



**PROCEEDINGS OF ABSTRACTS
VIII. INTERNATIONAL
AGRICULTURAL, BIOLOGICAL,
LIFE SCIENCE CONFERENCE
AGBIOL 2026**

06-09 SEPTEMBER 2026

ISTANBUL, TÜRKİYE



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**Organized by
Trakya University
İstanbul Beykent University
International Researchers Association**

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WELCOME NOTES

You are welcome to our VIII. AGBIOL Conference that is organized by Trakya University, Beykent University and International Researchers Association. The aim of our conference is to present scientific subjects of a broad interest to the scientific community, by providing an opportunity to present their work as oral or poster presentations that can be of great value for global science arena. Our goal was to bring three communities, namely science, research and private investment together in a friendly environment of Edirne, Turkey in order to share their interests and ideas and to get benefit from the interaction with each other.

In September 2018, we organized the first AGBIOL Conference with more than 700 scientists and researchers from all over the world with over 800 scientific papers. Due to COVID-19 situation, II. AGBIOL 2020 has organized fully on-line event which was one of the biggest online conferences in recent years in the world with 499 papers and 1133 authors with 333 oral and 166 e-poster presentations from 55 countries. Due to COVID-19 situation, AGBIOL 2021 was organized online again. AGBIOL 2022 conference was organized with a worldwide participation from 44 countries over 522 papers contributed by over 1300 authors. AGBIOL 2023 was organized with a record and worldwide participation from 33 countries 833 papers contributed by over 2000 authors with 522 oral and 311 poster presentations. AGBIOL 2024 consisted of 835 papers contributed by about 2000 authors with worldwide record participation again from 55 countries with 522 oral and 311 poster presentations. AGBIOL 2025 was organized with a worldwide record participation from 60 countries 988 papers contributed over 2300 authors with 400 oral and 588 poster presentations.

The AGBIOL 2026 is normal participation as well as with online participation in Beykent University in Istanbul, Turkey on 06-09 September, 2026. The program included oral talks by invited prominent scientists and oral and e poster presentations by participants in selected topics from the submitted abstracts focusing on Agriculture, Biology and Life Sciences topics.

There is a worldwide record participation again in AGBIOL 2026 from 61 countries 1057 papers contributed over 2500 authors then 800 of them were accepted and then the conference was organized with 390 oral and 410 poster presentations.

With care for our nature and environment, we aim the green congress, meaning that as little as possible papers will be used. Abstract book is published in electronic book and is distributed to the participants by e mail for online participants. All the e-posters are prepared in electronic form and then submit to via the conference e mail and exhibited in electronical poster boards as well as in online e poster hall in our web page during the conference.

The participants with paid conference fee accessed all the normal and virtual presentation talks in each session, as well as to visit the virtual poster hall via preliminary provided. The abstracts were published in the Conference Abstract and Proceedings Book. Participants might send us their full papers, which based on their preferences are published either in our Conference Abstract and Proceedings Book or in selected International Indexed Scientific Journals.

Conference Topics:

Agriculture, Forestry, Life Sciences, Agricultural Engineering, Aquaculture and Biosystems, Animal Science, Biomedical science, Biochemistry and Molecular Biology, Biology, Bioengineering, Biomaterials, Biomechanics, Biophysics, Bioscience, Biotechnology, Botany, Chemistry, Chemical Engineering, Earth Sciences, Environmental Science, Food Science, Genetics and Human Genetics, Medical Science, Machinery, Pharmaceutical Sciences, Physics, Soil Science.

We would like to thank all of you for joining this conference and we would like to give also special thanks to TUBITAK and collaborators for giving us a big support to organize this event.

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MICROPLASTICS IN SOIL ECOSYSTEMS: IMPACTS ON MICROBIAL COMMUNITIES, NUTRIENT CYCLING, AND AGRONOMIC SUSTAINABILITY

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ABSTRACT

Microplastics (MPs), defined as synthetic polymer particles smaller than 5 mm, have become pervasive contaminants in terrestrial ecosystems. Soils, particularly agricultural soils, are now recognized as major sinks for MPs due to inputs from plastic mulching, sewage sludge, compost, irrigation water, and atmospheric deposition. Their persistence, diverse morphology, and chemical complexity enable MPs to interact directly with soil microorganisms, which are central to nutrient cycling, organic matter decomposition, and plant health.

