



# The EXCALIBUR project: novel microbial-based bioproducts improving soil biodiversity and the effectiveness of biocontrol and biofertilization practices in horticulture

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# EXCALIBUR project

*"Exploiting the multifunctional potential of belowground biodiversity in horticultural farming"*

Excalibur addresses the call SFS-01-2018 **"Biodiversity in action: across farmland and the value chain"**, subtopic A **"Small organisms, big effects for plants - Belowground biodiversity interaction with plants (RIA)"**

- Grant number: 817946
- Duration: 60 months
- Start date: 01 June 2019
- Requested contribution: €6,995,107.50
- PO: Silvia Gemini
- Coordinator: Stefano Mocali (CREA, Firenze – ITALY)





# 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.

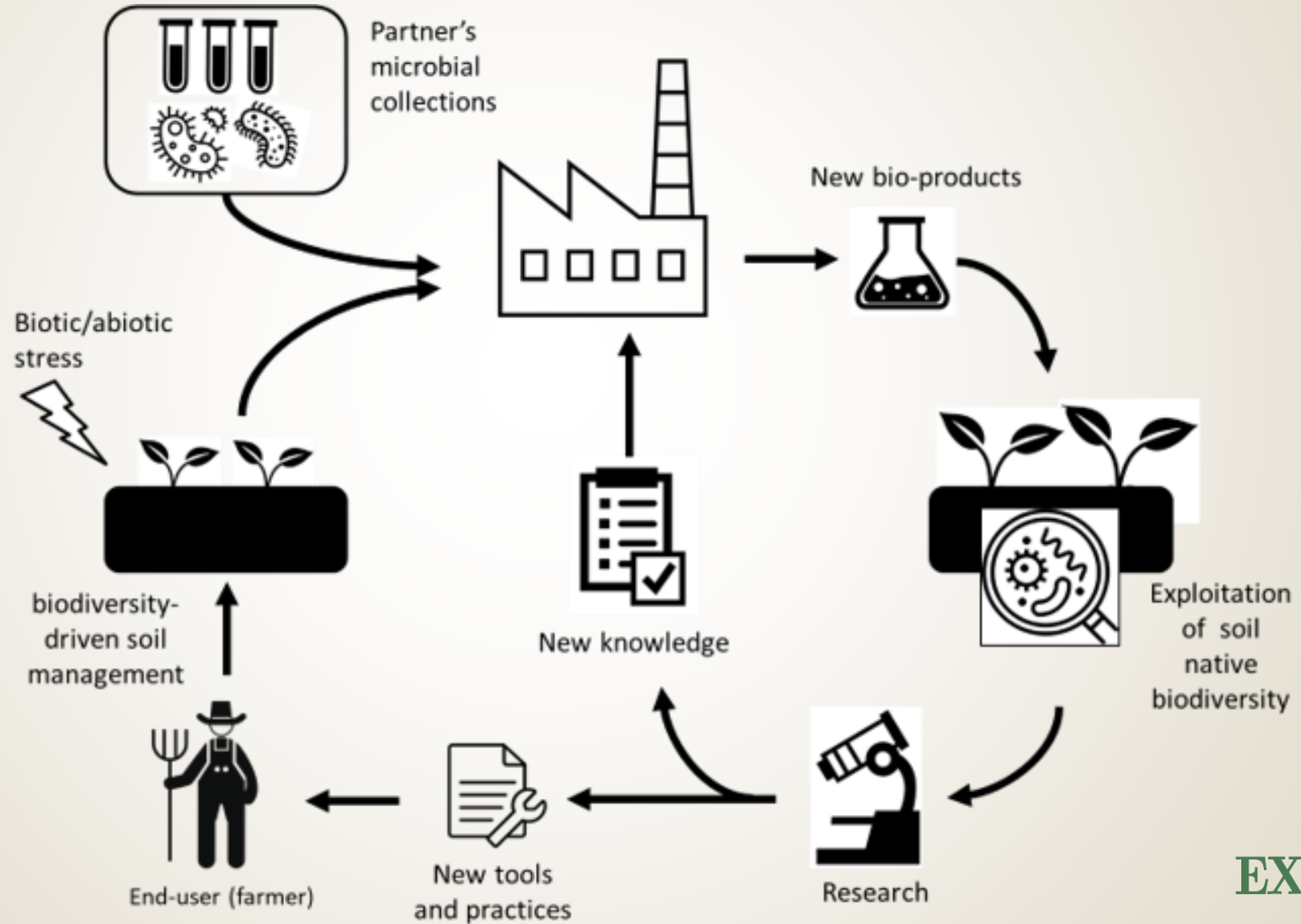


New multifunctional soil microbial inoculants and bio-effectors (compounds or by-products which directly or indirectly enhance plant performance) will be tested on three model crops (tomato, apple, strawberry) under conventional and organic management across Europe.



