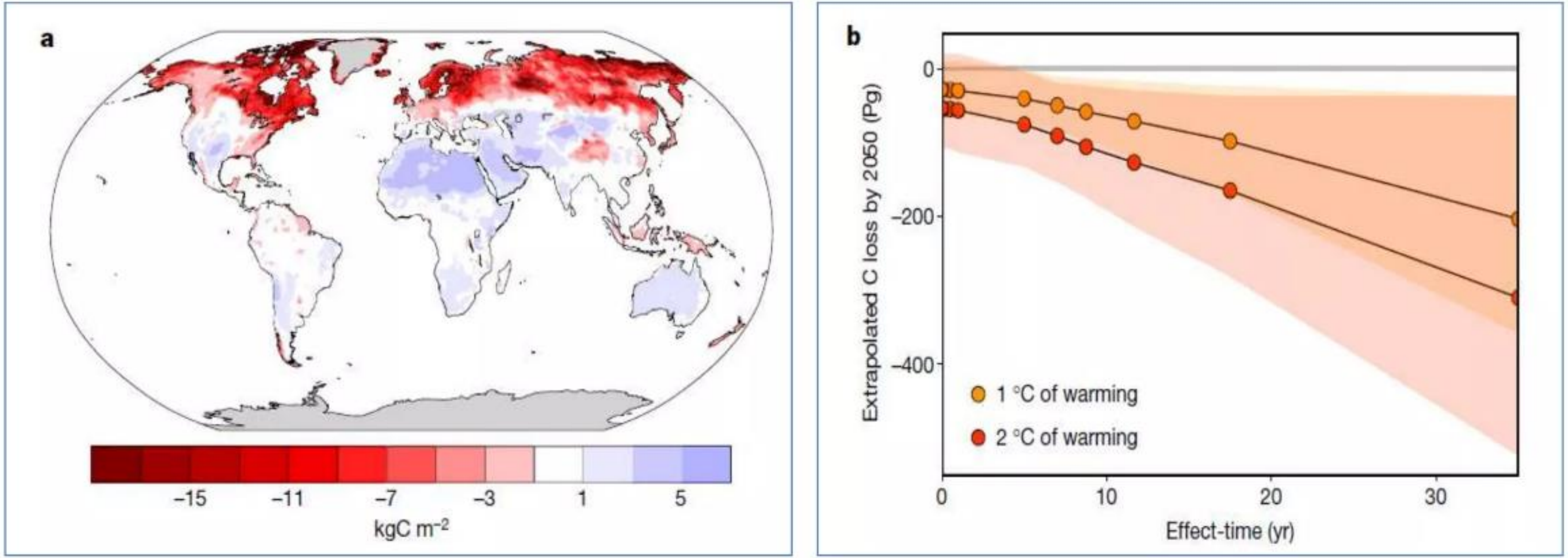
Ieva Mockevičienė, Monika Vilkienė, Kristina Amalevičiūtė - Volungė

Lithuanian Research Centre for Agriculture and Forestry

our Soils under threat
2015 International Year of Soils
fao.org/soils-2015
#IYS2015
Deforestation
Population growth
Urban expansion
Pollution and waste disposal
Climate change
Unsustainable soil management practices
Drivers of soil degradation
Biodiversity loss
Salinization and sodification
Nutrient imbalance
Compaction
Sealing
Pollution
Acidification
Erosion
Loss of organic carbon
Types of soil degradation
Water scarcity
Food and nutrition insecurity
Rapid climate change
Poverty and social insecurity
Migration
Reduction of ecosystem services
Consequences of soil degradation
Solution: sustainable soil management
Inclusive soil governance
Increase investment in sustainable soil management
Advocacy/ awareness raising
Establish soil information systems
Develop capacities and strengthen extension on soils
Stop soil degradation
Restore/ rehabilitate degraded soils
Implement land use planning
Analyse/ assess soil condition
Increase soil organic matter content
Keep soil surface covered
Use nutrients wisely
Minimum tillage
Crop rotation
Reduce erosion
Appropriate waste disposal
Waste water treatment
Food and Agriculture Organization of the United Nations
with the support of



Decline of C stock affects soil fertility and climate change regulation capacity. The global loss of the SOC pool since 1850 is estimated at about 66 billion tones, mainly caused by land use change.



A) Projected changes in C stocks until 2050.
B) A global loss of C is projected for a 1° to 2°C rise in soil surface temperatures by 2050. (Crowther et al., 2017)

This study aimed to achieve following objectives: 1) analyse the alterations in SOC caused by the various management techniques in Lithuania's acid soil; (2) estimate and compare the effect size of different agro-techniques on SOC sequestration and other chemical parameters in acid soil; (3) determine an appropriate management practice benefiting for SOC sequestration and improving soil quality.

Methodology

- Comparison of data from three long-term studies, carried out in the western region of Lithuania, on physicochemical indicators served as the basis for the study. Over the past 24 years (1999-2023), changes in the properties of the soil have been identified.
- The soil of the experimental site is *Bathygleyic Dystric Glossic Retisol* (texture – moraine loam (clay 13–15%)).

Methodology –selected measures

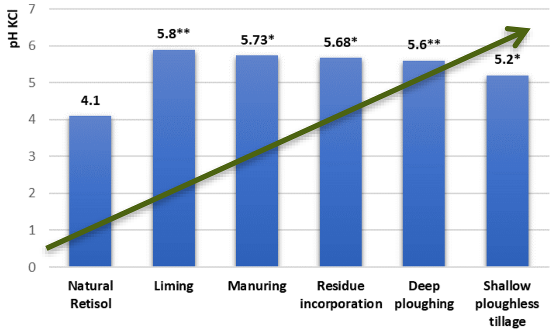
Soil liming

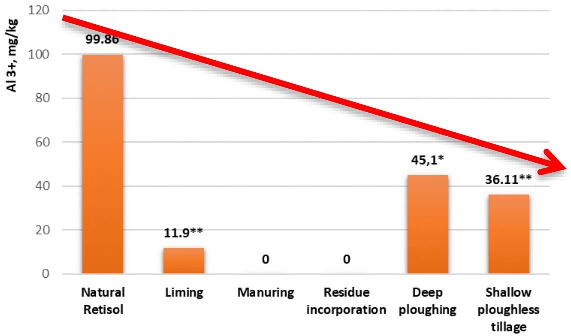
Soil manuring

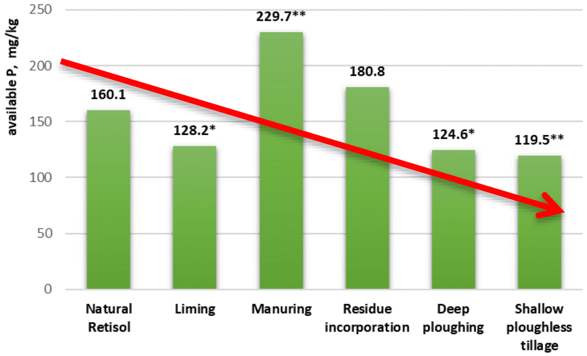
Residue maitenance

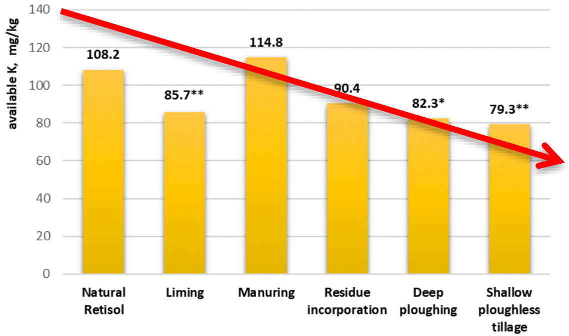
Soil tillage

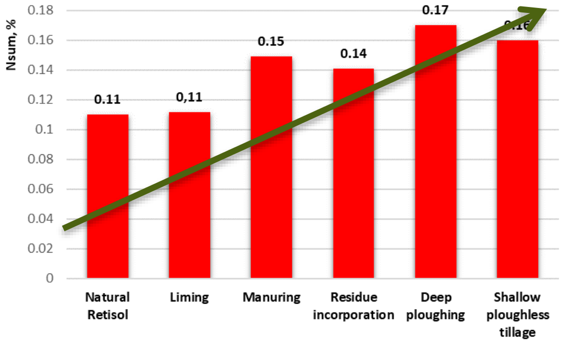
Comparison of main soil properties under different land management



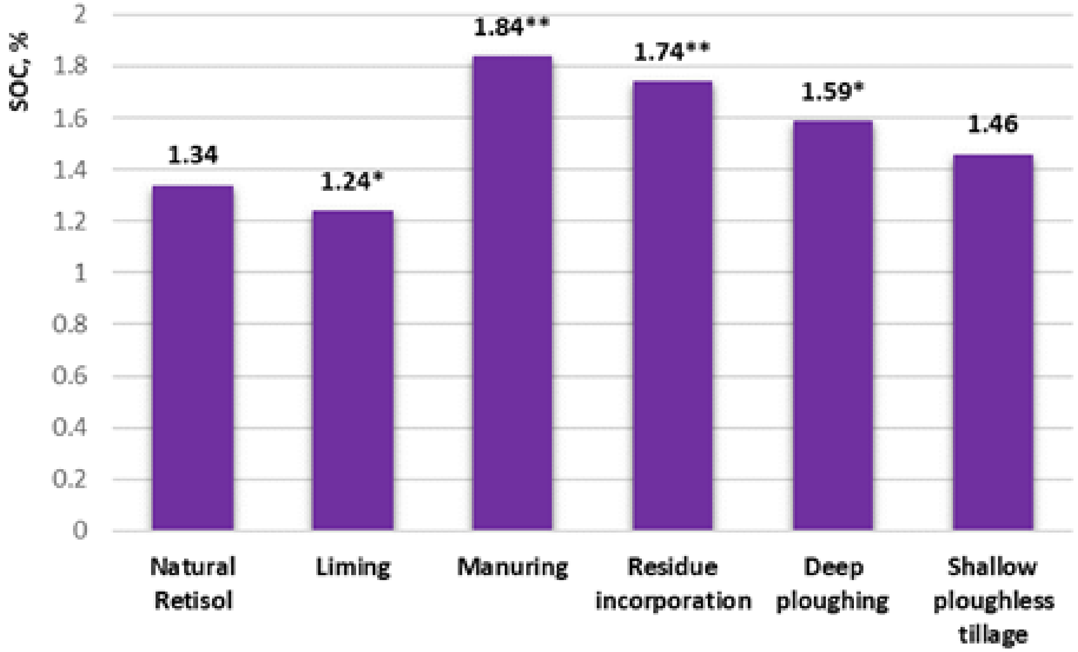




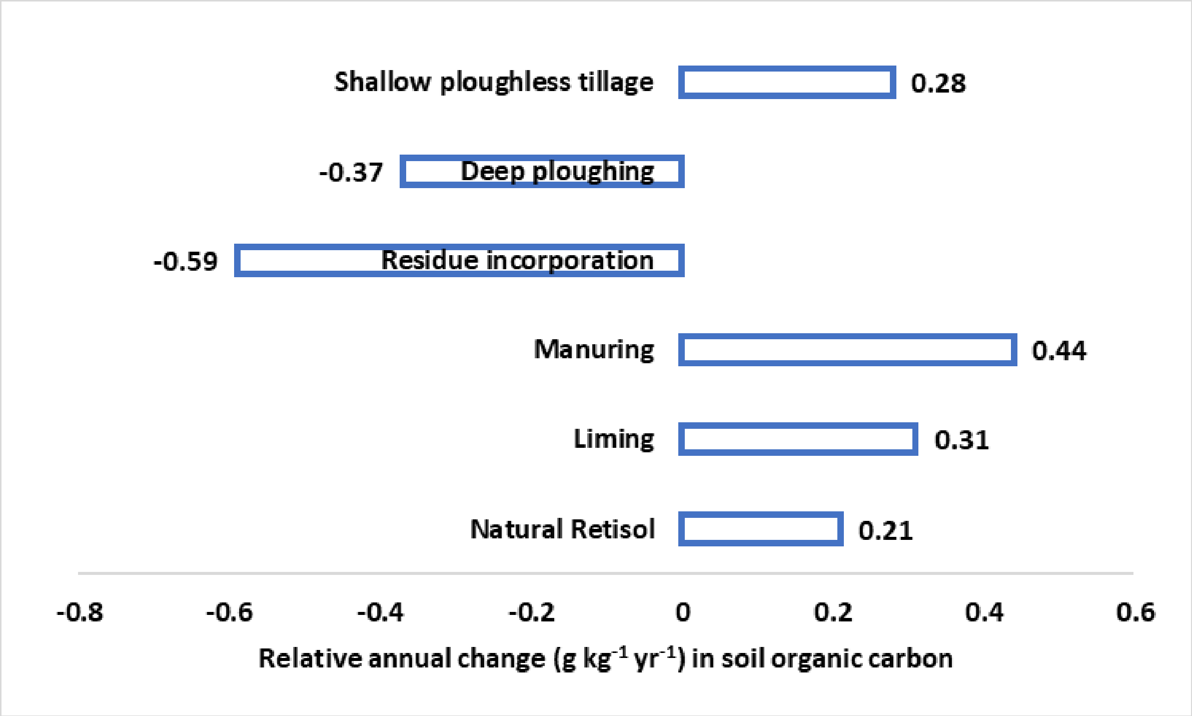


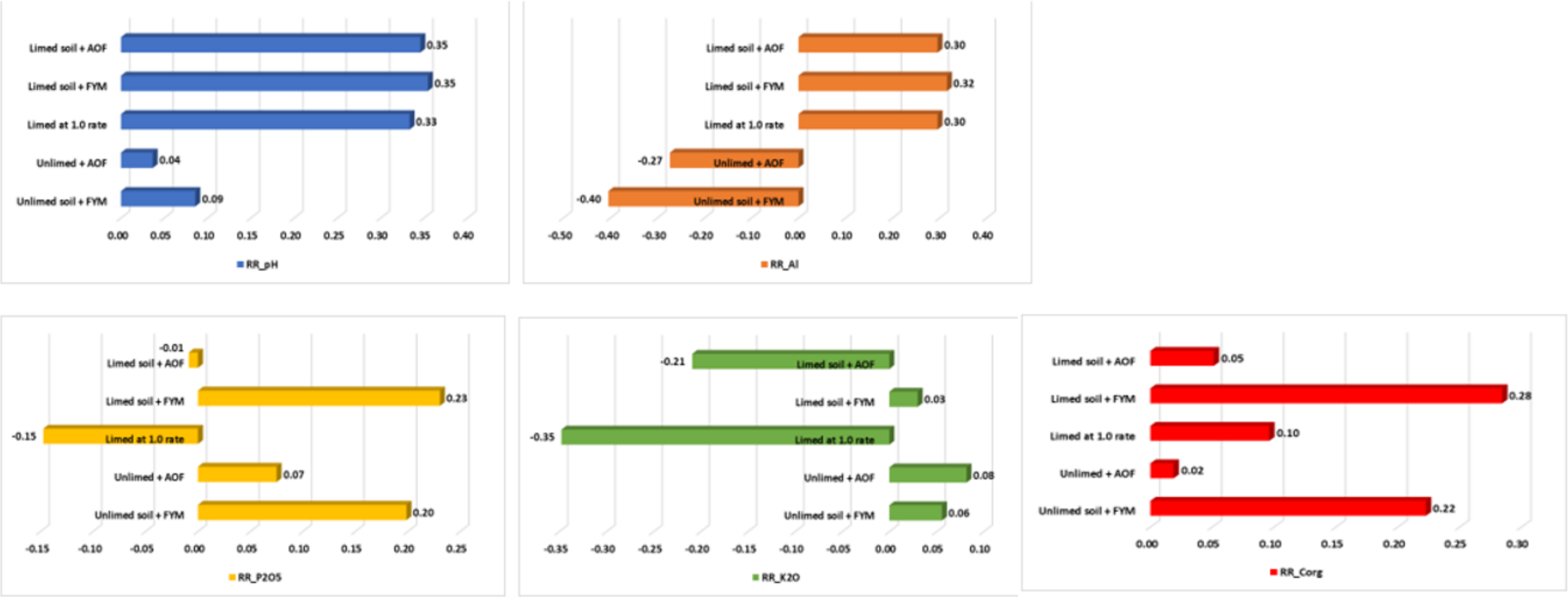


Changes in SOC content under different land management



Evaluation of carbon transformation processes as influenced by different land management





Response of acid soil properties to different fertilization types, where Al – mobile aluminum, P_2O_5 – plant available phosphorus; K_2O – plant available potassium; FYM – farmyard manure; AOF – alternative organic fertilizers. RR > 0 represents a positive effect, and RR < 0 represents a negative effect of applied agro-technique.