This review synthesizes current knowledge on the ecological risks and microbial responses associated with MPs in soil. MPs alter soil physical properties such as porosity, bulk density, and water retention, thereby reshaping microbial habitats. They also act as carriers of persistent organic contaminants, heavy metals, and antibiotics, amplifying combined toxicity. At the microbial level, MPs induce shifts in community composition, favoring taxa capable of colonizing plastic surfaces or tolerating oxidative stress, while reducing the abundance of nitrifiers and ammonia oxidizers. Functional consequences include disrupted carbon, nitrogen, and phosphorus cycling, altered enzyme activities, and increased greenhouse gas emissions. Plant–microbe symbioses, including nitrogen-fixing bacteria and arbuscular mycorrhizal fungi, are impaired, leading to reduced nutrient uptake and crop productivity.

Although certain microorganisms demonstrate limited biodegradation potential, ecological benefits are outweighed by concerns regarding long-term accumulation, persistence of additives, and potential horizontal gene transfer of resistance traits. Significant knowledge gaps remain, particularly regarding chronic field-scale impacts under diverse agro-climatic conditions. Future research should integrate molecular, ecological, and biogeochemical approaches to assess cumulative effects and inform sustainable strategies for mitigating MP pollution in soils.

Keywords: Microplastics, Soil microorganisms, Microbial community shifts, Biodegradation, Carbon and nitrogen cycling, Soil fertility, Ecological risks, Plastisphere, Environmental sustainability

INTRODUCTION

Plastic has demonstrated a wide range of applications since its creation at the start of the 20th century (Lu et al., 2020). Plastic has permeated every aspect of our life in a matter of decades (packaging, synthetic textile fibers, throwaway plastic items, components, and structural portions of cars), and in recent years, its production has grown exponentially faster than that of any other material (Amobonye et al., 2021). The benefits of plastic in daily life, including its strength, durability, practicality, adaptability, and affordability, are widely acknowledged (Geyer et al., 2017). Because of this, plastic items are favored over those composed of comparable, less durable, and perishable materials. However, plastic's durability is the exact cause of its environmental issues. Although plastic items are frequently used just once or for a brief time, they take several hundred years to decompose. Because of this, plastic garbage builds up and contaminates all environmental matrices (Capozzi et al., 2025), and its debris can be found all over the world. Global plastic output since the 1950s reached 400.3 million tons in 2022, up almost 1.6% from the year before. Approximately 12,000 megatons of plastic will be scattered throughout the ecosystem by 2050, mostly on agricultural soil and in the oceans. One of the top ten environmental issues that need to be resolved is marine pollution caused by plastic trash, according to the first United Nations Environment Assembly in 2014. Only 9% of plastic is recycled; the remainder is burned, buried, or dumped into the environment (Bremer, 2022). Plastic residues are building up in the environment, where they can linger for extended periods of time and break down into tiny plastic particles, because of their poor recovery and strong resistance to destruction (Wright and Kelly, 2017). "White pollution" is the term for this phenomenon (Chen et al., 2022). Microscopic plastic trash is now present everywhere, from crowded beaches to isolated Arctic ice, from aquatic ecosystems to land. The term "microplastic" (MP) was first used to describe plastic waste by Thompson et al. (2004).

Today, microplastics (MPs), defined as plastic particles smaller than 5 mm, have emerged as one of the most pressing environmental pollutants of the 21st century. While initial research focused on aquatic ecosystems, recent studies highlight that soils are equally, if not more, significant reservoirs of microplastic contamination (Garbounis et al., 2026). Their persistence, chemical diversity, and ability to interact with biological systems make them a growing concern for terrestrial ecology, particularly in relation to soil microorganisms that underpin nutrient cycling and plant health.

Table 1. Types of Microplastics in Soil Ecosystems

Polymer	Common Source	Morphology	Soil Distribution
Polyethylene (PE)	Mulching films, packaging	Fragments, films	Agricultural soils
Polypropylene (PP)	Irrigation pipes, packaging	Pellets, fibers	Agricultural/urban soils
Polystyrene (PS)	Packaging, insulation	Fragments	Urban soils
Polyvinyl chloride (PVC)	Construction, pipes	Fragments	Industrial soils

