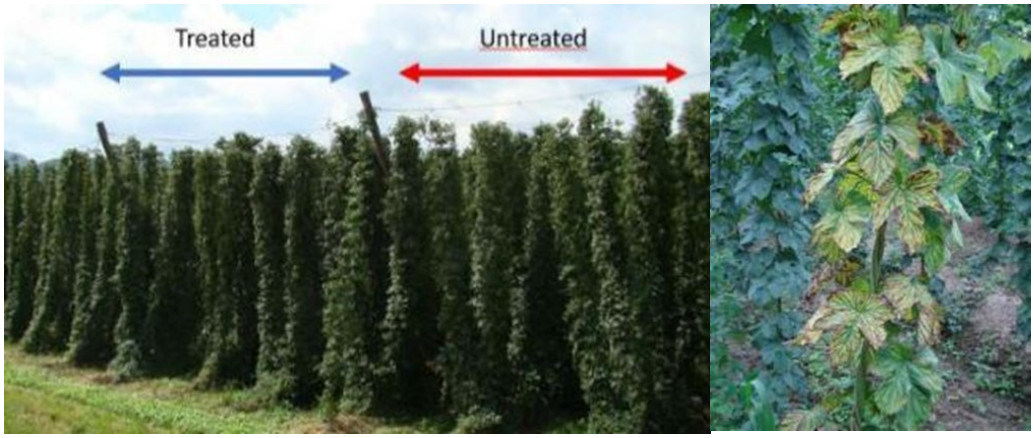
SUSTEMICROP PROJECT – NEWSLETTER

(December 2025)



SUSTEMICROP (PRIMA 2021 Section 2) is a research project focused in the development of different bio-based solutions applied to three targeted crops – date palm, grapevine, and hop – to increase the resilience of small farmers in the Mediterranean area

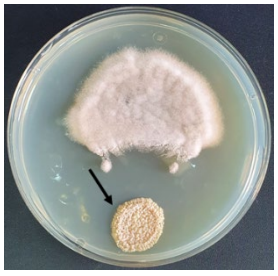
A biofertilizers based on compost enriched with biocontrol agents to combat young grapevine decline

Grapevine trunk diseases are one of the greatest threats to vineyards worldwide. This term encompasses various pathologies such as esca, eutypa dieback, black-dead arm syndrome, and young grapevine decline, among others.

Young grapevine decline is a serious threat to newly planted vineyards, encompassing diseases such as black foot and Petri disease. Among its most frequent causes are the use of infected plant material produced in nurseries or the subsequent infection of young plants in their early years of development in the vineyard by fungi such as *Cadophora*, *Dactylonectria*, *Phaeomoniella*, or *Phaeoacremonium* through the root system. Reducing the levels of these pathogens in vineyard soils is a key tool for controlling this devastating disease.

The working group from the University of León (Spain) has verified how the incorporation into the soil of a biofertilizer based on compost enriched with selected biocontrol agents (BCAs) of bacterial origin has been able to reduce the levels of some of these fungi in the soil.

A BCA is a microorganism able to efficiently inhibit the development of a pathogen. Researchers from ULE leaded by Dr. Rubio Coque selected different BCAs isolated from the root system of grapevine plants. These BCAs were selected by their high antifungal activity against different fungal phyotopathogens causing young grapevine decline



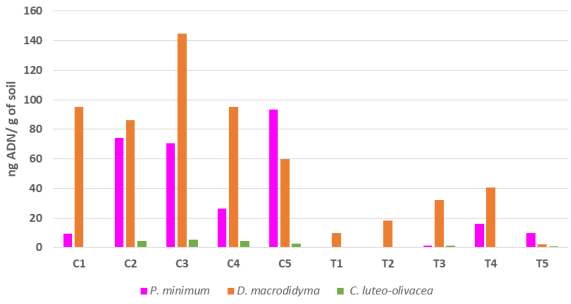
Selection in the laboratory of bacterial strains exhibiting a high antifungal activity against fungal phytopatogens involved in young grapevine decline

These BCAs agents were incorporated onto a organic compost to produce a biofertilizer that was tested in microplots of a vineyard plant nursery soil belonging to the Spanish company Viveros Villanueva Vides S.L. (Larraga, Spain).

