



EUSO STACKEOLDERS FORUM

19-21 October 2021

Developing the EUSO Knowledge Base

Diffuse pollution – Pesticides & Plastics

Nicolas Beriot

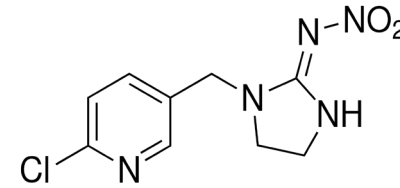
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I. Pesticides and plastics, two ubiquitous contaminant in agriculture

What are pesticides?

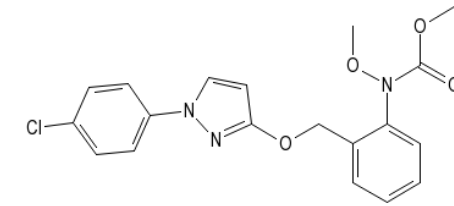
Chemicals for controlling unwanted 'pests'.

- Synthetic (Imidacloprid, Pyraclostrobin, Glyphosate)
- Inorganic (Ag, Cu, SiO₂, TiO₂, ZnO, Al₂O₃)
- plant extracts
- Pheromones
- micro-organisms or viruses



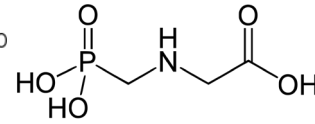
Imidacloprid

Insecticides



Pyraclostrobin

Fungicide



Glyphosate

Herbicide



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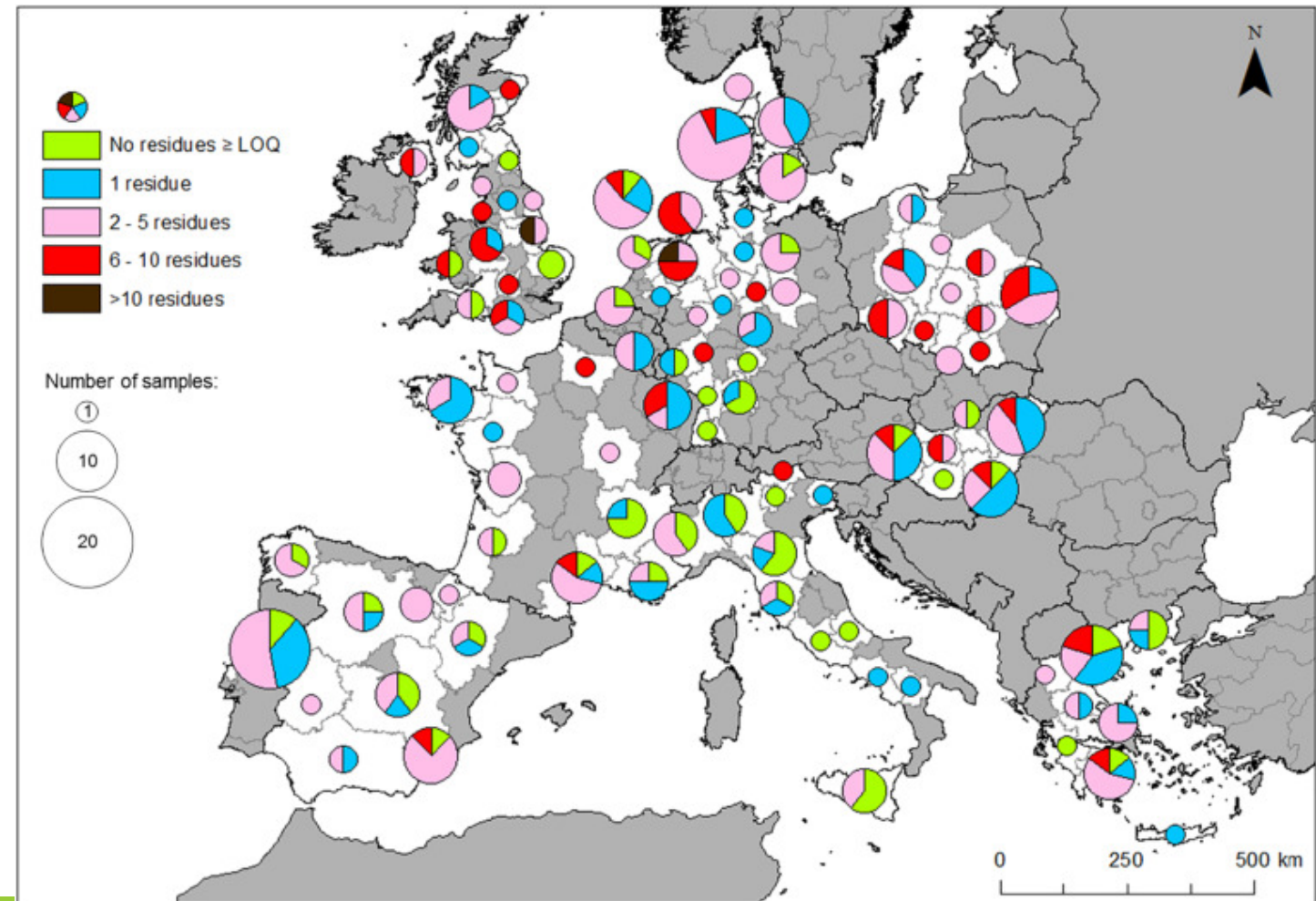
Pesticides in soil?

LUCAS soil survey 2018

317 agricultural topsoil screened for 76 pesticides

-> 83% of the soil samples positive

-> 58% contained mixtures



Number of pesticide residues in EU agricultural topsoils, Silva et al 2019

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What are plastics ?

