DC1 – Soil-Plant-Invertebrate Nexus for Nanoparticle Safety Assessment

Host institution: University of Aveiro (UAveiro)
PhD enrolment: UAveiro & University of Valladolid (UVa)
Start date: September 2026
Duration: 48 months

Project overview

DC1 will investigate the development, performance, and environmental safety of novel cationic biodegradable polymer nanoparticles (NPs) designed for dsRNA delivery to improve crop protection against fungal pathogens. The project focuses on understanding how these nanocomposites behave in complex soil–plant–invertebrate systems, ensuring both efficacy and environmental compatibility.

Main activities

· Develop and characterize innovative cationic biopolymer NPs and nanoclay composites with different crosslinkers.
· Optimize dsRNA encapsulation, protection, and controlled release to achieve long-lasting antifungal effects, particularly against Fusarium spp.
· Assess antifungal activity in vitro and in vivo to validate the effectiveness of the NPs.
· Evaluate NP behaviour in soil, impacts on the microbiome, plant health responses, and effects on a model detritivore invertebrate.
· Perform ecotoxicological assessments and field trials to confirm environmental safety and performance under real agricultural conditions.
· Writing scientific reports, manuscripts, and contributing to publications.
· Presenting research findings at national and international conferences.
· Collaborating with research teams and external partners.
· Participating in advanced courses, workshops, and seminars relevant to the research field.
· Planning and monitoring research objectives and milestones.

Training and mobility

The fellow will undertake secondments at EHU (Spain), UVa (Spain), UAveiro (Portugal), and Momentive (USA). The doctoral degree will be jointly awarded by UAveiro and UVa, under the supervision of Prof. Susana Loureiro (UAveiro) and Dr. Jonatan Niño-Sánchez (UVa).

DC2 – RNAi-Based Biofungicide Development Using Lipid Vesicles

Host institution: University of Valladolid (UVa)
PhD enrolment: UVa & Wageningen University (WU)
Start date: September 2026
Duration: 48 months

Project overview

DC2 will design and optimize innovative lipid vesicle carriers for the targeted delivery of dsRNA molecules to control Fusarium pathogens. By integrating extracellular vesicle engineering with surface proteomics and RNAi technology, this project aims to develop a stable, protective, and highly specific RNA-based biofungicide capable of suppressing fungal growth and pathogenicity in crops.

Main activities

• Engineer extracellular vesicles functionalized with affinity particles that specifically recognize proteins on the surface of Fusarium pathogens (F. graminearum and F. oxysporum f. sp. lycopersici).
• Encapsulate dsRNA molecules within these vesicles and optimize the formulation to ensure stability and protection against environmental degradation (UV light, temperature, enzymes, spray stress).
• Characterize the physicochemical properties of the vesicles and evaluate dsRNA loading efficiency, stability, and controlled release under realistic agricultural application conditions.
• Demonstrate effective gene silencing of essential and virulence-related genes in target Fusarium species, and assess the resulting impact on fungal growth and pathogenicity.
• Test the most promising vesicle-based formulations in greenhouse and field conditions to validate their performance as RNAi-based biofungicides.
· Writing scientific reports, manuscripts, and contributing to publications.
· Presenting research findings at national and international conferences.
· Collaborating with research teams and external partners.
· Participating in advanced courses, workshops, and seminars relevant to the research field.
· Planning and monitoring research objectives and milestones.

Training and mobility

The fellow will undertake secondments at UVa (Spain), WU (Netherlands) and Greenlight Biosciences Spain. The doctoral degree will be jointly awarded by UVa and WU, under the supervision of Dr. Jonatan Niño-Sánchez (UVa) and Dr. Thomas Kodger (WU).

DC3 – Plant Protection Products for Enhanced Immune Response

Host institution: Université libre de Bruxelles (ULB)
PhD enrolment: ULB & Universidad Nacional de Mar del Plata (UNMdP)
Start date: September 2026
Duration: 48 months

Project overview

DC3 will design and develop next-generation plant protection products based on oxidized cellulose and hemicellulose oligosaccharides combined with chitosan-oligos, using covalent crosslinking and aggregate formation to create stable, bioactive particles. These formulations aim to enhance plant immune responses and bio-stimulatory activity, while minimizing negative side effects such as growth retardation. By fine-tuning the combination of elicitors and improving formulation stability, this project seeks to deliver more efficient and sustainable crop protection solutions.