Effect of different fertilization on percent change of the mean effect size (RR) in acid soil

Treatments	Unlimed soil + FYM	Unlimed + AOF	Limed at 1.0 rate	Limed soil + FYM	Limed soil + AOF
pH_{KCl}	8.96	3.73	39.55	42.59	41.29
Al^{3+}	-33.24	-23.92	-44.42	-47.13	-44.42
P_2O_4	21.98	7.79	-13.71	25.93	-0.88
K_2O	5.75	8.53	-29.35	3.05	-18.85
N_{total}	17.05	9.30	6.20	15.50	9.30
C_{org}	24.94	1.89	10.09	32.89	5.26

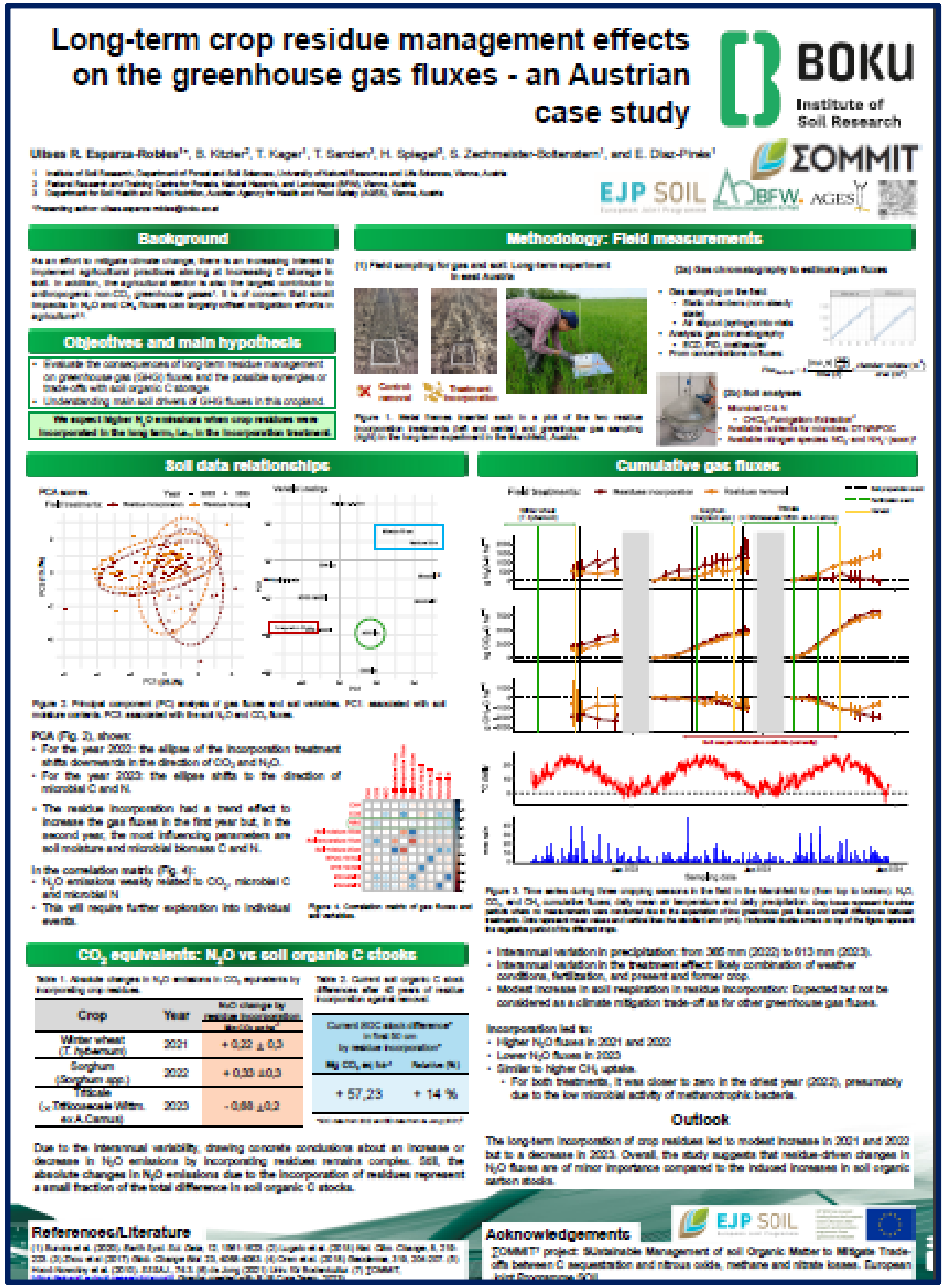
SUMMARIZING:

- The analysis of soil organic carbon sequestration indices of studied agricultural practices ranked as: **manuring > residue management > reduced tillage > liming (in the direction of carbon transformation and sequestration)**
- The combination of liming and organic fertilizers was a relatively effective measure to improve soil quality.
- In general, conducted analysis provide an in-depth quantitative assessment of the effects of management practices on SOC content and other parameters, which could assist in further understanding the feedback of SOC to agricultural management practices and offer evidence in support of the preservation of the acid soil.

Thank you for your attention...

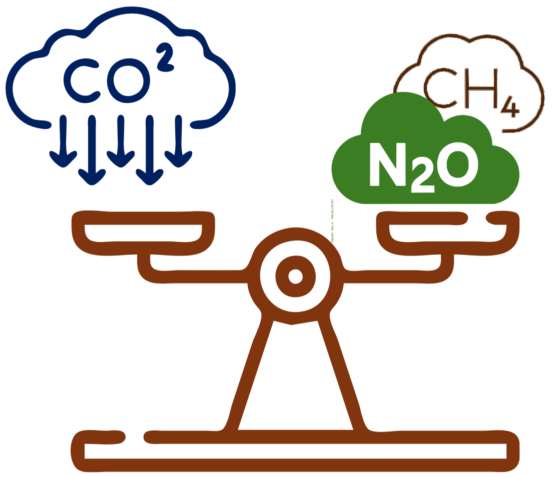
Long-term crop residue management effects on the greenhouse gas fluxes - an Austrian case study

Ulises Ramon Esparza-Robles
et al.



Objectives

- To **quantify** the impact of **residue management** on current GHG* fluxes after long-term management
- To **compare** the GHG fluxes with **SOC stocks**



Hypothesis

- We expect **higher GHG emissions** from the long-term **crop residue incorporation**

Control: removal

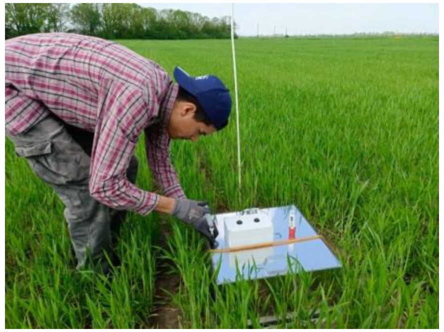
Treatment: incorporation

*GHG: Greenhouse gas

Cumulative emissons

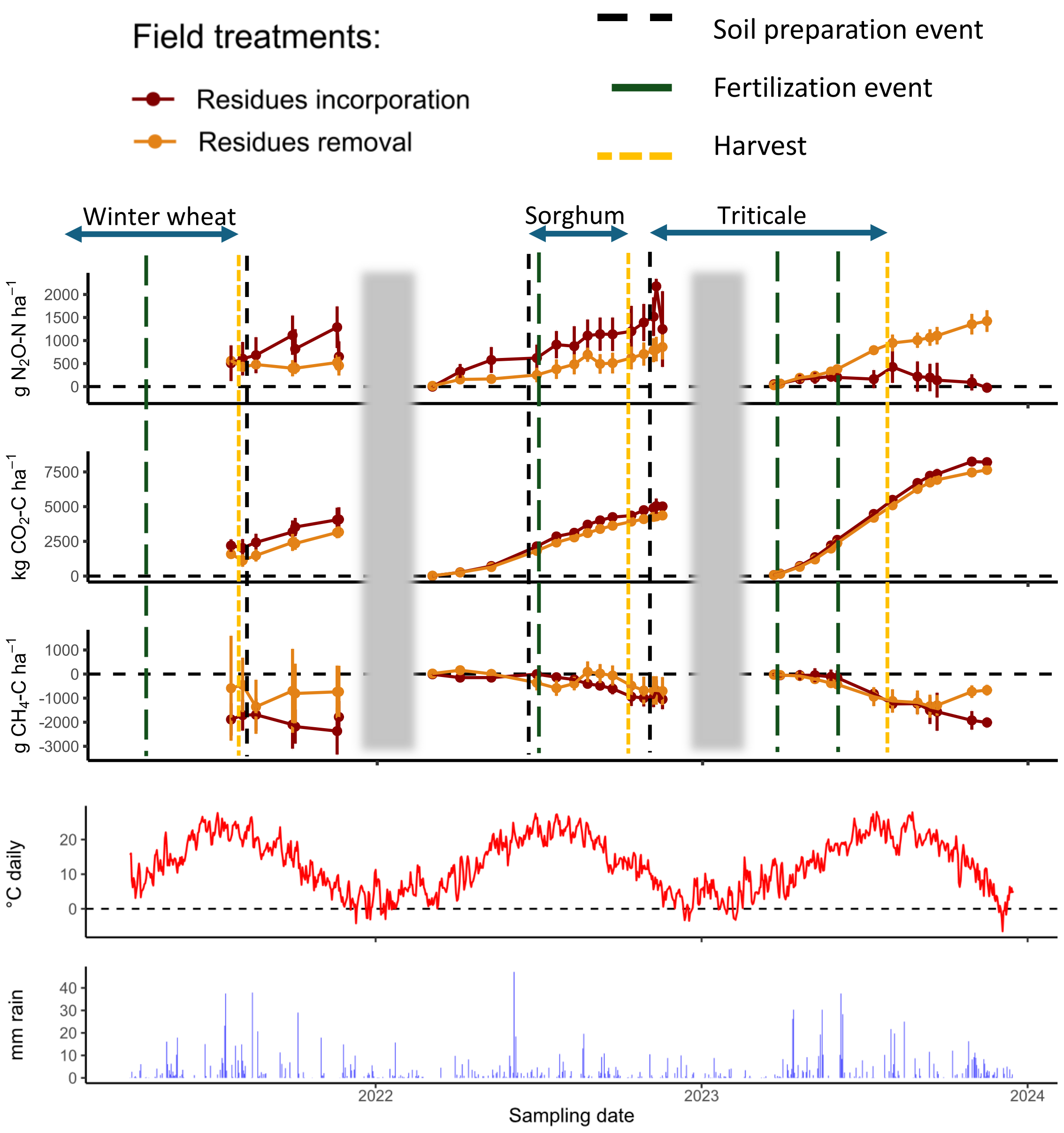
Gas sampling in 39 events

- Gas chromatography
- Static chambers



Soil sampling

- soil moisture, temperature,
- extractable C (NPOC) and N (DTN)
- microbial C and N



N_2O vs SOC stocks

Table 1. Absolute differences in N_2O emissions in CO_2 equivalents **by incorporating crop residues**.

Crop	**Year**	**N_2O change by residue incorporation**
		Mg CO_2 eq ha^{-1}
Winter wheat (*T. hybernum*)	2021	?
Sorghum (*Sorghum spp.*)	2022	?
Triticale (×*Triticosecale* Wittm. ex A.Camus)	2023	?

Table 2. Current soil organic C stock differences **after 40 years of residue incorporation** against removal.

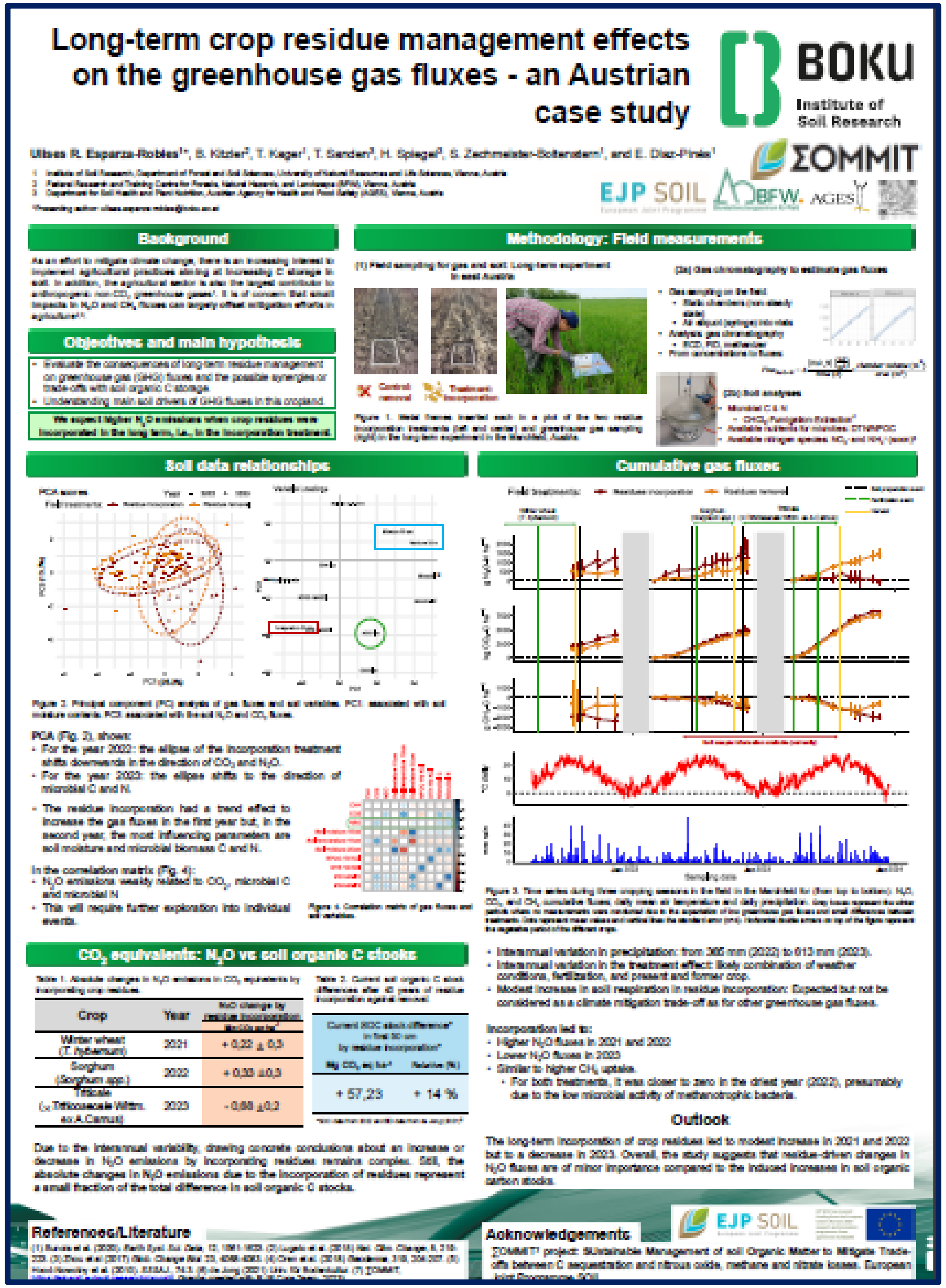
Current SOC stock difference in first 50 cm by residue incorporation	
Mg CO_2 eq ha^{-1}	Relative (%)
?	?

Thanks for your attention and…

See you at the poster session!

BOKU UNIVERSITY

EJP SOIL ΣOMMIT



Annual Science days 2024

Effects of different agriculture practices on ecosystem services in cereal fields worldwide

A meta-analysis to investigate the effects of conventional, organic and sustainable agriculture management in driving multiple ecosystem services from nutrient cycling to carbon stocks provides by cereals crop.

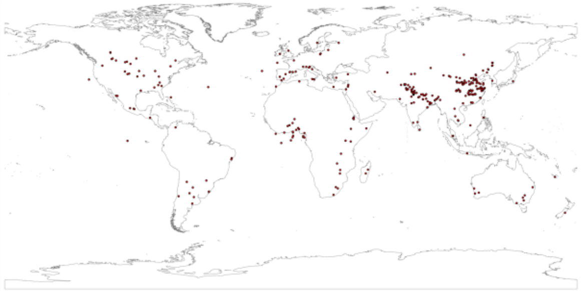


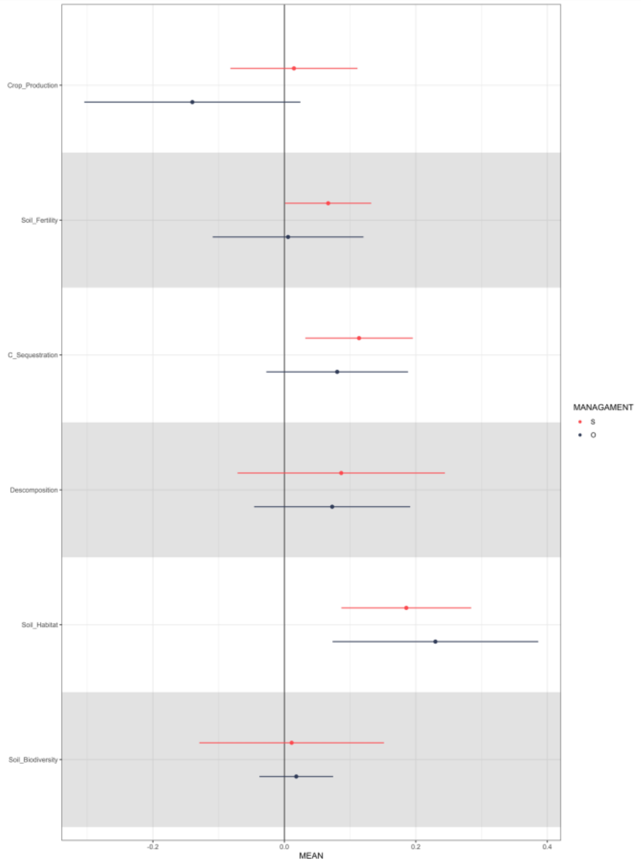
Fig. 1 Different experiments at global scale.

Revised 450 papers belong to SCI. Grouping of the different treatments assayed on the field experiments (Fig. 1). i) **Conventional**: traditional agriculture practice (tillage); ii) **Organic (O)**: organic management (no-tillage). iii) **Sustainable (S)**: optimized use of fertilizer (reduced-tillage)

Several parameter analyzed grouped in:

Crop production: yield
Soil fertility: organic+mineral+available nutrients
C sequestration: SOM+TOC+DOC+C seq rate.
Decomposition: mineralization+enzyme activities+ respiration + metabolic quotient+SeqRate.
Soil habitat: fungal and bacterial abundance+earthworms+microfauna+microbial biomass
Soil biodiversity: diferent biodiversity soil index

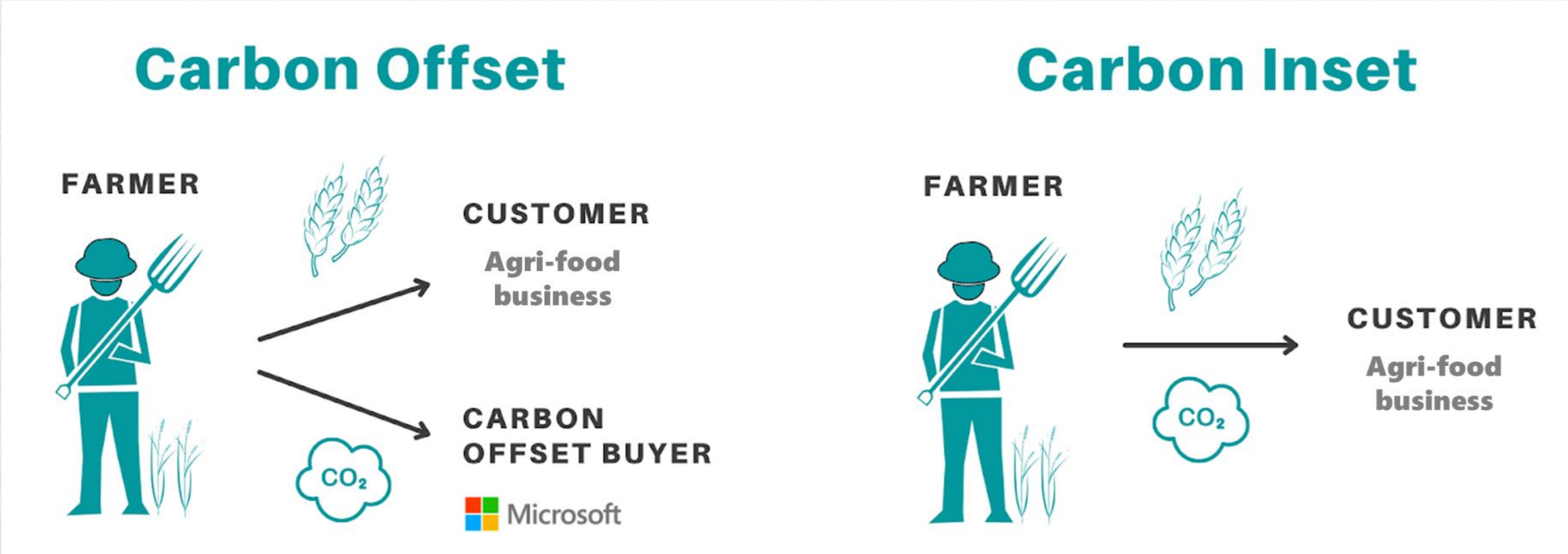
Fig. 2 Effect of different agricultural management on different ecosystem services

