ABSTRACTS (MASTER THESIS)

Microplastics in a forest soil environment: interactions with termites

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Introduction

Even though plastics have enormous benefits to society, they cause a serious environmental problem. In particular, plastics of <5 mm in size, called microplastics (MPs), have been intensively studied for their impacts on aquatic environments. However, there is little information about microplastics in terrestrial environments. Thus, it is essential to conduct research on the problem of soil pollution by plastics. The purpose of this research was to verify the effect of the activities of soil organisms on the movement of MPs in terrestrial environments, using termites as representatives of soil organisms. It is well known that termites play an important role in terrestrial environments, especially in the tropics and subtropics.

Materials and methods

Soil samples 5 cm in diameter and 30 cm in depth were obtained in Japan and Indonesia from sites showing a variety of termite activities and at different distances from the shore. MPs from the samples were extracted with a $ZnCl_2$ solution (density: 1.6) and analyzed with a Fourier-transform infrared (FTIR) spectrometer.

The pot experiment was employed as a model system for interaction between MPs and termites. The pots were 5.8 cm in diameter and 15 cm in height. Two subterranean pest termites, the Formosan Subterranean Termite (FST: *Coptotermes formosanus*) in Japan (obtained from a laboratory colony maintained at the Deterioration Organisms Laboratory, RISH, Kyoto University) and the Asian Subterranean Termite (AST: *C. gestroi*) in Indonesia (obtained from a laboratory colony maintained at the Research Centre for Biomaterials, Indonesian Institute of Sciences [LIPI]) were employed in combination with polyethylene (PE) and polypropylene (PP) MPs in three different sizes (2-5 mm, 1-2 mm, 0.5-1 mm), and polystyrene (PS) blocks (2×2×1 cm). The pot was filled with soil to a depth of 15 cm (moisture content = 20%), and 200 mg MPs and 220 termites (200 workers and 20 soldiers) were placed on the soil surface. The assembled pot was kept in the termite culturing room at 28 ± 2°C and > 60% relative humidity in the dark. After 3 weeks, the soils from each 3 cm of depth (a total of 5 samples) and the sample piled over the original soil surface were collected and quantitatively analyzed for MPs.

Results and discussion

Although the soil analyses are still ongoing, MPs were obtained from the soil samples collected from a pine forest 500 m inland from the beach in Kagoshima Prefecture and from a pine forest just behind the beach in Wakayama Prefecture.

In the pot experiments in Japan and Indonesia, it was observed that MPs were not only buried in the soil piled over the original soil surface, but had also been transported to depths of >3 cm. In the cases of PE and PP, smaller particles tended to be transported deeper, and particles of <0.5 mm in size were also detected. In the case of PS, the termites heavily attacked PS blocks and broke them into many smaller particles. MPs were seen in layers deeper than those where PE and PP were found. ASTs transported the MPs much more and deeper than FSTs.

Our study shows that MPs exist in the forest soil environment near the coast, that termites are associated with the movement of MPs from the soil surface into the soil, and that termites break plastics into smaller particles. These effects depend on the size and type of plastics. When termites break plastics into smaller pieces, and those pieces are then retained in soil where the environment is relatively stable, it is possible that there would be long-term negative impacts on soil biota, soil organisms, and plants. Further research is needed on the effects and fate of MPs in soil environments.