Organic polymer that can be moulded into solid, non-soluble, objects

Films



Fibers



Rubber



Micro beads

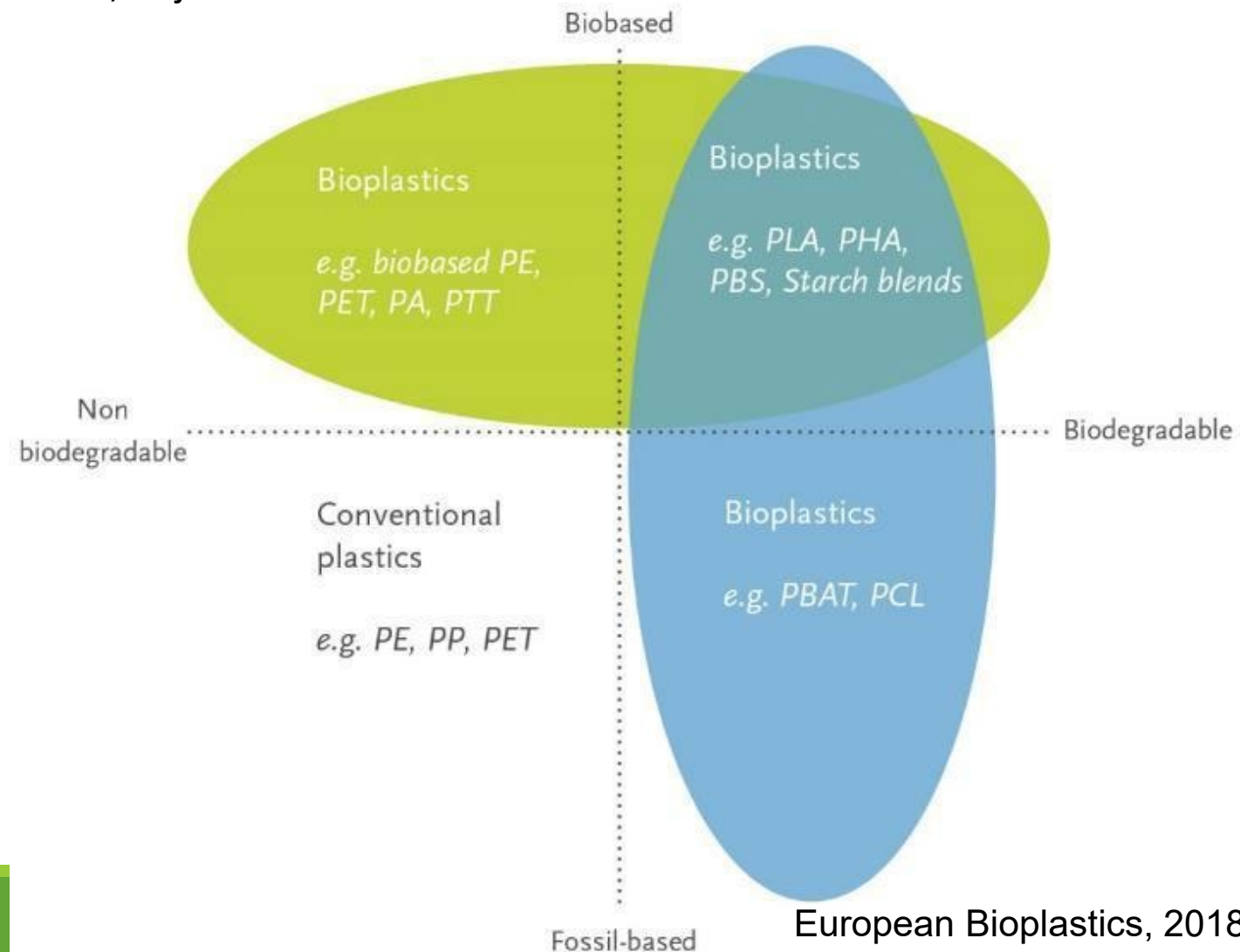


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Organic polymer that can be moulded into solid, non-soluble, objects

- **Polymer origin:** fossil (~99%) or bio (~1%) –based
- **Polymer degradation properties**