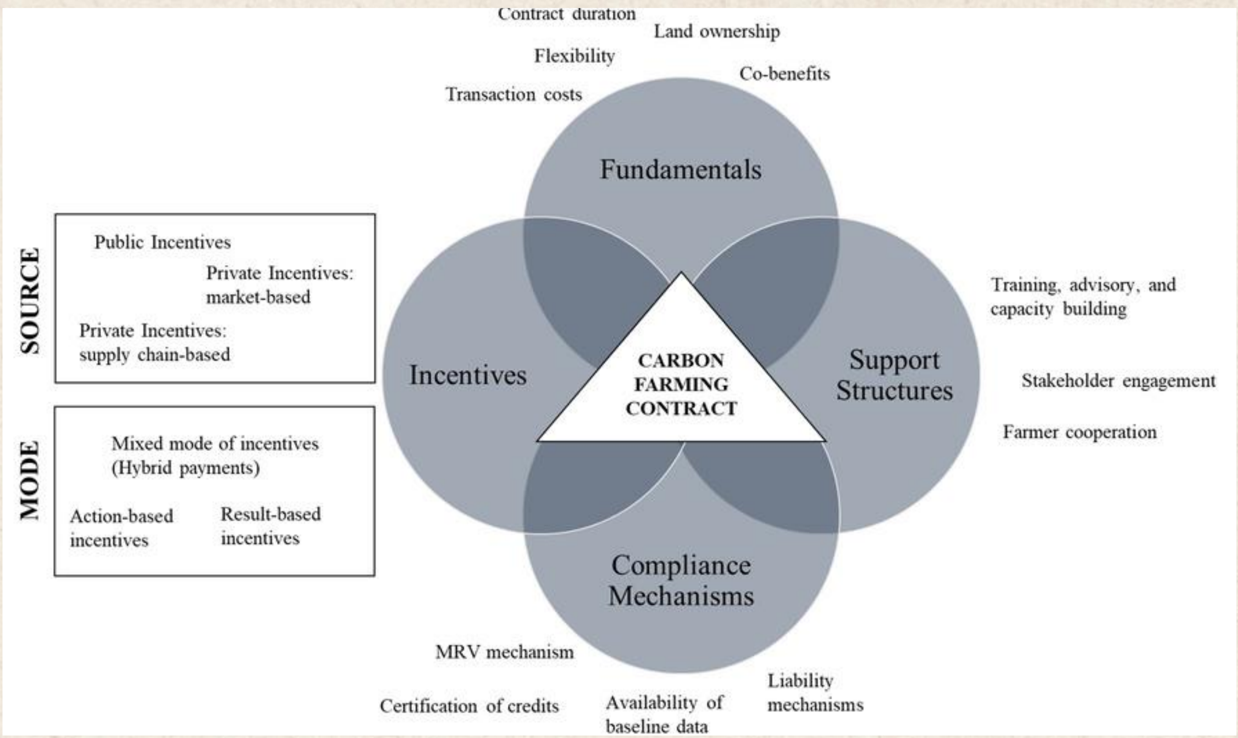


Sustainable agriculture has a significant positive effect on soil fertility, habitat and carbon sequestration, while organic agriculture only shows a significant positive effect on soil habitat compared to conservation agriculture (Fig. 2). In contrast, no significant effect of these practices on production is observed, indicating that both forms of cultivation maintain agricultural production while promoting key ecosystem services.

Presented by: Nidhi Raina

Carbon Farming Incentive Mechanisms





WHY?

Increased interest in carbon farming has been catalyzed by the development of financial instruments that can incentivize carbon emission reductions.

HOW?

Testing contracts and their design attributes against challenges to carbon farming schemes and understanding experts perspective of carbon farming current and future perspectives can not only incentivize farmers but also lead to maximum environmental benefits.

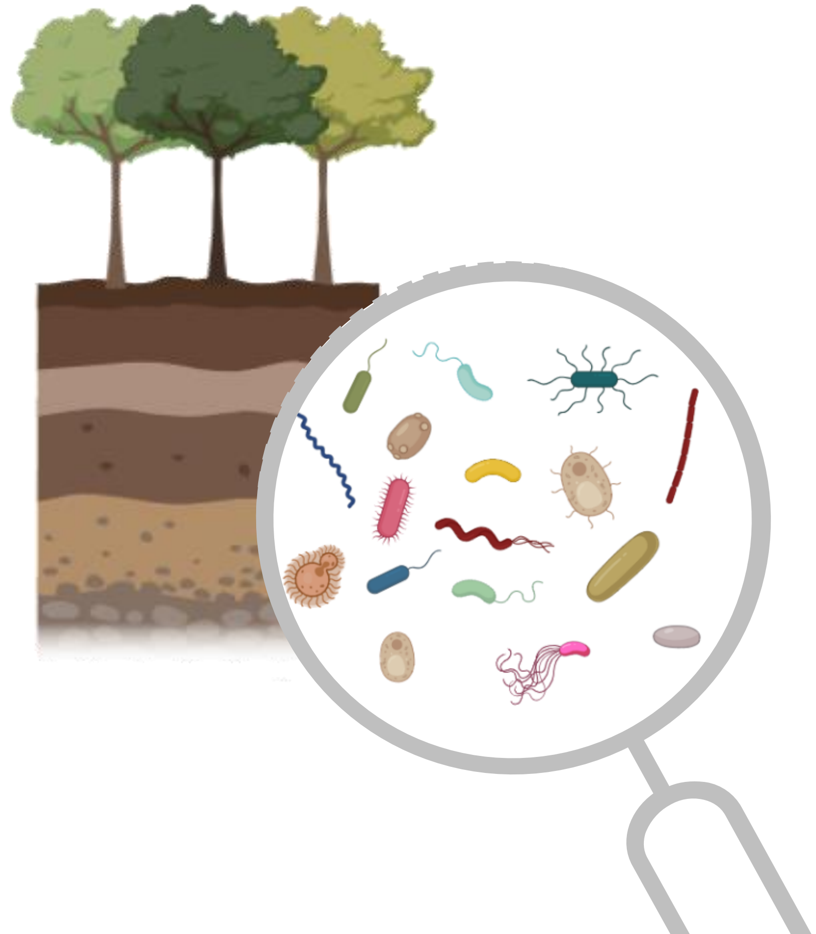
EFFICIENT CONTRACT?

A **mix** of action-based and results-based payment mechanism that is funded by **private players**, **monitored stringently** for outcomes, supported through **training and advisory of farmers**, and focuses on **co-benefits** is a winner!

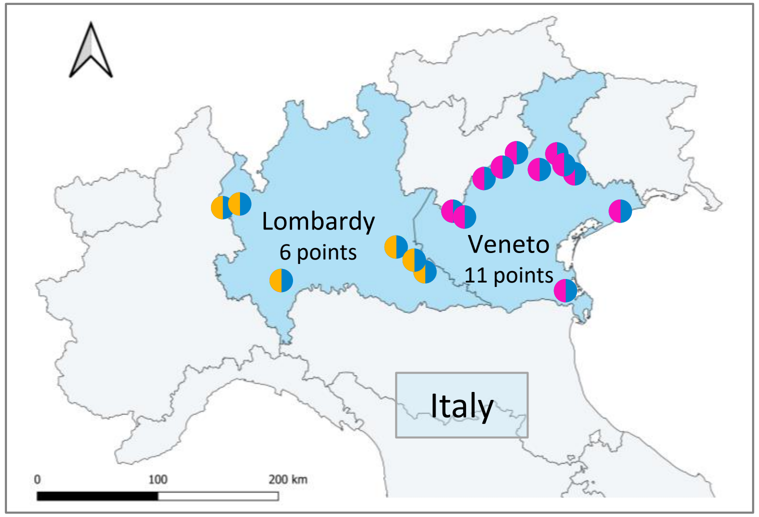
Towards soil health assessment establishing a unified framework for monitoring soil microbial diversity across Europe

Del Duca Sara, Vitali Francesco, Tondini Elena, Lumini Erica, Garlato Adriano, Vinci Ialina,
Brenna Stefano, Tagliaferri Elisa, Orgiazzi Alberto, Jones Arwyn, Fantappiè Maria, Mocali Stefano

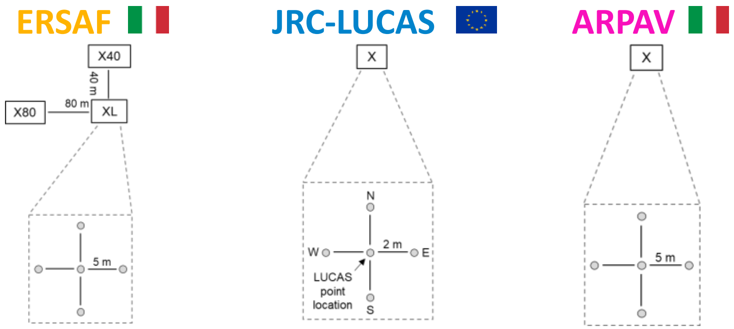
crea Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria
EJP SOIL European Joint Programme
WP6

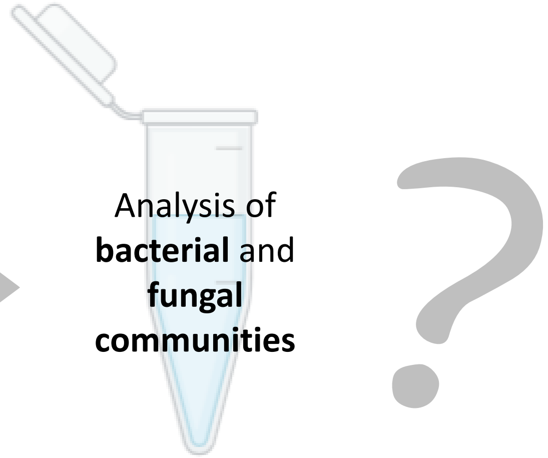


Soil sampling points



Soil sampling strategies



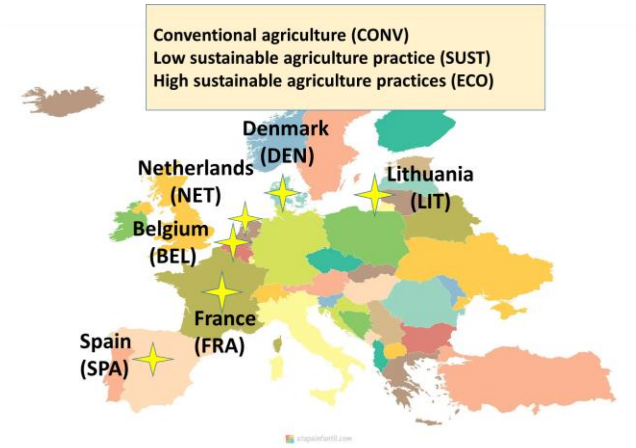


Analysis of **bacterial** and **fungal** **communities**

Analysis of soil microbial community associated with cereal crop under sustainable managements in different European countries

OBJECTIVE

Compare the dominant and rare soil bacteria across different regions of Europe under cereal crops, applying different ecological scales in terms of eco-efficiency.



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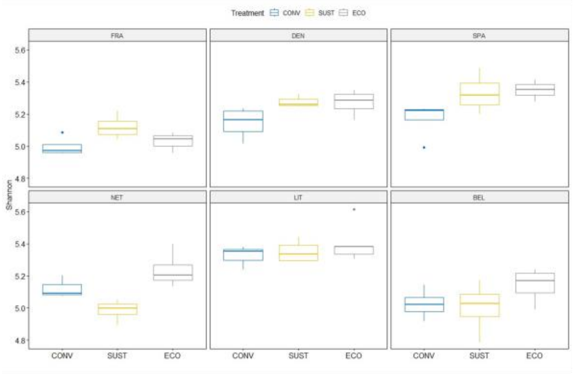
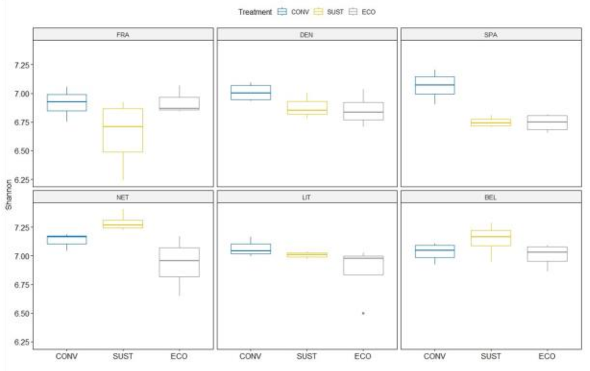
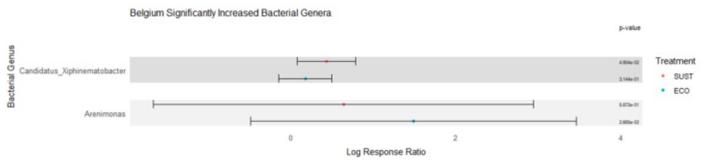


RARE

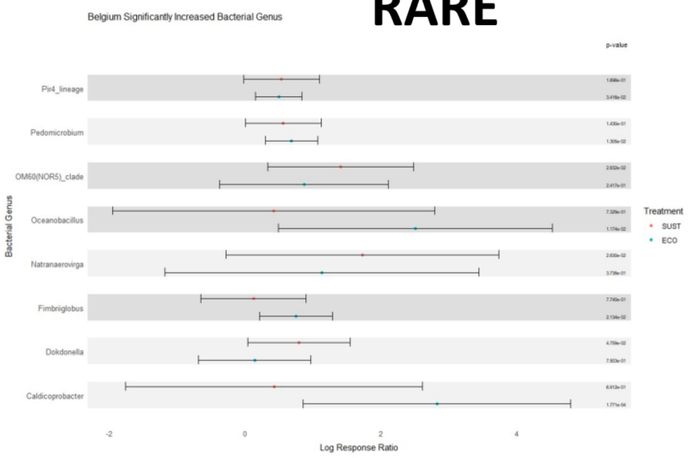


Higher alpha diversities were observed in the relatively rare communities compared to majority communities. This is consistent with Jiao et al., 2017 where rare species contributed the greatest alpha diversity.

DOMINANT



RARE



The increase of different genus in BEL by different sustainable agriculture management showed that the number of genus that increase is higher in the rare bacteria than in dominant, considering that although these genes are lower abundant they are more sensitive to changes than the majority.

EXPLORING DIVERSITY, ANTAGONISTIC PROPERTIES AND PHOSPHATASE ACTIVITY OF ENDOPHYTIC BACTERIA IN *ARTEMISIA* SPP.

LAMMC
LITHUANIAN RESEARCH CENTRE FOR AGRICULTURE AND FORESTRY

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EJP SOIL

Introduction:

Endophytic bacteria, which live within plant tissues without causing harm, provide promising solutions for sustainable agriculture. These bacteria can inhibit plant diseases, increase nutrient availability, and improve overall plant health, making them beneficial in integrated pest management and organic agricultural systems. *Artemisia* species, which are known for their medicinal virtues and ability to withstand a wide range of environmental conditions, host a variety of endophytic bacteria with potential agricultural applications. The purpose of this work is to investigate the diversity, antagonistic characteristics, and phosphatase activity of endophytic bacteria isolated from four *Artemisia* spp. tissues, with the goal of contributing to our understanding of plant-microbe interactions and their implications for sustainable agriculture.

Materials and Methods:

➢ Plant Sample Collection

Figure1. *Artemisia* spp. geographical collection place (Kaunas, Kėdainiai, Šiauliai), June 2021.

➢ Isolation endophytic bacteria

Figure 2. Four distinct species of Artemisia plants and an example of bacterial strains exhibiting different colony shapes, colors, and margins.

➢ Molecular identification isolated endophytic bacteria by 16srDNA

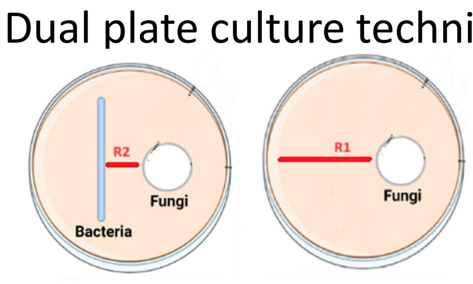
- DNA extraction from bacteria strains (CTAB DNA extraction protocol)
- Taxonomic identification (The bacterial 16S rDNA was amplified by PCR by universal primer pair 27F 5′-(AGAGTTTGATCMTGGCTCAG)- 3′, and 1387R 5′-(GGGCGGWGTGTACAAG GC)-3′.

➢ Pathogenic fungi isolation

Pathogenic fungi were obtained from diseased pea roots. Morphological characteristics and molecular identification of the ITS region by ITS3f (5′-GCATCGATGAAGAACGCAGC-3′) and ITS4r (5′-TCCTCCGCTTATTGATATGC-3′) primers were employed for pathogenic fungi.

➢ Inhibition of fungal growth by isolated strains

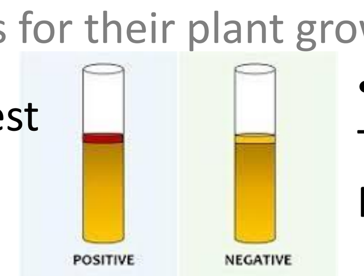
Dual plate culture technique on Potato Dextrose Agar (PDA) medium was used.



$(R1-R2)/R1 \times 100$
R1: Radial growth pathogen in the absence bacteria
R2:Radial growth pathogen in the present bacteria

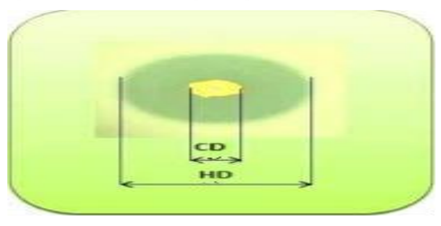
➢ Evaluation of isolates for their plant growth promotion potential

- Indole production test



- Nitrogen fixation
The assessment of nitrogen fixation utilizing Ashby's N-free medium (NFM).

- Phosphate Solubilization activity of endophytic bacteria Based on Pikovskaya methods
SI=(CD+HD)/CD
CD: colony diameter
HD: halo zone diameter.



➢ Statistical analyses

Analysis of variance (ANOVA), R studio statistical software (4.2.3), Post hoc test (Tukey's HSD) ($P < 0.05$).

Results:

➢ Isolation endophytic bacteria from *Artemisia* spp.

In total, 61 bacterial endophytes displaying distinct morphologies were isolated. Gram staining revealed that 83% of isolates were Gram-positive. Sixty-one percent of the isolates showed positive catalase activity. Based on 16S rDNA gene, most of strains belonged to the phylum *Proteobacteria* and *Firmicutes* (Figure 3).

➢ Inhibitory effect of endophytic bacteria on the growth of *Fusarium* sp.

AR11 (90.83%) and VR24 (88%) strains isolated from the roots of *A. absinthium* and *A. vulgaris*, respectively, showed the highest inhibitory effect on *Fusarium* spp. growth.