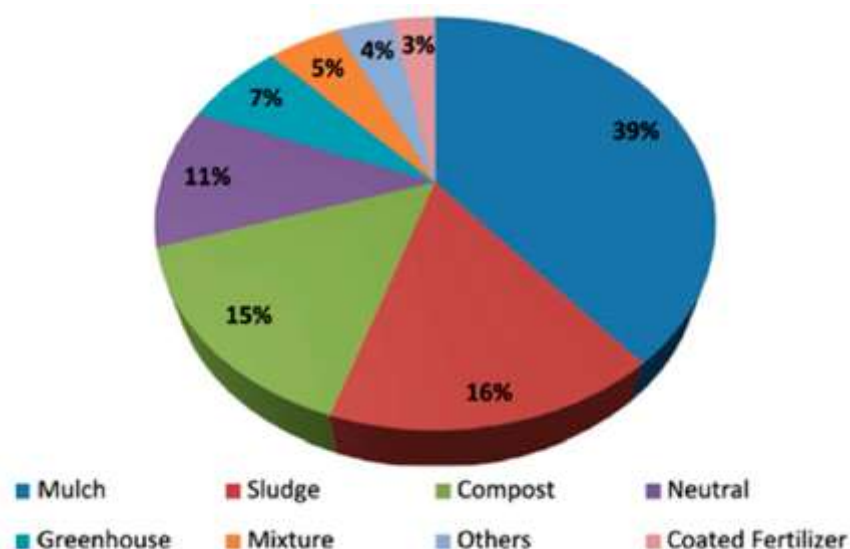


Figure 1. Microplastics sources in agricultural soils (from Sa'adu and Farsang, 2023)

ORIGINS AND PATHWAYS OF MICROPLASTICS IN SOIL

Microplastics (MPs), defined as synthetic polymer particles smaller than 5 mm, are now recognized as pervasive contaminants in terrestrial ecosystems. Their origin can be traced to primary MPs, intentionally manufactured for industrial and commercial purposes (e.g., cosmetic microbeads, industrial abrasives, textile fibers), and secondary MPs, which are formed through fragmentation of larger plastic debris under the influence of ultraviolet radiation, mechanical abrasion, and microbial degradation (Omidoyin & Jho, 2023).

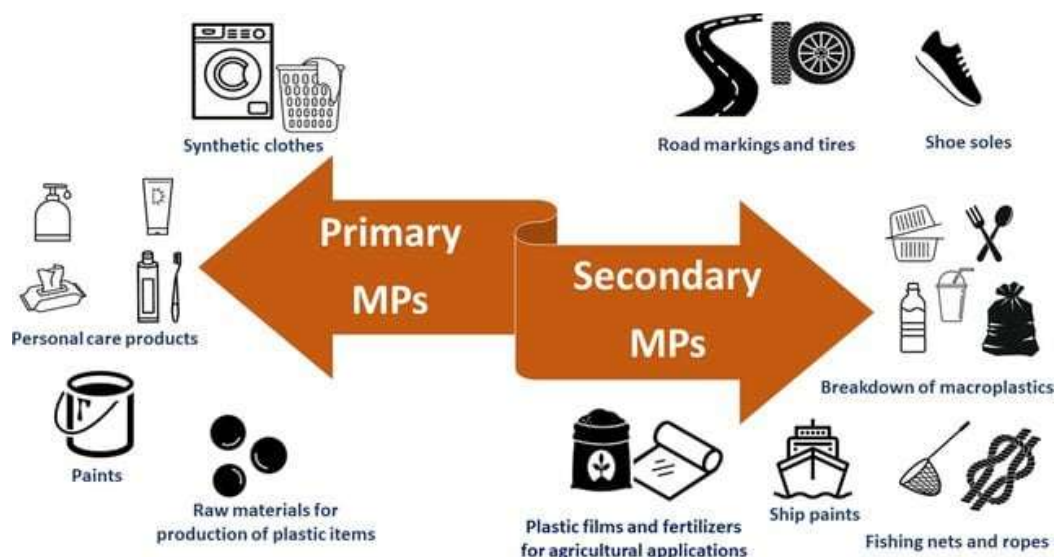


Figure 2. Sources of primary and secondary MPs.

Soils receive MPs through multiple pathways. Agricultural practices are a major contributor: plastic mulching films, greenhouse covers, and irrigation systems degrade over time, releasing MPs into fertile soils (Masciarelli et al., 2025). Organic fertilizers and sewage sludge, widely

applied in Europe and Asia, are another significant source, as biosolids retain up to 99% of microplastic particles from wastewater treatment (Aralappanavar et al., 2024). Atmospheric deposition also plays a role, with airborne fibers from textiles and tire wear settling even in remote forest soils (Masciarelli et al., 2025). Finally, industrial emissions, landfill leakage, and wastewater irrigation exacerbate contamination in peri-urban and industrial soils.