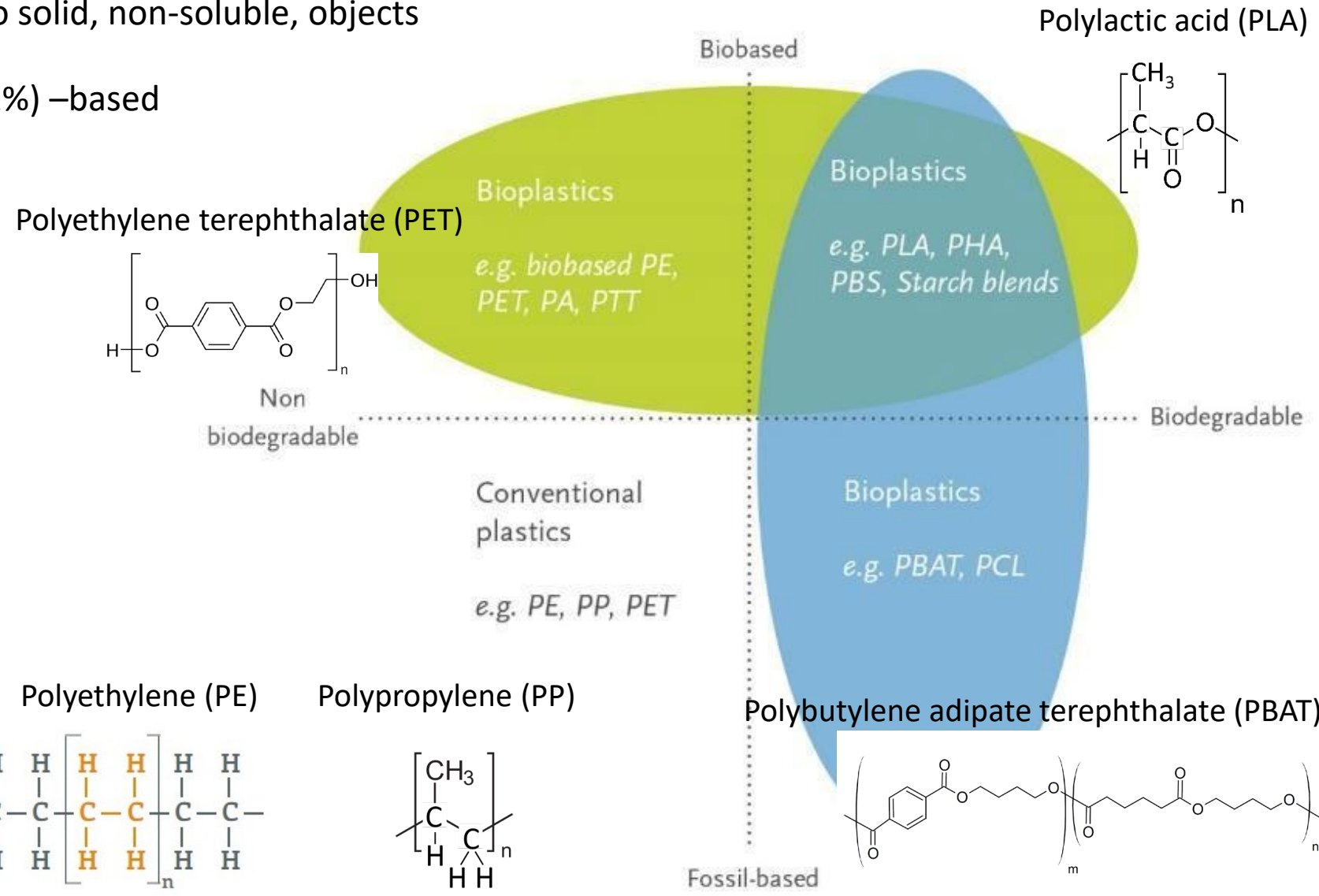


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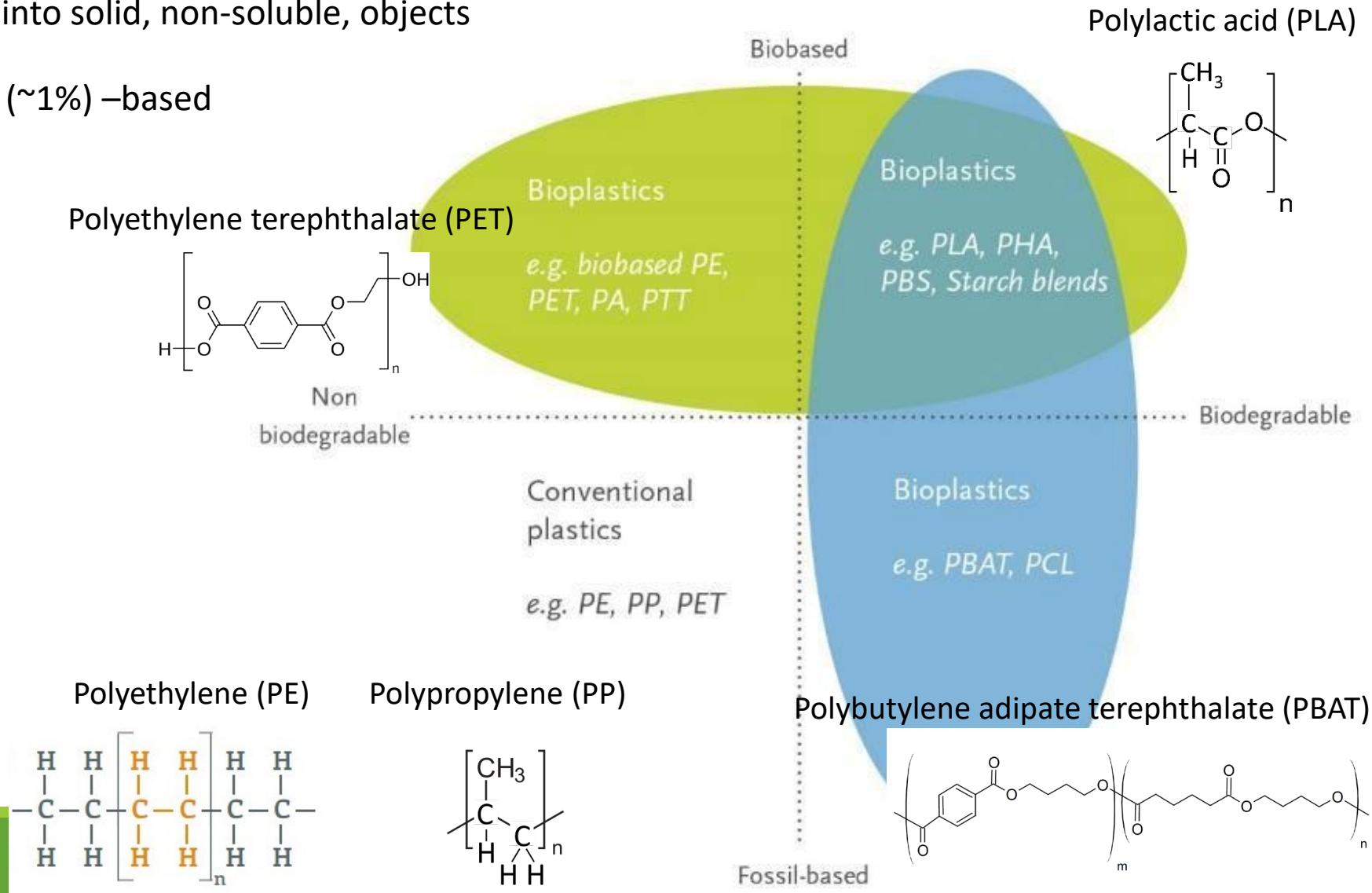
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Biodegradation is not only an intrinsic property of the plastic!

It also depends on:

- Temperature
- Humidity
- Solar radiation
- microbiome activity



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Plastics in agriculture ?