➢ Biochemical properties and Effects effect of the endophytic bacteria on pea plant growth

In this study, 20% of the isolated bacteria exhibited positive results in the indole production test, while 44% demonstrated nitrogen fixation potential. Based on these and other test results, 8 isolated strains were selected to study their effects on pea seed germination and growth promotion. The selected isolates are listed in Table 1.

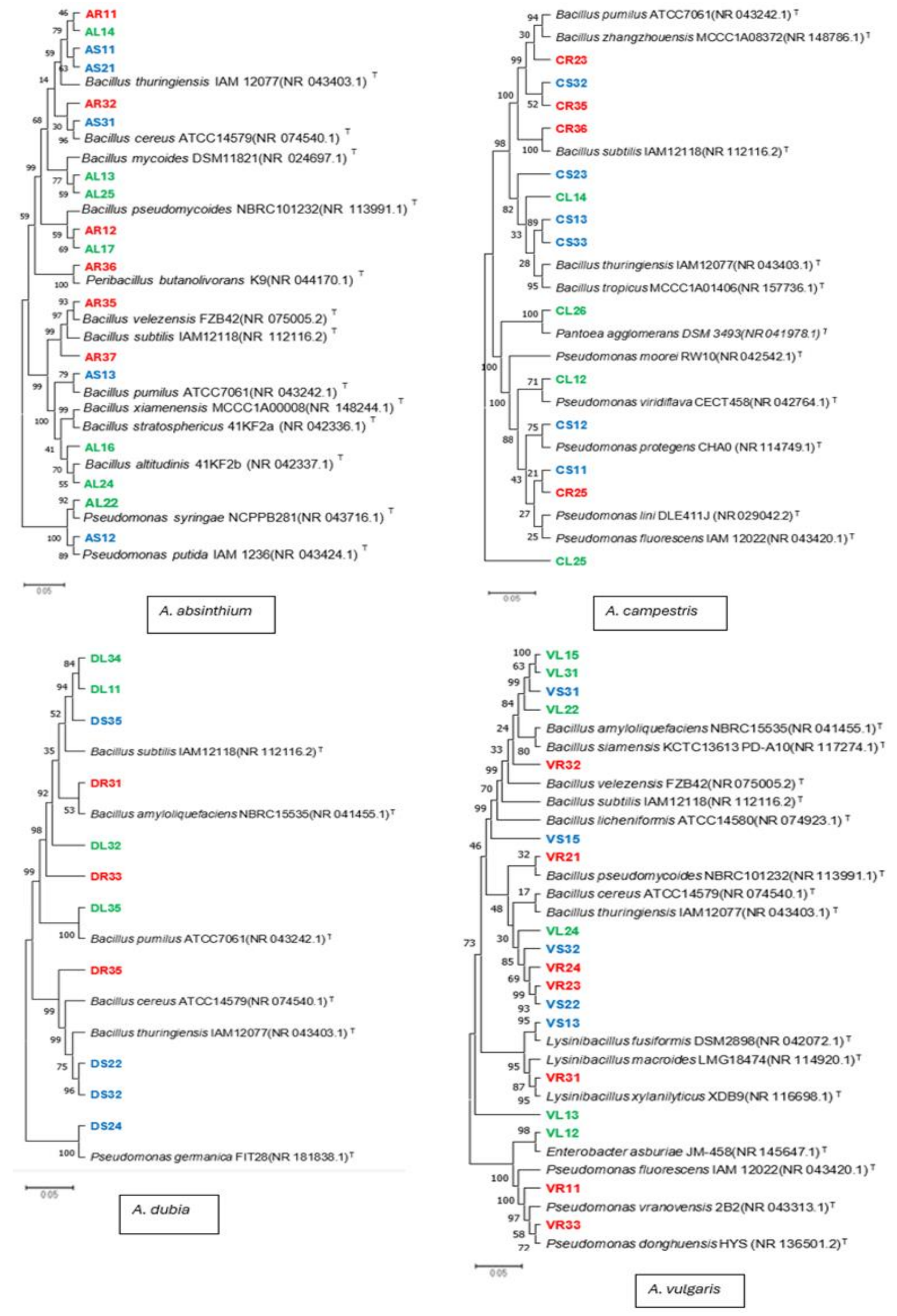


Figure3. Phylogenetic tree reconstruction based on 16S rDNA sequences of isolated endophytic bacteria

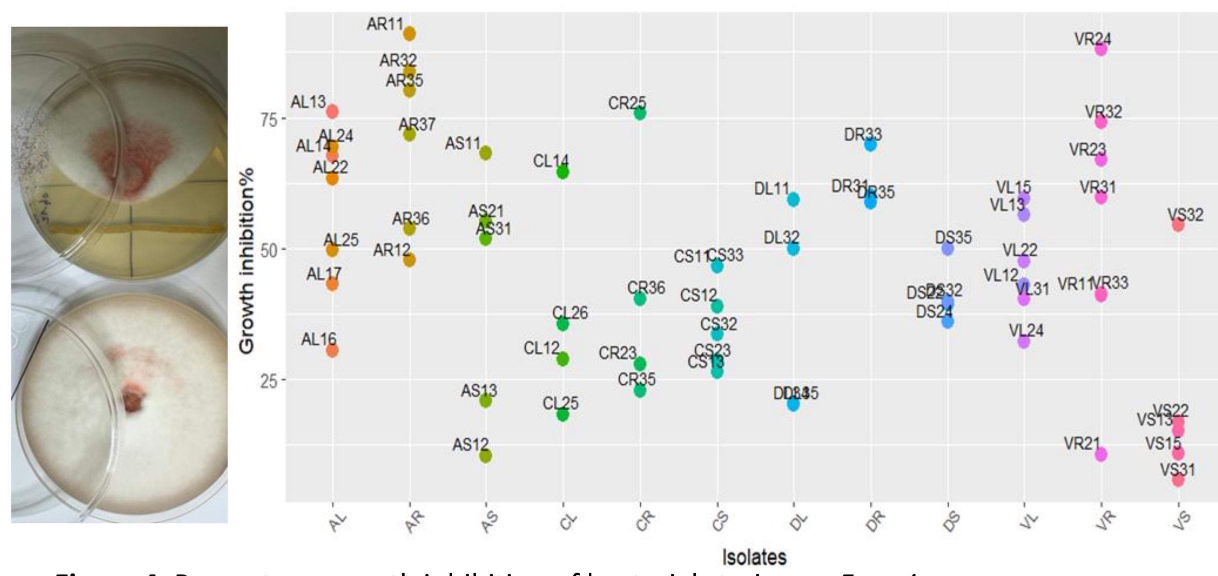


Figure 4. Percentage growth inhibition of bacterial strains on *Fusarium* sp.

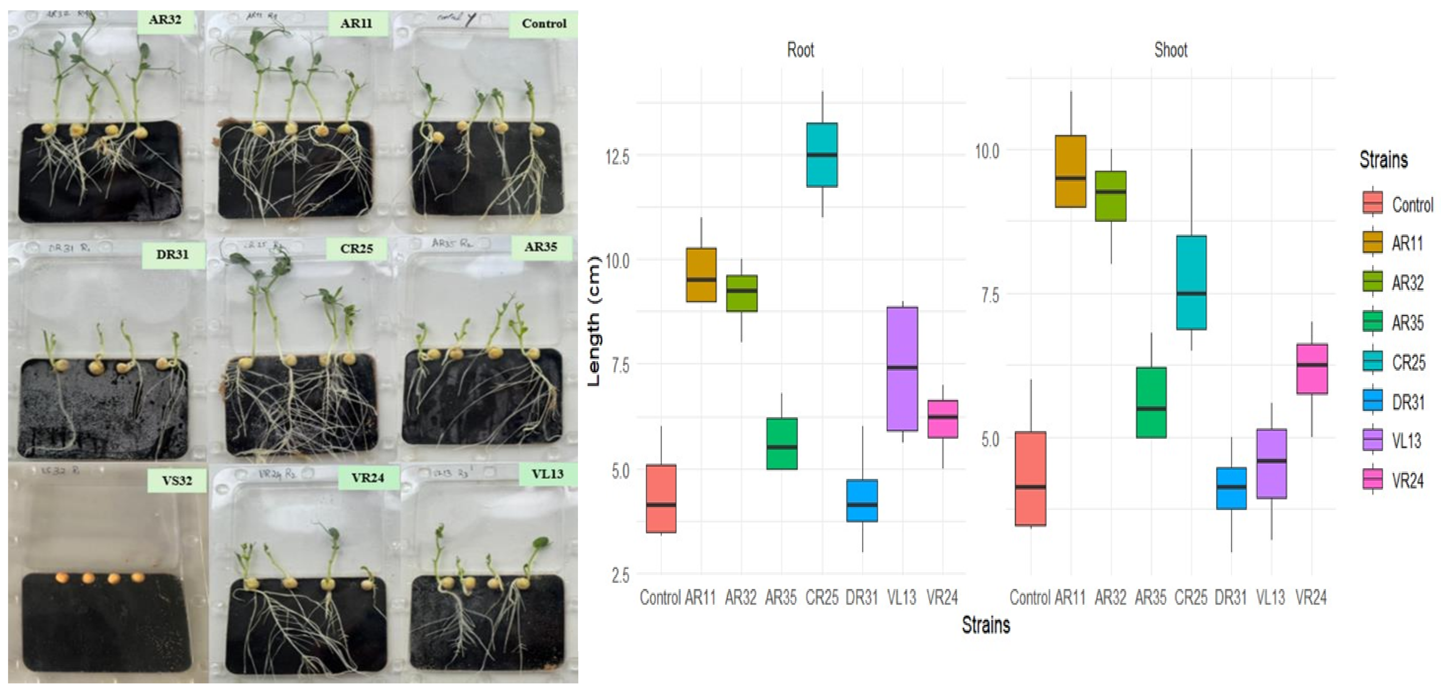


Figure5. Effect of different endophytic bacteria strains on pea plant root and shoot growth after 10 days.

Table 1. Characteristics of selected endophytic bacteria

Isolate	plant species, Parts	related species	Similarity	Growth inhibition	PSI	Indole production test	Nitrogen fixation test
AR11	A. absinthium, Root	Bacillus thuringiensis IAM12077	100%	90.83%	2.93	+	+
AR32	A. absinthium, Root	Bacillus cereus ATCC14579	99.57%	83.8%	2.7	-	+
AR35	A. absinthium, Root	Bacillus velezensis FZB42	100%	80.8%	2.33	-	+
VR24	A. vulgaris, Root	Bacillus thuringiensis IAM12077	99.91%	88%	-	-	+
VL13	A. vulgaris, Leaf	Bacillus cereus ATCC14579	99.98%	56.36%	2.5	-	+
VS32	A. vulgaris, Stem	Bacillus cereus ATCC14579	99.91	54.43%	2.3	-	+
CR25	A. campestris, Root	Pseudomonas fluorescens IAM 12022	100%	75.86%	2.1	+	+
DR31	A. dubia, Root	Bacillus amyloliquefaciens NBRC15535	100%	60%	2.6	-	+

Conclusions

This study underscored the significant pathogen inhibition and plant growth enhancement potential of endophytic bacteria isolated from different *Artemisia* species. The diversity of endophytic bacteria, including strains of *Bacillus* and *Pseudomonas*, highlights their functional importance in promoting plant health. The growth inhibition activity against *Fusarium* c.f. *oxysporum* by strains like *B. thuringiensis*, *B. cereus*, *B. velezensis, B. amyloliquefaciens*, and *Pseudomonas fluorescens* underscores their role as effective biocontrol agents. Furthermore, the biochemical properties, including phosphate solubilization, nitrogen fixation, and indole production, particularly by strain AR11, demonstrate their potential as plant growth-promoting agents. AR11 emerged as a promising candidate for further investigation as a microbial biofertilizer, potentially offering an environmentally friendly alternative to chemical pesticides for crop protection.

Teaching agricultural soil biology to support sustainable crop production under pending climate change conditions by semi-saline irrigation

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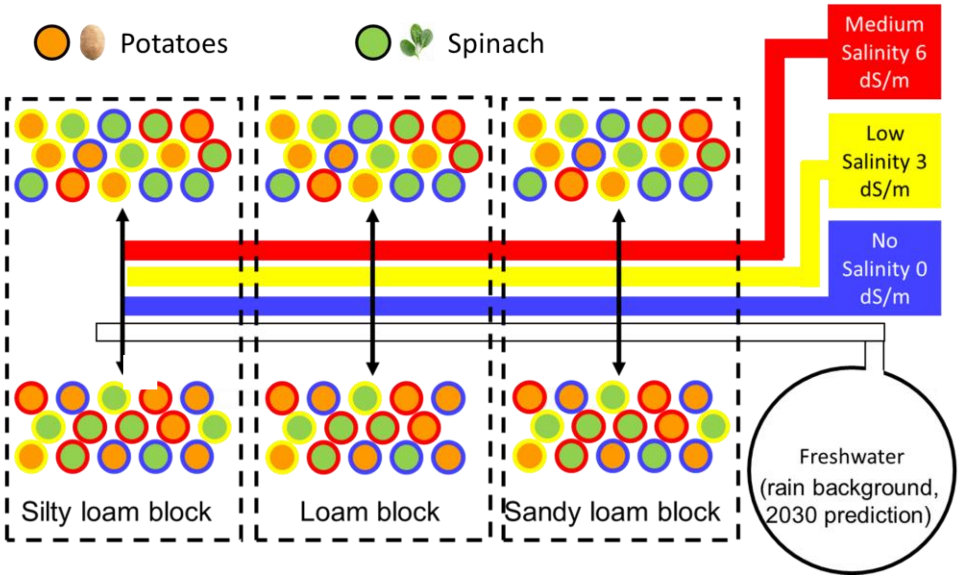
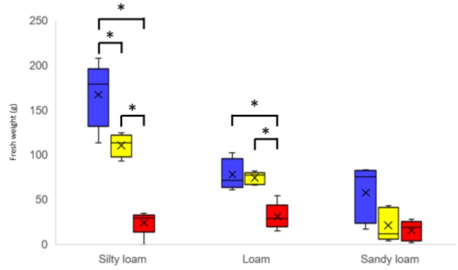
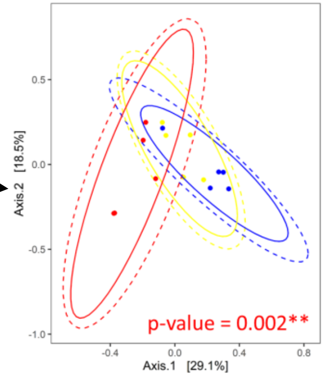
EJP SOIL European Joint Programme; University of Lincoln; SoilSalAdapt; iniav Instituto Nacional de Investigação Agrária e Veterinária, I.P.; UKRI Biotechnology and Biological Sciences Research Council; NMBU Norwegian University of Life Sciences

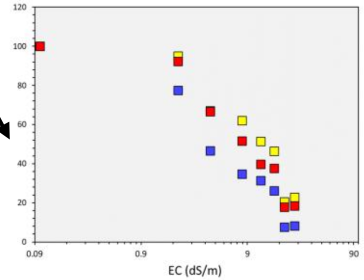




Only higher salinity treatment had a negative impact on crop yield



Salinity treatment will had an impact on soil bacterial communities



Different salinity treatments resulted in different adaptative responses

THE IMPACT OF OVER A CENTURY OF DIFFERENT ORGANIC FERTILIZATION ON THE PROPERTIES OF SOIL ORGANIC MATTER AND WATER HOLDING CAPACITY

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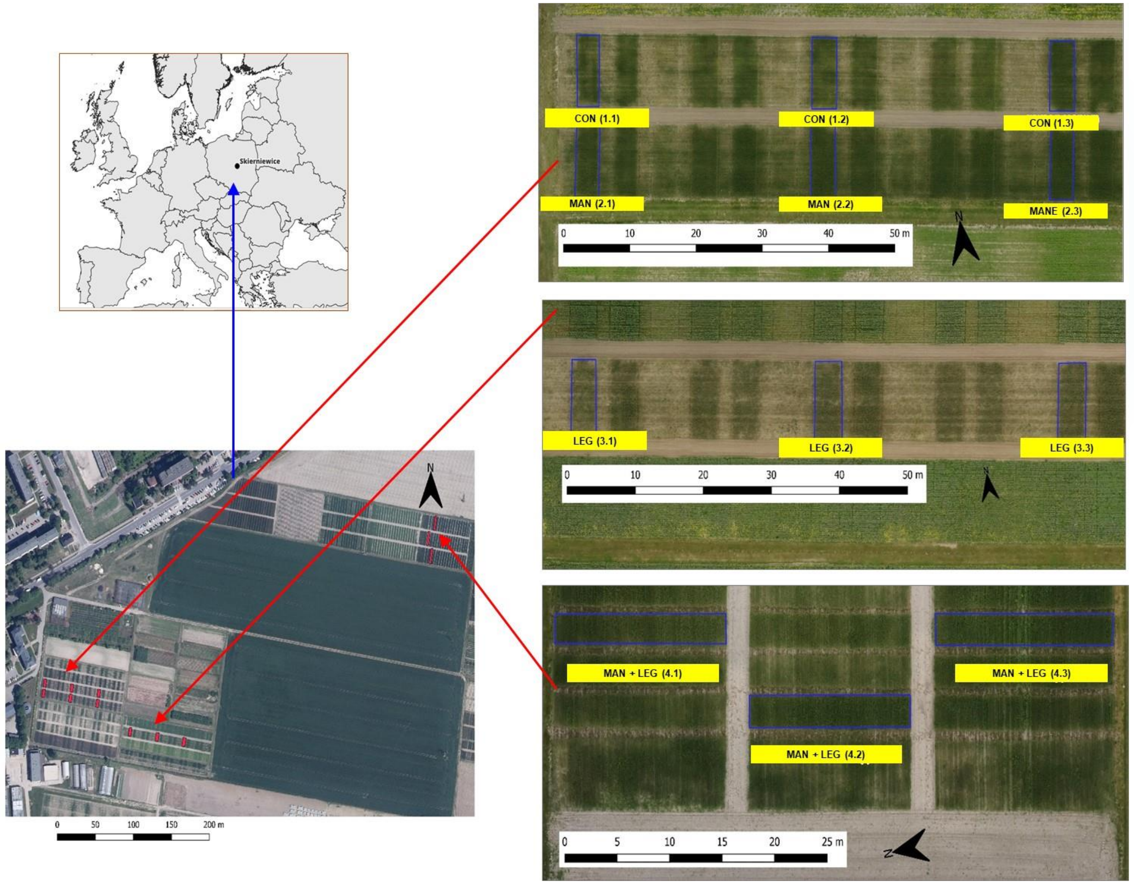
MINISTRY OF AGRICULTURE OF THE REPUBLIC OF LITHUANIA

Location of the long-term field experiment and methods

- The experiment was established at the Experimental Station of the Institute of Agriculture, Warsaw University of Life Sciences in Skierniewice (central Poland) on sandy loam Luvic Stagnosols, which received mineral fertilizers (Ca, N, P, K).
- The treatments included: control (CON); manure (MAN) applied every five years at a rate of 30 t ha–1; legumes (LEG); and manure with legumes (MAN+LEG).
- Soil samples (0-20 cm depth) were collected during the 2022 mid-growing season and analyzed for total organic carbon (TOC), plant available water, fractional composition of humic substances (HS), and spectroscopic properties of SOM and isolated humin fraction (HUM).
- Additionally, soil moisture, soil temperature, and CO2 emissions were measured in the field during 2022 and 2023 growing seasons from treatments CON and MAN only.



