Università degli Studi di Napoli Federico II

PhD in Biotechnology - 39th cycle

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Sustainable crop production and protection using insect frass: a molecular and functional approach

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The need to reduce pesticide use and their negative impacts on the environment and on human health[1] has made imperative the development of ecologically and economically sustainable new tools and strategies of crop production and protection[2].
In this scenario, there are several research efforts aiming to enhance plant growth and health using natural substances of different origin, with a special emphasis on by-products of the agri-food industry, acting as biostimulants, biofertilizers, and biopesticides, as part of a circular economy approach to sustainable food production. These substances, when distributed in the soil, may exert multiple positive effects on plant nutrition and health, which are in part mediated by their influence on the soil biotic community[3].
This PhD project aims to describe the mechanisms underlying the effects exerted by Insect Waste Streams (IWS), generated by insect rearing for by-product biomass conversion, on plant growth and defence against insects. The generated knowledge will be used as basis for rational manipulation of trophic network interactions and for the development of stacking strategies of synergistic biotechnologies for sustainable plant protection.
This general objective will be achieved by pursuing 3 specific objectives:
1 – Analysis of phenotypic and multi-omics traits for identification of biomarkers. The molecular and functional events within soil, plants, and associated insect trophic networks triggered by soil treatments with IWS will be characterized through the analysis of the phenotypic alterations and the acquisition of multi-omic data which will be used for biomarker identification; 2 - Molecular mechanisms underlying trophic interactions. Based on the candidate effector molecules, the second objective will be to reveal the intricate molecular mechanisms underlying the functional alterations observed at different trophic levels; 3 -Develop stacking strategies of synergistic biotechnologies for sustainable plant protection. To capitalize the background knowledge generated by Objectives 1 and 2, stacking strategies of complementary biotechnologies with potential synergistic interactions will be defined exploiting synergistic effects of IWS with microbial biocontrol agents and enhancing the killing activity of these latter by combining IWS and gene silencing of immune genes.

References

1 Parra-Arroyo et al, (2022). Sci.Total Environ. https://doi.org/10.1016/j.scitotenv.2021.151879
2 Lichtfouse et al., (2009). Agron. Sustain. DOI: 10.1051/agro:2008054
3 Puglia et al., (2021). Sustainability, DOI: 10.3390/SU13052710