(25)

Short Term Impacts of Polypropylene Microplastics on Soil pH and Microbial Enzyme Activities

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Abstract

Microplastics (MPs) are small plastic particles or fragments that measure less than 5 mm. Common existence MPs in the soil environment cause significant threats to microbial life, plant, animal, and human health. The accumulation of these microplastic particles can have varying effects on soil pH and microbial enzyme activities depending on the exposure time. The objective of this study was to examine the influences of polypropylene MPs at different exposure periods on pH and microbial enzyme activities of soil under laboratory conditions. Transparent single-time polypropylene (PP) cups labeled as PP 5 were used. The PP was crushed using a plastic shredder and separated into 3 different sizes (1mm, 2 mm & 2.8-5 mm). Fragmented PP MPs were mixed at concentrations of 0%, 2%, and 4% (w/w) with surface soil and incubated at room temperature. Samples were collected on the 0^{th}, 15^{th}, 30^{th} and 45^{th} day of incubation and the soil pH, urease, and dehydrogenase enzyme activities were measured. The soil pH decreased significantly over time, depending on the exposure duration, with an initial reduction from 13.1–19.0% on the 15^{th} day, further declining to 0.8–6.0% by 30^{th} day. However, by 45^{th} day, the soil pH had increased by 2.5–11.3% relative to the MP-free soil. PP fragments of size 2.8–5 mm resulted in higher pH values relative to the 1 and 2 mm fragment sizes after the 15^{th}, 30^{th} and 45^{th} days. Soil pH increased from 4.3% to 11.3% when the PP concentration was increased from 2% to 4% (w/w) after the 45^{th} day. Thus, the effect of MPs on soil pH was revealed to be dependent on size, concentration, and exposure period. Urease enzyme activity was decreased by 3.3–9.1% after the 30^{th} day while dehydrogenase showed a decreased activity of 8.7–40.6% after the 45^{th} day. The results indicate that after 45 days of incubation, PP MPs with different sizes, concentrations, and exposure periods caused increased pH and decreased urease and dehydrogenase microbial enzyme activities that suggest potential effects on equilibrium of the soil ecosystem.

Keywords: *Polypropylene, Urease, Dehydrogenase, Microplastics, Soil pH*