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Microplastic detection in soil amended with municipal solid waste composts as revealed by microscopy and pyrolysis/GC/MS

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Background & Objectives

Urban compost spreading in agrosystems enhances soil fertility but can also be a source of plastics, not entirely eliminated during the composting process. Knowledge of the fate of these plastics in regularly-amended soils is thus an issue for the environmental management of these soils. It is then necessary to have tools monitoring the identification of (micro)-plastics within the soil structures.

Materials and Methods

The studied soil is a loamy soil cultivated with wheat/maize production and amended every two years with municipal solid waste composts since 1998. We used and adapted a methodology based on the morphological and analytical characterization, by transmission electron microscopy (TEM) associated to EDX microanalysis, of the granulometric fractions of compost and soil [1][2]. Identification of plastics was defined and their association with soil particles described. Results were completed by soil physico-chemical analyses and pyrolysis/GC/MS of the soil granulometric fractions.

Results and Discussion

TEM-EDX results highlighted morphological and analytical tracers of the introduced plastics. For instance, specific features of organic membranes associated with titanium were identified in compost and soil fractions. Ti, Ba and Cl appeared as relevant plastic tracers. Main plastic fragments were not associated within soil aggregates and did not present any features of microbial degradation. Plastics fragments were frequently observed in the coarsest soil fractions (>50 µm), then, the finer the fraction, the lower the observation frequencies of them. Almost no micro-plastics (< 20 µm) were found either in the compost nor in the < 20 µm soil fractions. Some pyrolysis products possibly derived from plastics [3], such as styrene, were observed in some of these fractions. Relative proportions of styrene produced upon pyrolysis of soil fractions also decreased according to a same decreasing gradient of particle sizes. Detection limits of the method and plastic turn over are discussed.

Conclusion

This methodological approach provided morphological, elemental and molecular tracers of micro-plastics in compost and soil granulometric fractions. Having tool to monitor the fate of micro-plastics over time will complete information on their availability in soils and their contribution to the organic matter dynamics in soils amended with bio-based products.

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