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

Utilizzo di bioinoculi microbici per valorizzare la biodiversità nativa del suolo e promuovere la difesa e la nutrizione delle produzioni agricole: il progetto H2020 EXCALIBUR

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 817946

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Towards a sustainable agriculture

The strategy sets targets to significantly reduce the use and risk of chemical pesticides, the use of fertilisers and sales of antimicrobials as well as increase agricultural land under organic farming.

Protecting and restoring biodiversity and well-functioning ecosystems is therefore key to boost our resilience and prevent the emergence and spread of future diseases

SOIL health

Sustainable development goals (Agenda 2030)

About half of all sustainable development goals depend on SOIL

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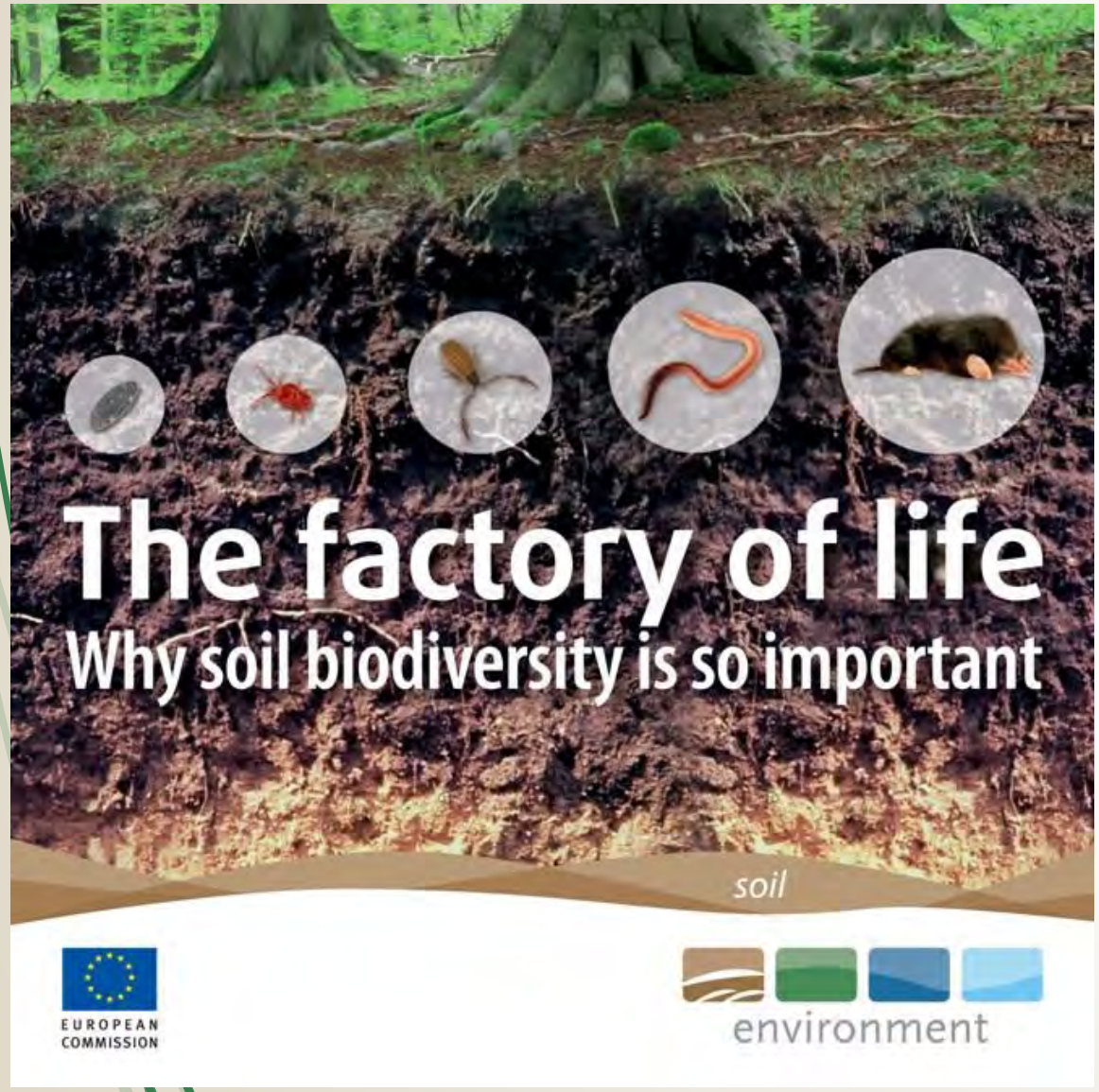
Soil biodiversity: the factory of life



Beneath our fields and our feet, an eclectic and unfamiliar community of soil organisms are involved in a remarkable, coordinated effort that sustains life on Earth. Food production depends on this "hidden" biodiversity to maintain fertile soils. However, a large fraction of soil organisms and functions remains unidentified.

- Soils are home to over a quarter of all living species on earth

- Only 1% of soil micro-organism species have been identified

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Soil ecosystem services

Soil ecosystem services are vital components to all aspects of life and they support the production of ecosystem goods and services, such as: Food, fibre, and energy provision. Water storage and purification. Neutralization, filtering and buffering of pollutants.

Soil micro-organisms contribute to a wide range of ecosystem services, vital in supporting every individual and our planet