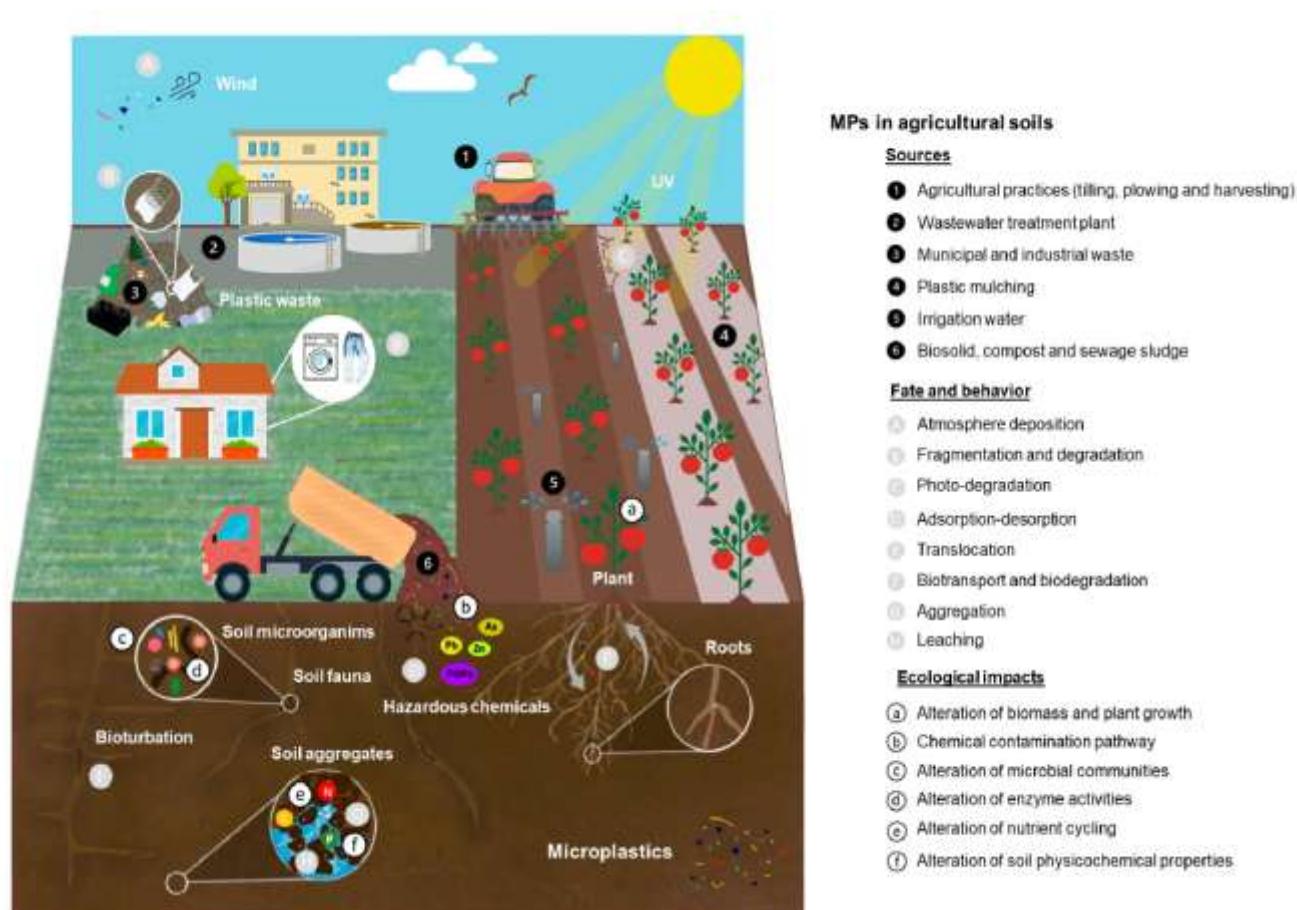


Figure 3. Microplastic entry pathways into soil (from Masciarelli et al., 2025).

