Are microplastics a threat to healthy soils?

Plastics are everywhere, particularly in agriculture. But are they really harmful? The EU Horizon research programme MINAGRIS researched the impacts of microplastics over five years. Here's what they found.



Infographic: Charlotte Chivers

Growers, particularly those working at scale, face a difficult dilemma when it comes to agricultural plastics. Do we look for alternatives, which, according to farmers involved in our project, can be both expensive and inefficient, or are we just intrinsically reliant on plastics to protect crops and wrap our food?

The EU Horizon research programme MINAGRIS has been grappling with these questions and more as it publishes its final results, after five years of hard and sometimes disturbing research.

The news isn't good. Plastics, when left on the land to decay, break down into micro- and nanoplastics. These particles negatively impact soil organisms, the soil microbiome, the ability of soil to hold water, and plant growth. Given that plastic use in agriculture is growing, we are facing a literal time bomb of soil contamination – the resource we need to grow food and thrive.

Let's break down some of what we've found so far.

Soil contamination

Microplastic and nanoplastic contamination of soils comes from a variety of sources, including farm activity — plastic mulch films, silage wraps, and polytunnels, especially when left to degrade in the field.

But contamination also comes from compost, manure, tyre wear particles and more. We've found microplastics in almost all the 220 agricultural sites across 11 countries, and the organic farmers we worked with were very concerned that contamination could come from sources they had little control over, as well as the lack of cost-effective and efficient alternatives to plastic.

And once microplastics are in the soil, there is no proven way of removing them. Plastics left in the soil will continue to degrade into smaller pieces, potentially releasing toxic additive compounds in the process. And they can move through the soil, too.



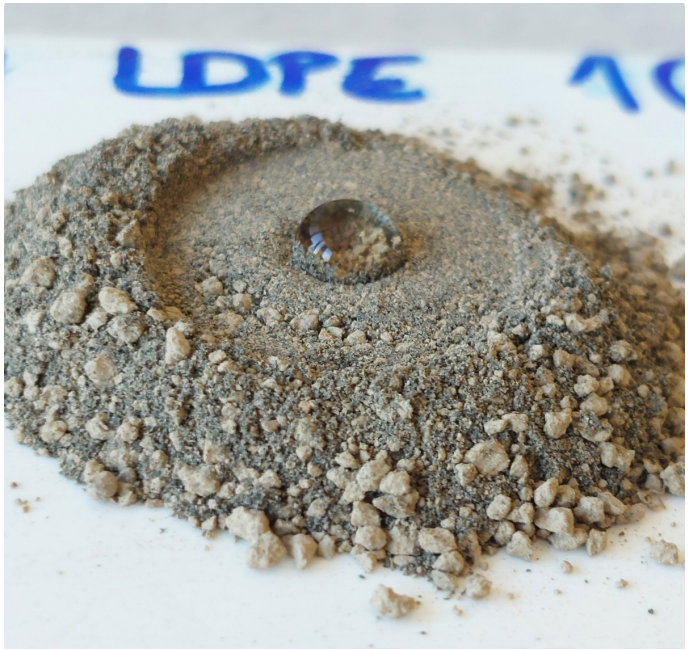


Photo: Dr Špela Železnika

Soil water repellency experiment

Soil organisms, microbial diversity and drought resistance

Soil ecosystems are a vital part of soil health. Our research on earthworm casts found that the presence of microplastics altered the chemistry of fresh casts, with elevated pH, ammonium, and dissolved carbon detected compared to controls. Over time, these differences diminished.

Field assessments of agricultural soils where plastic mulch or plastic-contaminated compost had been used for decades showed measurably lower invertebrate diversity compared to control sites with the same soil type and management.

We also found that the biodegradable plastic Polybutylene adipate terephthalate (PBAT) can affect the microbiome of the honeybee gut, research that will be published soon.

We conducted experiments on how microplastics affected the soil's ability to absorb water. We found microplastics can alter how repellent soil is to water, because certain substances can 'coat' soil particles, making them water repellent.