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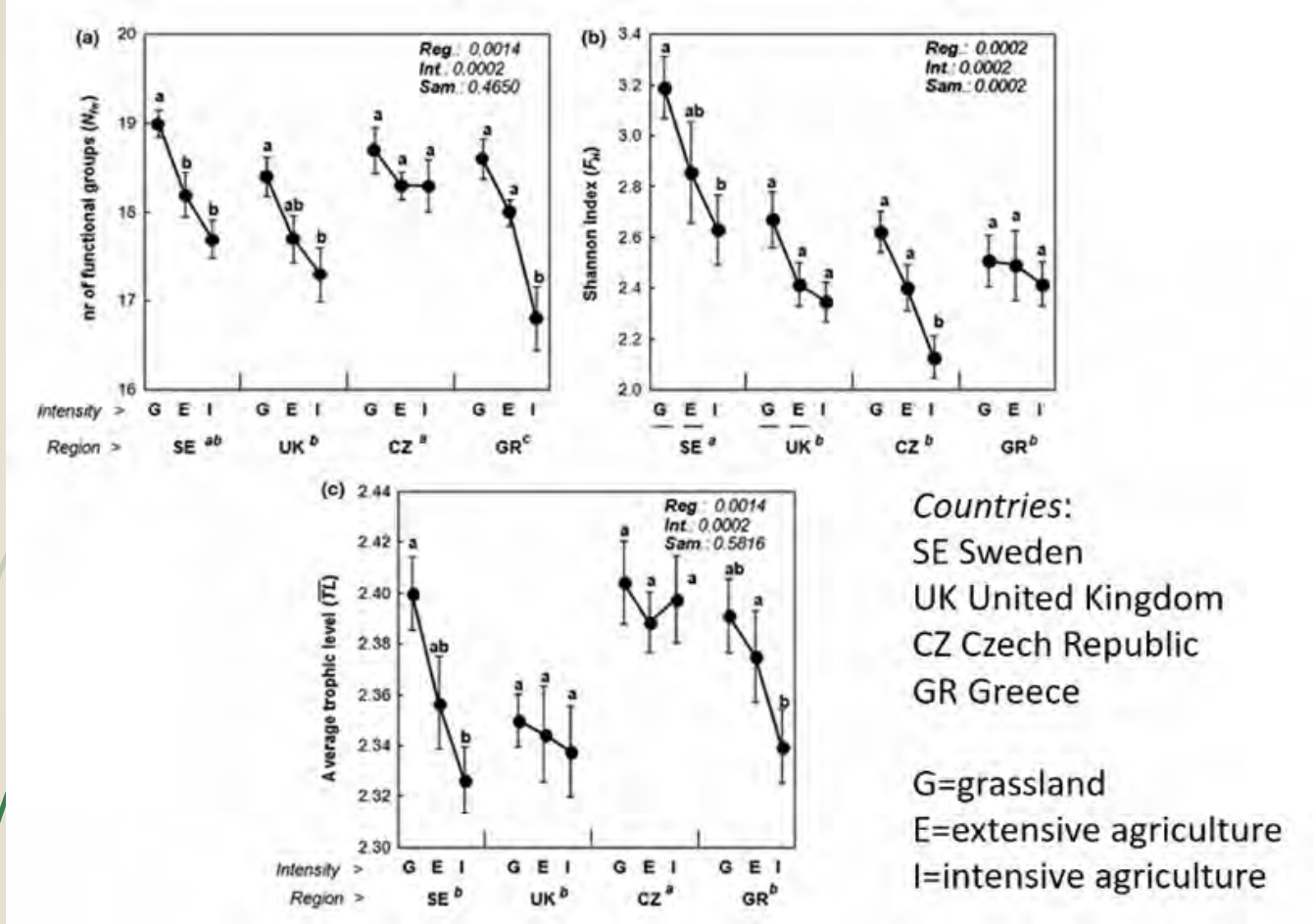
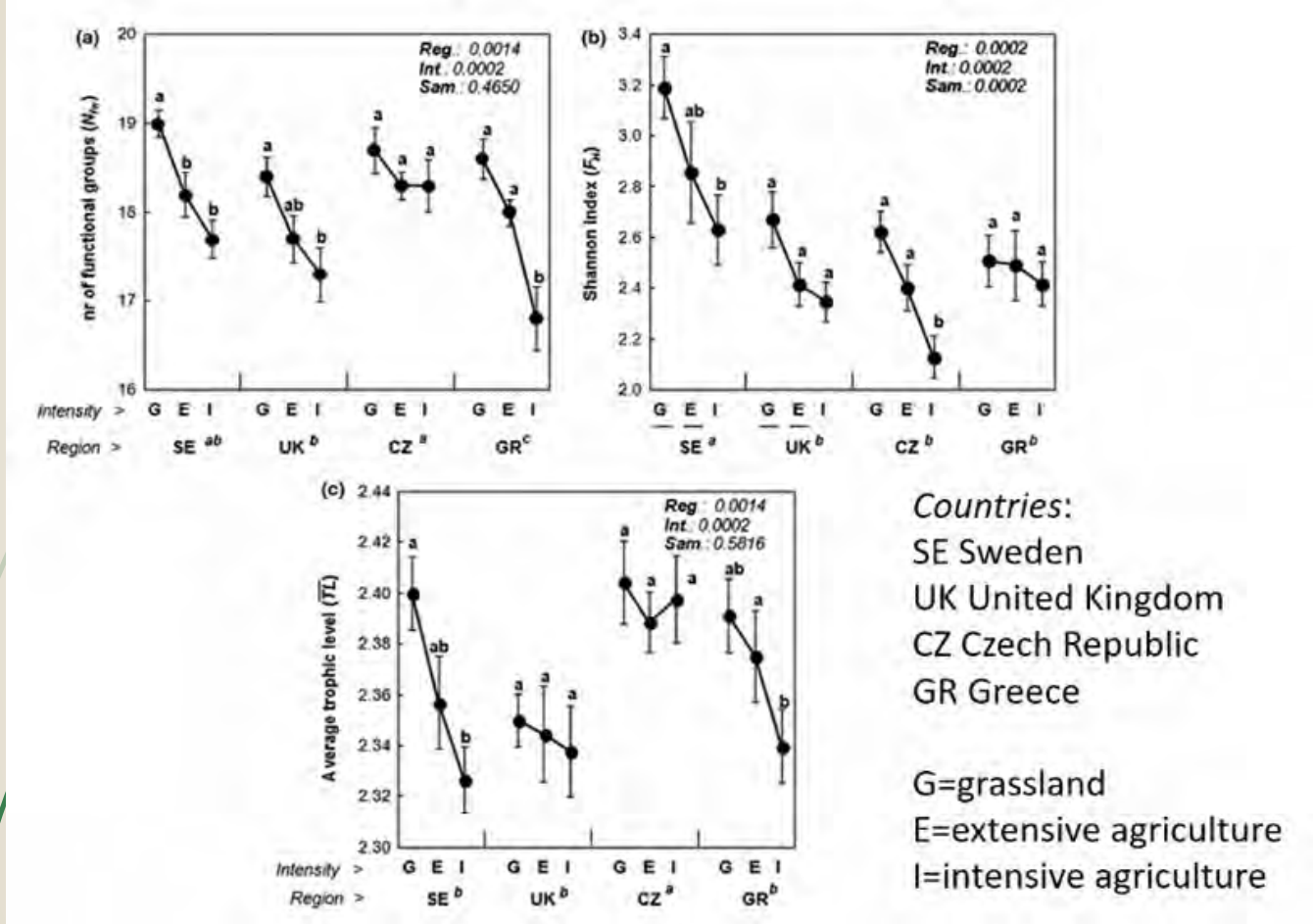
Perdita di biodiversità del suolo



Perdita di biodiversità del suolo in Europa a causa dell'agricoltura intensiva

Tsiafouli et al., 2014_Global Change Biology

Perdita di biodiversità del suolo



Perdita di biodiversità del suolo in Europa a causa dell'agricoltura intensiva

Si può recuperare la biodiversità del suolo ?

Tsiafouli et al., 2014_Global Change Biology

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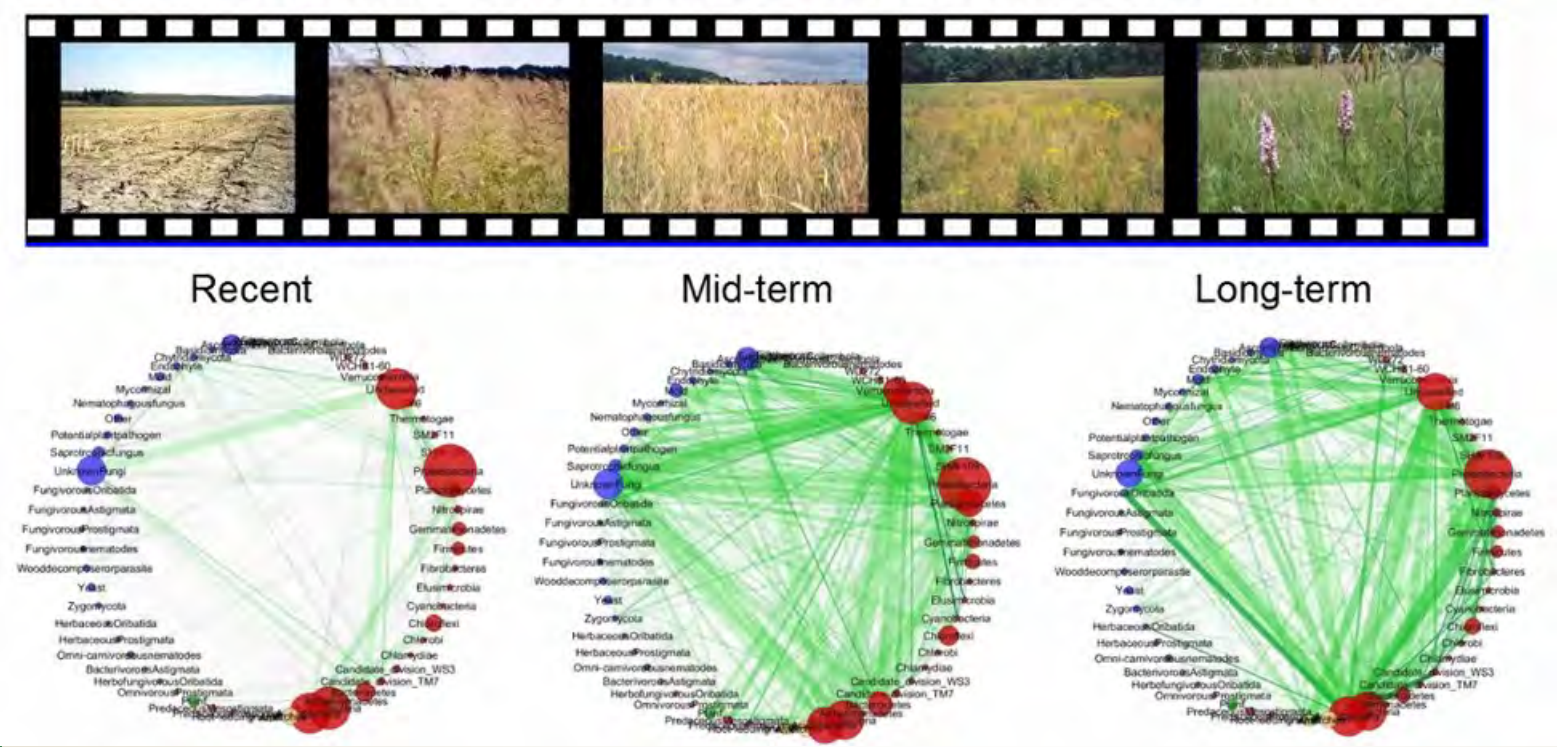
Ex-seminativi abbandonati in diversi momenti durante gli ultimi 30 anni (South Veluwe region, The Netherlands)

