Microplastics (MP) in agricultural soils – A growing concern?

Research on microplastics in agricultural soil reveals critical threats to soil health, crop productivity, and food safety and hence is of critical concern. As the foundation of global food security, agricultural soils must be safeguarded against contamination, underscoring the need for immediate policy intervention in the face of escalating environmental challenges.

WHAT'S AT STAKE?

The global production trend of plastics has increased since the 1960s, amounting to 440.3 Mt in 2022, with the European Union (EU) producing the third highest (14%, behind China and North America), of which agriculture is responsible for 4% (1). Plastics are directly prevalent in agriculture (in crop and animal production systems) via plastic mulching films, greenhouses, tunnels, nets, seed coatings, irrigation pipes, fodder, nets, stretch films, etc. Indirectly, microplastics enter soil systems via compost and sewage sludge applications, and tire wear. So, what does using these plastics mean in the context of agricultural soil systems?

Continuous use of plastics in agriculture produces microplastics (MP<5 mm) that persist for centuries, spreading via wind, water, and atmospheric deposition. Terrestrial microplastic levels may be 4 to 23 times higher than in oceans (2). Traditional plastics degrade slowly, releasing harmful chemicals, while biodegradable alternatives risk incomplete degradation and chemical leaching. Balancing economic benefits with environmental impacts is challenging. This brief highlights findings from the SOPLAS project, funded by the EU under Horizon 2020 (Grant No 955334), to enhance the current understanding of agricultural plastic pollution.

KEY POINTS

- The highest reported MP concentrations due to plastic mulching film residues are up to 2200 particles per kilogram of soil (3)
- MP concentrations in sewage sludge used as fertilizer range from 18 to 41 particles per gram of soil (4)
- Compost applied soils in the Nether-lands and Spain have reported concentrations of 2242 ± 984 and 888 ± 500 MP particles per kilogram of soil (5)
- Of 58.7 MT of plastic produced in the EU, the bio-based and bio-attributed plastic share is only 1% (1)

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RESEARCH APPROACH

Project SOPLAS puts together 14 PhD students from various countries, performing their research at 13 top research institutes/ universities around Europe, to cover the topic of microplastics in agricultural soils in its whole complexity. PhD candidates formed 4 thematic work packages (WP): WP2 inputs and detection of microplastics, WP3 degradation and remediation processes, WP4 impact on soil micro and macro fauna, WP5 transport of MPs through agricultural landscapes (Figure down right).

MAJOR OUTPUT

Inputs and detection

General methodology of remote sensing application for plasticulture detection has been developed and tested for scale of Germany. Agricultural and industrial composts are important sources of microplastics to the soils. Fluorescent and luminescent microplastic particles has been applied as easy to use and cost-efficient tracer.

Degradation and remediation

Photodegradation reduces the mechanical stability, especially of thin mulching foils. Biodegradability dynamics and microbial composition of mulch film experiments have shown that biodegradability is not only a function of material, but also the environment.

Impact on soil fauna

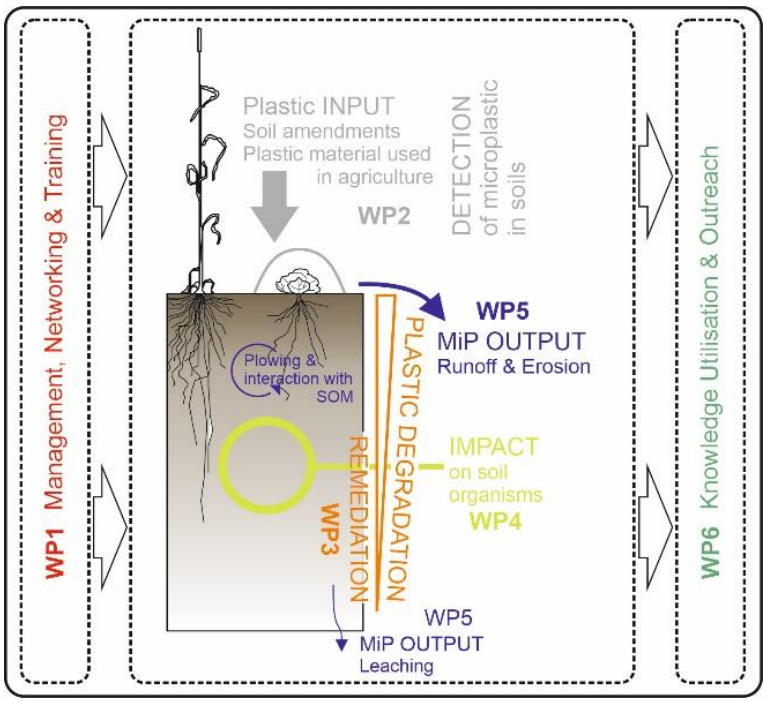
Long-term experiments under different conditions and materials have shown that the presence of microplastics affects microbial activity, germination, plant growth and prosperity.

Redistribution of MPs

Soils were identified as plastic sinks due to limited export by surface runoff during rainfall events and vertical redistribution into the soil matrix.

POLICY INSIGHTS

Priority should be given to reducing, reusing, and recycling plastic while halting microplastic generation to combat microplastic contamination in agricultural soils. Encouraging biodegradable alternatives and incentivizing plastic reduction can reduce inputs. Implementing reuse programs and enhancing recycling infrastructure ensure efficient plastic management. Strict regulations, monitoring, and enforcement are crucial. Banning harmful additives and investing in innovative research is vital. Education and awareness campaigns promote sustainable practices. Community engagement is essential, advocating for biodegradable alternatives, supporting eco-friendly brands, and organizing clean-ups. Farmers can adopt reusable mulches and sustainable practices. Precision agriculture, composting, and citizen science initiatives further reduce pollution, fostering environmental consciousness.



SOPLAS, an innovative training network under Horizon 2020, funded by the EU under Horizon 2020 (Grant No 955334), enhances our understanding of agricultural plastic pollution.

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