TYPES AND MORPHOLOGY OF MICROPLASTICS IN SOIL

The most common polymers detected in soils are polyethylene (PE) and polypropylene (PP), associated with agricultural films and packaging, while polystyrene (PS) and polyvinyl chloride (PVC) dominate in urban and industrial soils (Omidoyin & Jho, 2023). Morphologically, MPs occur as fragments, fibers, films, and pellets. Their distribution within soil horizons depends on particle size: larger fragments tend to remain in surface layers, whereas smaller MPs penetrate deeper, increasing their bioavailability and potential for microbial interaction (Aralappanavar et al., 2024).

Table 2. Sources of MPs in Agricultural Soils.

Source	Type of Plastic	Concentration Range	Remarks	References
Plastic Mulching	PE	500–2000 particles/kg	Major contributor	Steinmetz <i>et al.</i> 2016
Sewage Sludge	PE, PP, PET	1000–24000 particles/kg	High contamination	Nizzetto <i>et al.</i> 2016; Corradini <i>et al.</i> 2019
Compost	PE, PP	200–900 particles/kg	Secondary source	Weithmann <i>et al.</i> 2018
Irrigation Water	Mixed	10–10000 particles/m ³	Diffuse input	Li <i>et al.</i> 2018; Zhang <i>et al.</i> 2020a,b
Atmospheric Deposition	Fibers	50–700 particles/m ² /day	Continuous input	Dris <i>et al.</i> 2016; Allen <i>et al.</i> 2019

DISTRIBUTION ACROSS SOIL ECOSYSTEMS

Microplastics are now reported across diverse terrestrial ecosystems. Agricultural soils show the highest concentrations, often exceeding 10,000 particles per kilogram, particularly in intensively managed vegetable farms (Aralappanavar *et al.*, 2024). Urban soils are heavily impacted by tire wear, industrial emissions, and landfill leakage. Forest soils generally contain lower concentrations, but MPs are transported via wind, runoff, and deposition from nearby anthropogenic sources (Masciarelli *et al.*, 2025).

A meta-analysis estimated global MP concentrations in surface soils (up to 5 cm depth) at $\sim 4.4 \times 10^{11}$ particles km⁻², with an average of 500 ± 266.7 mg kg⁻¹ soil (Aralappanavar *et al.*, 2024). Importantly, terrestrial ecosystems receive 4–23 times more plastic input than oceans, underscoring the soil environment as a critical sink for MPs.

