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MICROPLASTICS IN AGRICULTURAL SOILS POSE RISKS TO FOOD SYSTEMS & HUMAN HEALTH

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Microplastic pollution is often viewed as an ocean problem, but terrestrial environments – and especially agricultural soils – may represent an equally important and underexamined source of exposure. Plastics do not simply remain intact in soil. As they fragment, smaller particles become more biologically available, release chemical additives, and accumulate environmental contaminants. Plants, including food crops, can take up, transport, and accumulate microplastics in roots, shoots, and leaves.

Microplastic exposure in plants has been associated with altered germination, root development, photosynthesis, nutrient content, metabolism, biomass, and crop yield. Microplastics can also modify soil structure, water-holding capacity, microbial communities, and interactions with other pollutants such as heavy metals. Here, we review how plastics enter soils through agricultural and horticultural products such as plastic mulch, greenhouse materials, irrigation pipes, and packaging, as well as through contaminated compost, treated wastewater, sewage sludge, runoff, and atmospheric deposition.

KEY RESEARCH FINDINGS

Plants can take up microplastics. Multiple studies demonstrate uptake, translocation, and accumulation of micro- and nanoplastics in crop plants. Particles have been detected in roots, shoots, and leaves, with vascular transport documented in crops including lettuce and wheat.

Plant performance is generally negatively affected, but responses vary. Microplastic exposure most often reduced plant biomass, chlorophyll, photosynthesis, root or shoot growth, and nutrient content. Some studies found stimulatory effects, particularly at lower concentrations, demonstrating that effects depend on polymer type, shape, size, concentration, species, and growing conditions.

Crop yields may decline. Long-term exposure to microplastics or plastic mulch residues has been associated with lower yields in rice, cotton, and maize.

Microplastics alter entire soil systems, changing soil structure, water availability, microbial communities, and the behavior of other pollutants. Crop systems can be affected by microplastic impacts as direct effects on plants and indirect effects mediated through the soil ecosystem.

Major knowledge gaps remain. Many experiments use pristine plastics, relatively high concentrations, hydroponic systems, and short exposure periods that do not fully represent agricultural conditions.

POLICY IMPLICATIONS

Establish coordinated monitoring of microplastics in agricultural soils and food crops, including California and other major U.S. agricultural regions, to determine concentrations, polymer types, and major sources.

Develop standardized testing and risk-assessment protocols using environmentally realistic plastic mixtures and concentrations, dose-response experiments, and full crop-growth cycles.

Evaluate agricultural pathways that introduce plastics into soils, including plastic mulch, compost, biosolids, treated wastewater, irrigation infrastructure, and atmospheric deposition; identify opportunities for reduction.

Prioritize food-crop and human-exposure research, including measurement of microplastics accumulation in edible plant tissues and differences among crop types and growing conditions.

Incorporate terrestrial microplastics into soil-health and agricultural sustainability policy, rather than managing plastic pollution primarily as an aquatic or waste-management issue.

MORE INFORMATION

This policy brief summarizes findings from the article, “Plants and microplastics: Growing impacts in the terrestrial environment” by Amanda Wong and Gail Taylor, available at <https://doi.org/10.3389/fpls.2025.1666047>. For more information, email Amanda Wong: amewong@ucdavis.edu.

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