Field trial on soil microplots to test the effectiveness of a biofertilizer based on compost enriched in BCAs to combat young grapevine decline

Experimental results confirmed that incorporating the biofertilizer into the soil resulted in a decrease in the levels of the pathogenic fungi *Cadophora luteo-olivacea*, *Dactylonectria macrodidyma*, and *Phaeoacremonium minimum*, three of the fungi responsible for young grapevine decline.

These promising results confirm that biofertilizers based on compost, obtained from the crop residues and enriched with beneficial bacteria, can improve the health of vineyard soils, helping to reduce the incidence of soil-borne grapevine trunk diseases, and more specifically, young grapevine decline.



Levels of fungal phytopathogens detected in the control microplots (C; control) and in the microplots treated with a biofertilizer made of compost enriched in BCAs (T; treatment).

This work was financed through a PRIMA grant (Section 2-2021) and is part of the project PCI2022-132966, funded by the Ministerio de Ciencia e Innovación (MCIN) and the Agencia Estatal de Investigación (AEI) (Spain).

Design of a biofertilizer based on phosphate-solubilizing bacteria (PSBs) for application in hop cultivation

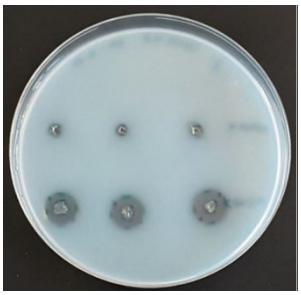
The productivity of agricultural soils around the world largely depends on the use of both organic and inorganic fertilizers to increase crop productivity. However, most of the phosphorus incorporated into agricultural soils through the use of fertilizers precipitates in the form of insoluble salts that are incapable of being used by plants. This insoluble phosphorus present in large quantities in soil forms the well-known "phosphorus legacy". The solubilization of this "phosphorus legacy" has become a goal of great agronomic importance, and the use of PSBs would be a useful tool for this purpose.

Hops (whose female flowers, or cones, are essential to the brewing industry as they contribute bitterness and aromas to the beverage) is a very demanding crop from a nutritional point of view, requiring significant fertilization each year, which entails considerable costs for the farmer.

View of a commercial hop plantation and detail of the female flowers or cones. Photo courtesy of Dr. Sebastjan Radišek (The Slovenian Institute of Hop Research and Brewing, Žalec, Slovenia)

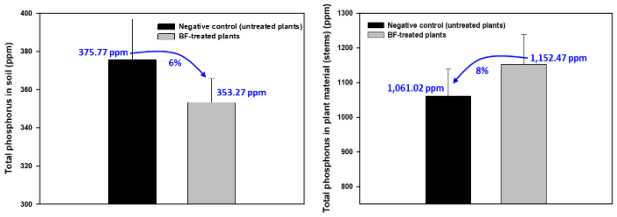
In this study we have isolated and characterized PSBs bacteria from the rhizosphere (the soil attached or in direct, intimate contact with the plant's roots) of hop plants.

Two particular bacterial strains, *Pseudomonas taetrolens* ULE-PH5 and *Pseudomonas* sp. ULE-PH6, were selected as plant growth-promoting rhizobacteria due to their high phosphate solubilization capability in both plate and liquid culture assays and other interesting traits to promote the growth of the plant. These strains were able to significantly increase phosphate uptake and accumulation of phosphorus in the aerial part (stems, petioles, and leaves) of hop plants, as determined by greenhouse trials.



Selection of bacterial strains as PSBs according to their capability to solubilize an insoluble salt (tricalcium phosphate) in NBRIP Agar media (note the presence of clear halozones surrounding the PSB colonies)

These bacterial strains were later applied and their efficacy tested as a biofertilizer in an experimental hop plantation established at the School of Agricultural Engineering of the University of León (Spain). After one year of application, a positive trend was observed, suggesting its effectiveness. The soil where the biofertilizer was applied contained lower levels of total phosphorus (indicating its solubilization), while the plants treated with the biofertilizer had higher levels of phosphorus in their stems compared to the control plants that did not receive the biofertilizer.



Total phosphorus levels in soil (graph on the left) of hop plants treated with PSB-based biofertilizer and their comparison with untreated plants, and total phosphorus levels in stems of plants treated with biofertilizer (graph on the right) and their comparison with untreated plants

These promising results suggest that these bacterial strains are promising candidates to produce biofertilizers specifically designed to increase phosphate adsorption by hop plants.

