

ARISTO PROJECT NEWSLETTER

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ARISTO

Academia Network for Revising and Advancing the Assessment of the Soil Microbial Toxicity of Pesticides.

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EDITORIAL

Prof. Dr. Antonis Chatzinotas – ARISTO Project PI

Pesticides and microbial food webs

In their review on the role of soil protists in the rhizosphere, Gao and colleagues describe soil protists as "puppet masters of the rhizosphere microbiome" (1). The term "puppet master" is likely to conjure up different images in different people's minds, e.g. someone who controls other people, entities or events on a stage. In the context of ARISTO, the "stage" is the soil, which is a complex ecosystem that provides habitats for myriads of organisms and is essential for many ecosystem functions. The "manipulated entities" are the soil bacteria, which undoubtedly deserve our utmost attention due to their crucial role in decomposing organic matter, cycling nutrients, supporting plant growth and improving soil structure and productivity. Understanding the ecotoxicology of pesticides on soil bacteria is therefore essential for sustainable agriculture. Traditionally, this research has focused on studying the effects on individual bacteria or functional groups, which is justified given the crucial role of soil bacteria. However, in some cases this approach can be limited because it ignores the complex interactions that occur in soil, particularly across trophic levels.

This is where the "puppet masters", i.e. the protists, enter the stage! Protists are a diverse group of eukaryotic microorganisms that play several - but often neglected - functional roles in soils (2), such as predation on bacterial communities, nutrient cycling, and symbiotic relationships with plants. In fact, the study of protists as bioindicators of stressors or land use goes back many decades, mostly using single larger protistan species (3), or by studying protistan community composition (4).

In ARISTO, we aim to go beyond this and gain a more holistic insight into the effects of pesticides on the interconnected web of microbial interactions and associated functions. Microbial interactions can act either as indicators, mediators or buffers of pesticide exposure. One approach is to simultaneously analyze all major players of the soil microbial zoo and their networks (bacteria, fungi, protists) in field samples. Another approach is to artificially construct microbial food webs in the laboratory and expose them to pesticides, either by de novo assembly of communities with interacting microbes (5), or by manipulating the food webs through size exclusion of larger protists.

Our ultimate goal is to bring further realism to the ecotoxicological assessment of pesticides and to complement the available assays. Accordingly, the motto is: Let's consider food-web interactions in soil ecotoxicology research!

1. Gao et al (2019). Protists: puppet masters of the rhizosphere microbiome. *Trends in Plant Science*, 24, 165-176.
2. Geisen et al. (2018). Soil protists: a fertile frontier in soil biology research. *FEMS Microbiology Reviews* 42, 293-323.
3. Foissner (1997). Protozoa as bioindicators in agroecosystems, with emphasis on farming practices, biocides, and biodiversity. *Agriculture, Ecosystems & Environment* 62, 93-103.
4. Lentendu et al. (2014). Effects of long-term differential fertilization on eukaryotic microbial communities in an arable soil: a multiple barcoding approach. *Molecular Ecology* 23, 3341-3355.
5. Saleem et al (2012). Predator richness increases the effect of prey diversity on prey yield. *Nature Communications*, 3, 1305.

UPDATES FROM THE FELLOWS



Eleftheria Bachtsevani

ESR1. In vitro assessment of the toxicity of pesticides on AOM

Ecole Centrale de Lyon – Dr. Graeme Nicol

NCIMB Ltd – Dr. Carol Phillips

Eleftheria has moved to her industrial partner NCIMB in Scotland. She has finished with the development of *in vitro* bioassays for assessing pesticides' toxicity on soil nitrifying microorganisms and she has started the tests to compare her results with the existing kit, MARA.



Marjan Roshanfekrrad

ESR2. In vitro assessment of the toxicity of pesticides on AMF

Universite Catholique de Louvain – Prof. Stephane Declerck

INOQ – Dr. Carolin Schneider

Marjan has finished her short secondment in Hydreka in Lyon, France. There was a delay in starting her industrial part because of a visa issue. However, finally she will start soon at INOQ in Germany.



Laura Johanna Müller

ESR3. Studying the toxicity of pesticides on AOM, and other nitrifiers, in soil

Swedish University of Agricultural Sciences – Prof. Sara Hallin

SAYENS – Dr Abdelwahad Echairi

Laura has just set up a field experiment with her industrial partner SAYENS in Bretenièrre, France. The experiment was designed in collaboration with Anna Manukyan (ESR4) and her industrial partner INOQ in Germany, where a sister experiment is now running simultaneously! Maize plants will be treated with one herbicide and one fungicide in different dosages – how will this affect the ammonia and nitrite oxidising bacteria and archaea? We will take samples at different time points to find out!



Anna Manukyan

ESR4. Assessing the toxicity of pesticides on natural soil and plant assemblages of AMF

University of Thessaly – Dr. Kalliope Papadopoulou

INOQ – Dr. Caroline Schneider

Anna has already started her work at INOQ. Right now, the preparation of the field trial is in progress. She is also working on implementation and application of a new mycorrhizal inoculum: very low dose of inoculum powder, formulated as pellets (which are produced in a new handmade prototype protocol) for use in scientific trials and for implementing a new standardized assay to evaluate mycorrhiza-pesticide compatibility.