Resilienza della biodiversità del suolo



Networks di correlazioni tra «specie» di microrganismi del suolo in tre fasi di abbandono: 5 anni, 15 anni e 30 anni

- La forza delle interazioni aumenta col tempo
- Networks con maggiore intensità hanno una maggiore efficienza nell'acquisizione di C e N e presentano meno patogeni

Morriën et al., 2017_Nature Communications

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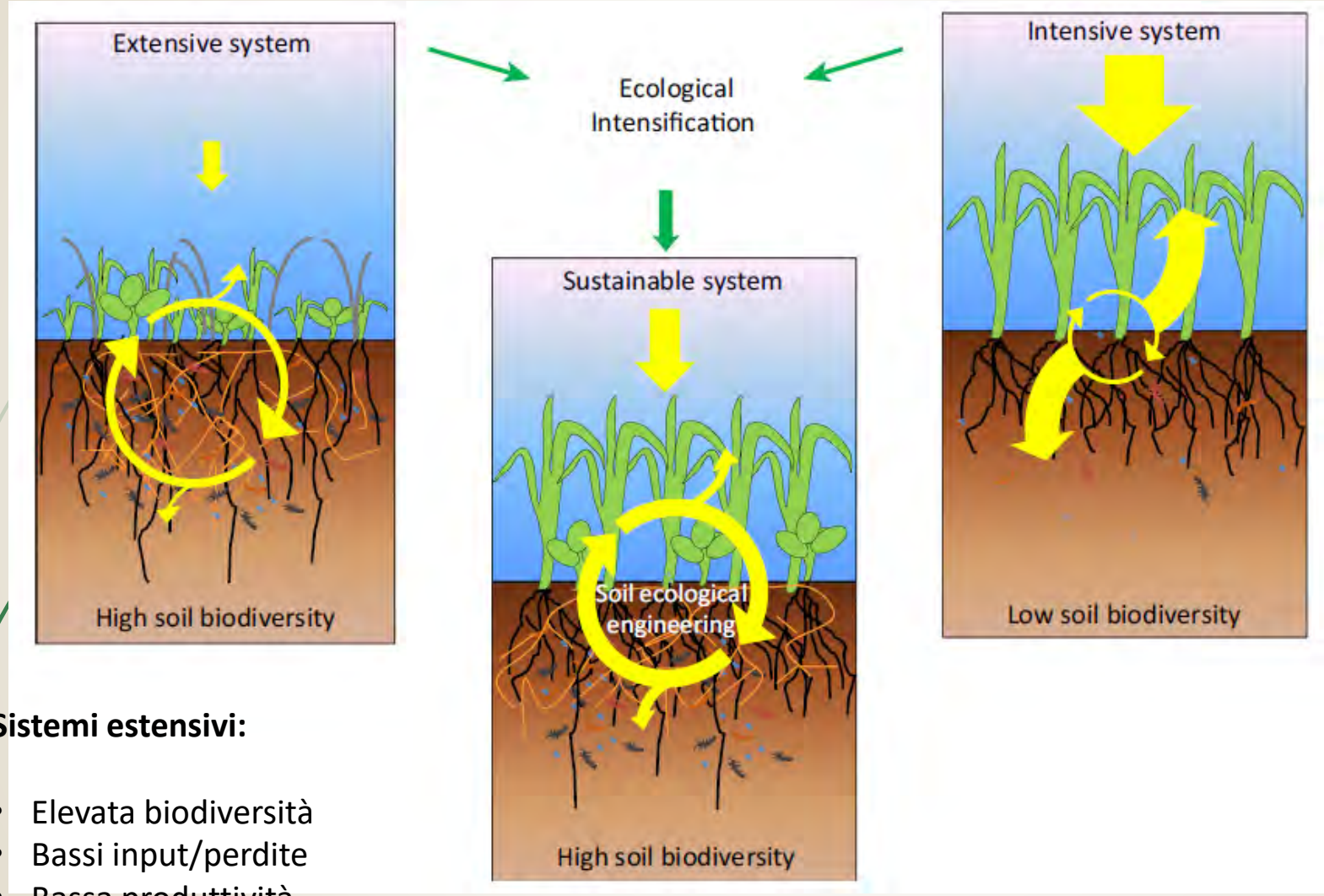
Verso un'agricoltura sostenibile



Sistemi estensivi:

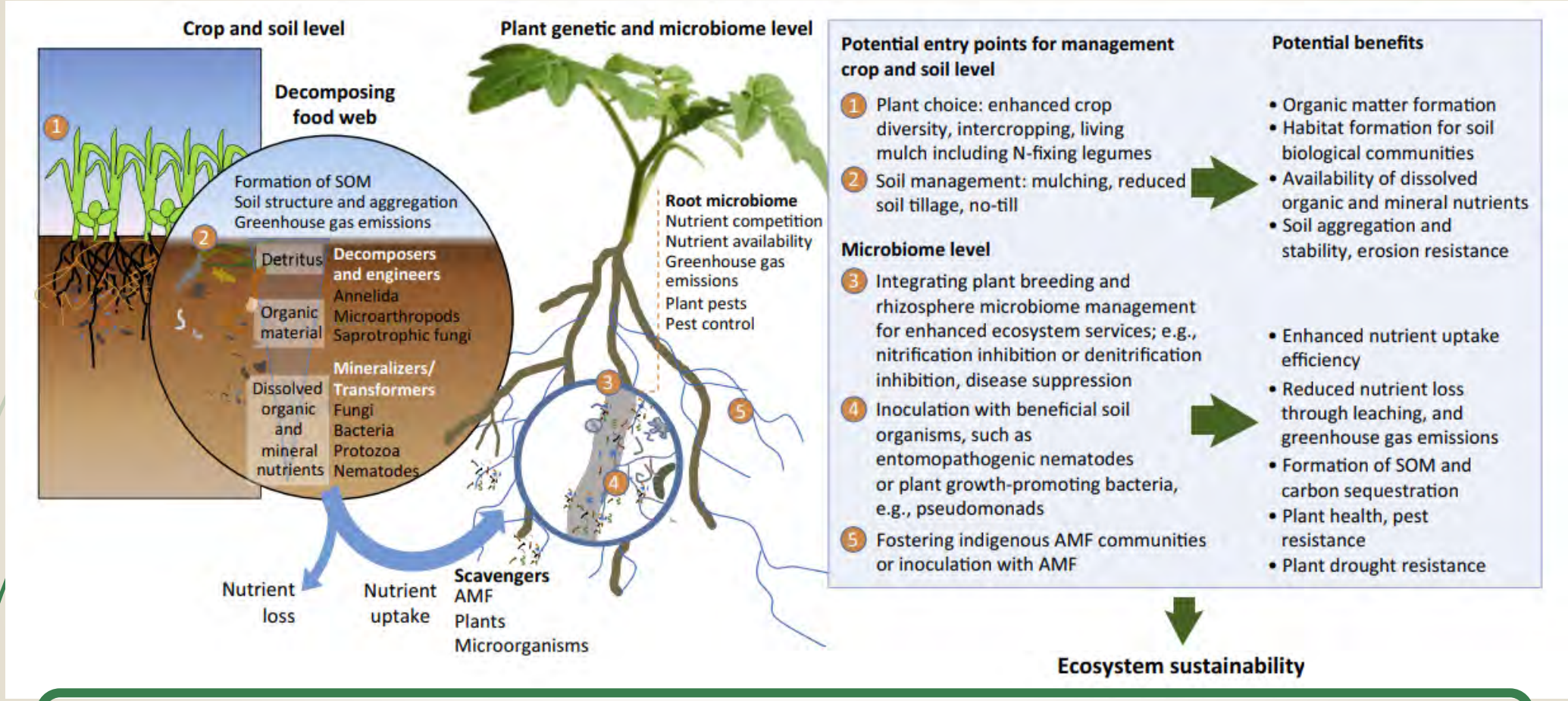
- Elevata biodiversità
- Bassi input/perdite
- Bassa produttività

Sistemi intensivi:

- Bassa biodiversità
- Elevati input/perdite
- Elevata produttività

Bender, et al. (2016). *Trends in ecology & evolution*, *31*(6), 440-452.

Strategie attualmente più promettenti



Esistono differenti approcci basati su: 1) scelta/miglioramento della pianta; 2) gestione del suolo; 3) utilizzo/manipolazione del microbioma.