**SOIL BIODIVERSITY**

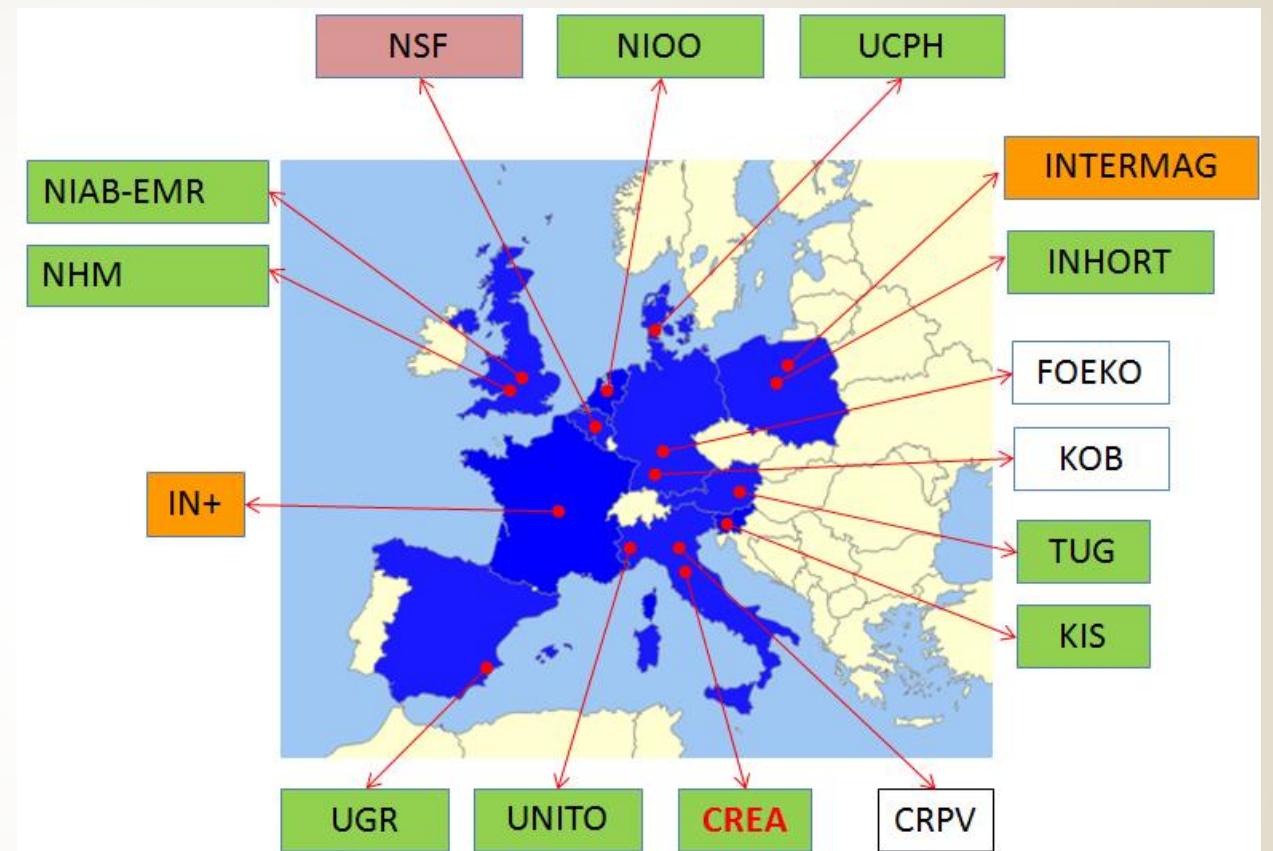
# Project concept





# 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

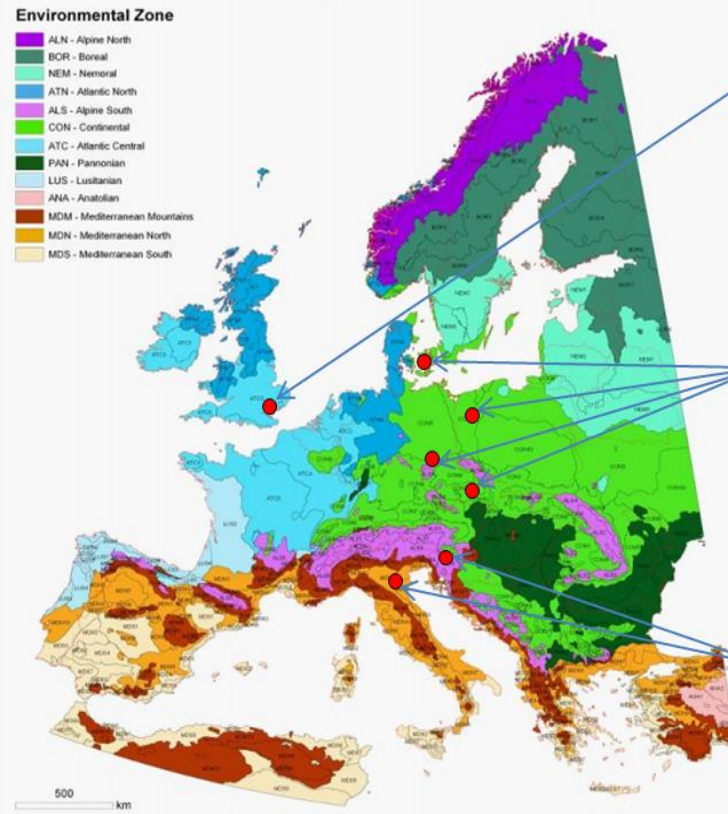


- = Research/University
- = Farmers/Advisors
- = SME (manufacturers)
- = SME (consultant)

# The experimental areas

We will 'artificially' promote soil biological functions and diversity integrating management practices with newly developed formulations containing beneficial microbial bio-inocula ('probiotic approach') and bio-effectors ('prebiotic approach'), to understand how they are affecting crop productivity, soil biodiversity and fertility.

Environmental Stratification of Europe

























**Atlantic Central (UK):** The area under influence of the Atlantic ocean and the North sea, humid with rather low temperatures in summer and winter, but not extremely cold

**Continental (AT, DE, PL, DK):** The part of Europe with an environment of warm summers and rather cold winters. This is a main agricultural production zone in EU-27.

**Mediterranean North (IT, SI):** The Mediterranean north represents the major part of the Mediterranean climate zone with Cork Oak, fruit plantations and Olive groves

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Partner	Country	Management	Open field	Protected conditions
INHORT	PL	Organic	 	
		IPM	 	
CRPV	IT	Organic	  	
		IPM	  	
NIAB EMR	UK	IPM		
KIS	SI	Organic		
		IPM		
UNITO	IT	IPM		
UCPH	DK	Organic		
		IPM		
TUGRAZ	AT	Organic		
		IPM	 	
KOB	DE	Organic		
FOEKO	DE	Organic		



# Main objectives

1. Generate **new knowledge** on interactions between plant, soil, micro-, meso- and macro-organisms and on the links between native soil biodiversity and agricultural practices;
