Study on Generation of Microplastics in Agricultural Land and Transfer to Marine Environment

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[Abstract]

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The use of plastic materials in agriculture has achieved the production of high-quality crops, labor savings, and reduction of environmental impact. On the other hand, the recent problem of plastic waste in the ocean has created a need to address new issues, such as the proper disposal of plastic materials used in agricultural fields and prevention of their runoff. Fertilizer-containing plastic microcapsules with a diameter of 2 to 5 mm (coated fertilizer) are not recovered after use, and after diffusion of the fertilizer components these microcapsules are found in large quantities, not only on agricultural land but also along the coast, which suggest that agricultural lands are a source of marine microplastics, but the actual situation has remained unclear. This study evaluated (1) the accumulation and discharge of microcapsules in rice paddies, (2) the migration process to the ocean via agricultural water, (3) and monitoring of microcapsules at the shoreline in order to understand the actual condition of microcapsules in the environment.

The density of microplastics in the shoreline increased during the irrigated season and decreased during the non-irrigated season. During the irrigated season, 70-90% of the microplastics at the shoreline were microcapsules, and rice paddies were one of the sources of microplastics in areas where rice cultivation was prevalent.

The highest amount of microcapsule runoff from the paddy fields occurred in May. Microcapsules were discharged from the paddy fields primarily during puddling, when the weir plate was overflowed, and when surface drainage was implemented. Comparing the inflow and outflow of microcapsules, the outflow rate to inflow was 7.1%, indicating that most of the applied microcapsules accumulated in the paddy soil. Indeed, a survey of the accumulation of microcapsules derived from coated fertilizers in 19 paddy fields revealed that microcapsules were detected in all paddy fields, with concentrations ranging from 6 to 369 mg/kg, much higher than microplastic concentrations in agricultural land in other countries. In order to prevent additional pollution to the ocean in the future, the development of technology to control the outflow of microcapsules from paddy fields is urgently needed.

Monitoring of loadings at the mouths of agricultural waterways revealed that the migration of microcapsules into the sea was concentrated from mid-April to late May, coinciding with the timing of paddy field runoff. The most important issue for the future is to clarify the actual status of secondary microplastics, which are the miniaturization of primary microcapsules.

[References]

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