2024 DOCTORAL INPhINIT FELLOWSHIPS PROGRAMME – INCOMING

IMPEST - Unraveling the impacts of pesticide mixtures on ecosystem health

Area of Knowledge: LIFE SCIENCES

Group of disciplines: Plant, Animal & Environmental Biology, Physiology, Ecology & Conservation

Research project

Context: The conventional agriculture sector heavily relies on plant protection products (PPPs) to ensure crop yield and food security. In Europe approximately 2000 PPPs containing nearly 500 active substances are used annually, totaling between 420,000 and 500,000 tons. These residues are frequently detected in various compartments such as soil, water, crops, animals, and humans. Alarmingly, almost 50% of the active substances approved in the EU market can bioaccumulate, 25% persist in soil, 30% exhibit high acute aquatic toxicity, and 28 are suspected carcinogens, posing significant threats to ecosystems and human health. Despite their known toxicity, the ecological impact of PPPs, especially their interactions in mixtures, has been largely overlooked. Moreover, current ecotoxicological data mainly involve standard species, disregarding native species' responses.

Aim: Under the scope of the European Project – SPRINT (https://sprint-h2020.eu), the main objective of IMPEST is to assess the effects of PPP mixtures on the ecosystem health. Based on more realistic scenarios, the specific objectives of this proposal are: (i) evaluating the ecotoxicological effects of PPP mixtures found in distinct crop systems across Europe on native terrestrial and aquatic species; (ii) assessing the ecosystems' ability to maintain their natural functions and deliver services.

Research team: IMPEST draws on CESAM's interdisciplinary teams, SES RG and ATRA RG, including experts in ecotoxicology and ecological risk assessment. They have a proven track record in collaboration and mentoring post-graduate students.

Relevance: IMPEST aligns with CESAM's mission and UN SDG (e.g. 12 and 15), offering cutting-edge ecotoxicological insights into realistic PPP mixtures' impact on non-standard species and ecosystem functioning. This knowledge is vital for regulators, policymakers, farmers, and the public, aiding in understanding causal links between pesticide mixtures and ecosystem health.

Job position description

To address the goals of IMPEST, the following four tasks were defined (T1-5):

T1- Ecotoxicological effects of PPP mixtures on terrestrial species.

Monospecific assays with non-standard terrestrial species, including earthworms and beneficial insects, will be performed to assess the effects of 11 distinct PPP mixtures (corresponding to the 11 case studies of the SPRINT project across Europe). Besides the traditional endpoints at individual level, sub-individual endpoints will also be assessed, including biochemical, genotoxicity and cellular biomarkers.

T2- Ecotoxicological effects of PPP mixtures on aquatic species.

Similarly to the previous task, monospecific assays with non-standard aquatic species (e.g. native macroinvertebrates) exposed to the 11 PPP mixtures will be conducted. Both sub-individual and individual endpoints will be assessed.

T3- Impacts of PPP mixtures on terrestrial ecosystem functioning.

To assess the effects on the ecosystem function distinct parameters will be measured, including nitrification, potentially mineralisable N, hot water extractable C, microbial biomass, microbial respiration and bait lamina (following Griffiths et al 2016);

T4- Impacts of PPP mixtures on aquatic ecosystem functioning.

The functions of the aquatic system will be assessed by measuring distinct parameters, including: microbial and decomposers/detritivores activity, diversity of bacterial, fungal and diatom communities.

The student will also be responsible for the outreach activities, such as publication of scientific papers and presentations at conferences and attend complementary training workshops.

The candidate will work at the Centre for Environment and Marine Studies (CESAM), University of Aveiro, under the supervision of CESAM researchers Nelson Abrantes, Joana Pereira and Isabel Campos. The CESAM has all the facilities and laboratories with cutting-edge equipment, providing all the support and required conditions to achieve the goals.

Supervisor team

Dr. Nelson José Cabaços Abrantes; Dr. Joana Luísa Lourenço Estevinho Pereira; Dr. Isabel Maria Alves Natividade Campos

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Research Group description

The CESAM's research group "**Social-Ecological Systems Analysis, Management & Planning" (SES RG)** integrates environmental, socio-economic and policy sciences, contributing to three CESAM's Thematic Lines: Environment & Health, Integrated Environmental Systems and Marine Ecosystems & Resources. One of the main research topics of the SES RG research is the environmental assessment studies underpinning decision-making on sustainable land and surface water resources management, focusing on the assessment, prediction, mitigation and demonstration to key stakeholders. Special attention is given to the surface processes driven by climate change, with a particular focus on post-fire impacts on soil, resulting in contamination of downstream aquatic habitats and the eco-toxicological effects on aquatic organisms.

Additional information

Website of CESAM: www.cesam-la.pt

Website of the University of Aveiro: https://www.ua.pt/en/