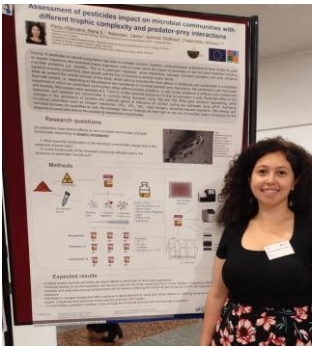
Cara Meyer

ESR5. Studying the toxicity of pesticides on soil microbial networks

INRAE – Dr. Laurent Philippot

SYNGENTA – Dr. Claudio Screpanti

Cara has moved to Syngenta in Stein, Switzerland. She has just launched the 3rd experiment of her PhD which will study how interactions between taxa in a soil microbial community affect the community's response to pesticide application.

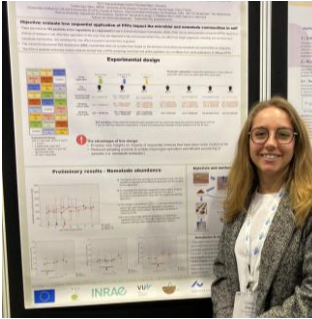


Marta E. Pérez-Villanueva

ESR6. Pesticides toxicity at the soil food-web level: Defining effects on microbial predator-prey systems

UFZ – Leipzig – Prof. Antonis Chatzinotas
 HYDREKA – Dr. Cedric Malandain

Marta is currently working at HYDREKA in Lyon, France. She is preparing her first paper on the effects of pesticides on soil predator-prey microbial communities in soil. She presented her microcosm experiment in a poster at the EcotoxicoMic 2022 Conference in Montpellier, France, and will present a poster with her results at BAGECO 2023 in Copenhagen, Denmark. Additionally, she is about to start her Secondment at Sayens in Dijon, France where she will collaborate with Laura Müller (ESR3).



Camilla Drocco

ESR7. Assessment of the toxicity of pesticide mixtures on soil microorganisms

INRAE – Dr. Fabrice Martin-Laurent
 ECT Oecotoxicologie – Dr. Jorg Roembke

Camilla has completed the last experiment of her PhD. She is finalizing some data analysis before moving to Syngenta for her secondment in June. During the secondment, she will visit Alexandre at University of Thessaly to help him with some microbiome analysis. Also, she just presented some preliminary results of her second experiment at SETAC conference, in Dublin.

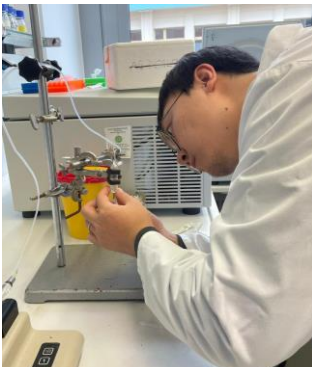


Alexandre Pedrinho

ESR8. Assessing the toxicity of bio-pesticides on soil microorganisms

University of Thessaly – Prof. Dimitrios Karpouzas
 Metabolic Insights Ltd – Dr. G. Wittenberg

Alexandre finished his two-month secondment training at Western Sydney University, Australia, where he was trained on the use of bioinformatic tools. Currently, he is analyzing the data from his first experiment. He is also preparing to start a new experiment at Metabolic Insights in Israel, where he will assess the effects of bio-pesticides on microorganisms in the rhizosphere of cucumber plants in the presence and absence of a target pathogen (*Rhizoctonia*).



Kunyang Zhang

ESR9. Development of tools for in silico prioritization of pesticide TPs for soil microbial ecotoxicity testing

EAWAG – Dr. Kathrin Fenner
 ENVIPATH – Tim Lorshbach

Kunyang finished his academic training at Eawag, Zürich. He is now working on the predictive models of pesticide toxicity at enviPath, Germany. He will soon visit NCIMB, Aberdeen for one-month secondment training.

Aristo fellows during 5th training event at UFZ in Leipzig, Germany in March



UPCOMING EVENTS

ARISTO Webinars

26.05.2023

Biopesticides and risk assessment
– RATION EU project
(Anne Steenbergh)

28.07.2023

The role of protists in soil
microbial ecology
(Stefan Geisen)

29.09.2023

Antibiotics fate and behavior
in soil
(Ed Topp)

Mikrobiokosmos Conference
Special ARISTO Session
Larissa, Greece
19.09.2023

ARISTO Open Day
Larissa, Greece
17.09.2023

ARISTO School Visits
Larissa, Greece
20.09.2023

COLLABORATION WITH EU PROJECTS

PRORISK – Collaboration between
some ARISTO and PRORISK fellows in a
field experiment

INTOMED-PRIMA – Bioinformatic
training course organized for fellows of
both projects

Academic beneficiaries



Industry beneficiaries



Third-party partners



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