Intentional use of plastic:

- **Crop protection** (~180 Mt) : Greenhouses, polytunnels, nets



Greenhouses

“the see of plastic”

Almeria (South Spain)

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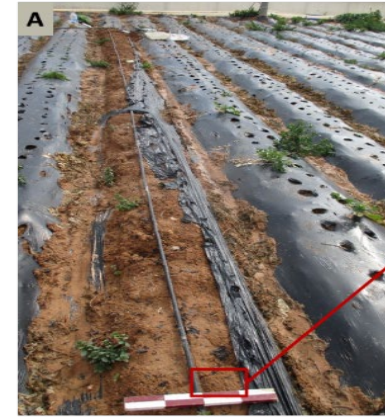


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- Others: irrigation pipes, plastic coated fertilizers/pesticides/seeds, containers, packaging

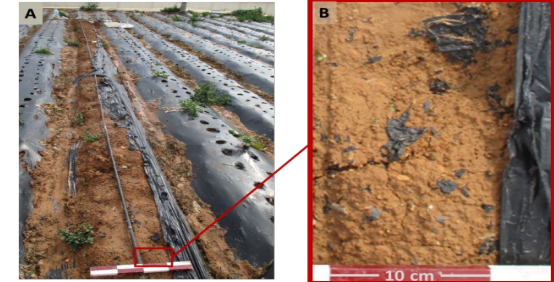


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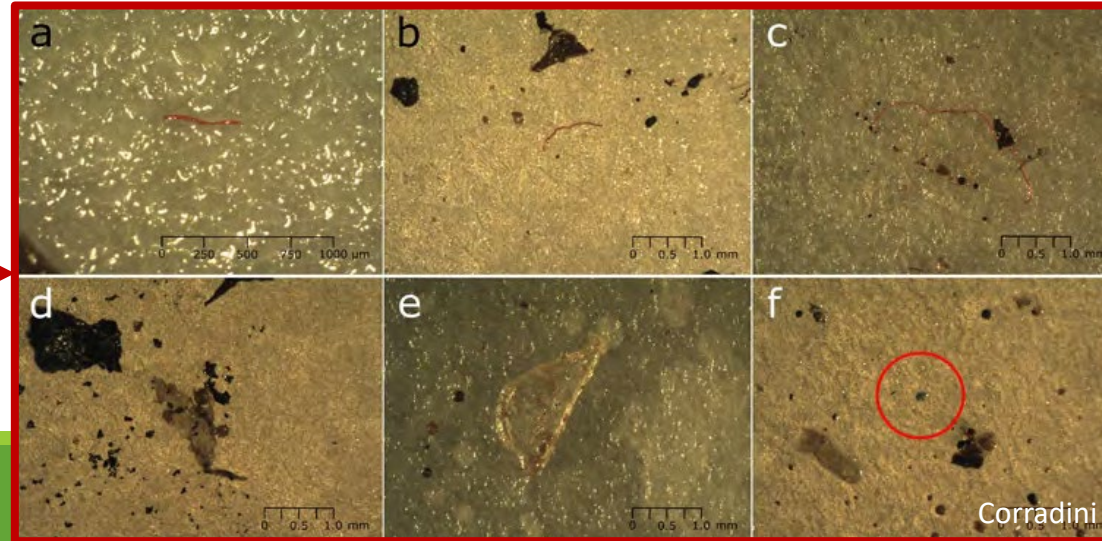
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Unintentional inputs of plastic debris:

- Organic fertilizers (sewage sludge, manure, compost)
- Irrigation water

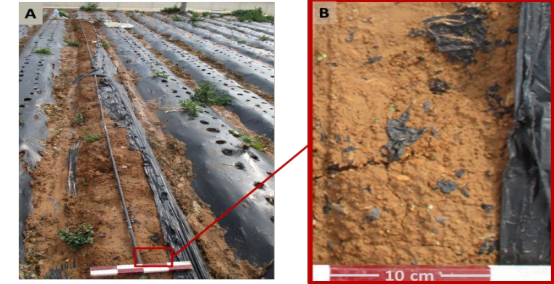


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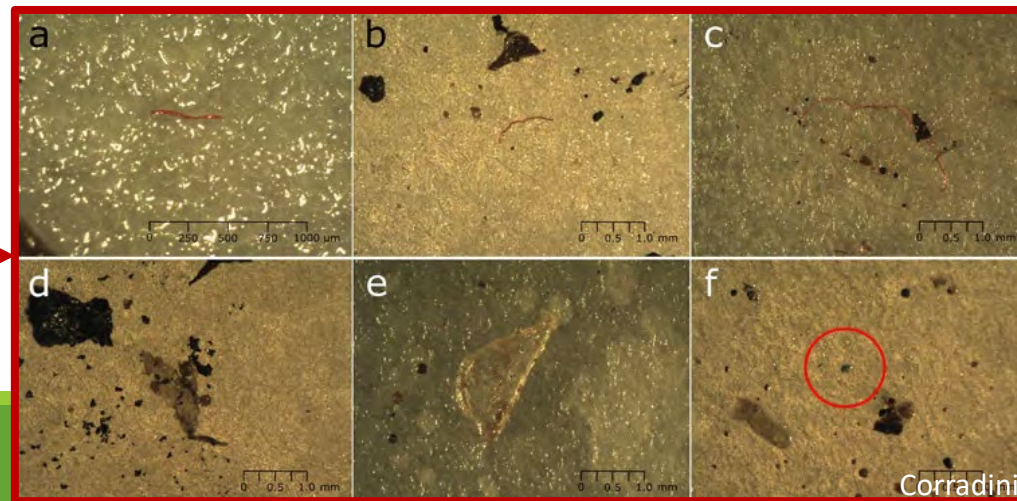
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Unintentional inputs of plastic debris:

- Organic fertilizers (sewage sludge, manure, compost)
- Irrigation water
- Poor plastic waste management : improper removal and storage, on-site burning, wild dumping