2. **Optimize the formulation** and the application methods of novel multifunctional microbial-based products, using already available soil-derived microbial strains and organic products (biostimulants, soil amendments) for plant nutrition and protection purposes;
3. Evaluate the efficacy of the new strategy under **open-field conditions** in improving plant health and reduction of external inputs as well as its economic feasibility;
4. To deliver **models and tools (DSS)** to help practical application of a comprehensive biodiversity-driven strategy for soil management;
5. Develop adequate **tools to monitor** the persistence and the fate of the microbial inocula in the field;
6. Evaluate the effects of the new strategy on **soil quality and ecosystem functions**, dynamics of soil and plant-associated microbial biodiversity at multi-scales;
7. Disseminate the results to relevant stakeholders and encourage the adoption of **best practices**



# ***Analyses on soil-plant-microbe interactions:***

## **Monitoring the diversity and composition of plant endophytes, rhizosphere and soil microbiota over time (3 years)**

- Amplicon-based metabarcoding NGS and qPCR (bacteria, fungi, archaea, oomycetes and nematodes) of rhizosphere
- earthworms, arthropods, nematodes, protist
- The expression of key functional genes related to C, N and P cycling (RT-PCR and enzymes)
- Soil processes (SOM mineralisation and quality , GHG emissions, N losses, etc.)
- Soil structure, nutrient availability (i.e. mineral leaching)
- Crop productivity and LCA

Only in cases where significant results occur:

## **PLANT-SOIL-MICROBE INTERACTIONS**

- Metagenomics-transcriptomic-metabolomics (i.e. VOCs)
- Target groups (i.e. pathogens) of rhizosphere and endophyte microbiome.
- Plant response against pests

