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Plastic input and dynamics in industrial composting

Stoyana Peneva et al.

Despite various attempts by composting facilities to remove plastics from compost, high levels of particularly small microplastics (1 µm - 5 mm, MiPs) are detected in compost.

To elucidate the potential removal or enrichment of MiP during the composting process, we first analyzed the input of macroplastics (> 20 mm, MaPs) via bio-waste collection in an industrial composting plant. Then, we further determined MiPs at five different stages during the composting process (before and after distinct shredding and screening processes), as well as in the water used for irrigation.

We found varying total concentrations of MaP in the bio-waste collected from different municipalities, ranging from 0.36 - 4.72 kg ton^{-1} bio-waste, with polyethylene (PE) and polypropylene (PP) being the most abundant types. Further, we found a similar presence of “foil” and “non-foil” plastics, with 0.824 ± 0.34 kg ton^{-1} and 0.83 ± 0.34 kg ton^{-1} bio-waste, respectively; only 0.3 ± 0.1 kg ton^{-1} bio-waste of biodegradable plastic was found. The total concentration of MaP and MiP increased from 12 items kg^{-1} before shredding to 34 items kg^{-1} bio-waste in the final compost, indicating a relative enrichment of the number of particles during the process. Analyzing the rain water used for moistening the compost (collected on the roof of the compost facility) revealed that already high amounts of PE, polyamide (FA) and PP particles with sizes of 6 - 70 µm were found in rainwater (22,714 ± 2,975; 3,108 ± 748 and 685 ± 398 particles L^{-1}, respectively). These plastic loads were 1.4 to 5-fold lower in the process water collected after irrigation, indicating a co-contamination of compost by irrigation.

This study highlights the importance of reducing plastic input via bio-waste, as it is one of the main sources for MiP contamination of compost, while also recognizing the challenges in effectively removing MiP during composting. The complex dynamics of MiPs, i.e. the enrichment of small MiPs, is problematic as small particles in particular have many ecotoxicological properties. We could identify irrigation water as a plastic source for compost, an input pathway that has been overlooked so far. Therefore, our results underline the need for comprehensive strategies to tackle plastic pollution throughout the composting cycle, from bio-waste input to final compost products.

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