2nd Conference on Green Chemistry and Sustainable Coatings

greenchemco

Pisa, Italy, 28th-30th June 2023

RECOVER overview: Development of innovative biotic symbiosis for plastic biodegradation and synthesis to solve their end of life challenges in the agriculture and food industries

Maria J Lopez[1], Macarena Jurado[1], Raul Moral[2], Steven Verstichel[3], Marie-Aline Pierrard[4], Patrizia Cinelli[5]

[1]Dpt. Biology and Geology, CIAIMBITAL, ceiA3, University of Almeria, Almeria, 04120, Spain
[2]CIAGRO-UMH, Miguel Hernandez University, Orihuela, 03312, Spain
[3]Normec OWS, Dok-Noord 5, 9000 Gent, Belgium
[4]IDELUX Environnement, Drève de l'arc-en-ciel 98, 6700 Arlon, Belgium
[5]Dpt Civil and Industrial Engineering, University of Pisa, Largo Lucio Lazzarino 2, 56122, Italy
Telephone: +34950015890, mllopez@ual.es

Keywords: Agri-food plastic waste, biotechnology, chitin, biofertilizers

Introduction and objective

The complexity of plastic waste in terms of the diversity of polymers, many as multilayers, as well as the presence of food scraps and other remains, are among the barriers to achieving a higher recycling rate, which in the EU only accounts for around 30%. The destination of these heterogeneous waste streams is usually their disposal in landfills or incineration, with the consequent loss of resources and aggravation of environmental pollution. The BBI JU H2020-funded RECOVER project (https://recover-bbi.eu/) joins 17 partners to explore routes for the biotechnological recycling of plastics and their removal from soil and compost. The project focuses on plastic waste from food packaging and agriculture, and involves the synergistic action of microorganisms, new enzymes, earthworms and insects to convert plastics into biofertilizers and bio-based materials for food packaging and agricultural applications (Figure 1).

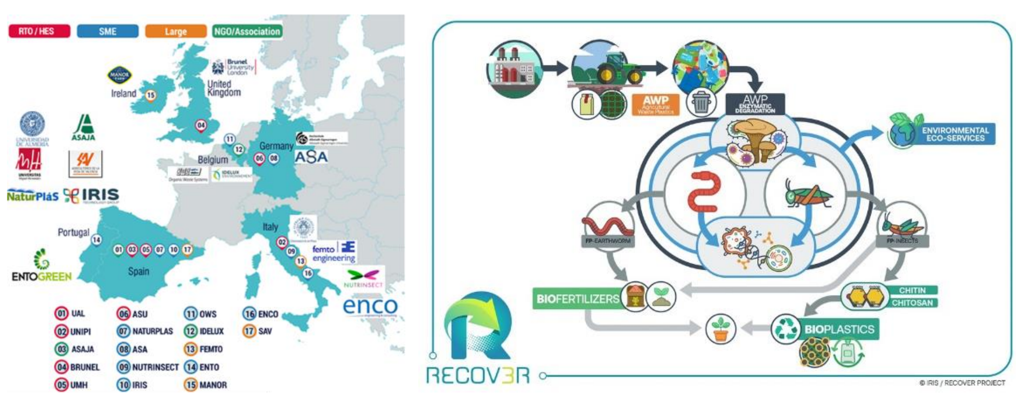

Figure 1. RECOVER consortium and concept

Project actions and current status

The problem addressed - target plastic waste: We focus on actual mixed plastic waste streams. Fossil-based plastics used in agricultural and packaging sectors have been mapped and characterized being the most representative: polystyrene (PS), low-density polyethylene (LDPE), linear low-density polyethylene (LLDPE) and polyethylene terephthalate (PET).

The biotech tools –Combined biocatalytic systems for plastic waste biorecycling and removal: Multiple biocatalytic systems collaborate to biotransform complex plastic mixtures into products or remove them. A set of microbial consortia, two novel enzymes, two earthworms (*Eisenia fetida* and *Lumbricus terrestris*) and insects (*Tenebrio mollitor, Galleria mellonella*) have been selected. The protocol for their combination to improve target plastic biodegradation in different scenarios has been established.

The solution – Plastic waste treatment scenarios: The optimized biotechnology-based protocols are being up-scaled in two scenarios: i) *ex-situ* treatments in insect-rearing chambers or compost reactors for non-recyclable plastics from municipal solid waste or agricultural plastic waste; and ii) *in-situ* treatment applied directly on polluted plastic soil (e.g. mulching films).

The added-value products: Bioplastic formulations for application in agriculture (mulching films, sticks, pots), food packaging (trays, rigid containers, films) and coatings based on chitin/chitosan extracted from insects as well as biofertilizers from insect frass and vermicompost are being developed.

Expected impact

Convert agri-food waste plastics into chitin/chitosan-based plastics and new fertilizers.

Create three new effective biobased value chains that link standard plastics with insects, microorganisms and enzyme providers.

Reduce the generation and dispersion of microplastics and increase plastic recycling in the EU by 12%.

Provide alternatives for the removal of non-biodegradable plastics from the soil and the compost.

Avoid around 80% of CO_2 emissions caused by the incineration of plastic.

Acknowledgments

This project has received funding from the Bio Based Industries Joint Undertaking (JU) under grant agreement “GA887648” project RECOVER. The JU receives support from the European Union's Horizon 2020 research and innovation programme and the Bio Based Industries Consortium.

Biography

Maria J Lopez is full professor at the Department of Biology and Geology of the University of Almeria (Spain) - She received her PhD in Pharmacy at the University of Granada (Spain). Her research is focused on lignocellulose-degrading microorganisms; microbial valorization of organic waste; and bioremediation. She has been the PI of 4 national projects, 4 EU projects and 1 USA project. She published over 70 scientific papers with impact factor, 7 book chapters and 3 patents. She has completed two research stays at the University of Edinburgh (UK) and at the US Department of Agriculture (Peoria, IL, USA).