Main activities

• Synthesize and characterize oxidized cellulose and hemicellulose oligosaccharides as key elicitor components.
• Develop covalently crosslinked hybrid nanoparticles incorporating chitosan-oligos to stabilize the active compounds while preserving their favorable diffusion properties.
• Optimize the ratio and structure of elicitors to maximize plant immune stimulation and bioactivity while minimizing undesirable physiological effects.
• Evaluate the persistence and degradation resistance of the developed formulations under realistic environmental conditions, including foliar application scenarios.
• Assess the ability of the formulations to trigger robust plant defense responses by extending their retention on foliage and improving elicitor availability.
· Writing scientific reports, manuscripts, and contributing to publications.
· Presenting research findings at national and international conferences.
· Collaborating with research teams and external partners.
· Participating in advanced courses, workshops, and seminars relevant to the research field.
· Planning and monitoring research objectives and milestones.

Training and mobility

ULB (Belgium) and UNMdP (Argentina). The PhD will be awarded jointly by ULB and UNMdP, under the supervision of Dr. David Cannella (ULB) and Prof. Vera Alejandra Alvarez (UNMdP).

DC4 – Development of Peptide-Based Biopesticides Targeting Symbiosis Control

Host institution: INSA Lyon
PhD enrolment: UCBL & UNESP
Start date: September 2026
Duration: 48 months

Project overview

DC4 will investigate Bacteriocyte-specific Cysteine Rich (BCR) peptides in aphids to understand their role in symbiosis regulation and explore their use as peptide-based biopesticides. The project aims to develop polymer nanoparticle formulations for slow release and targeted delivery, enhancing efficacy while supporting sustainable pest control.

Main activities

• Map the tissue and subcellular localization of BCR peptides in aphids across developmental stages.
• Investigate the role of BCR peptides in bacteriocyte differentiation and regulation of symbiotic bacterial growth.
• Develop stable peptide-based biopesticide formulations and encapsulate them into polymer nanoparticles.
• Optimize release properties and stability to maximize targeted efficacy.
• Test bioactivity under controlled conditions, including phytotron and greenhouse experiments.
· Writing scientific reports, manuscripts, and contributing to publications.
· Presenting research findings at national and international conferences.
· Collaborating with research teams and external partners.
· Participating in advanced courses, workshops, and seminars relevant to the research field.
· Planning and monitoring research objectives and milestones.

Training and mobility

INSA Lyon (France) and UNESP (Brazil). The PhD will be awarded jointly by UCBL and UNESP, under the supervision of Dr. Pedro Da Silva (INSA Lyon) and Dr. Leonardo Fraceto (UNESP).

DC5 – A Physical, Sprayable, Biosourced Adhesive for Biotic Stress Reduction

Host institution: Wageningen University (WU)
PhD enrolment: WU & UCBL
Start date: September 2026
Duration: 48 months

Project overview

DC5 will develop biosourced trichome-mimic particles that can be sprayed onto horticultural crops lacking natural trichomes, providing a physical method to reduce biotic stress. The project aims to optimize these particles for adhesion, targeted pest control, and slow-release delivery of bioactive compounds, while integrating with existing pest management strategies.

Main activities

• Formulate sprayable biosourced adhesive particles with dimensions suited for specific pest insects.
• Investigate interactions between trichome mimics, pests, and beneficial insects.
• Optimize physicochemical properties to enhance adhesive contact with pest footpads and enable slow-release delivery of volatile bioactive compounds.
• Develop methods to quantify particle efficacy and monitor the release of bioderived volatiles on whole plant leaves.
• Assess performance under realistic horticultural conditions to validate efficacy.
· Writing scientific reports, manuscripts, and contributing to publications.
· Presenting research findings at national and international conferences.
· Collaborating with research teams and external partners.
· Participating in advanced courses, workshops, and seminars relevant to the research field.
· Planning and monitoring research objectives and milestones.

Training and mobility

WU (Netherlands) and INSA Lyon (France). The PhD will be awarded jointly by WU and UCBL, under the supervision of Dr. Thomas Kodger (WU) and Dr. Pedro Da Silva (UDL).

DC6 – Biopolymer-Deri ved Hydrogels for Soil Moisture Retention and Quality Improvement

Host institution: INTEMA, UNMdP
PhD enrolment: UNMdP & EHU
Start date: September 2026
Duration: 48 months

Project overview

DC6 will develop biodegradable superabsorbent hydrogels from natural polymers, incorporating artificial humic substances (AHS) to enhance water retention, plant growth, and soil quality. The project aims to create sustainable hydrogels that gradually release water to crops, mitigate drought stress, and improve soil health while remaining environmentally safe.