Bender, et al. (2016). *Trends in ecology & evolution*, *31*(6), 440-452.

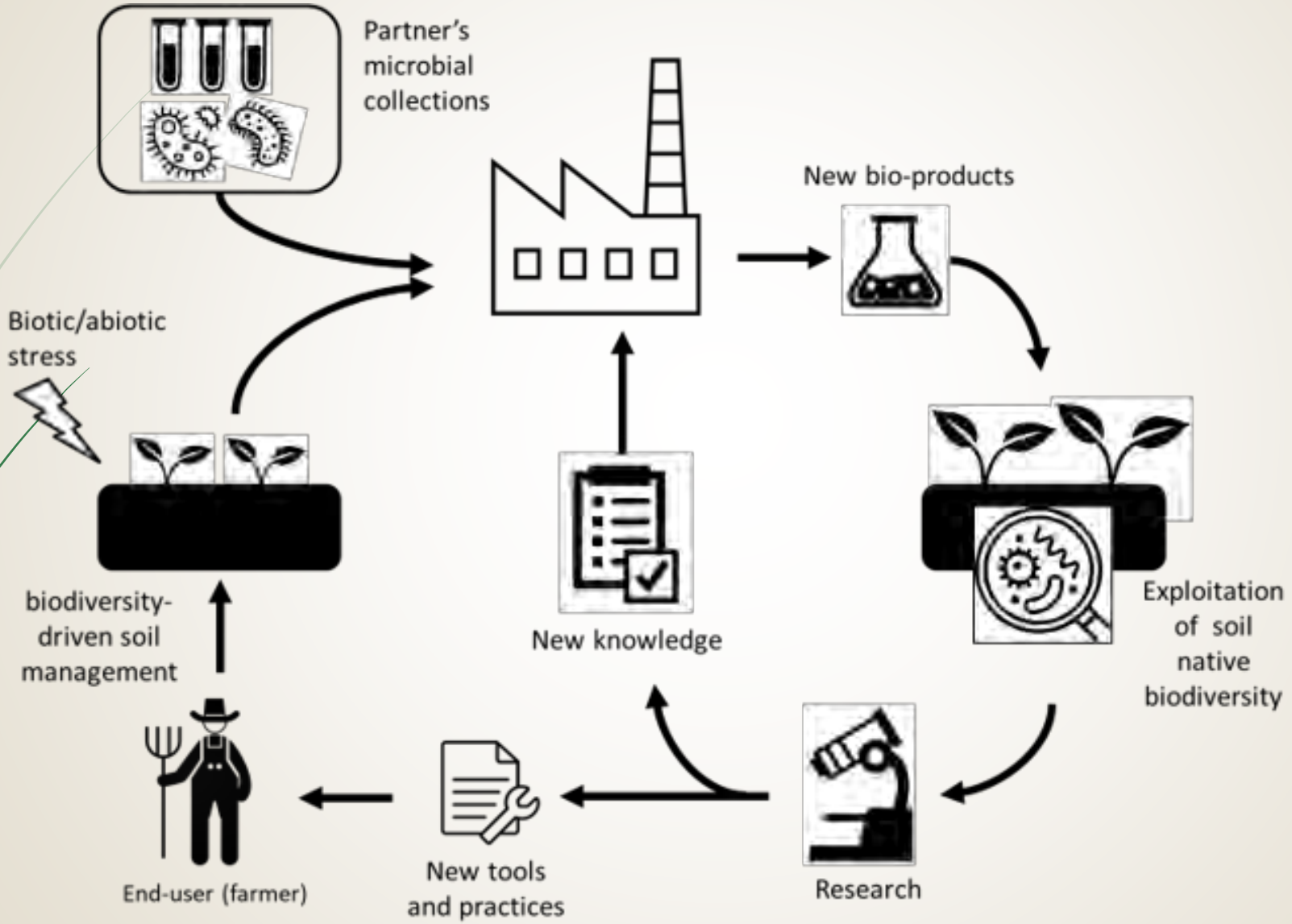
EXCALIBUR project

The main purpose of the project is to improve the knowledge on soil biodiversity dynamics in relation to the different agro-ecological factors, for enhancing the efficacy of biocontrol and biofertilization practices in horticultural farming.

New multifunctional soil microbial inoculants and bio-effectors (compounds or by-products which directly or indirectly enhance plant performance) will be tested on three model crops (tomato, apple, strawberry) under conventional and organic management across Europe.

EXCALIBUR

Project concept



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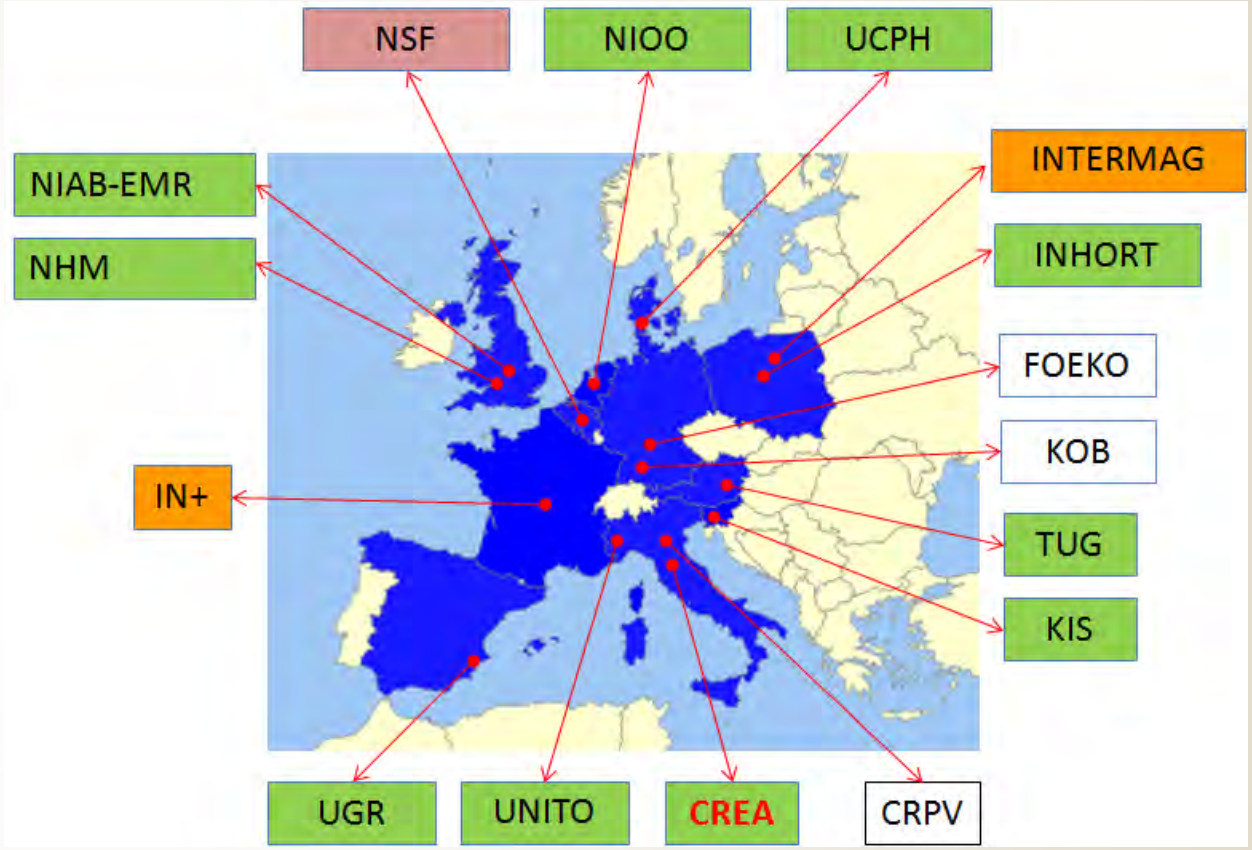
The Consortium

1	**Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria**	**CREA**	**IT**
2	Research Institute of Horticulture	INHORT	PL
3	Centro ricerche produzioni vegetali soc. Coop.	CRPV	IT
4	Natural History Museum	NHM	UK
5	NIAB East Malling Research	NIAB EMR	UK
6	Kmetijski Institut Slovenije - Agricultural Institute of Slovenia	KIS	SI
7	Università degli Studi di Torino	UNITO	IT
8	Koninklijke Nederlandse Akademie Van Wetenschappen (KNAW)	NIOO-KNAW	NL
9	Kobenhavns Universitet	UCPH	DK
10	Technische Universitaet Graz	TUGRAZ	AT
11	Inoculumplus	IN+	FR
12	Universidad de Granada	UGR	ES
13	Intermag sp. z o.o.	INTERMAG	PL
14	NSF Euro Consultants	NSF	BE
15	Kompetenzzentrum Obstbau Bodensee	KOB	GE
16	Fördergemeinschaft Ökologischer Obstbau e.V.	FOEKO	GE



