Adsorption of polyethylene microbeads and physiological effects on hydroponic maize

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About 90% of the plastic garbage remains in terrestrial ecosystems, and increasing evidence highlights the exposure of crops to plastic particles. However, the potential bioaccumulation of microplastics by plants and their effects on plants' physiology remains unexplored. Here, we evaluated the adsorption, potential uptake, and physiological effects of polyethylene (PE) microbeads in an experimental hydroponic culture of maize. Using isotope analysis, taking advantage of the different carbon isotope composition (?13C) of fossil-derived PE and C4 plants (e.g., maize), we estimated that about 30% of the carbon in the rhizosphere of microplastic-exposed plants was derived from PE. Still, we did not find evidence of PE translocation to the shoots. Plastic bioaccumulation in the rhizosphere caused a significant decline in transpiration, nitrogen content, and growth. Our results indicate that plastic particles may accumulate in the rhizosphere, impairing water and nutrient uptake, and eventually reaching root eaters. Due to the implications for food production and livestock feeding, our findings encourage further research on the mechanism leading to the bioaccumulation of microplastics on the surface of belowground tissues.

Bioaccumulation

Green fodder

Hydroponics

Microplastic uptake

Microplastics

Stable isotopes

Agriculture

Aliphatic compounds

Bioaccumulation

Biochemistry

Carbon

Isotopes

Microplastic

Nutrients

Polyethylenes

Soils

Carbon isotope composition

Food production

Hydroponic culture

Isotope analysis

Nitrogen content

Physiological effects

Plastic particle

Terrestrial ecosystems

Microbeads

carbon 13

nitrogen

polyethylene

water

adsorption

bioaccumulation

experimental study

hydroponics

maize

physiology

plastic waste

polymer

terrestrial ecosystem

adsorption

Article

bioaccumulation

controlled study

food industry

fossil

hydroponics

isotope analysis

livestock

maize

microplastic pollution

nonhuman

plant growth

plastic waste

priority journal

rhizosphere

shoot

sweating

water transport

Zea mays