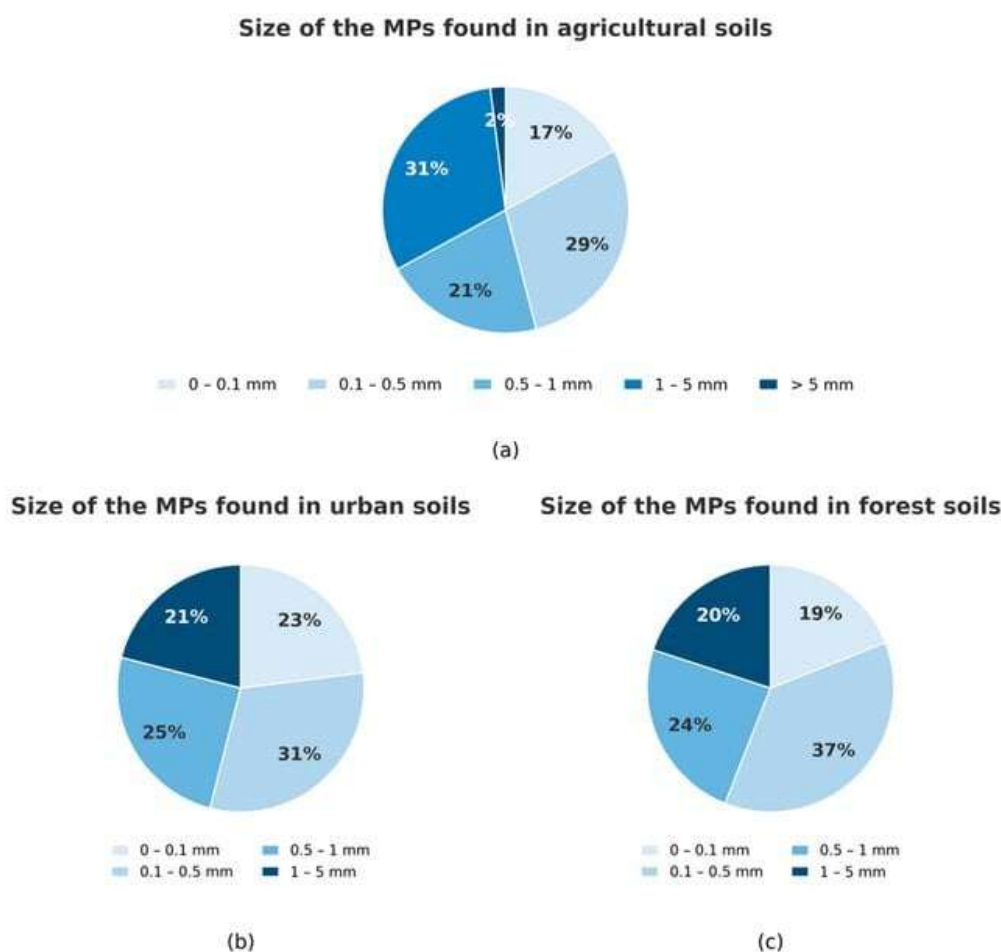


Figure 4. MP size distribution in: (a) agricultural soils, (b) urban soils, (c) forest soils (from Tzitzira et al., 2026).

MICROPLASTIC–MICROBE INTERACTIONS AND THE PLASTISPHERE

Soil is a dynamic habitat for microorganisms, and MPs provide novel surfaces for colonization. Microorganisms attach to MPs via extracellular polymeric substances (EPS), forming biofilms that protect against UV radiation and toxic compounds (Aralappanavar et al., 2024). These biofilms facilitate metabolite exchange and genetic transfer, leading to selective enrichment of specific microbial taxa.

The microbial consortium associated with MPs is termed the plastisphere. Unlike aquatic plastispheres, soil plastispheres are less mobile but harbor distinct microbial communities with lower diversity than surrounding bulk soil (Omidoyin & Jho, 2023). Studies show enrichment of Actinobacteria and Proteobacteria on PE and PS MPs, while fungi such as Ascomycota dominate plastisphere communities (Aralappanavar et al., 2024). However, MPs also increase the proportion of pathogenic bacteria and antibiotic-resistance genes (ARGs), raising concerns about soil health and biosecurity.

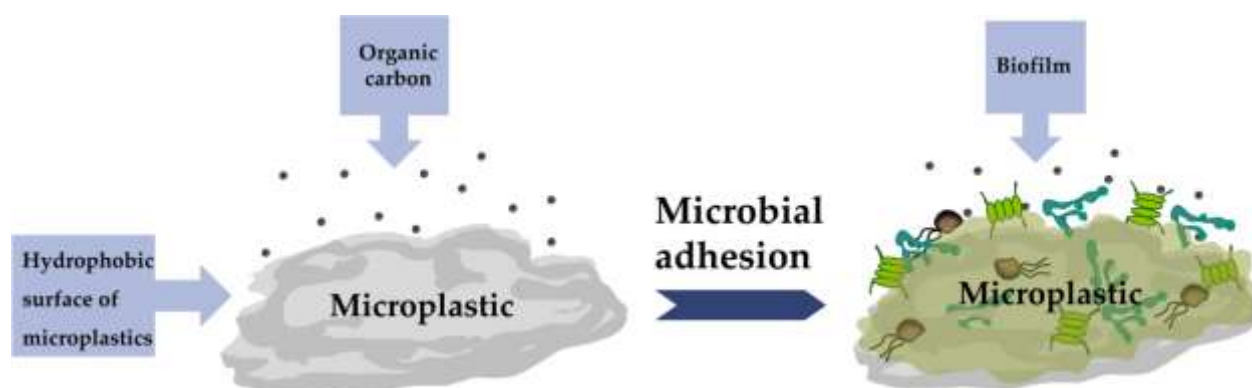


Figure 5. Development of biofilms on MP surfaces and microbial colonization (from Qin et al., 2024).

EFFECTS ON BENEFICIAL SOIL MICROORGANISMS

Soil microorganisms are essential for nutrient cycling, organic matter decomposition, and plant health. MPs disrupt these processes in several ways:

Nitrogen-fixing bacteria: At low concentrations (<1%), MPs can increase the relative abundance of N₂-fixing bacteria, potentially enhancing nitrogen availability (Aralappanavar et al., 2024).

Phosphate-solubilizing bacteria: MPs sometimes increase P availability, but phosphatase activity is often reduced, impairing phosphorus turnover (Aralappanavar et al., 2024).

Nitrifiers and ammonia oxidizers: MPs decrease the abundance of nitrifiers, reducing ammonia oxidation and altering nitrogen cycling (Aralappanavar et al., 2024).