# 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.





**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, Hohenheim (Germany)**





# ON-GOING ACTIVITIES....





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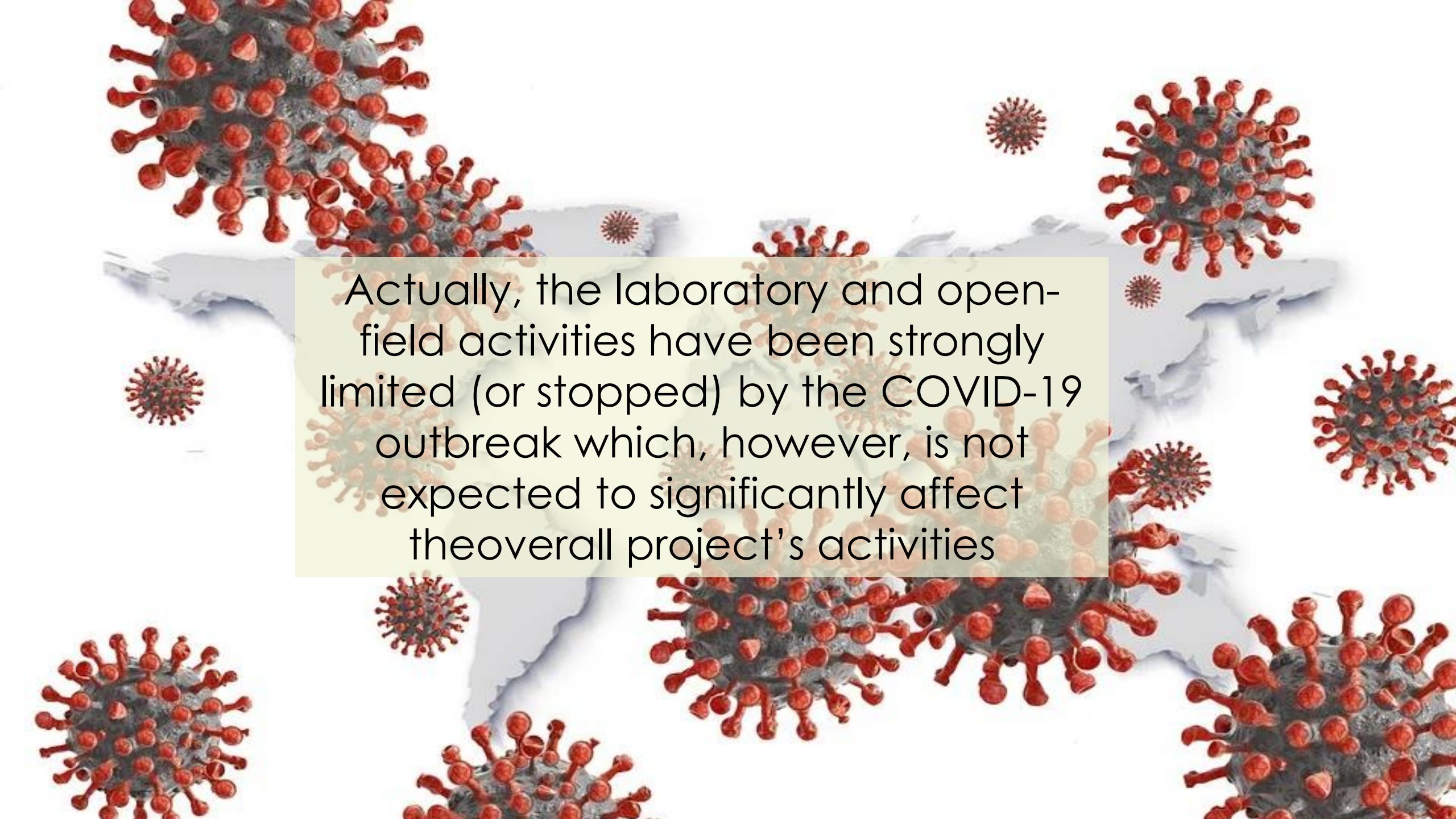




# ON-GOING ACTIVITIES....

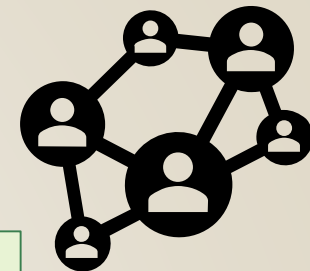




The background of the slide features a light blue world map. Overlaid on the map are several 3D renderings of COVID-19 virus particles. These particles are depicted as spherical, greyish-blue structures covered in numerous red, spike-like protrusions. The particles are scattered across the map, with some appearing larger and more detailed than others. A semi-transparent yellow rectangular box is centered over the map, containing the main text.

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

# Synergies with related projects



- N. 817819 – **SoildiverAgro** "Soil biodiversity enhancement in European agroecosystems to promote their stability and resilience by external inputs reduction and crop performance increase"
- N. 728003 – **Diverfarming** "Crop diversification and low-input farming across Europe: from practitioners' engagement and ecosystem services to increased revenues and chain organization"
- N. 817696 – **BEST4SOIL** "Boosting 4 BEST practices for SOIL health in Europe"
- N. 774244 – **BRESOV** "Breeding for Resilient, Efficient and Sustainable Organic Vegetable production"
- N. 818431 - **SIMBA** "Sustainable Innovation of Microbiome Applications in the Food System"

➤ **WHO'S NEXT?**



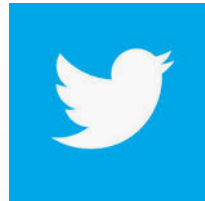
# THANK YOU



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