Changes in TOC content and SOM fractions

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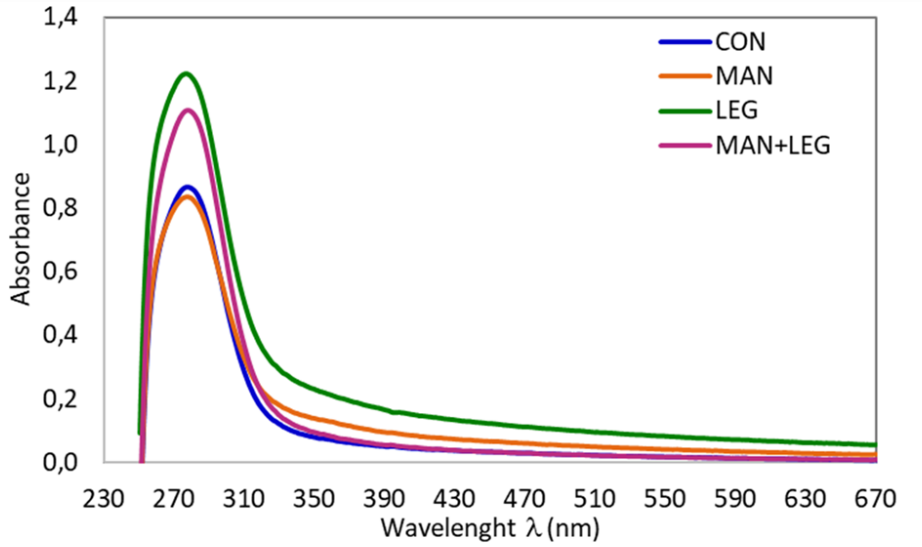
Treatment	TOC	TOC/TN	FF	HA	FA	HUM	HA/FA	HUM
	g kg^{-1}		C % in TOC					g kg^{-1}
CON	5.48 ± 1.0 a	12.1 ± 1.0 a	15.3 ± 1.7 b	53.4 ± 5.1 b	7.0 ± 1.8 a	24.3 ± 2.6 bc	8.1 ± 2.5 b	1.32 ± 0.19 a
MAN	8.12 ± 0.4 bc	10.5 ± 1.5 a	12.6 ± 0.3 a	43.5 ± 2.2 a	15.6 ± 2.9 b	28.2 ± 1.1 c	2.9 ± 0.6 a	2.30 ± 0.21 b
LEG	7.24 ± 0.5 b	12.5 ± 3.8 a	13.2 ± 0.2 ab	56.6 ± 1.4 b	10.1 ± 3.9 ab	20.0 ± 2.6 ab	6.1 ± 2.0 ab	1.51 ± 0.25 a
MAN + LEG	9.21 ± 1.2 c	11.4 ± 0.8 a	12.4 ± 1.7 a	60.1 ± 5.0 b	11.3 ± 5.2 ab	16.2 ± 3.0 a	6.4 ± 3.7 ab	1.49 ± 0.30 a

- The greatest impact on SOM content was observed in plots where manure has been applied, which resulted in an increase in TOC by 48% and 68% in variants MAN and MAN+LEG, while in variant LEG by 32% (Table 1).
- The analysis of the fractional composition of humic substances revealed that transformation of SOM under fertilization with manure led to significant increases in the humic acids/fulvic acids ratio compared to CON, while LEG caused a decrease in HUM in relation to MAN.

UV-Vis properties



- UV-Vis spectra provide information about the presence of characteristic chromophore groups in the structure of humic substances. They are related to the structure and size of the particles, indicating the progress/intensity of the humification process.
- The obtained HUM absorption spectra are distinguished by the presence of a specific band in the range of 245–310 nm with a maximum at a wavelength of 280 nm (Figure 2). The greatest impact had the use of legumes (LEG, MAN+LEG), causing a significant increase in absorbance.

Fluorescent properties of HUM

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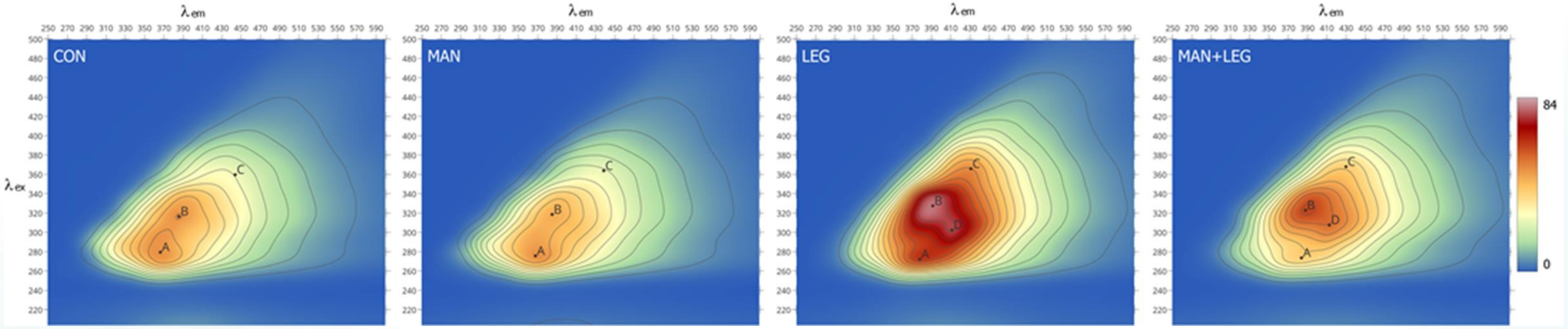

- The analysed three-dimensional fluorescence spectra (EEM) are similar and are characterized by the presence of a double broad maximum of fluorescence (CON and MAN).
- Its occurrence is attributed to the presence of simple structural components with high molecular heterogeneity and a low degree of aromatic polycondensation.
- In the case of LEG and MAN+LEG, a maximum of D stood out in this area, suggesting the presence of more complex structures, such as conjugated quinones and/or phenols with an increased degree of polycondensation.

TC-GC/MS analysis of bulk soil and HUM

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Treatment	Bulk Soil			HUM		
	Carbohydrates	Lignin	Lipids	Carbohydrates	Lignin	Lipids
CON	27.8	16.6	39.9	35.8	15.2	43.2
MAN	33.6	23.4	24.6	38.2	17.4	37.5
LEG	33.0	19.9	30.5	37.3	26.5	24.5
MAN + LEG	34.0	19.0	38.7	46.3	14.4	32.5

- Thermochemolysis and gas chromatography/mass spectrometry showed that HUM was enriched in carbohydrates in all pairs of soil and HUM (Table 2).
- For lignins and lipids there was no consistent trend in differences between bulk soil and HUM.
- The analyzed soil management methods (MAN, LEG and MAN+LEG) influenced the enrichment in carbohydrates and lignins both in bulk soil and HUM, with the exception of the lignins content in HUM for the MAN+LEG variant.

Water holding capacity

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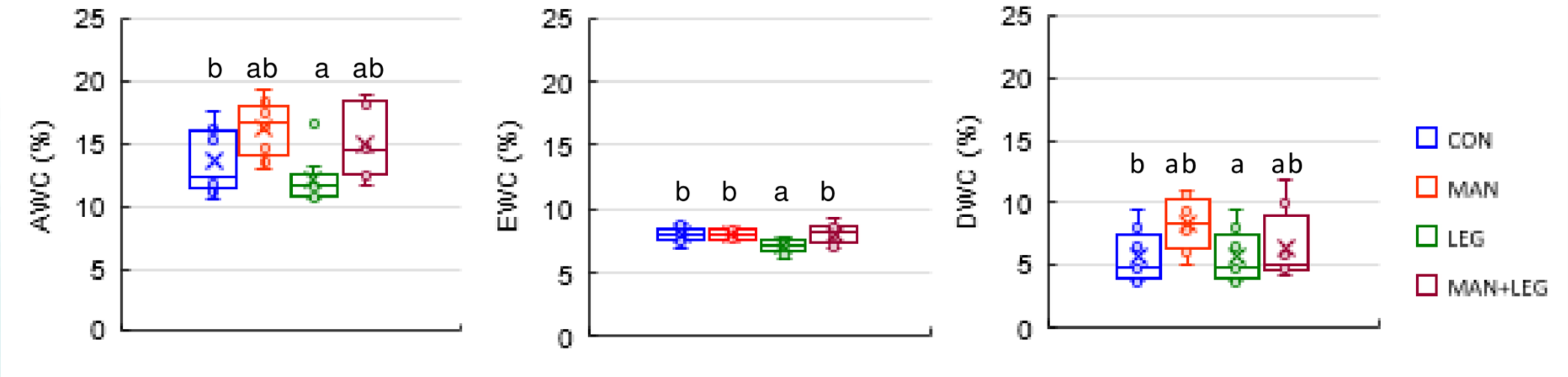
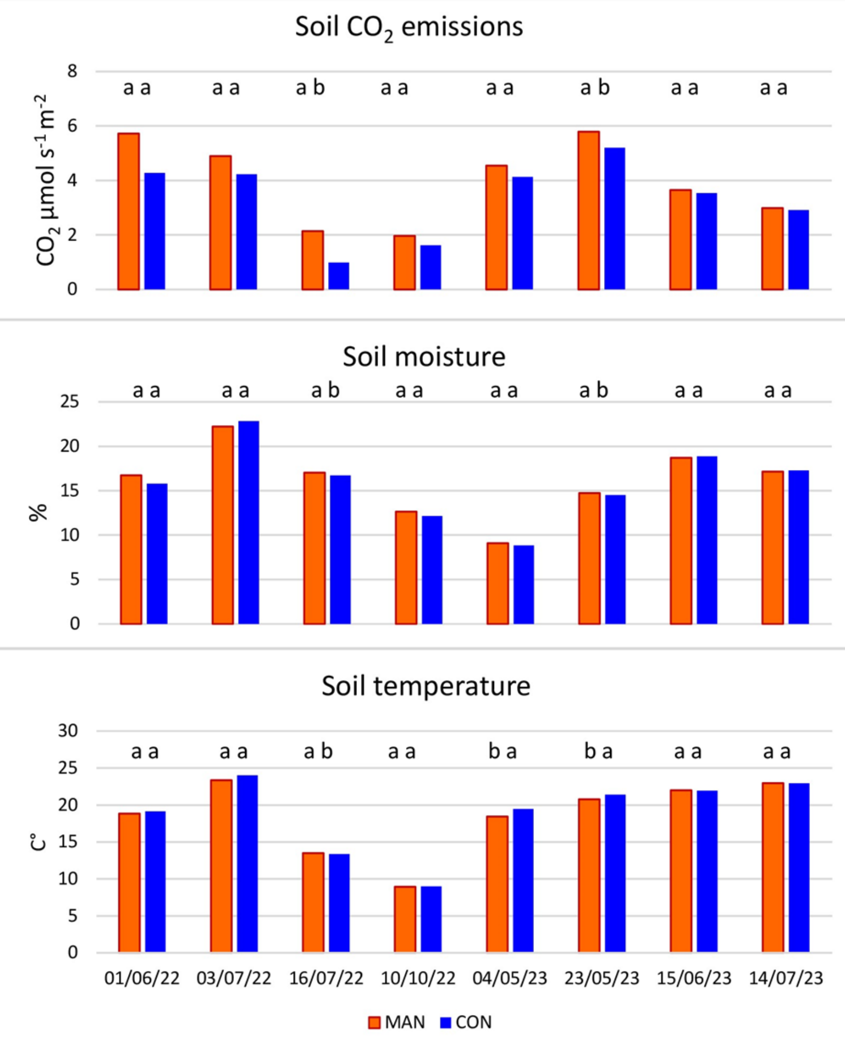


- Changes in the amount and properties of SOM influenced the water holding capacity (Figure 4), although not all changes were statistically significant. Manure fertilization increased plant available water (AWC) by 20% and 10% in variants MAN and MAN+LEG, respectively. However, LEG treatment decreased AWC by 11%.

CO_2 emissions



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2022-2023		
	F	p
Soil moisture	4.6	0.03446
Soil temperature	68.0	0.00000
Treatment	19.4	0.00002

Conclusions

SOMPACS

- long-term different organic fertilization practices have changed the content and chemical and physical properties of SOM, as well as the chemical composition of the HUM fraction;
- compared to bulk soil, HUM indicated a relatively high proportion of carbohydrates, which is consistent with summarized evidence for carbohydrate enrichment in clay-sized fractions;
- the highest proportion of carbohydrates, especially in HUM fraction, occurs as a result of fertilization with manure together with legumes;
- the most visible changes in the UV-Vis and fluorescent properties of HUM resulted from the use of legumes (LEG and MAN+LEG). These properties indicate that legumes favor more advanced SOM humification processes, contributing to forming a HUM fraction with a more complex structure
- reduction in water holding capacity was observed resulting from LEG crop, however, legumes with manure additive improve soil water properties;
- MAN+LEG type of soil management enables effective use of sandy soil ecosystem services.

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SHORT-TERM STUDY ON THE FATE OF ORGANIC CONTAMINANTS IN SOIL AFTER THE APPLICATION OF BIOWASTE COMPOST OR BIOGAS DIGESTATE

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EJP SOIL
European Joint Programme

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CSIC
INIA Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria
AGES Österreichische Agentur für Gesundheit und Ernährungssicherheit GmbH
BOKU Universität für Bodenkultur Wien

OBJECTIVE

To evaluate the **fate of 32 organic contaminants in soil** under real environmental conditions in a short-term field experiment. The **effect of two organic amendments** (biowaste compost and biogas digestate) **on the fate of these contaminants** was assessed **analysing their content** (total and bioavailable) in soil **before and after** applying the treated wastes as amendments.

Soil samples were collected **at time 0, 3, 7 and 12 months** and stored dry until analysis.

32 Target analytes

- 18 Polycyclic aromatic hydrocarbons (PAHs)
- 7 Polychlorinated biphenyls (PCBs)
- 2 Alkylphenols: Octylphenol and Nonylphenol
- 2 Personal care products: methylparaben and propylparaben
- 3 Organophosphates: tri-n-butyl phosphate (TBP), tris(2-chloroethyl) phosphate (TCEP) and tris(2-chloroisopropyl) phosphate (TCPP).

SAMPLE PREPARATION

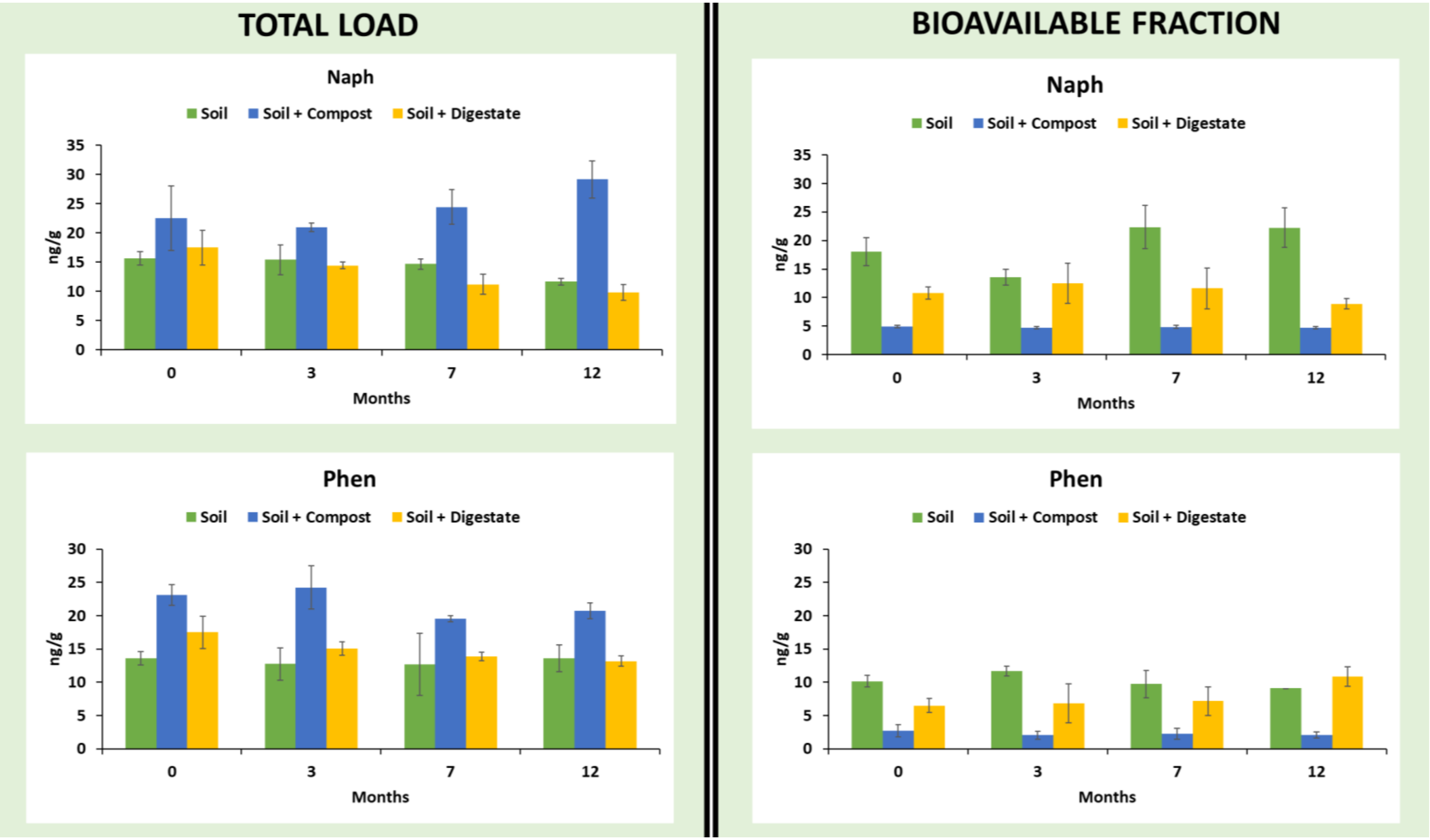
Exhaustive extraction (organic solvents) → **Total content fraction**

Soft extraction (water) → **(Bio)available fraction**

ANALYSIS

Gas chromatography coupled to a triple quadrupole mass spectrometer (GC-MS/MS)

SOME RESULTS



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CONCLUSIONS

- The analysis of the bioavailable fraction of the soil suggests that **the contaminants are more readily adsorbed in compost-treated soil,** resulting in lower availability of contaminants in the aqueous fraction.