Arbuscular mycorrhizal fungi (AMF): MPs interfere with root colonization, reducing plant biomass and resilience (Omidoyin & Jho, 2023).



Figure 6. Effects of microplastics on key soil microbial functional groups. Microplastics (MPs) alter microbial processes essential for soil fertility and plant health. At low concentrations, MPs may increase the abundance of nitrogen-fixing and phosphate-solubilizing bacteria, while higher levels reduce nitrifier activity and interfere with arbuscular mycorrhizal fungi (AMF) colonization, ultimately impairing nutrient cycling and plant growth.

These disruptions cascade into altered soil enzyme activities (urease, phosphatase, β -glucosidase), changes in greenhouse gas emissions (N_2O , CO_2 , CH_4), and reduced soil fertility (Masciarelli et al., 2025).

ECOLOGICAL AND AGRONOMIC CONSEQUENCES

The ecological consequences of microplastic (MP) contamination in terrestrial ecosystems are multifaceted and far-reaching. Microplastics alter the physical structure of soils, influencing porosity, bulk density, and water-holding capacity, which in turn affect aeration, root penetration, and microbial habitat stability (Aralappanavar et al., 2024). Their presence can fragment soil aggregates, reduce infiltration rates, and modify the soil's hydraulic conductivity. These changes disturb the delicate balance between soil particles and organic matter, leading to reduced soil cohesion and increased erosion potential. Moreover, MPs can act as hydrophobic barriers, decreasing water retention and altering capillary flow, which affects both microbial activity and plant water availability.

From a chemical perspective, MPs serve as carriers of persistent organic contaminants (POCs), heavy metals, and antibiotics, thereby amplifying the combined toxicity of pollutants in soil environments (Masciarelli et al., 2025). Their large surface area and hydrophobic nature enable adsorption of polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and heavy metals such as cadmium and lead. Once adsorbed, these contaminants can desorb under changing pH or redox conditions, releasing toxic compounds directly into the rhizosphere. This dynamic behavior increases the bioavailability of pollutants to soil microorganisms, often resulting in oxidative stress, enzyme inhibition, and disruption of

nutrient cycling. MPs also interact with antibiotics and antibiotic-resistance genes (ARGs), facilitating horizontal gene transfer among microbial populations and potentially contributing to the spread of antimicrobial resistance (Aralappanavar et al., 2024).

The biological consequences are equally significant. Soil microbial communities—key drivers of nutrient cycling and organic matter decomposition—experience shifts in composition and functionality under MP exposure. Beneficial groups such as nitrogen-fixing and phosphate-solubilizing bacteria may initially increase at low MP concentrations (<1%), but prolonged exposure leads to reduced enzymatic activity and impaired nutrient turnover. Nitrifiers and ammonia-oxidizing bacteria decline, disturbing nitrogen transformation processes and reducing soil fertility. Arbuscular mycorrhizal fungi (AMF), which form symbiotic relationships with plant roots, are particularly sensitive; MPs interfere with root colonization, reducing plant biomass and resilience (Omidoyin & Jho, 2023).

For plants, the consequences manifest through physiological and morphological stress. MPs can obstruct seed germination by physically blocking pores and altering soil temperature and moisture regimes. Root penetration is hindered by changes in soil compaction and aggregate stability, while shoot biomass declines due to reduced nutrient uptake and impaired rhizosphere interactions (Masciarelli et al., 2025). The disruption of plant–microbe symbioses, including nitrogen-fixing bacteria and mycorrhizal fungi, diminishes nutrient efficiency and weakens plant tolerance to abiotic stress. In addition, MPs can accumulate on root surfaces or within plant tissues, potentially entering the food chain and posing risks to human and animal health.

At the ecosystem level, MP contamination contributes to altered greenhouse gas fluxes. Studies have shown increased emissions of nitrous oxide (N₂O) and carbon dioxide (CO₂) from MP-polluted soils, linked to changes in microbial respiration and denitrification pathways (Aralappanavar et al., 2024). These emissions exacerbate climate change impacts and further degrade soil quality. The cumulative effect of these processes is a decline in soil fertility, reduced crop productivity, and compromised agroecosystem sustainability.