This work was financed through a PRIMA grant (Section 2-2021) and is part of the project PCI2022-132966, funded by the Ministerio de Ciencia e Innovación (MCIN) and the Agencia Estatal de Investigación (AEI) (Spain).

Meeting with Agricultural Association of Young Farmers (ASAJA) – Transfer of results to farmers

15 November 2023 – León (Spain)

The members of the research team of the University of León in the SUSTEMICROP project, Daniel Alonso-Martínez, Beatriz Jiménez-Parra and Laura Cabeza-García, carried out a working session titled *Sustainability Assessment of Farms at a "Click"*, under the umbrella of Science Week of Castilla and León.

A dedicated dissemination session was held with the Agricultural Association of Young Farmers (ASAJA), one of Spain's major farmers' organizations, to present the project's practical results to end-users. Researchers shared key findings from field trials in vineyards, hops and date palms, illustrating how SUSTEMICROP biofertilizers and sustainable management practices can help reduce chemical inputs while maintaining productivity and improving soil health.

The meeting fostered dialogue with farmers on challenges, needs and adoption barriers, ensuring that the project's outcomes remain aligned with real agricultural contexts and facilitating future uptake of the developed solutions.

Representatives from ASAJA and the University of León during the session.

Participation in PRIMA Days

22 November of 2023 — Sitges, Barcelona (Spain)

SUSTEMICROP was represented at PRIMA Days through the participation of Daniel Alonso-Martínez, from the University of León, a key Mediterranean forum for research, innovation and policy dialogue in sustainable agriculture and food systems. The consortium highlighted project advances in microbial-based biofertilizers, nutrient management, soil health and sustainability assessment. Participation in this event strengthened cooperation with other PRIMA projects, enhanced the visibility of SUSTEMICROP's outcomes, and contributed to the exchange of knowledge and good practices within the Mediterranean research community.

Participation of Daniel Alonso-Martínez (University of León) representing the SUSTEMICROP project during PRIMA Days.

Scientific publication

One important scientific achievements of SUSTEMICROP's project has been published in the journal *Environmental and Sustainability Indicators* (Elsevier). The article, titled "Theoretical framework to foster and assess sustainable agriculture practices: Drivers and key performance indicators" (doi: 10.1016/j.indic.2024.100434), presents a comprehensive methodological contribution to evaluating sustainability in agriculture.

It is authored by Daniel Alonso-Martínez, Beatriz Jiménez-Parra and Laura Cabeza-García, all partners of the SUSTEMICROP project and members of the University of León.

This work is central to Work Package 1, where the authors developed a robust theoretical framework and a comprehensive set of Key Performance Indicators (KPIs) to assess sustainable agricultural practices across the three dimensions of the Triple Bottom Line (TBL): economic, social and environmental. These KPIs have been essential for evaluating the sustainability impact of SUSTEMICROP biofertilizers and field practices, enabling a structured, evidence-based assessment of the project's contributions.

Beyond SUSTEMICROP, the article provides tools that can support agri-food stakeholders, farm managers and policymakers in measuring sustainability performance and guiding more responsible and resilient agricultural strategies.

The scientific article authored by researchers from the University of León.

SUSTEMICROP Final Meeting in Er-Rachidia (Morocco)

9-12 November 2025 — Er-Rachidia (Morocco)

The SUSTEMICROP Consortium held its Final Meeting in Er-Rachidia (Morocco), with the majority of partners attending in person and a small number joining online. The event was hosted by Mohammed VI Polytechnic University (UM6P) and brought together all participating institutions from Spain, France, Slovenia, Tunisia, Morocco and Italy. Representatives from the University of León (ULE), IFV and INRAE (France), IHPS (Slovenia), INRGREF (Tunisia), UM6P and UMP (Morocco), Agrogenia Biotech SL (Spain) and HORTA S.R.L. (Italy) presented the final scientific and technical achievements of the project.

Over two days of working sessions, partners reviewed the progress made across all Work Packages, discussed remaining tasks and clarified the final steps required for project closure. The meeting provided an opportunity to consolidate results, ensure consistency across the different research activities and coordinate the preparation of the final reporting.

The meeting concluded with a field visit to date palm plantations in the Er-Rachidia region, allowing partners to observe local agricultural conditions and reflect on the potential applicability of the project's outcomes in arid and semi-arid Mediterranean contexts. The event marked the successful completion of three years of coordinated collaboration within the consortium.