- Although an increase in the concentration of some target contaminants was observed immediately after soil amendment, **the overall concentration remained constant for the 12 months following application**.

- The analysis of the soluble fraction shows that **the availability of the compounds remains throughout the 12-month period.**

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Mean annual water table underestimates CO_2 emissions from rewetting peatlands

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Department of Agroecology, Aarhus University, Viborg

EJP SOIL has received funding from the European Union's Horizon 2020 research and innovation programme: Grant agreement No 862695

OBJECTIVE

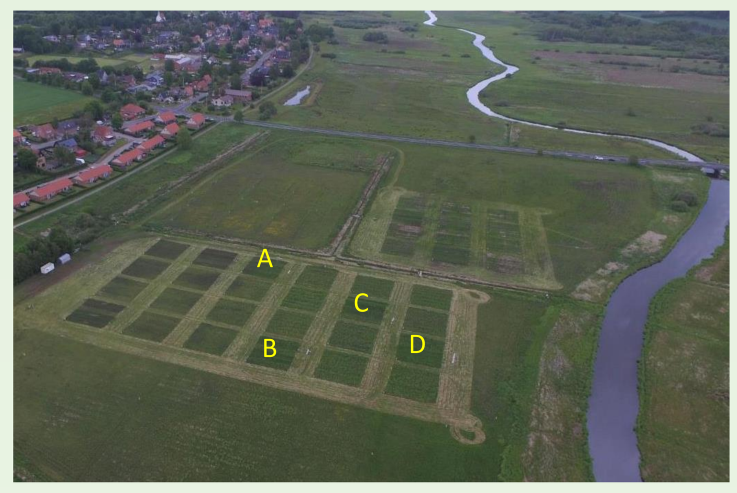
In this study, we use high temporal resolution water table data to estimate CO_2 emissions of a managed rewetting peatland. Additionally, we evaluate how pore water nutrients relate to these emissions.

BACKGROUND INFORMATION

- Peatland drainage is a significant agricultural greenhouse gases (GHG) source.
- Rewetting limits decomposition and reduces CO_2 emissions.
- There are uncertainties on the influence of nutrients and vegetation on GHG emissions from rewetted peatlands.
- Current GHG emission estimations are based on mean annual water table depth (Tiemeyer et al., 2020; Evans et al., 2021).

STUDY AREA

- Study was conducted between May 2021 and May 2022 in a fen peatland in central Denmark.
- Site was poorly drained and in transition to rewetting.
- Reed canary grass was sown in 2018 in the four studied plots.
- Three harvest treatments (zero cut, two cut, and five cut per year) in each plot.
- 200 kg N ha^{-1} y^{-1} applied equal in split doses to the two and five cut harvest treatments.



Study site, Nørrea valley, Vejrumbro

DATA COLLECTION

- Biweekly CO_2 measurements collected using a transparent manual chamber connected to an LGR-ICOS^{TM} GLA131-GGA gas analyzer. Shroudings, including opaque condition, used to measure under four radiation levels.
- Nutrient concentrations: *NO_3, NH_4, total N (TN), total dissolved N (TDN), total P (TP), total dissolved P (TDP), total organic C (TOC), dissolved organic C (DOC), and Fe* measured in water samples collected biweekly from piezometers.

DATA PROCESSING

Hourly water table depth (WTD), soil temperature (Ts), photosynthetic active radiation (PAR), and ratio vegetation index (RVI) were used to model and obtain annual ecosystem respiration (Reco), and gross primary productivity (GPP).

$$Reco = t1 + (a * RVI) * e^{\left[b * \left(\frac{1}{T_{10} - T_0} - \frac{1}{T_S - T_0}\right)\right]} + [(WTD - WTD_{max}) * C]^2$$

$$GPP = \frac{GPP_{max} * PAR}{k + PAR} * \left(\frac{RVI}{RVI + \alpha}\right) * FT$$

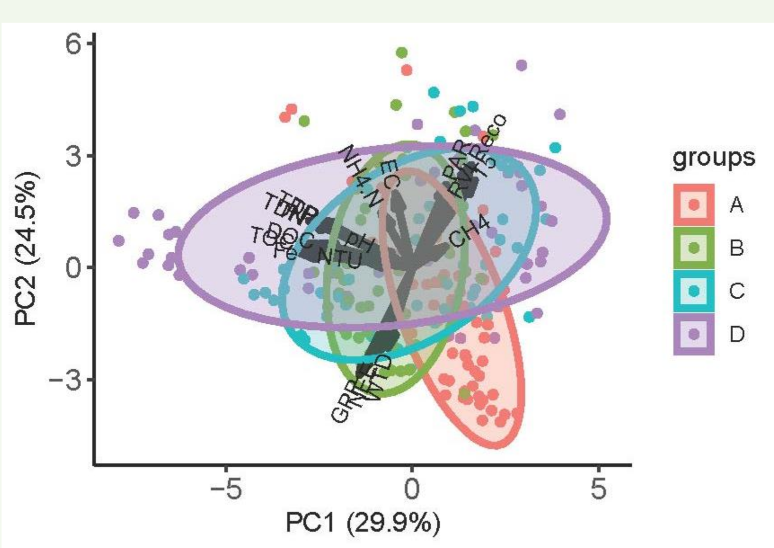
The net ecosystem exchange *(NEE)* was calculated as = *GPP + Reco*

The sensitivity of Reco to WTD and Ts data was tested by using mean annual data and comparing results to those of the hourly models.

RESULTS

Plot	Harv. treatment	Reco t CO_2-C ha^{-1} yr^{-1}	GPP t CO_2-C ha^{-1} yr^{-1}	NEE t CO_2-C ha^{-1} yr^{-1}	Yield t C ha^{-1} yr^{-1}	NECB t C ha^{-1} yr^{-1}
A	0	15.43	-14.19	1.24	NA	1.24
B		18.61	-13.02	5.59	NA	5.59
C		26.23	-16	10.23	NA	10.23
D		29.43	-18.88	10.55	NA	10.55
Average ± SE		22.43 ± 3.25	-15.52 ± 1.28	6.9 ± 2.2	NA	6.9 ± 2.2
A	2	14.9	-15.29	-0.39	1.92	1.53
B		23.57	-20.82	2.75	4.52	7.27
C		26.36	-22.04	4.32	4.63	8.95
D		23.7	-20.59	3.11	5.03	8.14
Average ± SE		22.13 ± 2.5	-19.69 ± 1.5	2.45 ± 1	4.03 ± 0.71	6.47 ± 1.68
A	5	20.6	-18.45	2.15	3.48	5.63
B		21	-20.17	0.83	3.88	4.71
C		23.66	-20.39	3.27	3.53	6.8
D		24.26	-21.88	2.38	4.5	6.88
Average ± SE		22.38 ± 0.92	-20.22 ± 0.7	2.16 ± 0.5	3.8 ± 0.23	6.0 ± 0.52

- GPP was different between harvest treatments. Biomass harvesting led to more photosynthesis.
- Marginally significant differences in Reco and net ecosystem C balance (NECB) between studied plot replicates.



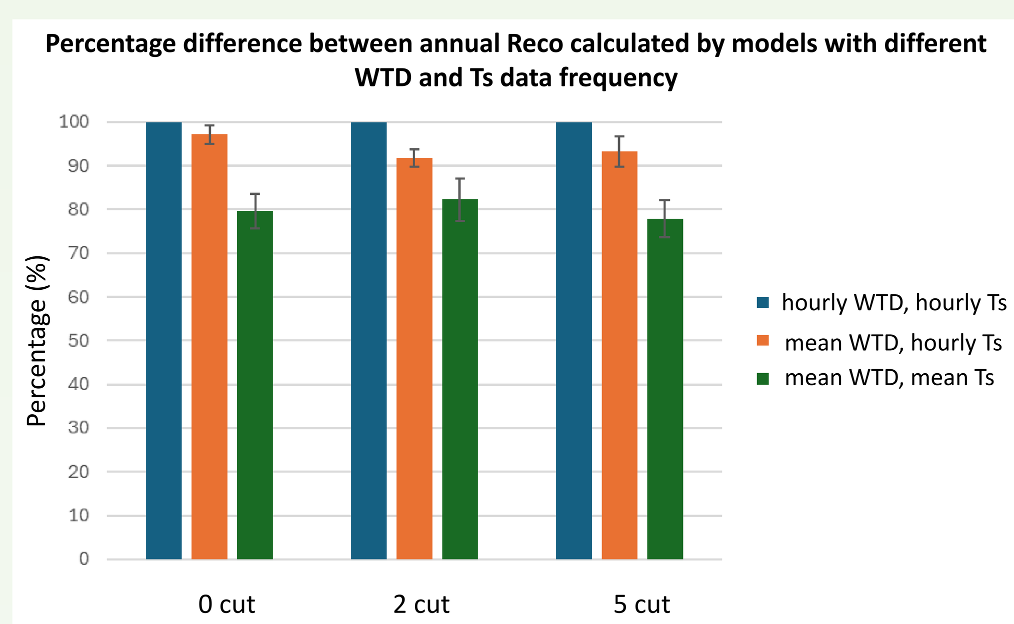
PCA plot showing variability on the data. PC1 shows the influence of nutrients, PC2 shows the influence of Reco and GPP the data.

- Nutrients positively correlated to each other suggesting common drivers.
- Reco and Ts negatively correlated to GPP and WTD.
- Data clustering with plots A and D having the largest differences.
- Higher nutrient concentrations generally found in plots C and D (plots with highest CO_2 emissions), while lowest nutrient concentrations were found in plot A.
- Including nutrients to linear mixed models improved Reco models.

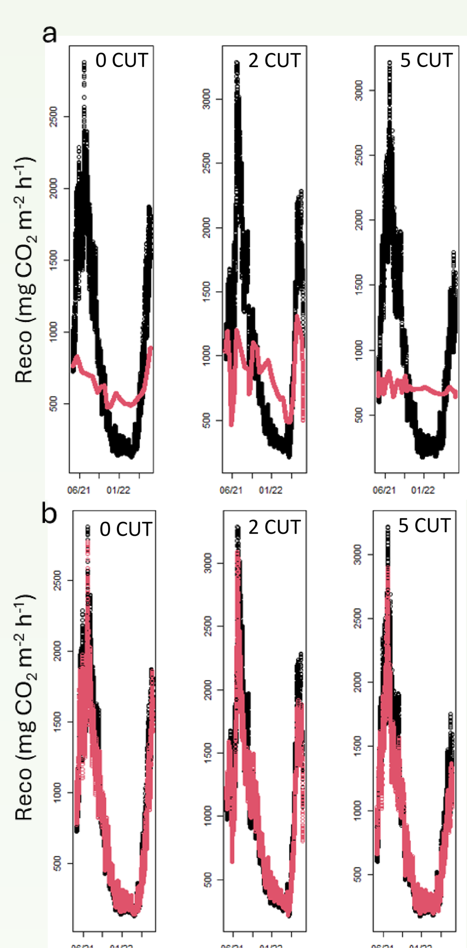
Table showing the effect of adding nutrients to linear mixed models of Reco, GPP, and NEE.

Parameter	Reco effect	GPP effect
TOC	Sig	N
DOC	Sig	N
TN	Sig	N
TDN	Sig	N
NH_4	N	N
TP	Sig*	N
TDP	Sig*	N
Fe	Sig*	N
pH	Sig*	Sig*
Turbidity	N	N
EC	N	Sig*

Sig* indicates an improvement of linear model which varied between harvest treatments, N indicates no effect of improving linear model.



- Using mean WTD and mean Ts, while keeping hourly RVI leads to an underestimation of annual Reco that ranged between 11 and 29%.
- Using mean WTD and hourly Ts and RVI leads to an Reco underestimation of 6% on average.



Comparison of Reco modelled by hourly WTD and Ts (black line) to Reco modelled with mean annual WTD (red line, top), and Reco modelled with mean annual WTD and hourly Ts (red line, bottom). Example for plot B.

CONCLUSIONS

- Biomass harvesting did not increase GHG emissions during early rewetting.
- The use of high frequency WTD data can capture CO_2 dynamics throughout the year.
- Data on pore water nutrient concentrations can lead to an understanding of peatland heterogeneity and could potentially improve Reco estimations.

ASSESMENT OF THE PRESENCE OF MICROPLASTICS IN COMPOST SAMPLES

Paloma Sánchez-Argüello[1], Gema Sáez-Salto[1], Simon Weldon[2], Pierre-Adrien Rivier[2], Alice Budai[2] and Antonio Martín-Esteban[1]

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[2]Norwegian Institute of Bioeconomy Research (NIBIO), Ås, Norway

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OBJECTIVE

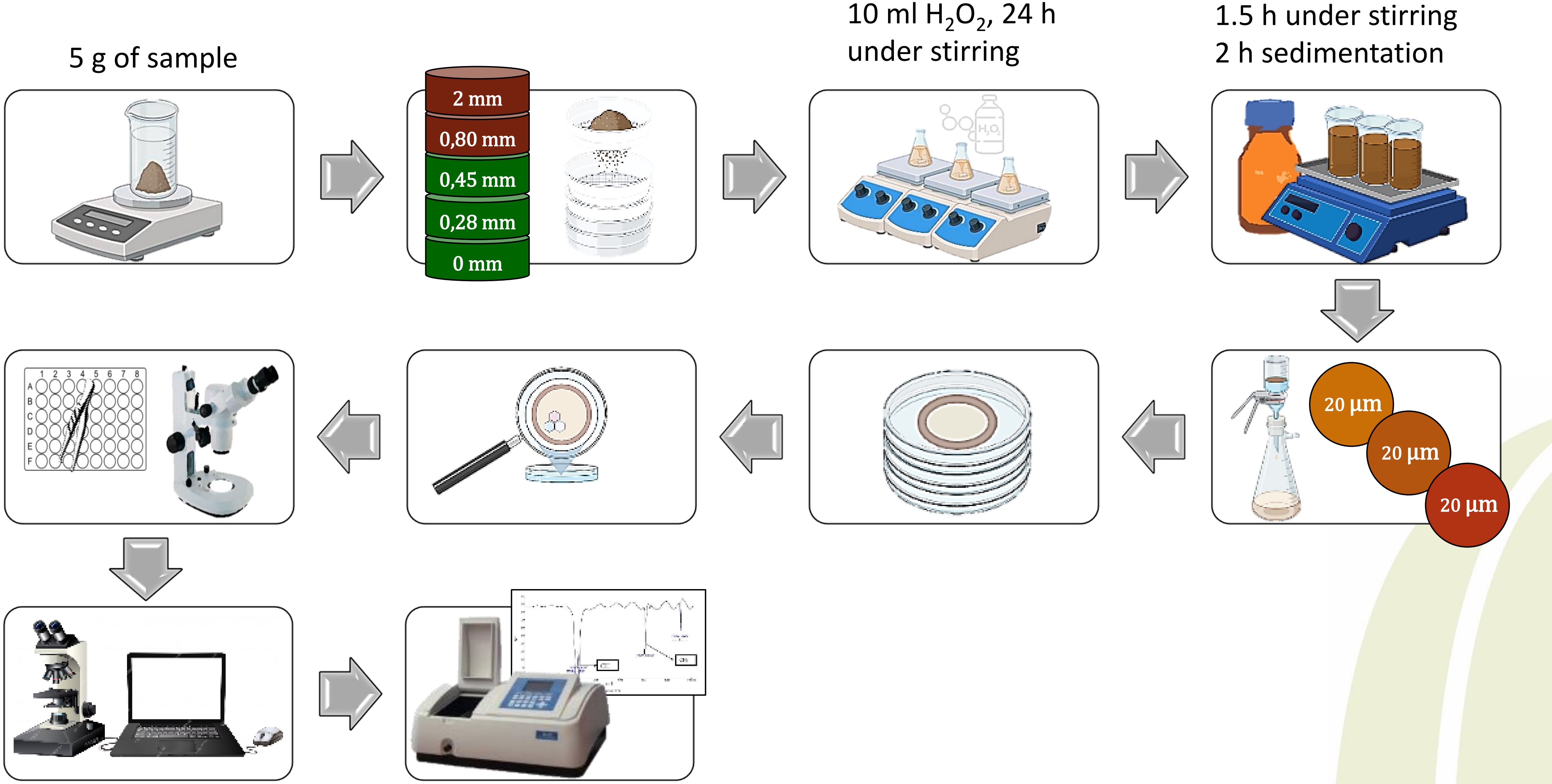
To evaluate the **presence of microplastics** in two different **compost samples** and corresponding feedstocks

SAMPLES

Substrate: mix of 55% household food waste and 45% animal manure
Biochar: mixed wood pyrolysed at 550°C HTT (Highest Treatment Temperature)
Compost 1: substrate (30 L) + wood shavings (68 L) + wood chips (20 L)
Compost 2: substrate (30 L) + wood shaving (65 L)+ wood chips (20 L) + **biochar** (3 L)

Composting conditions: Composts were turned daily during the thermophilic stage (3 weeks above 50°C with peaks above 65°C) and then turned every second week during the maturation phase (about 6 month).