From an agronomic standpoint, MPs threaten long-term soil health and food security. Their persistence and slow degradation mean that contamination accumulates over time, particularly in intensively farmed regions where plastic use is widespread. The infiltration of MPs into agricultural soils not only affects plant growth but also poses occupational risks for farmers through inhalation or dermal exposure to contaminated dust (Masciarelli et al., 2025). Consequently, MP pollution represents both an environmental and a public-health challenge, demanding integrated management strategies that combine sustainable agricultural practices, improved waste handling, and the development of biodegradable alternatives.

Ultimately, the presence of microplastics in soil ecosystems undermines the fundamental ecological functions that sustain plant productivity and biodiversity. By altering soil physicochemical properties, disrupting microbial networks, and impairing plant–microbe interactions, MPs compromise the resilience of agroecosystems and pose a growing threat to global food security and human health.

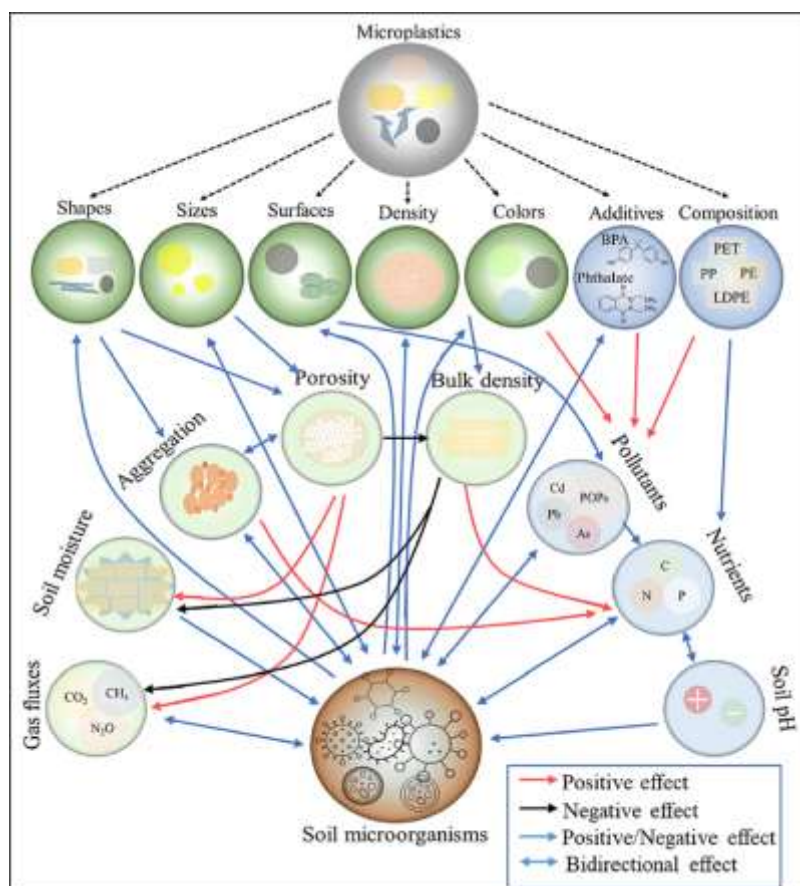


Figure 7. Pathways for interactions of MPs with microorganisms in relation to soil properties. Dark green and light green bubbles represent physical attributes of MP and soil, respectively, while dark blue and light blue bubbles represent chemical attributes of MP and soil, respectively. Grey and brown bubbles represent MP and soil microorganisms, respectively (from Aralappanavar et al., 2024).

CONCLUSION

Microplastics represent an emerging and complex threat to soil ecosystems. Their persistence and widespread distribution compromise soil structure, alter microbial diversity, and disrupt biogeochemical cycles essential for ecosystem resilience and agricultural productivity. Evidence consistently shows that MPs impair beneficial microbial functions, reduce plant–microbe symbioses, and increase pollutant bioavailability, thereby undermining soil fertility and food security. Despite advances in laboratory studies, long-term field data remain scarce. Addressing this gap is critical to understanding chronic impacts and developing effective mitigation strategies. Future research should prioritize:

Integrated field studies across soil types and climates.

Molecular and ecological approaches to unravel microbial responses and resistance mechanisms.

Biodegradable alternatives and sustainable agronomic practices to reduce plastic inputs.

Risk assessments linking soil contamination to food safety and human health.

Ultimately, safeguarding terrestrial ecosystems requires coordinated efforts in research, policy, and agricultural management. By addressing microplastic pollution at its source and understanding its ecological consequences, we can preserve soil health, sustain crop productivity, and protect environmental and human well-being.

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