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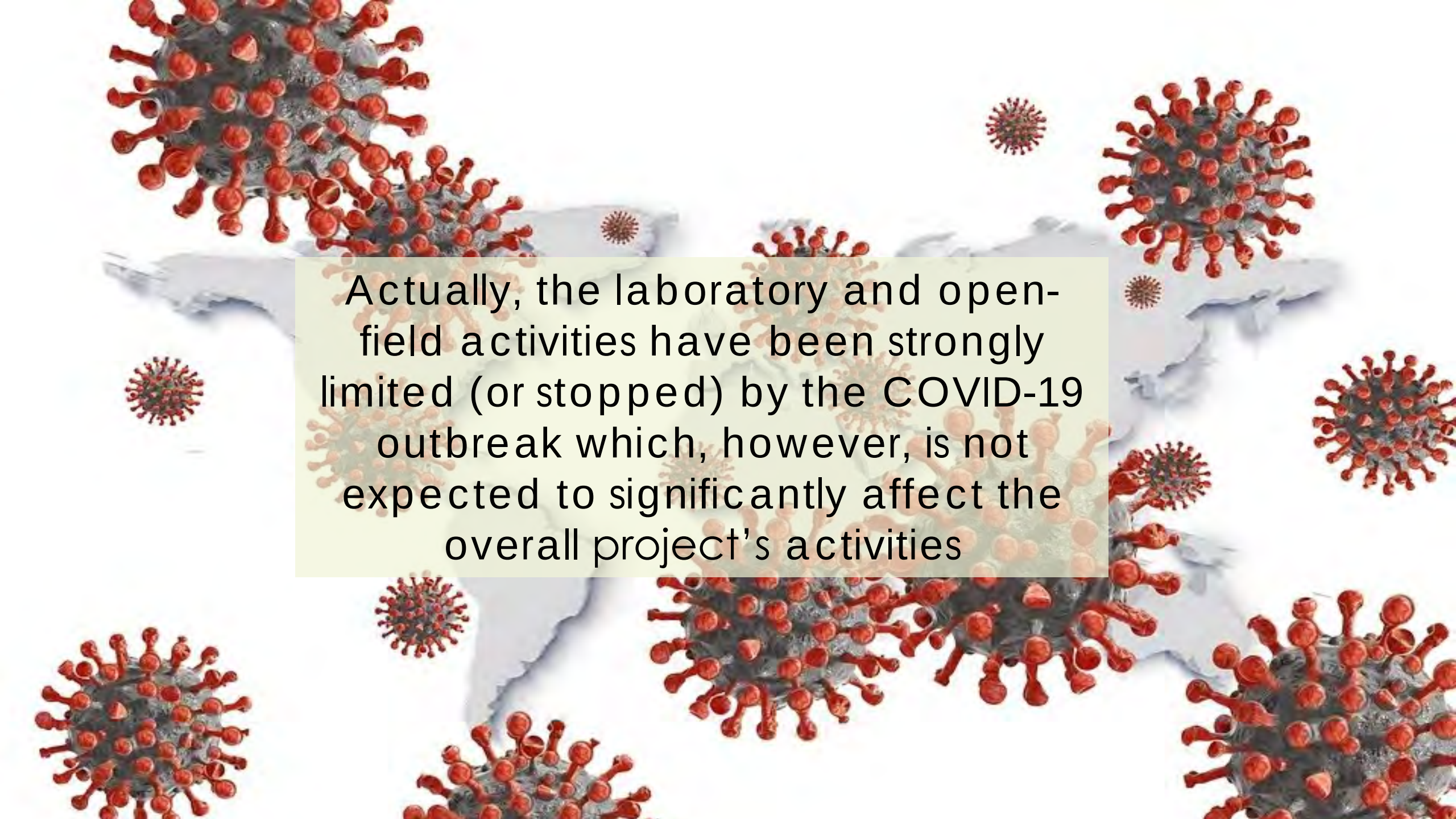
EXCALIBUR – Kick off meeting
19-24 June 2019, Florence (Italy)

Fruchtwelt Bodensee 2020 fair (Germany)

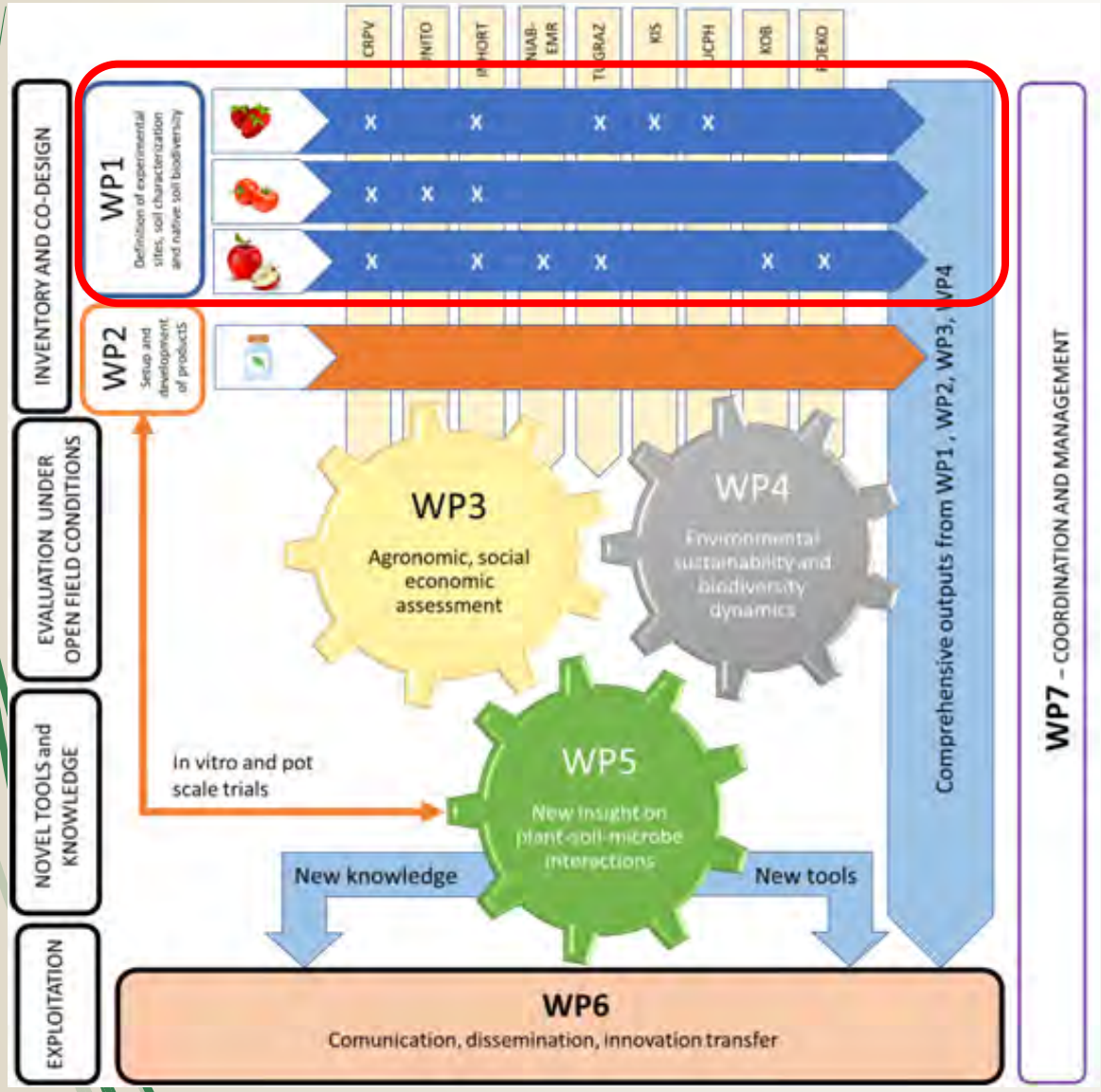
Scientific event at INHORT, Skierniewice (Poland)

19th International Conference on Organic Fruit Growing
17-19 February 2020, Hohenheim (Germany)



Actually, the laboratory and open-field activities have been strongly limited (or stopped) by the COVID-19 outbreak which, however, is not expected to significantly affect the overall project's activities

WP1 - Selection of field trials and definition of native belowground biodiversity



TRIAL 1 - Preliminary

Partner	INHORT	Public (Public or private)
Institution hosting the trial	INHORT	Public *(Public or private)*
Trial location	Skierniewice - Podlesna (PL) (51.9547° N, 20.1583° E)	
Total core-plot area	3500 m^2	
Crop species	Apple	
Management method	Organic	
Research topic	Iinocula for plant protection	
Experimental treatments	Inoculum 1 Inoculum 2 Inoculum 3 Inoculum 4 Inoculum 5 Inoculum 6	
Experimental control	Untreated	
N. of blocks	4	
N. of plant per treatment per block	6	
N. plant per treatment	24	
Parameters monitored	Soil chemical analysis Soil physical analysis OTHERS TO BE DEFINED	
PHOTO		

ON-GOING ACTIVITIES….