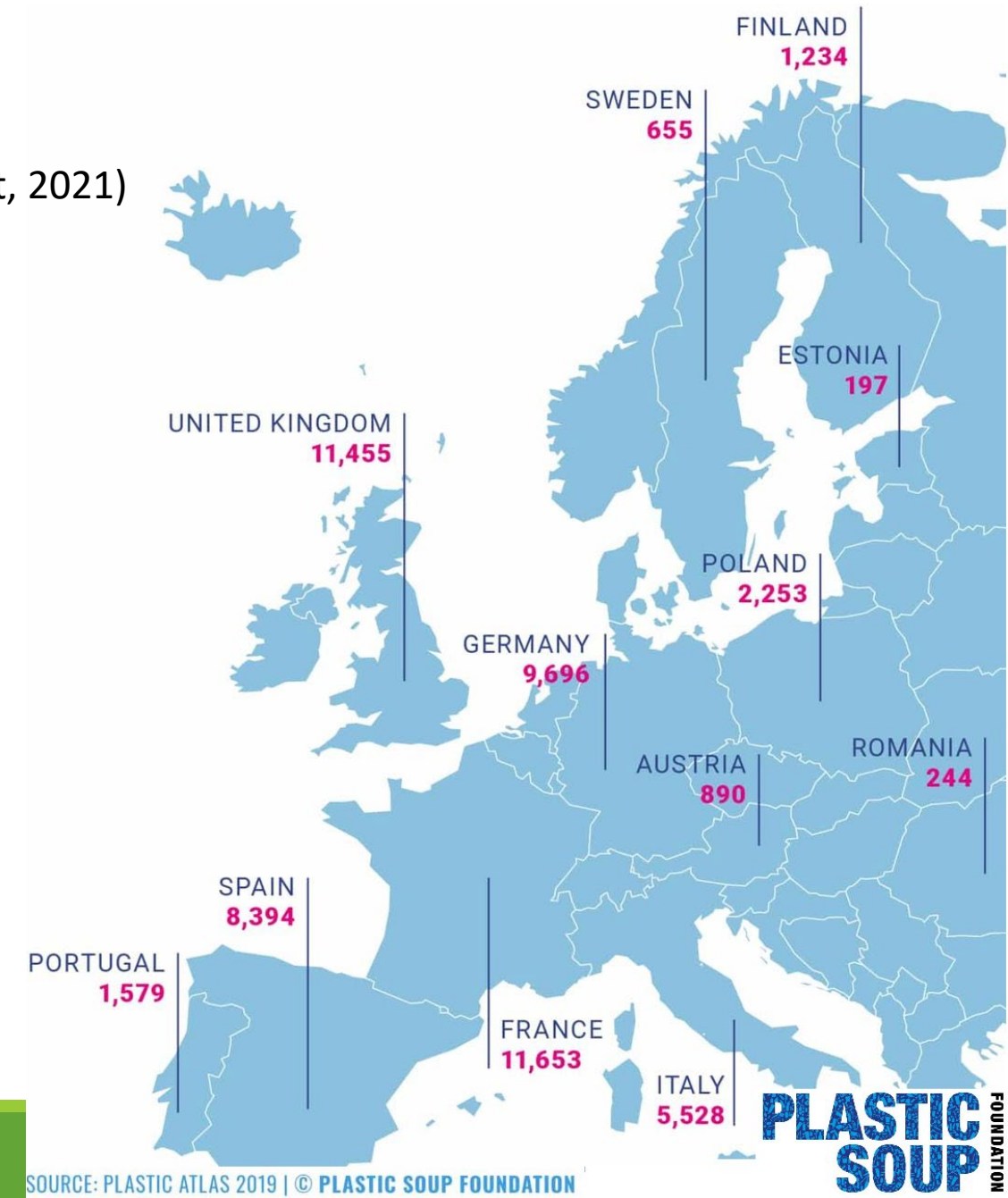
van Schothorst

Corradini

I. Pesticides and plastics, two ubiquitous contaminant in agriculture

Plastics in soil ?

Netherlands, vegetables : 40 soil samples, 100% positive (van Schothorst, 2021)
Spain, cereal: 128 soil samples, 97% positives (van den Berg 2020)
Spain, vegetables: 54 soil samples, 100% positive (Beriot 2021)