Sustemicrop's partners in the field visit to date palm plantations in the Er-Rachidia region.

SUSTEMICROP: Dissemination and Capacity-Building Activities Led by INRGREF

During the implementation of the SUSTEMICROP project, several dissemination, training and awareness-raising activities were successfully carried out by INRGREF (Tunisia), in line with the project's communication and dissemination strategy. These activities, widely shared through the official SUSTEMICROP Facebook page, aimed to promote sustainable agroecological practices and to strengthen knowledge transfer among farmers, students, advisors and other stakeholders.

Key dissemination and training events

- **Project Kick-off Meeting (23 October 2023)**

On **23 October 2023**, a dissemination workshop of the SUSTEMICROP project was held at the **INRAT Auditorium in Tunis (Tunisia)**. The event presented the project objectives and ongoing activities, and provided

an opportunity to exchange with researchers, farmers and other stakeholders on sustainable and agroecological practices in Mediterranean crop systems.

The workshop contributed to strengthening awareness and engagement around SUSTEMICROP activities in Tunisia.

➢ Training Session for Rural Women – Tunisia

From **6 to 8 November 2023**, INRGRE organized a training session for rural women in Tunisia. The activity was held at the Women's Training Centre in Ben Arous (Chebbeda region).
The main objective of this training was to disseminate SUSTEMICROP project results among rural women, strengthen their skills, and support the sustainable use of forest resources, with the aim of improving livelihoods and creating employment opportunities.
The training session was organized in collaboration with the CRDA Ben Arous (Regional Commission for Agricultural Development).

Participants expressed strong interest and enthusiasm, highlighting the importance of such initiatives for their socio-economic development and the success of local projects supported by SUSTEMICROP.

➢ Student Field Visit – Ain Drahem, Tunisia

As part of the dissemination of research results from the PRIMA project SUSTEMICROP, INRGREF organized an educational field visit on **10 November 2023** for students specializing in plant biotechnology from ISBBAT. The visit took place at the Agricultural Development Group (GDA) El Baraka in Ain Drahem.

During this activity, students had the opportunity to observe innovative agricultural practices firsthand and to explore pilot plots dedicated exclusively to the domestication of Medicinal and Aromatic Plants. This practical exposure allowed them to better understand recent advances in sustainable agriculture promoted by the SUSTEMICROP project.

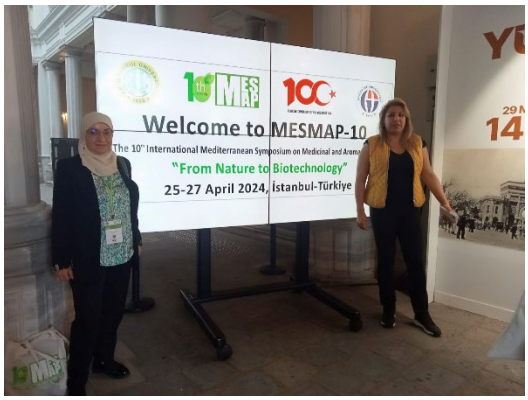
➢ Training and Dissemination Activity – Ain Drahem, Tunisia

On 27 February 2024, a dissemination and training activity was carried out in Ain Drahem within the framework of the PRIMA project SUSTEMICROP. During this activity, research results were shared with rural women, with a particular focus on strengthening their skills in the distillation of Medicinal and Aromatic Plants (MAPs).

In parallel, a nursery dedicated to the preservation and cultivation of valuable plant species was inaugurated. This initiative reflects the project's commitment to sustainable development and highlights the importance of teamwork and local stakeholder engagement in achieving meaningful impact.

➢ International Conference Participation – Istanbul, Turkey

On 9 May 2024, the SUSTEMICROP PRIMA project was presented at the International MESMPAM 2024 Congress on Medicinal and Aromatic Plants, held in Istanbul (Turkey). This participation represented an important opportunity to disseminate project objectives and approaches at international level and to engage with the scientific community working on sustainable agriculture and plant-based innovations.



➢ Dissemination Event – PRIMA SUSTEMICROP Project

On **5 September 2024**, a dissemination event was organized within the framework of the PRIMA project SUSTEMICROP, focusing on the development of eco-sustainable systemic technologies for key Mediterranean crop systems. The event aimed at strengthening the socio-economic resilience of small-scale farming systems in the context of climate change.