ON-GOING ACTIVITIES….

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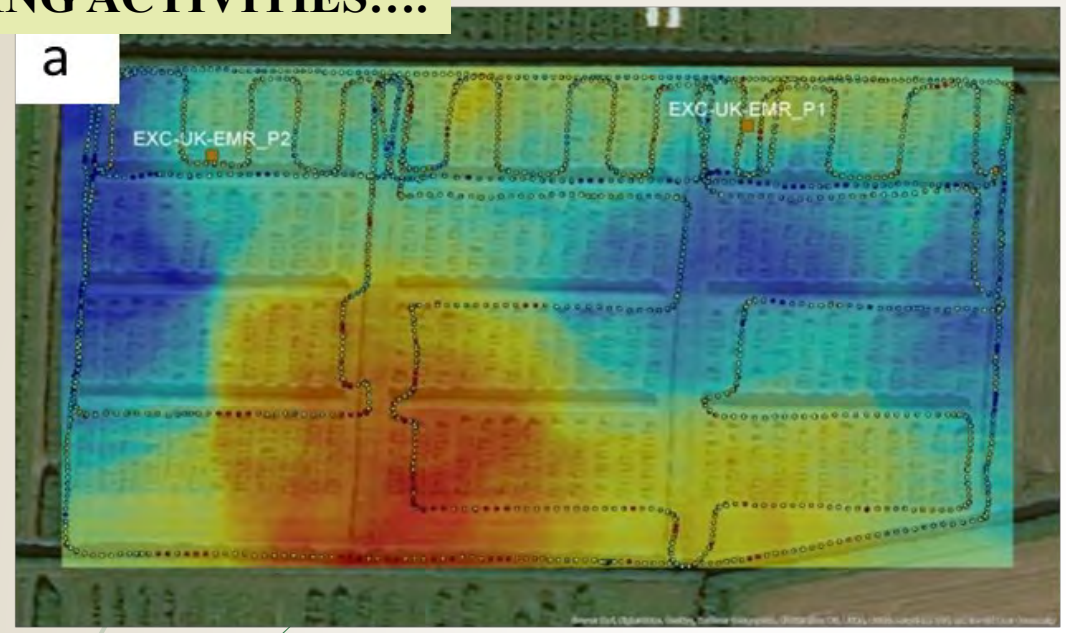
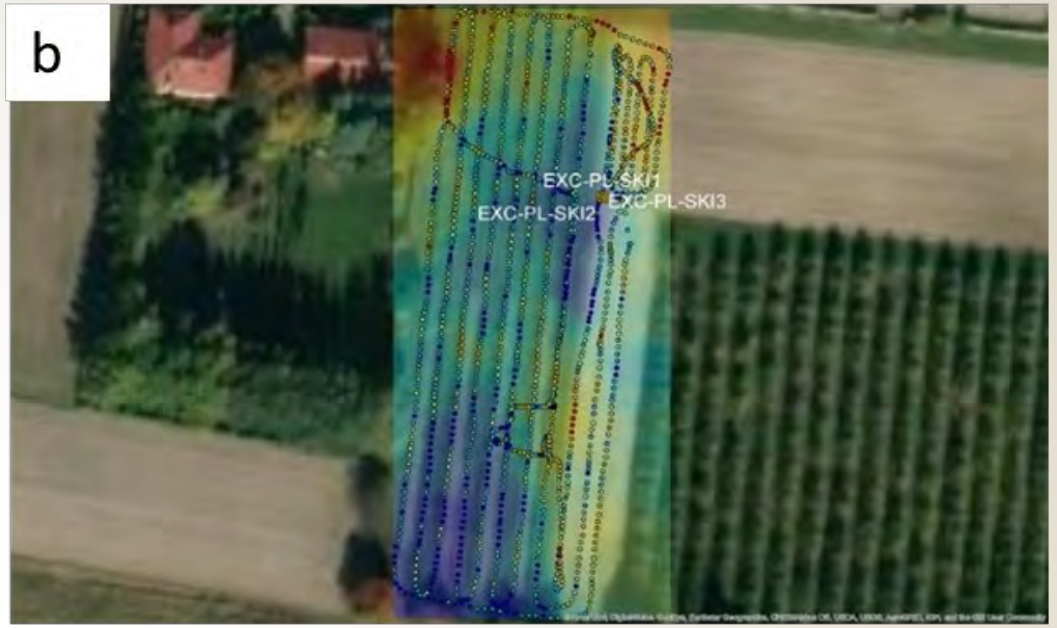
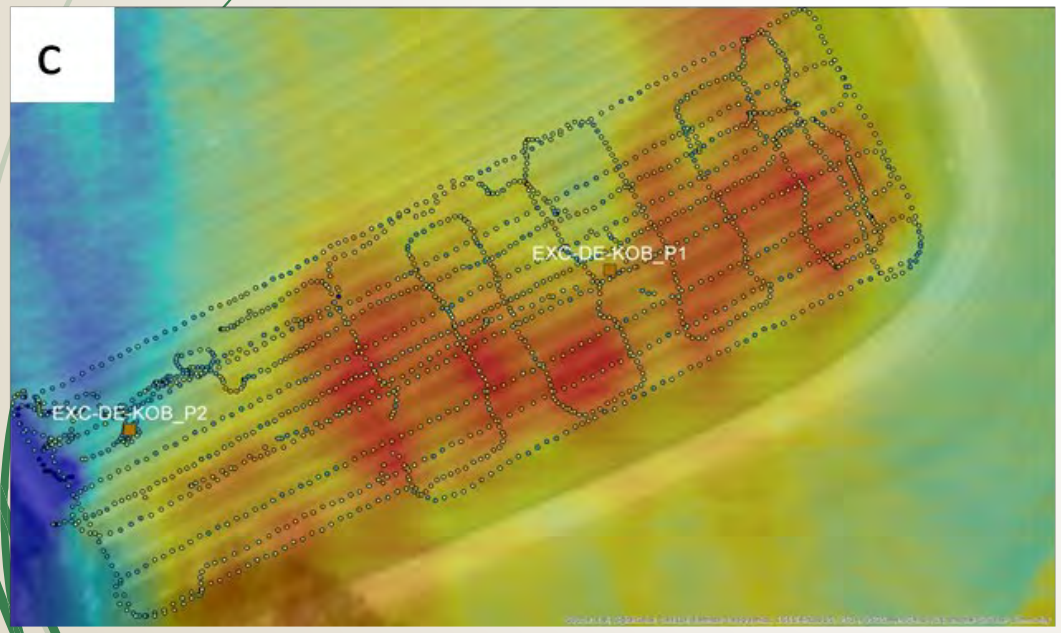
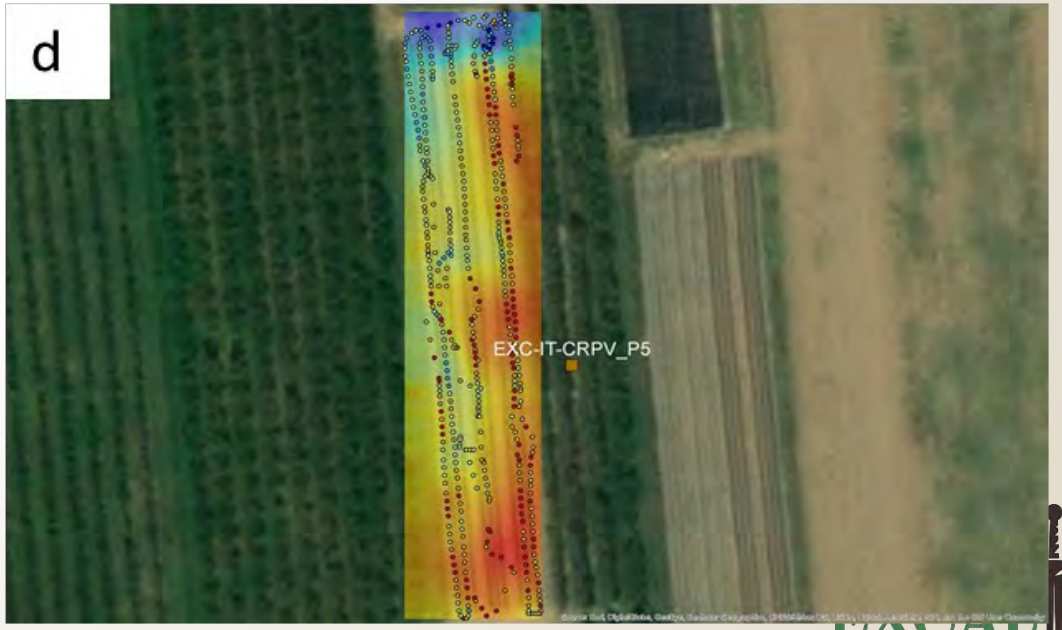
ON-GOING ACTIVITIES….