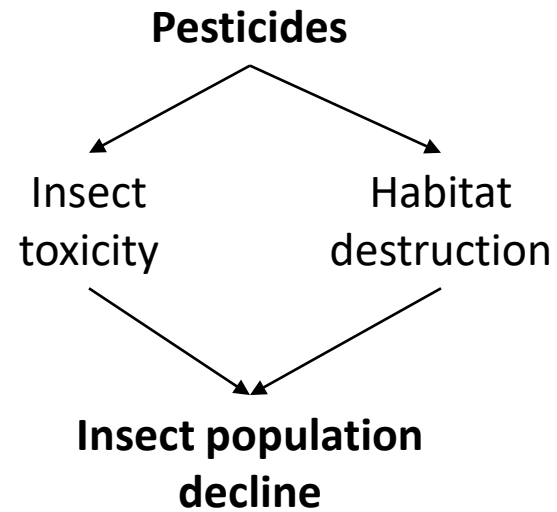


II. Pesticides and plastics, effects on the environment

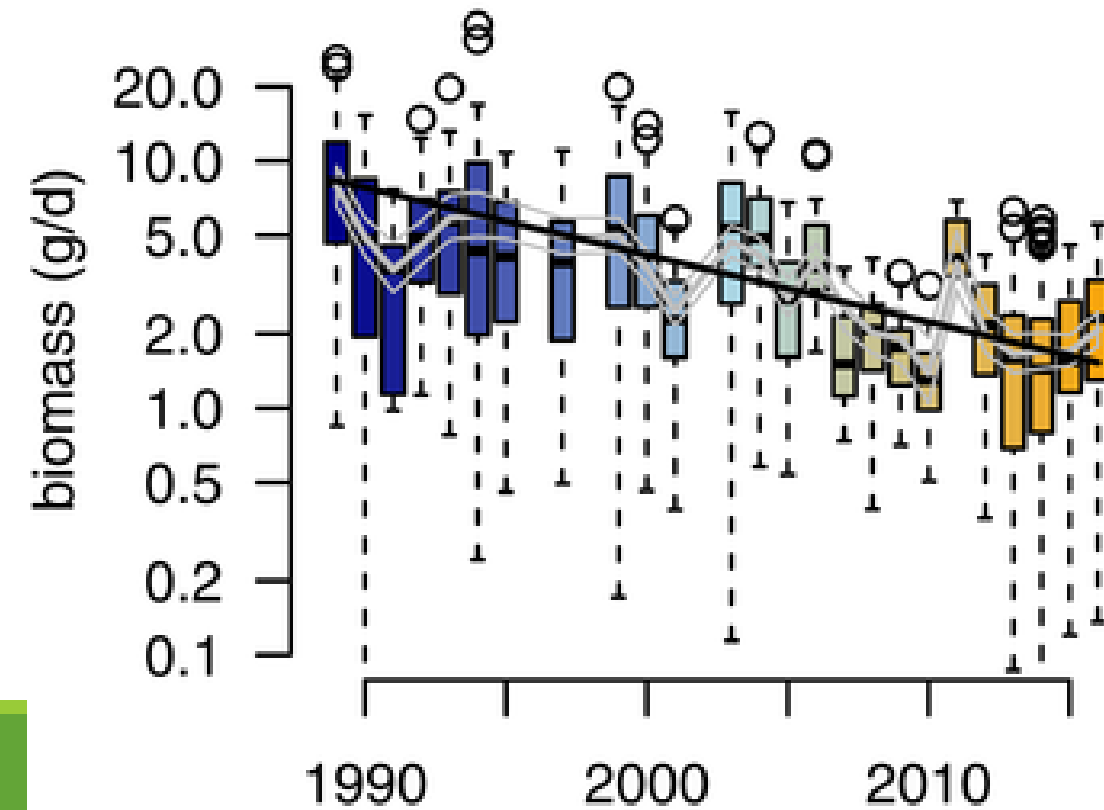
Ubiquitous contaminants -> effects in all components of the ecosystems

Two examples:

- Pesticides part in the decline of insect populations in developed countries



75% decline over 27 years in flying insect in Germany (Hallmann, 2017)

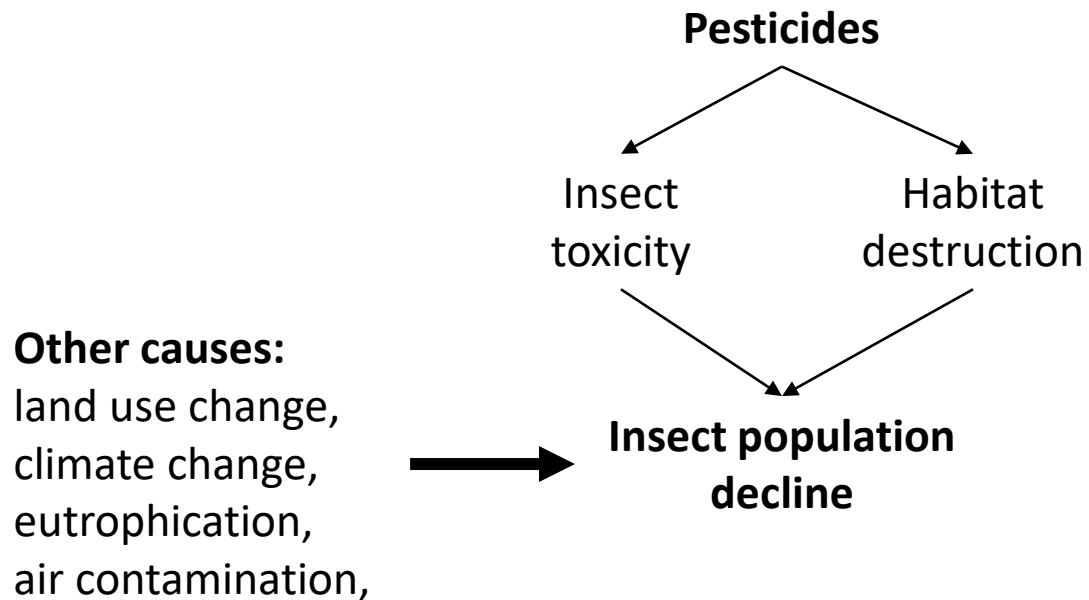


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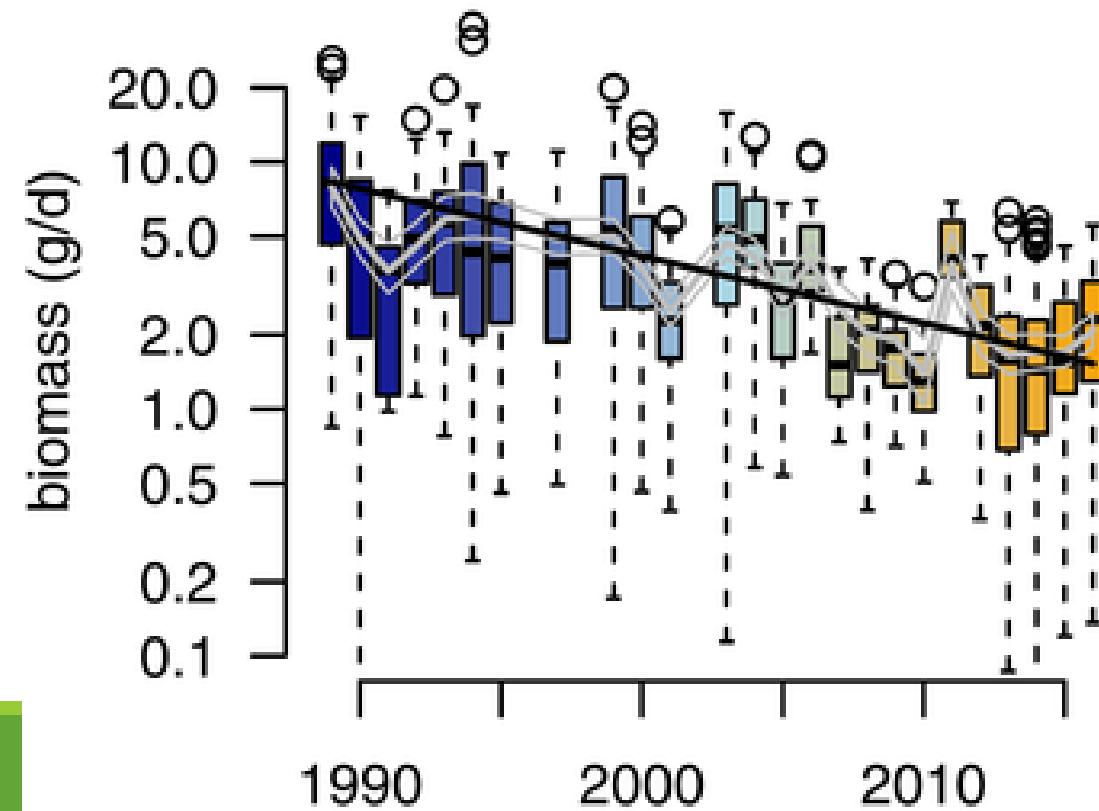
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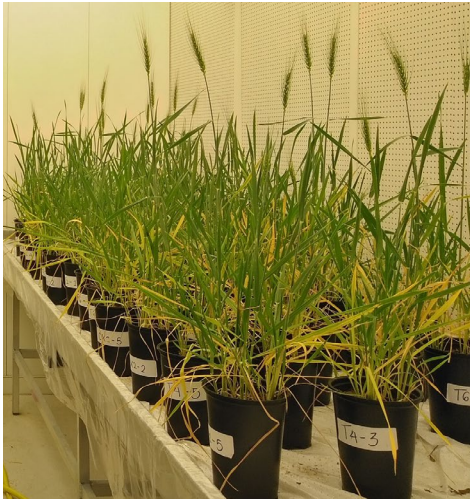
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Two examples:

- Pesticides part in the decline of insect populations in developed countries
- Plant growth reduction after exposure to soil contaminated with biodegradable plastics

Commercial Biodegradable plastic	Soil	Plastic content w/w	Plant	Measured plant production	Article
PBAT+ Pullulan	sandy soil	1%	Wheat	reduced shoot, root biomass and fruit biomass	Qi et al 2018
PBAT+PLA+CaCO ₃	sandy soil	0.5% - 2.5%	Common bean		Meng et al 2021



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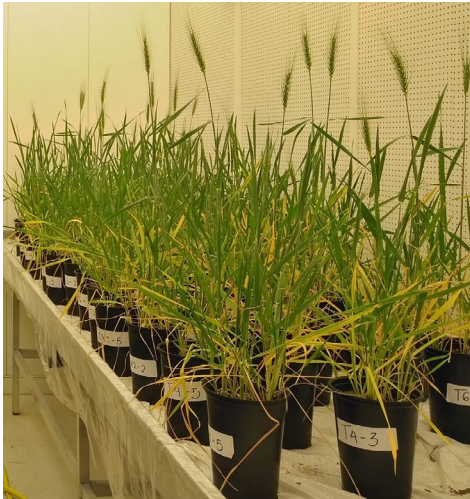
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Hypothesis:

- Nutrient competition?
- Toxic additive or metabolite?
- Increase of pathogen?

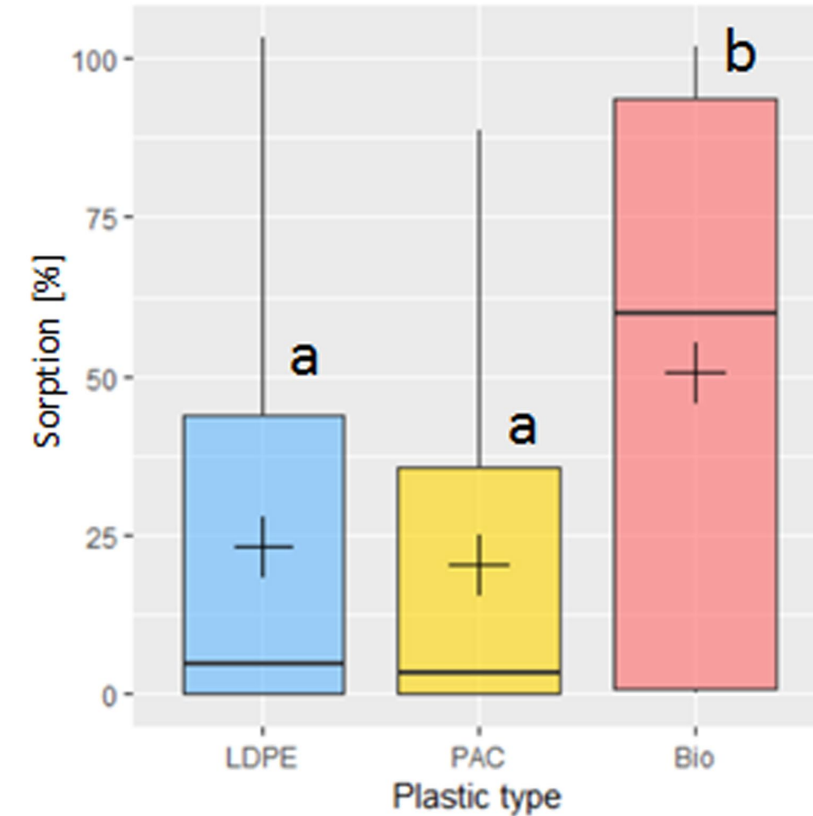


Plastic and pesticides interactions:

1. Sorption and desorption

Depend on the type of plastic, type of pesticide and environmental matrix

Sorption (%) for 36 different pesticides (Beriot et al 2020)



