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Glyphosate degradation and bioavailability in soil system

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Glyphosate is the active ingredient of the common herbicide Roundup. The increasing presence of glyphosate and its byproducts has raised concerns about its potential impact on the environment and human health. In this study, we used liquid chromatography mass spectrometry (LC-MS) and electrospray ionization (ESI) source Q Extactive Orbitrap mass spectrometry (ESI-Orbitrap MS) to identify glyphosate degradation products and investigated the transformation of orthophosphate released in soil. The LC-MS and ESI-Orbitrap MS results showed that glycine formed during the early stage but was rapidly utilized by soil microorganisms. AMPA was the dominant product at the late stage and was 3–6 times more persistent than glyphosate against degradation. The ^{18}O labeling and phosphate oxygen isotope results allowed a clear distinction of the fraction of inorganic P (P_i) derived from glyphosate, about half of which was then rapidly taken up and recycled by soil microorganisms. Soil incubation results are different from abiotic degradation with Mn-oxide in which AMPA production was suppressed. These results point that AMPA is preferred pathway of degradation in biotic degradation. The rapid cycling of P_i derived from glyphosate degradation constitute a disregarded source of P that has important implications on nutrient management in agricultural as well as loss from soil to open waters.