Main activities

• Synthesize and characterize hydrogels from natural polymers (e.g., sodium alginate, chitosan) and AHS.
• Evaluate hydrogel swelling, water retention, release properties, and degradation kinetics in different soils.
• Assess hydrogel effects on plant growth, drought tolerance, and crop yield under laboratory and field conditions.
• Optimize hydrogel formulations for various plant species and soil types to ensure broad agricultural applicability.
• Generate field-ready prototypes for sustainable water management and soil improvement.
· Writing scientific reports, manuscripts, and contributing to publications.
· Presenting research findings at national and international conferences.
· Collaborating with research teams and external partners.
· Participating in advanced courses, workshops, and seminars relevant to the research field.
· Planning and monitoring research objectives and milestones.

Training and mobility

EHU (Spain) and INTEMA, UNMdP (Argentina). The PhD will be jointly awarded by UNMdP and EHU, under the supervision of Prof. Vera Alejandra Alvarez (INTEMA, UNMdP) and Dr. Haritz Sardon (EHU).

DC7 – Improving Soil Quality and Sowing with Specialized Nutrient-Rich Biomimetic Seed Coatings

Host institution: University of Freiburg (UFR)
PhD enrolment: UFR & EHU
Start date: September 2026
Duration: 48 months

Project overview

DC7 will develop fully biobased, nutrient-rich seed coatings from renewable biomass, incorporating stress-protectant compounds and artificial humic substances (AHS) to enhance germination and resilience against abiotic stresses such as drought, salinity, and temperature fluctuations. Using advanced microfabrication techniques, the biomass formulations will be shaped into "HybriBots", biodegradable plant-inspired structures designed for precision seed delivery and improved establishment.

Main activities

• Prepare AHS and integrate them with biomass-derived composites for seed coating optimization.
• Fabricate HybriBots using microfabrication methods including two-photon lithography, bioprinting, and micro-molding.
• Test seed germination, plant growth, and resilience under controlled phytotron and greenhouse conditions.
• Evaluate the impact of coated seeds on soil quality, nutrient delivery, and plant-soil-invertebrate interactions.
• Optimize formulations for broad agricultural applicability and enhanced crop performance.
· Writing scientific reports, manuscripts, and contributing to publications.
· Presenting research findings at national and international conferences.
· Collaborating with research teams and external partners.
· Participating in advanced courses, workshops, and seminars relevant to the research field.
· Planning and monitoring research objectives and milestones.

Training and mobility

EHU (Spain) and UFR (Germany). The PhD will be jointly awarded by UFR and EHU, under the supervision of Dr. Isabella Fiorello (livMatS, UFR) and Dr. Danila Merino (EHU).

DC8 – Development of Biodegradable and Biostimulant Mulch Films for Abiotic Stress Mitigation

Host institution: POLYMAT, EHU
PhD enrolment: EHU & University of Aveiro
Start date: September 2026
Duration: 48 months

Project overview

DC8 will develop biodegradable mulch films, including liquid formulations, derived from plant and marine biomass, incorporating seaweed-derived biostimulants to enhance crop growth and resilience against abiotic stresses such as drought and soil temperature fluctuations. The project also focuses on ensuring soil compatibility and environmental safety while promoting sustainable agricultural practices.

Main activities

• Design and fabricate biodegradable solid and liquid mulch films from renewable biomass sources.
• Integrate seaweed-derived biostimulants to improve plant growth, stress tolerance, and soil quality.
• Assess decomposition rates and ensure films degrade into environmentally benign byproducts.
• Evaluate the impact of mulch films on plant growth, soil health, and the soil–plant–invertebrate nexus.
• Test mulch film performance under controlled and field conditions to validate crop resilience benefits.
· Writing scientific reports, manuscripts, and contributing to publications.
· Presenting research findings at national and international conferences.
· Collaborating with research teams and external partners.
· Participating in advanced courses, workshops, and seminars relevant to the research field.
· Planning and monitoring research objectives and milestones.

Training and mobility

EHU (Spain), UNIBAIO (Argentina), and University of Aveiro (Portugal). The PhD will be jointly awarded by EHU and UAveiro, under the supervision of Dr. Danila Merino (POLYMAT, EHU) and Dr. Susana Loureiro (UAveiro).