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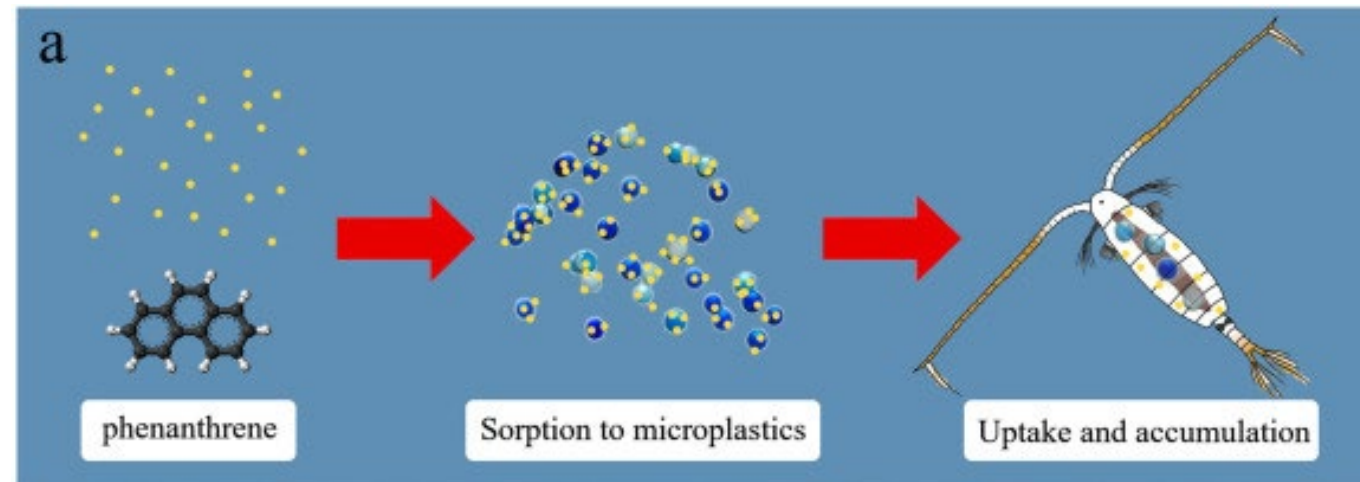
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2. Transport in the environment and in the food chain

- Transport with plastic debris
- Possible ingestion and desorption
- Accumulation?

Bioavailability of sorbed contaminants (Torres et al 2021)



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1. Sorption and desorption

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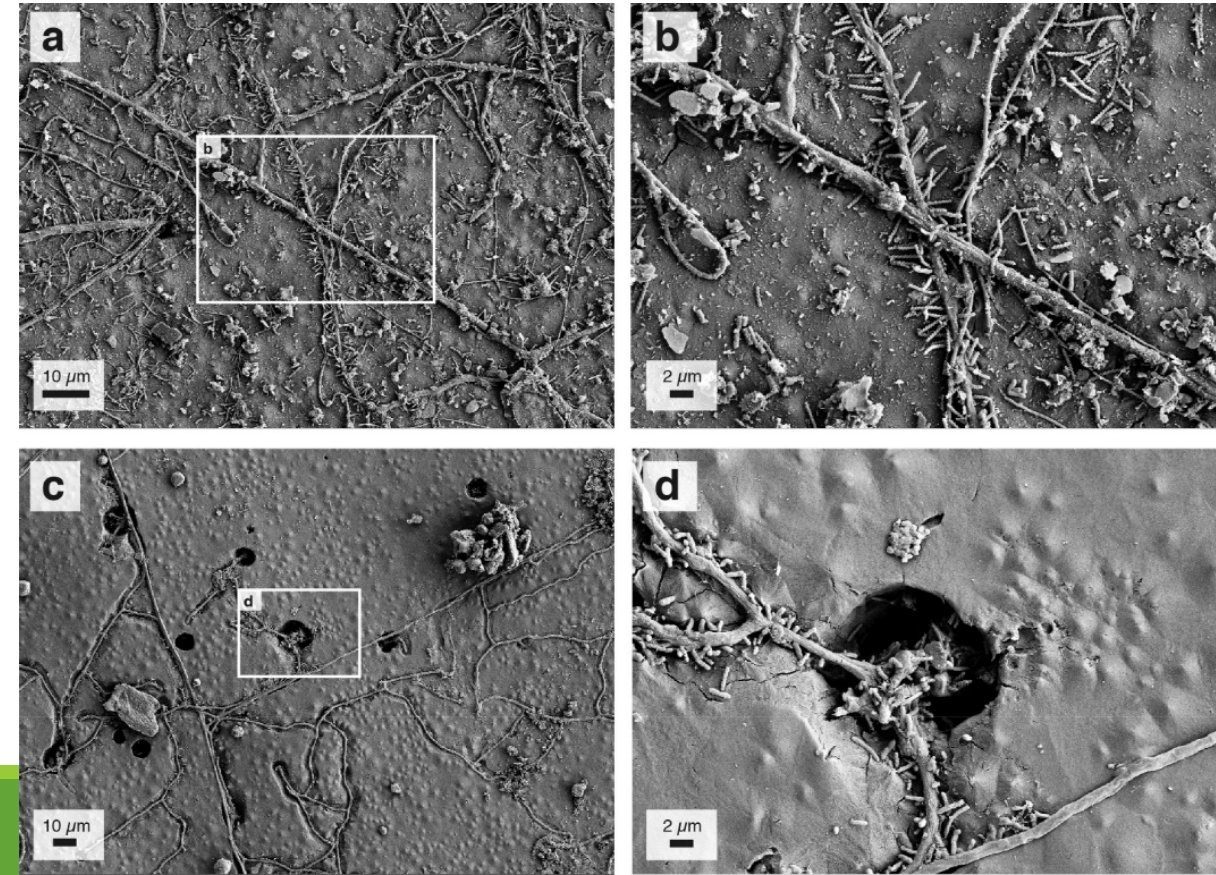
2. Transport in the environment and in the food chain

- Transport with plastic debris
- Possible ingestion and desorption
- Accumulation?

3. Reduced degradation

- Reduced degradation of sorbed contaminants
- Reduced degradation of biodegradable plastic?

Surfaces of PBAT films colonized by microorganisms (Sander 2019)



What can be done?

1. Control the inputs

- Reduce pesticide use in Europe by 50% in 2030 – Farm to Fork Strategy and the Zero Pollution Strategy
- Reducing the plastic footprint of agriculture – EIP-Agri focus group

2. Improve the assessments

- Test effects, transport and degradation in field conditions and with mixtures of contaminants

3. Promote awareness : transparency and communication

- Communicate the additives formulation in commercial plastics
- Monitor

IV. Pesticides and plastics, challenges and way forwards



Thank you for your attention!



LUCAS

Soil survey 2018



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