METHODS



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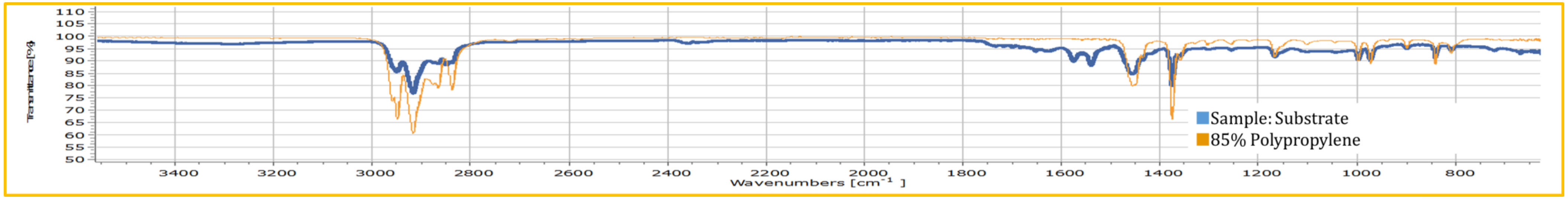
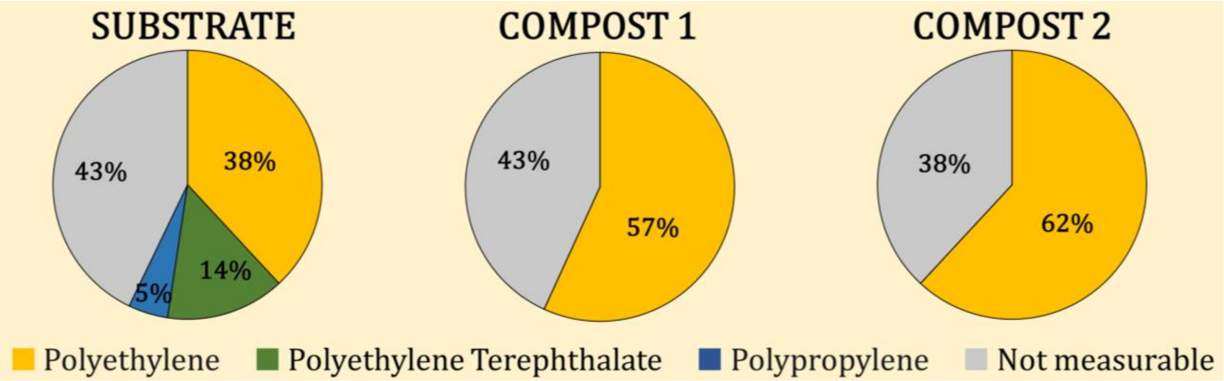
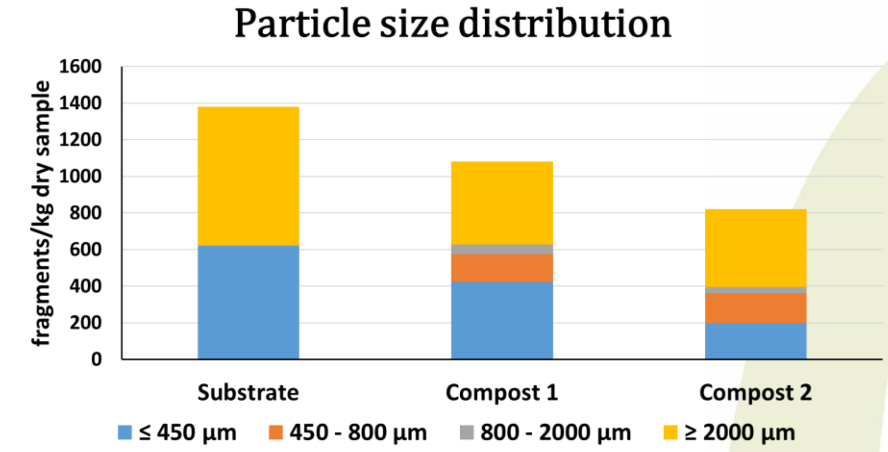
RESULTS

EXAMPLE

SUBSTRATE			
	Texture	Hard	
	Colour	Red	
	Size	>2000 µm	
	Composition	Polypropylene	







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CONCLUSIONS

- The estimated **concentration of microplastics ranged from 820 to 1340 fragments/Kg** of dry sample range, depending upon the sample.

- Three polymers represented the totality of **identified plastic items**: **polyethylene** (including both low and high density), **polyethylene terephthalate** and **polypropylene** in order of abundance.

- Fragments presented different shape, size and colour.

- Although an effect due to 'dilution' with wood additives cannot be ruled out, **the results obtained suggest that microplastics are further fragmented during composting.**

- Finally, **further research is needed to determine whether biochar in compost enhances microplastic fragmentation**, as the lower levels of microplastic fragments observed in our study could be explained by an increase in fragments not measurable with our method (i.e. extremely small fragments and nanoplastics).

ACKOWLEDGEMENTS

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Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria

NIBIO
NORSK INSTITUTT FOR BIOØKONOMI

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BioCASH

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Trade-off analysis of conventional and organic crop rotations under current and future climate scenarios in Finland

Calone Roberta, Acutis Marco, Valkama Elena, Botta Marco, Perego Alessia, Di Bene Claudia, Bregaglio Simone

crea
Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria

UNIVERSITÀ DEGLI STUDI DI MILANO

Luke
NATURAL RESOURCES INSTITUTE FINLAND

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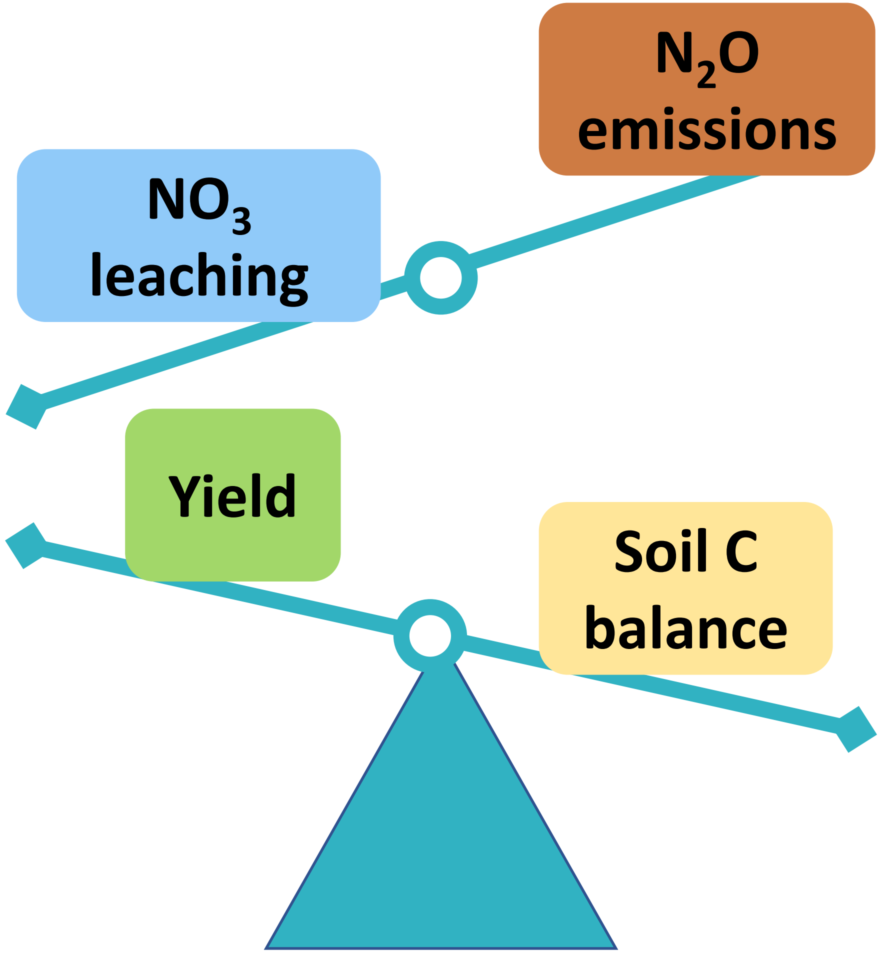
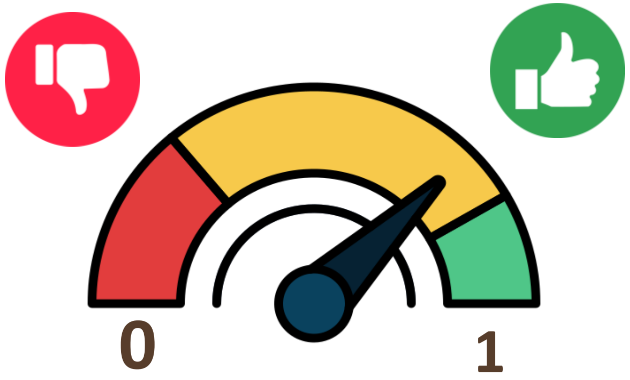
Identify the best crop rotation strategy

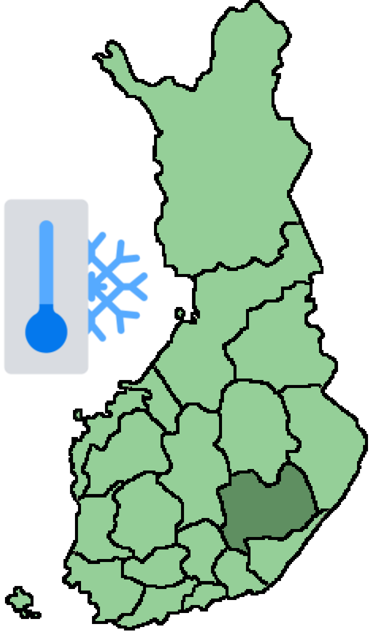
Trade-offs





Fuzzy logic based composite index

Finland, South Savo



9 rotation strategies

ORGANIC VS

ARMOSA crop model

Yield

Soil C balance

N_2O emissions

NO_3 leaching

historical (1999-2022)

future (2040-2069 & 2070-2100)


ti
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More than a Dialogue between actors, seeking the integration of soil-based principles in agroecological systems

KNOWING AND NEEDS ON SOIL QUALITY INDICATORS FOR AGROECOLOGICAL PRACTICES: RESULTS FROM A SYSTEMATIC REVIEW OF LONG-TERM EXPERIMENTS IN COUNTRIES PARTICIPATING IN “INTO DIALOGUE” EJP SOIL PROJECT

A. Maienza, A. Un, J. Renovell, G. Biancofiore, G. Buttafuoco, O., Szabó, M. Pisarčik, P. Fuksa, J. Grabinski, E. Lumini, S. Di Lonardo, M. Kushnir, M. Kovandova, M. Vilkiene, I.Mockeviciene, B. Dirnena, S. Asins

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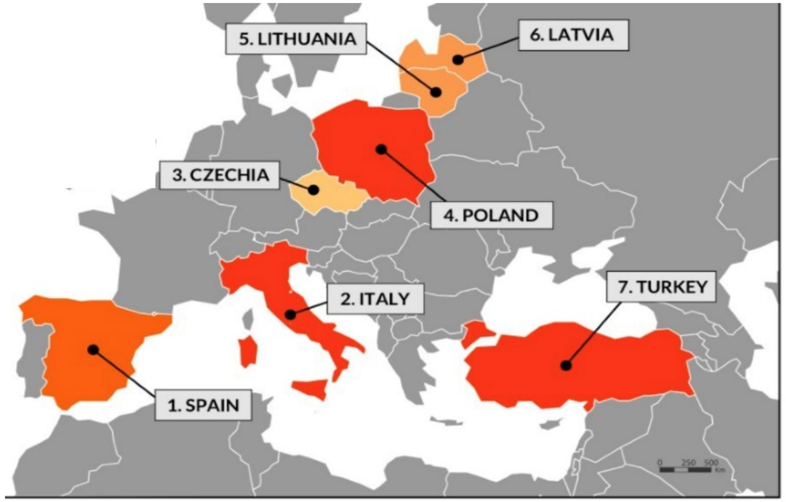
Into-DIALOGUE

RATIONALE

Agroecological practices are **promoted** with the aim of soil conservation preserving soil quality, fertility, and health.

WHAT IS KNOWN AND WHAT IS NEEDED ON INDICATORS OF SOIL HEALTH AND ECOSYSTEM SERVICES IN AGROECOLOGICALLY MANAGED FIELDS?



A total of 366 papers on **LTE** were read.
After the screenig process,
166 publications were included in the review,
published between 2018-2022
(SCOPUS and WOS)

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Into-DIALOGUE

KNOWN

SOIL COMPONENT	SOIL HEALTH PARAMETER	INDICATOR	ECOSYSTEM SERVICES
Physical	Soil structure (macro and micro pores)	porosity	Soil Structure-SUPPORTING
Physical	Soil structure	penetration resistance	Soil Structure-SUPPORTING
Biochemical/Functional	Enzymes	Enzymes (uresase. B glucosidase etc)	Nutrient and Cycling-SUPPORTING
Chemical	Available Nitrogen	Nav ;N	Nutrient and Cycling-SUPPORTING
Chemical	Available Phosphorus	P; Pav; P olsen	Nutrient and Cycling-SUPPORTING
Chemical	Exchangeable basese	K Ca Mg	Nutrient and Cycling-SUPPORTING
Chemical	Soil exchangeable capacity	CEC-CSC	Nutrient and Cycling-SUPPORTING
Chemical	Soil exchangeable capacity	pH	Nutrient and Cycling-SUPPORTING
Chemical	Soil organic carbon	SOC-SOM-TOC-C-OC	Soil organic Matter-REGULATING
Biochemical/Functional	Carbon microbial biomass	MBC	Microbial biomass-SUPPORTING
Biological	Arbuscular mycorrizhe	AMF	Microbial biomass-SUPPORTING
Biological	Fungi	Fungi	Microbial biomass-SUPPORTING
Biological	Bacteria	Bacteria	Microbial biomass-SUPPORTING
Biological	Mesofauna	microatropods	Soil biota- SUPPORTING
Biological	Macrofauna	eatrworms	Soil biota- SUPPORTING
Biological	Mesofauna	mesofauna	Soil biota- SUPPORTING
	Biomass	yield	Production-PROVISIONING

Considered in 20% of the papers

Considered in 51% of the papers

Considered in only 7% of the papers

The main Long-Term experiments are focused on cereals

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KNOWN

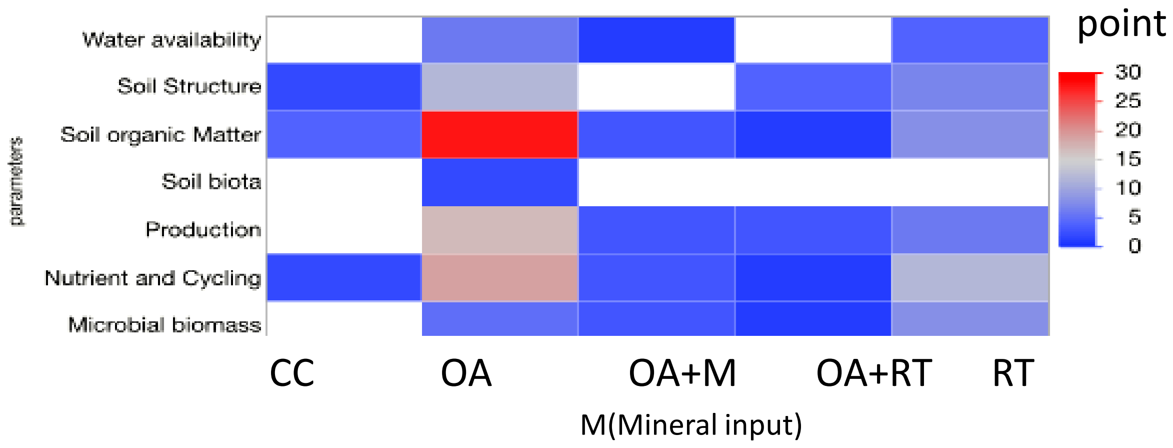
PAPERS DEALING WITH **AGRONOMIC PRACTICES** in relation to soil health in LTE were respectively:

Organic amendment (OA) (n=70)

Cover crops (CC) (n=25)

Reduce Tillage (RT) (n=70)

Intercropping (IC) (n=52)



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NEEDS……?

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Effects of Long-Term Soil Compaction on Physical Parameters and Carbon Stocks under Pannonian Conditions

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Federal Agency for Water Management

EJP SOIL SoilCompaC

Introduction:

- Soil compaction is a major threat to soil productivity and ecological and hydrological soil functioning.
- The impact of soil compaction on SOC storage has been little studied and the results differ.
- Long-term experiments on soil compaction are rare.

Research Objective:

Comparison of soil physical indicators and stocks of total carbon (TC), total organic carbon (TOC), and total nitrogen (TN) in a non-compacted area (in-field=IF) and a compacted area (headland=HL) in an arable field. Sampling conducted in the year 2023.


Site with Pits, Raasdorf 2023. Photo: Paul Riedl

Methods

- Soil penetration resistance (0-40 cm) with Eijkelkamp Penetrologger (1 cm², 60°)
- 3 pits in-field (IF) and 3 pits headland (HL), each 1,2 m deep
- Sampling for bulk density, total soil N, and TOC in 6 layers (0-10, 10-20, 20-30, 30-40, 40-50, 50-70 and 70-100 cm), 3 cylindrical rings per layer.

Study Site

- *Pedo-climatic-zone-name*: Pannonian.
- Soil region 153 (Calcic and Chernic Chernozems) Clayey Sand (T ~ 25%, S > 70% , Calcaric Chernozem of alluvial origin.
- *Location:* Raasdorf, Lower Austria, altitude 197 m.
- Mean precipitation (1980-2018): 546 mm, Mean annual temperature: 10.9° C.
- Management: ploughless, plant residues left on the field.
- Crops since 2016: yellow oat, winter wheat, spring durum wheat, winter wheat, winter durum wheat, winter barely, sugar beet, spring durum wheat.


Excavation of Profiles Raasdorf 2023. Photo: Gerhard Moitzi


Sampling Raasdorf 2023 Photo: Gerhard Moitzi

HL1 Profil Raasdorf 2023 Photo: Paul Riedl

IF3 Profil Raasdorf 2023. Photo: Paul Riedl

Result: Bulk Density

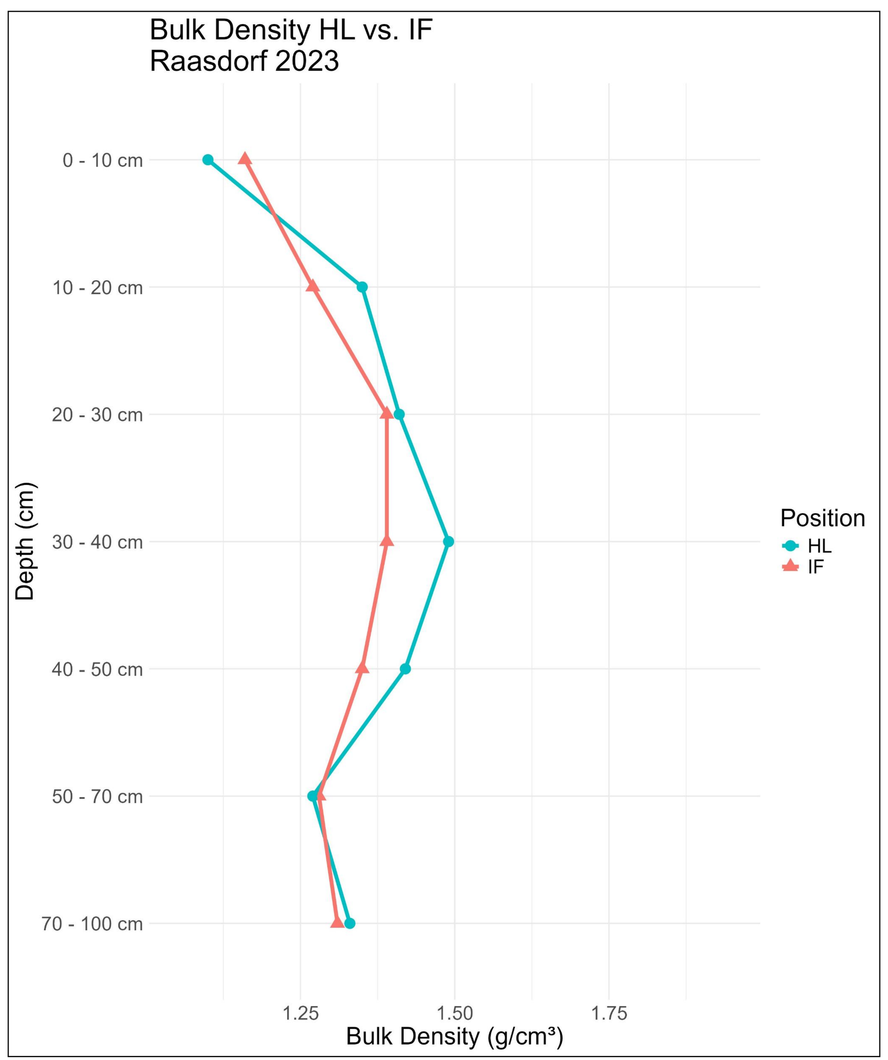


Figure 1: Bulk Density in g/cm³ , taken in Raasdorf (Austria) from Headland (HL) and In-Field (IF) from different depths, sampling date: September 27, 2023, n=9,