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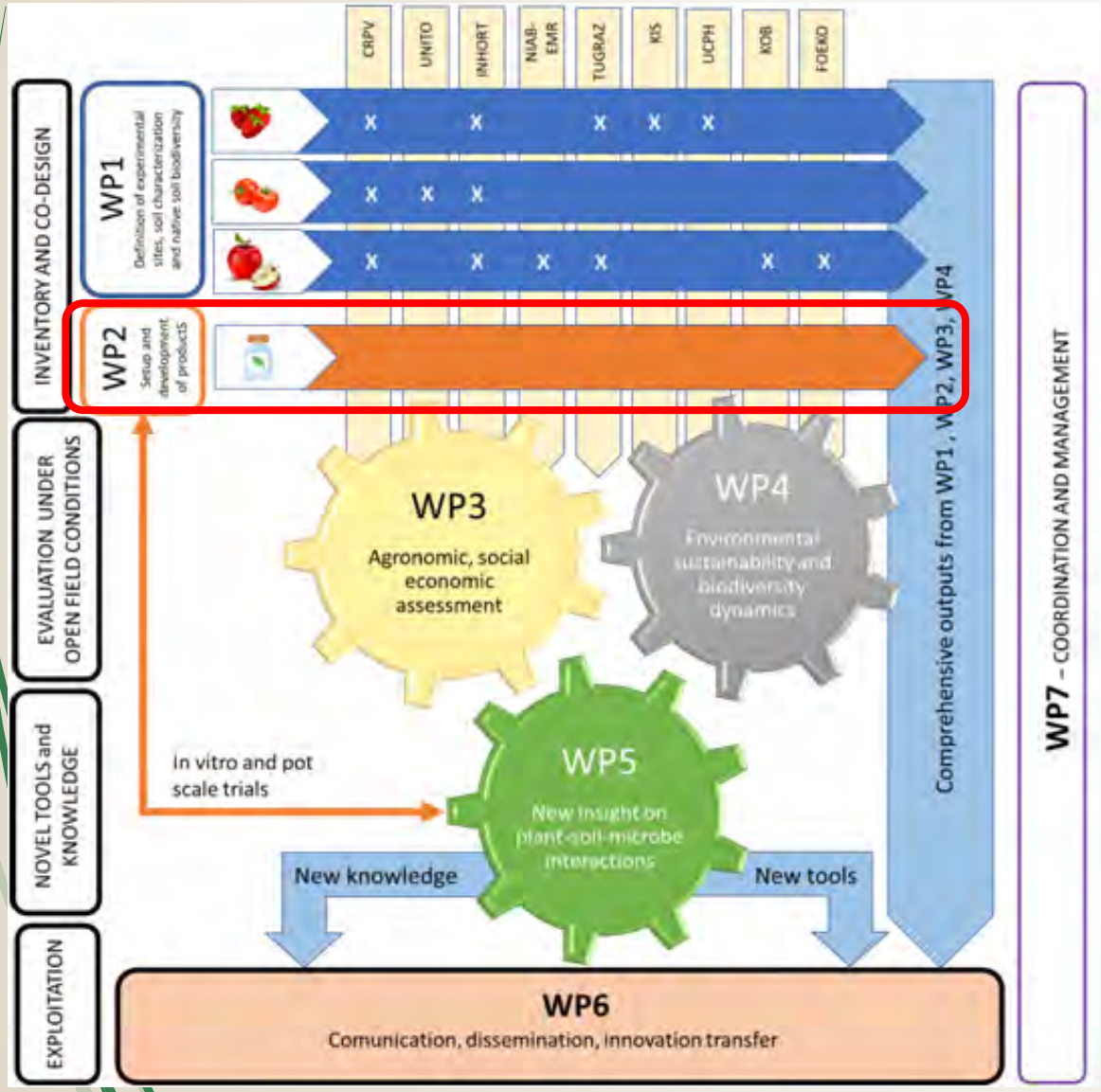
Native biodiversity: meso and macrofauna

- This activity aims at assessing the populations of the native macro (earthworms), meso (nematodes and microarhtropods) and microfauna (protists) communities, in representative fields of the different trials.
- Microbial diversity will be assessed in spring 2021

WP2 - Development of novel bio-products and practices under controlled conditions



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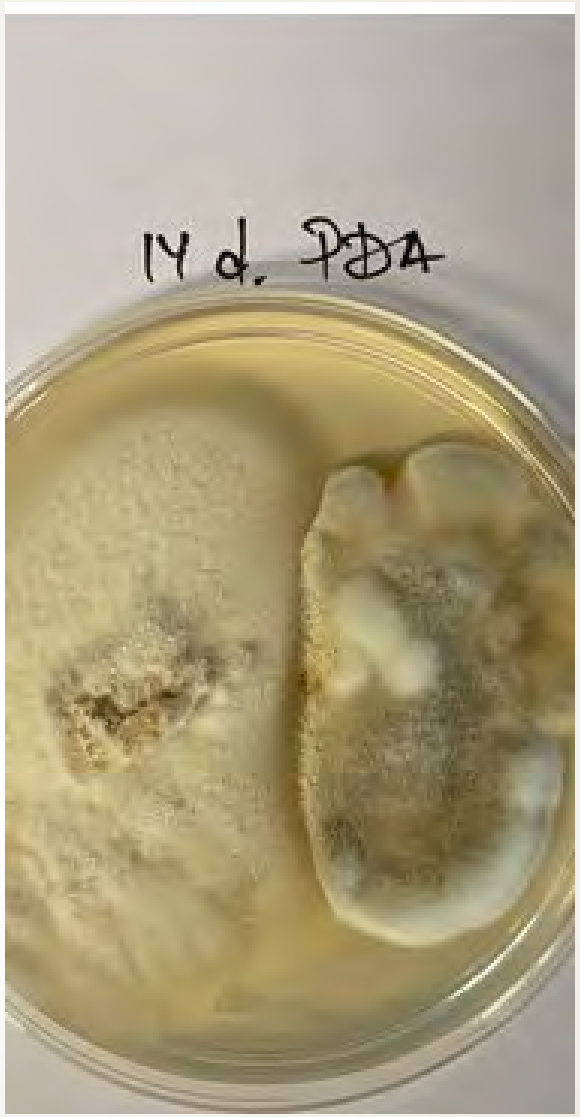
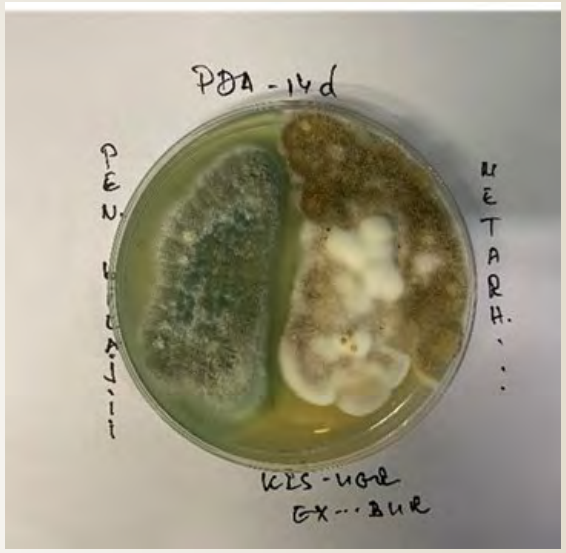
Selection of microorganisms and bio-effectors

- Several PGP microorganisms were selected based on their previously shown ability to provide biocontrol and biostimulation effects. Compatibility experiments were also carried out.