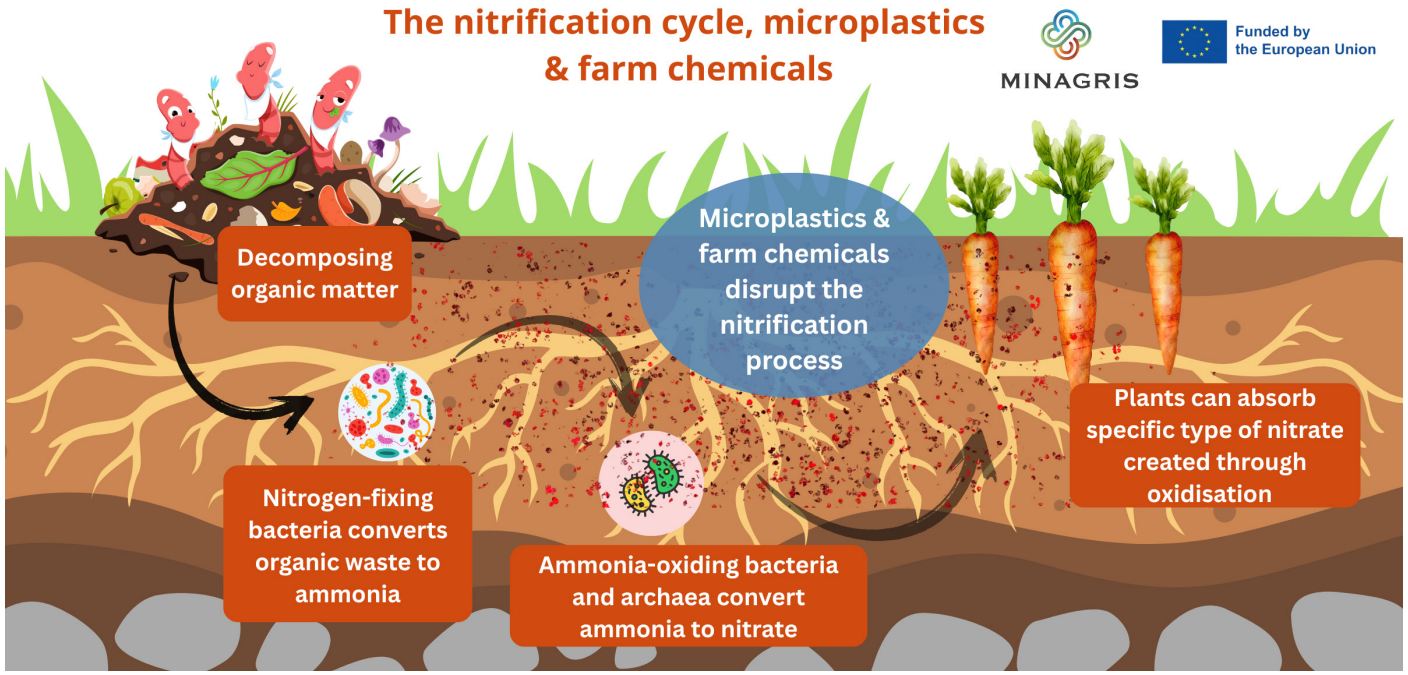
This effect was particularly the case with conventional and biodegradable (PBAT) plastics and less so with starch-based biodegradables. And sandy soils were more affected than silty-clay-loam soils. Again, soil richness and health influence how soil reacts to these pollutants. Our findings around soil water repellency are particularly relevant to climate change and the emergence of drylands, since we might conclude that microplastics may accelerate these processes.

Growing crops

Organic farmers are interested in managing pollutants, not just because they care about the earth but also because they want to grow healthy food.

We conducted experiments with some common crops – rocket and lettuce. We found that conventional microplastics plus the agrochemicals pyraclostrobin (a fungicide) and albendazole (an antiparasitic veterinary medicine) caused significant growth restrictions in the common food crop, rocket. The biodegradable plastic tested – PBAT – did not show the same growth restrictions. Microplastics (LDPE and PBAT) alone also caused the root-to-shoot biomass ratio to increase, a sign of plant stress.

We also looked at what happens when you combine microplastics and drought conditions. The research found that microplastics are harmful to lettuce, and drought makes things worse. At the higher concentration tested (1.5%, rarely found in real-world conditions as yet), microplastics alone reduced chlorophyll content, photosynthetic efficiency, leaf area, the number of leaves, fresh and dry biomass, and root development. Drought conditions increased the damage across all these metrics.



Infographic: Dr Deborah Talbot

Toxic combinations

As we've already seen, it's not just microplastics that are in agricultural soils, causing the damage. Farms use pesticides, antibiotics and other chemical compounds that can interact with microplastics.

We've found, for example, that microplastics in combination with the veterinary anthelmintic albendazole and the pesticide pyraclostrobin can disrupt the microorganisms that drive soil nitrification in different ways. Nitrification is an essential process for plant growth, converting ammonia into nitrate that plants can efficiently absorb and use for growth and crop production.

Microplastics interactions with chemicals affect the invertebrates that process organic matter in soils. We've found that microplastics – particularly PBAT - and common farm chemicals can disrupt the life cycle of Springtails, which are vital to soil decomposition and the processing of dead plant material, mould and fungi.

Plastics can therefore accelerate the transport of pesticides, pollutants, and pathogenic bacteria within soils.

Is there any good news?

If this all feels a bit like bad news, to some extent it is. But we have some good news too, particularly for organic growers.

We hope that knowing more about the science might propel governments to act, cutting down on microplastic use, investing in innovating alternatives, and improving recycling of farm plastics. One of our proposals is that risk assessments will need to change to take account of interactions between farm chemicals and microplastics, and we are actively engaging policymakers in this.

Given our findings on plastics labelled biodegradable, this is again something we can take action on. Better labelling and regulation are needed here, too, to guide farmers.

Our studies on microplastic/farm chemical interactions found that soils with more microbial diversity (healthy soils) proved to be more resistant to the effects of contamination than soils degraded by drought and intensive farming. While this is only one finding, it does suggest that we may have some options to manage plastic contamination in the future.

One study of the plastisphere – the microbial communities that grow on microplastics – found that some new bacterial strains consumed plastic particles. That said, this research is at an early stage, and we can't rely on it to reassure ourselves that no action is needed. Equally, the plastisphere can generate pathogens and microbial resistance.

As researchers, we know that a lot more needs to be done. But we hope that we have made good progress in understanding its effects and what actions we can take to limit the damage.

Dr Deborah Talbot

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MINAGRIS: Enhancing Soil Health for Sustainable Practices

Countryside & Community Research Institute

Intrigued by our research? Join us in Brussels or online on September 16 2026 for our one-day conference, Healthy soils for sustainable food: Examining the presence and impacts of plastics in agricultural soils. Find out more here: https://minagris.eu/ (events)

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