The event brought together researchers, experts and farmers, providing a platform to exchange on innovative strategies to support small farms, enhance productivity and promote environmentally sustainable agricultural practices.

➢ Educational and Awareness-Raising Day – Ain Drahem, Tunisia

On **17 December 2024**, an educational and awareness-raising day was organized at the INRGREF Experimental Station in Ain Drahem within the framework of the PRIMA II SUSTEMICROP project. The event highlighted the importance of biodiversity conservation and environmental protection.

The programme included interactive workshops, educational activities and the planting of 60 trees and medicinal plants, contributing to increased environmental awareness, particularly among children and young participants. This initiative reflects the project's commitment to sustainability and community engagement.

➢ Start of SUSTEMICROP Experimental Trials – Slovenia

On 2 April 2024, the Slovenian Institute of Hop Research and Brewing initiated the implementation of SUSTEMICROP experimental trials aimed at evaluating the effectiveness of hop compost enriched with biocontrol agents against Verticillium wilt in hop fields contaminated by Verticillium nonalfalfae. These trials represent an important step toward the development of eco-sustainable crop protection strategies promoted within the SUSTEMICROP project.

➢ SUSTEMICROP Workshop – Slovenia

On **7 February 2025**, a SUSTEMICROP workshop was held during the 62nd Hop Seminar in Portorož (Slovenia). During this event, Dr. Sebastjan Radišek's team from the Slovenian Institute of Hop Research and Brewing presented the results of SUSTEMICROP trials to hop farmers and other stakeholders.

The session focused on the prevention of Verticillium wilt in hop production through the use of biologically enriched compost, as well as on the effectiveness of essential oils in controlling hop powdery and downy mildew.

The lecture was attended by 82 participants, including hop growers and professionals involved in the hop production sector, contributing to effective knowledge transfer and stakeholder engagement.

➢ International Conference Presentation – Germany

On **1 July 2025**, Dr. Sebastjan Radišek from the Slovenian Institute of Hop Research and Brewing presented the results of the SUSTEMICROP trials on the control of Verticillium wilt in hop during the meeting of the Scientific-Technical Commission of the International Hop Growers' Convention.

The event took place from 29 June to 3 July 2025 in the Spalt hop-growing region, Bavaria (Germany) and provided an important platform for the dissemination of SUSTEMICROP research outcomes at international level among experts and stakeholders in the hop sector.

➢ SUSTEMICROP at AGRA 2025 Agricultural Fair – Slovenia

Between **25 and 28 August 2025**, the Slovenian Institute of Hop Research and Brewing presented the SUSTEMICROP project at the AGRA 2025 Agricultural Fair held in Gornja Radgona (Slovenia). The project was showcased through a poster introducing visitors to innovative approaches for disease prevention in integrated and organic hop production.
The presentation highlighted key project objectives, including the development of new strains of biocontrol agents targeting soil-borne pathogens and compost enrichment, as well as the formulation of novel biofungicides based on essential oils to prevent foliar diseases.

Visitors expressed strong interest in the use of essential oils for the management of downy mildew and powdery mildew in hops, particularly regarding the selection and evaluation of effective oils.

➢ SUSTEMICROP Workshop – 62nd Hop Growing Seminar (Slovenia)

A SUSTEMICROP workshop was organized on 7 February 2025 during the 62nd Hop Growing Seminar, held from **6 to 7 February 2025** in Portorož (Slovenia). During this session, Dr. Sebastjan Radišek's team from the Slovenian Institute of Hop Research and Brewing presented the results of SUSTEMICROP trials to hop farmers and other stakeholders.

The workshop focused on the prevention of Verticillium wilt in hop cultivation through the use of biologically enriched compost, as well as on the effectiveness of essential oils in controlling powdery and downy mildew in hops.

The session was attended by 82 participants, including hop growers and professionals involved in the hop production sector, contributing to effective knowledge transfer and dissemination of project results.

➢ International Conference Presentation – Spalt, Germany

From **29 June to 3 July 2025**, Dr. Sebastjan Radišek from the Slovenian Institute of Hop Research and Brewing presented the results of the SUSTEMICROP trials on Verticillium wilt control in hop at the meeting of the Scientific-Technical Commission of the International Hop Growers' Convention, held in the Spalt hop-growing region, Bavaria (Germany).

This presentation provided a platform for disseminating project results at international level, engaging experts and stakeholders in discussions on innovative strategies for sustainable hop production.