Result: Total carbon (TC) Stock

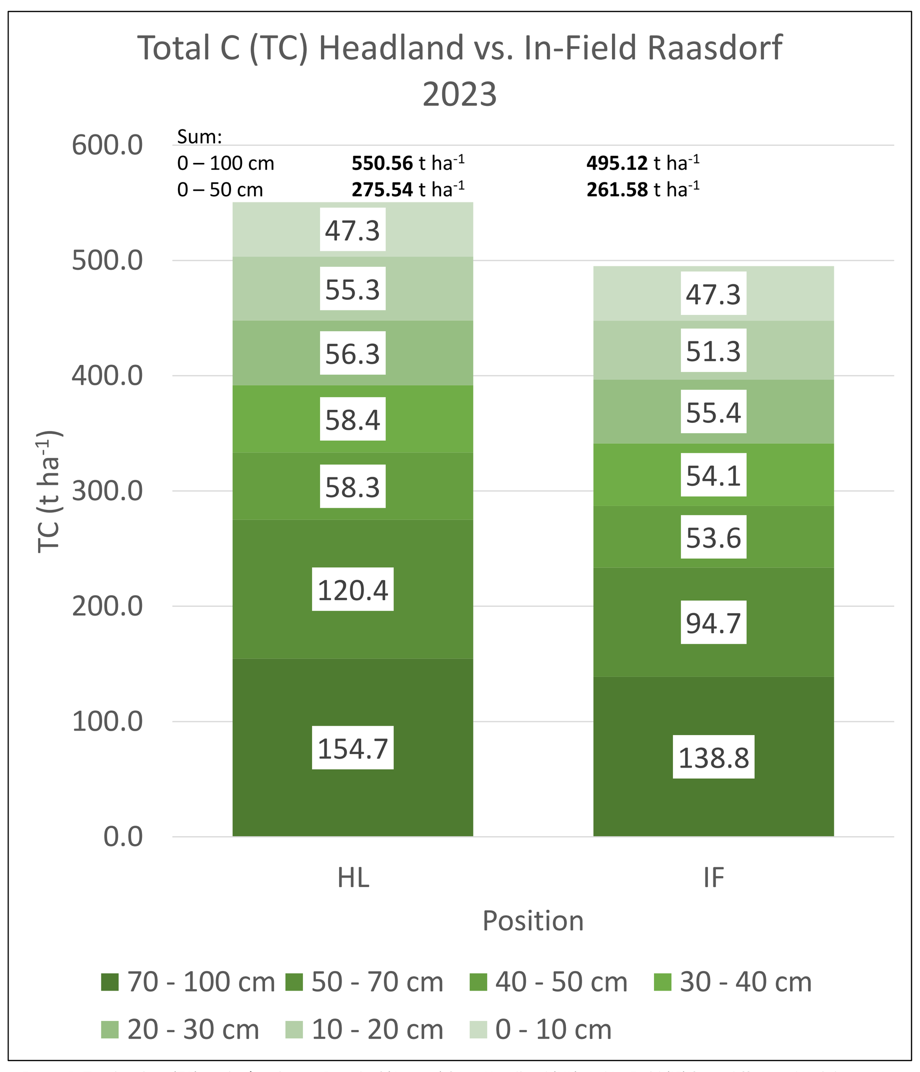


Figure 2: Total carbon (TC) in t ha⁻¹ , taken in Raasdorf (Austria) from Headland (HL) and In-Field (IF) from different depth layers, calculated for each layer, sampling date: September 27, 2023, n=9,

Result: Total Organic carbon (TOC) stock

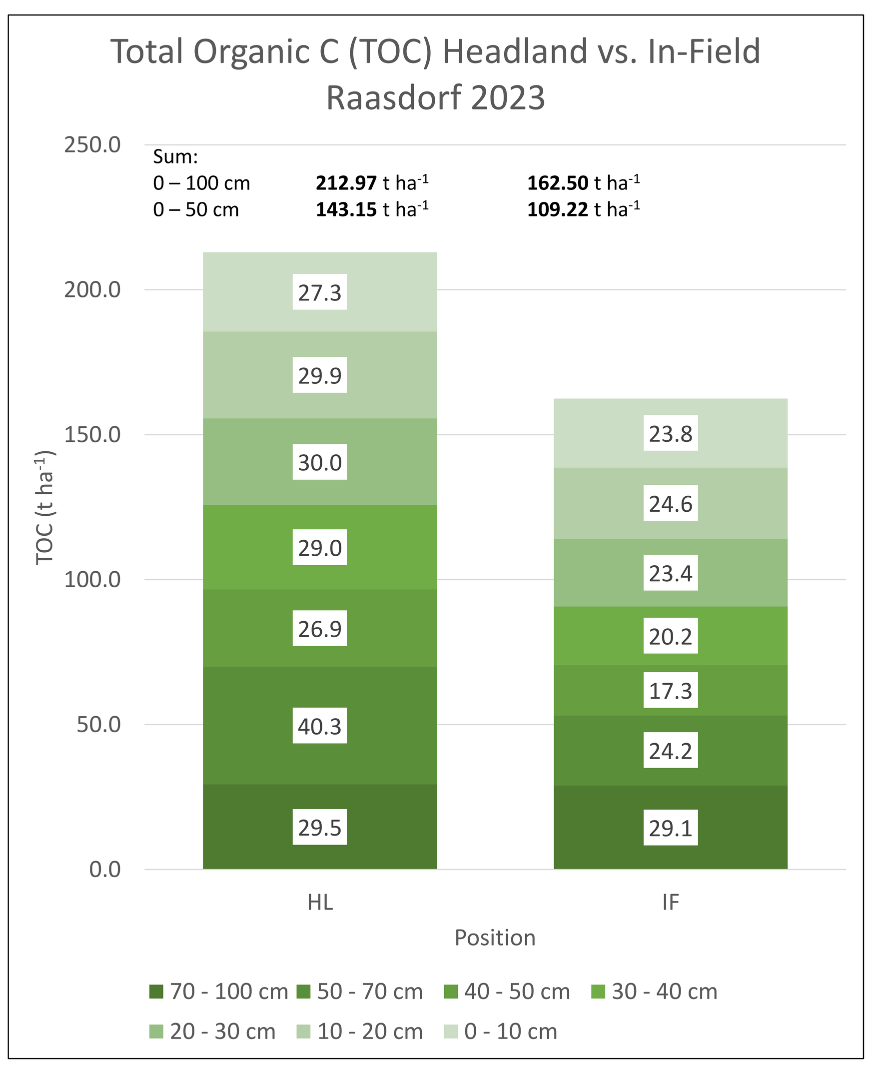


Figure 3: Total organic carbon (TOC) in t ha⁻¹ , taken in Raasdorf (Austria) from Headland (HL) and In-Field (IF) from different depth layers, calculated for each layer, sampling date: September 27, 2023, n=9,

Result: Total Nitrogen (TN) stock

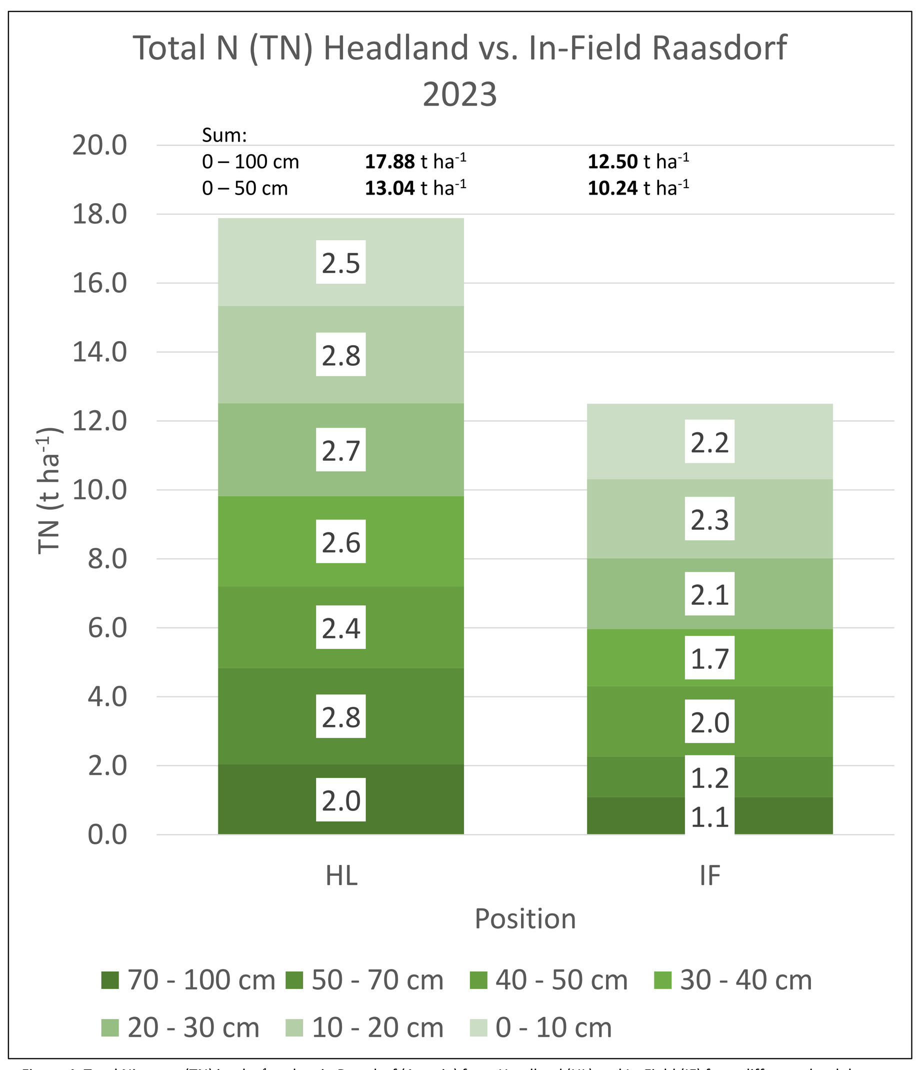


Figure 4: Total Nitrogen (TN) in t ha⁻¹ , taken in Raasdorf (Austria) from Headland (HL) and In-Field (IF) from different depth layers, calculated for each layer, sampling date: September 27, 2023, n=9,

Result: Crop yield 2023

Spring Durum Wheat

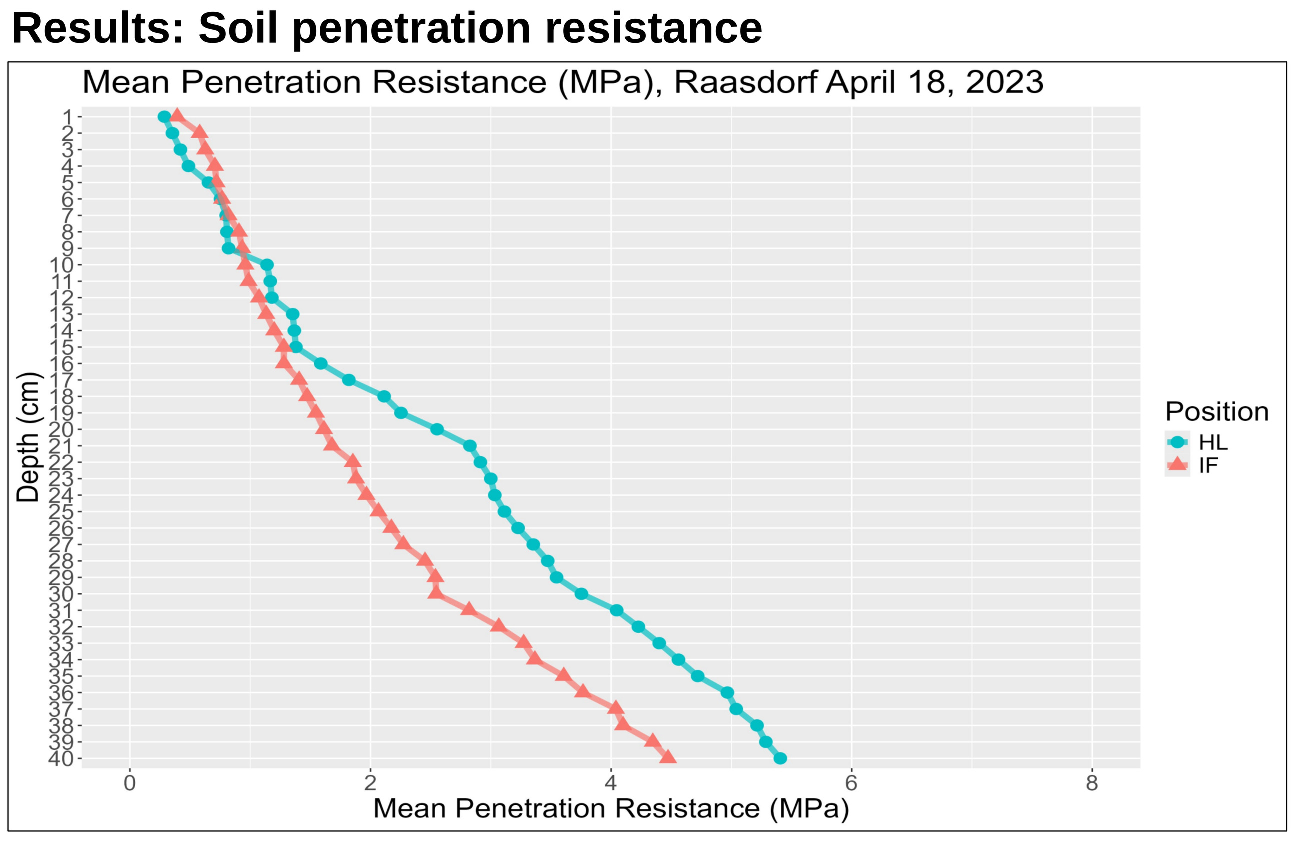
Variety: Floadur

Seeding date: 6th of March 2023

Manually harvested in 1 m² on 18th July 2023 (n=3)

Position	Grain yield (kg/ha)_14%	Straw yield (kg/ha)_14%	Harvest-index (%)	TKW (g)_14%
Mean **IF**	3640	6408	36.3	32.0
Mean **HL**	4193	6870	37.9	37.5

Results: Soil penetration resistance



Increases:
20 cm: +58%
30 cm +47%
40 cm +21%
10-20 cm: +26%
20-40 cm: +42%

Figure 5: Mean soil penetration resistance, taken in Raasdorf (Austria) from Headland (HL) and In-Field (IF) to a depth of 40 cm, sampling date: April 18, 2023, cone penetrometer (Eijkelkamp, The Netherlands) (60° cone and 1 cm2), n=15, soil moisture: 0 - 10 cm: 22%; 10 - 20 cm: 25%; 20 - 30 cm: 28%; 30 - 40 cm: 28%.

Summary

- Headlands of arable cropping fields are an evident site for soil compaction.
- The higher field traffic frequency with higher wheel load in the Headland resulted in higher soil penetration resistance in the subsoil.
- The bulk density differed between IF (=reference) and HL:
  0-10 cm: -4%, 10-20 cm: +1%, 20-30 cm: +1%, 30-40 cm: +7%, 40-50 cm: +5%, 50-70cm: 0%, 70-100 cm: +1%.
- HL (0 - 50 cm) had higher stocks of TC (+5.3 %), TOC (+31.1 %) and of TN (+27.3 %).
- This site-specific result indicates that the compacted soil accumulated organic carbon and nitrogen in the soil. This could be explained by a reduced decomposition of soil organic matter due to mitigated air permeability.

1. **Effects of sheep wool pellets and black soldier fly (*Hermetia illucens*) frass on soil biota**

2. **The impact of Black Soldier Fly (*Hermetia illucens*) larvae frass on the abundance and diversity of springtails (Collembola) and on cereal crop yield**

3. **The impact of various organic materials in pot experiments on the survival of forest trees**

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Effects of sheep wool pellets and black soldier fly (*Hermetia illucens*) frass on soil biota

Shanskiy Merrit, Kuu Annely, Reissaar Rihard, Escuer-Gatius Jordi, Ivask Mari, Noormets Merilin, Konsap Kadri, Sutri Merit, merrit.shanskiy@emu.ee

Introduction

Sheep wool valuable resource for slow release nutrients, organic origin.
Hermetia illucens larvae are highly efficient decomposers of various types of organic wastes, frass is valuable organic fertilizert.

Materials and Methods

Field trial with five treatments:

- Control (unfertilized)
- Sheep wool pellets were applied 40, 60, 80 kg N/ ha
- H. illucens frass was applied 40, 60 kg N/ha

Each treatment was replicated three times.

Results

- There were 3 earthworm species in 2022 and 4 in 2023.
- Higher the frass norms had greater impact on earthworm abundance (2.2 kg: 96.0±14.1 vs 1.65 kg: 85.3±23.4 in 2022).
- Microbial respiration was reduced by higher rate of sheep wool pellets.
- The yields from experiment were 6.4 -7.9 t/ha






Photos Noormets, M., Ivask, M., Shanskiy, M.

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Estonian University
of Life Sciences

The impact of Black Soldier Fly (*Hermetia illucens*) larvae frass on the abundance and diversity of springtails (Collembola) and on cereal crop yield

Reissaar Rihard[1*], Kuu Annely[1], Sutri Merit[1], Talgre Liina[2] and Shanskiy Merrit[1]

In the field trial, there were six different treatments:

- control (unfertilized)
- mycorrhiza (unfertilized)
- mycorrhiza + frass (74 kg N/ha)
- small dosage of frass (74 kg N/ha)
- large dosage of frass (150 kg N/ha)
- full agrotechnology (fertilized with NPK mineral fertilizer, 150 kg N/ha).

Each treatment was replicated three times.

- highest average abundance = mycorrhiza + frass
- total of 42 species of springtails were identified

The most abundant species were:

- *Xenylla grisea*
- *Parisotoma notabilis*
- *Folsomia quadrioculata*.

*Photo by Andy Murray

Hermetia illucens larvae are highly efficient decomposers of various types of organic waste, food waste, and agricultural by-products.

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The impact of various organic materials in pot experiments on the survival of forest trees

Kuu Annely and Shanskiy Merrit

The aim of this research project is to find techniques and materials that retain moisture for forest trees to assist in better rooting in mining areas

- The pot experiment
- Various organic materials (sheep wool pellets, sheep wool discs, biochar, sewage sludge etc.)

Results:

- Biochar and sheep wool discs had a positive impact
- The sheep wool pellets and mixture of materials (sheep wool pellets, biochar, sewage sludge on top) had a negative impact

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