- Dual culture tests indicated that *some bacterial strains* are not compatible with a set of diverse fungal taxa, e.g. *Trichoderma* sp., whose colony growth is suppressed by secondary metabolites produced by *bacteria.*





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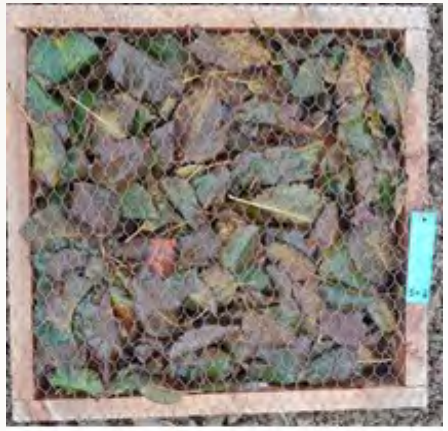
Selection of microorganisms and bio-effectors

- Tests on selected bioeffectors were carried out in a modern phytotron chamber, where in daily cycle, parameters such as temperature, air humidity, light intensity (LED lamps), CO2 concentration, wind simulation, frequency and method of irrigation (droplet, flooding or rain simulation) can be controlled (INTERMAG, Poland)

Selection of microorganisms and bio-effectors

- Vinasse (left, below) with new bioeffectors is used by KOB to accelerate the leaf degradation process over the winter to reduce the occurrence of the apple scab fungus Venturia inaequalis.



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Tests assessing the effect of formulated bio-products under lab/greenhouse conditions

- A tunnel pot experiment was performed by KIS with *M. brunneum* to evaluate its ability to colonize strawberry rhizoplane and leaves and to evaluate the effect on pests. Moreover, potential physiological effects of crop-pest-microbe interactions were assessed on leaves mineral nutrient content, photosynthetic gas exchange and chlorophyll content.

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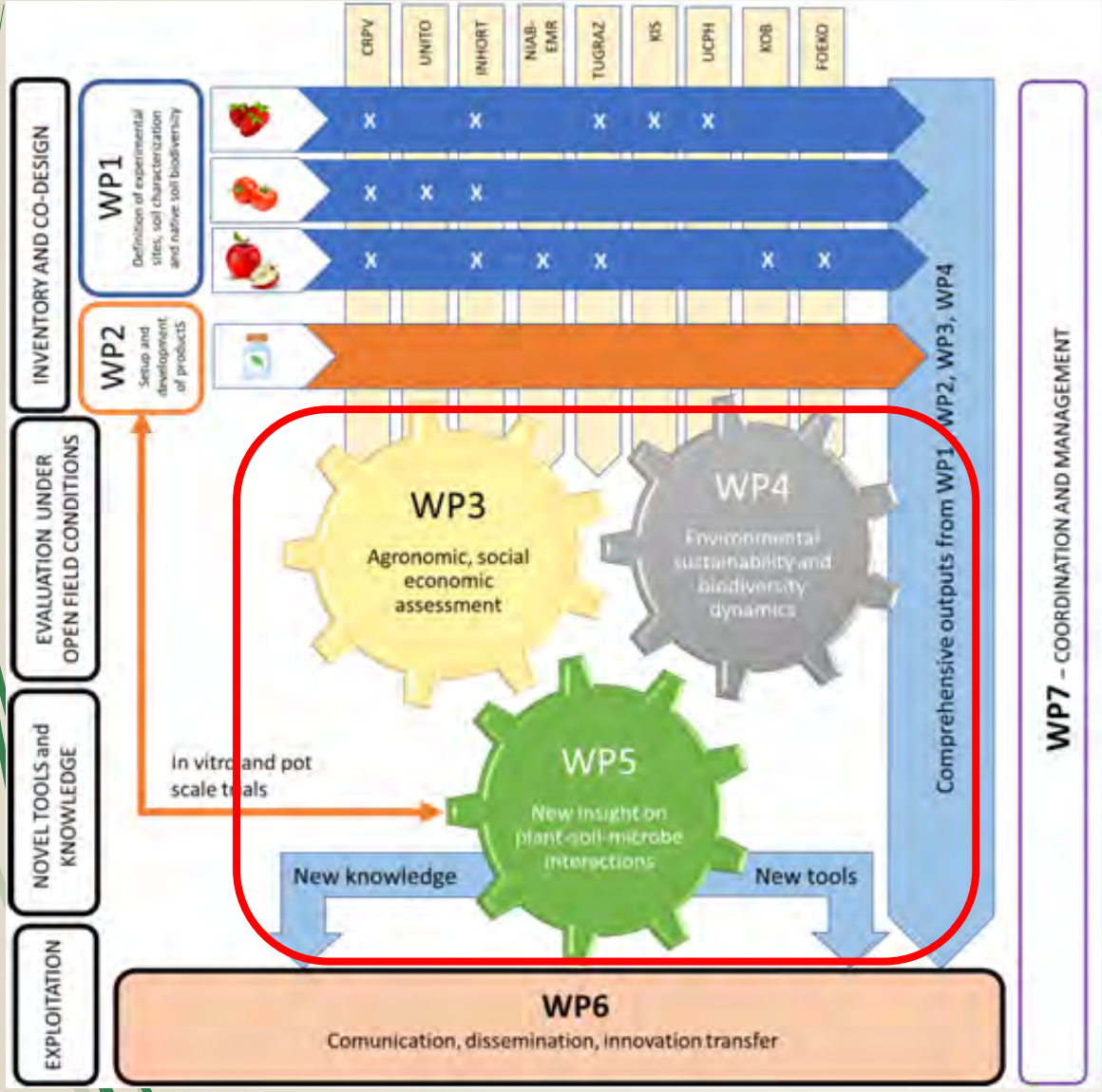
Next steps…



- Field trials will start in Spring 2021
- We will deeper investigate on plant-soil-microbe interactions, and the mechanisms underlying effects of bio-inocula on plant responses to stress. Moreover, a model for biodiversity management, a DSS and diagnostic tools will be also developed and validated.

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Expected impacts

- Expand the agro-ecological knowledge base on the links and dynamics between soil biodiversity and agricultural production
- Development of novel multifunctional bio-products and approaches to embed benefits of soil biodiversity into farming practices
- Value creation: we expect a reduction on external chemical inputs of at least 10-30% (depending on crops, soil characteristics and pedoclimatic conditions). The adoption of the practices provided by Excalibur will let farmers save up to approximately 240€/Ha for apple, 120€/Ha for tomato and 100€/Ha for strawberry (source: CRPV).
- The development of a provisional model for biodiversity management will help farmers to manage soil biodiversity of their fields in an optimal way.
- A Decision Support System (DSS) will be developed in conjunction with partners and stakeholders to help farmers to adopt a biodiversity-focused soil management.
- Bioindicators and molecular diagnostic tools for monitoring the persistence of bio-inocula and their impact on soil and plant-associated biodiversity.
- Development of a molecular diagnostic kit to profile soil microbial diversity.

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Broader policy context

EXCALIBUR will develop methods for evaluating the persistence of applied bioproducts and their impact on soil biodiversity.

Such information will be utilized to develop guidelines supporting the regulatory process of this category of products in both organic and integrated horticulture. Even though the methods and guidelines for the biopesticides evaluation are already established as a result of EU Reg 1107/2009, their continuous improvement is also expected to receive benefit from the projects results and the documents developed under this task. This is particularly relevant for the organic sector, which needs highest standards of quality and security for biofertilizers and biopesticide for their admissibility.

The EXCALIBUR project will support the development of derivative legal provisions (i.e. implementing EU Regulations, national requirements necessary to fully adopt EU legal provisions, registration and control guidelines, etc.), proposing their adoption for bioproducts registration.

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Fertilizing Product Regulation (Reg. EU 2019/1009)

Regulation (EU) 2019/1009 on EU fertilising products (FPR)

- adopted in June 2019
- fully applicable as of 16 July 2022
- CE-marking, optional harmonisation
- replaces the EC Fertilisers Regulation (EC) No 2003/2003
- product regulation → does not regulate use of products or mode of application

CMC 7 (Micro-organisms)			
Exhaustive list of microorganisms undergone no other processing than drying or freeze-drying:			
Azotobacter spp.	*Rhizobium* spp.	*Azospirillum* spp.	Mycorrhizal fungi
Nothing else but the above may constitute → PFC 6(A) – Microbial Plant Biostimulants			

PPP vs BIOSTIMULANTS

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THANK YOU

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