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Microplastic Contamination in Agroecosystems: Effects of MSW Compost on Soil and Plants

PRERNA PATEL, MADAN KUMAR, VIVEK KUMAR AND POOJA GHOSH

Indian Institute of Technology Delhi

Microplastics (MPs) are tiny plastic particles (<5 mm) that have become pervasive environmental pollutants, infiltrating soil ecosystems through agricultural inputs like compost and irrigation. Their persistent nature poses a growing threat to soil health, plant growth, and overall ecosystem stability. This study aims the existence of MPs in agricultural and the impact of MPs on soil properties and plant growth. Additionally, future research will focus on developing a treatment method for the removal of MPs during the composting process to mitigate their environmental impact. The samples were collected from landfill and municipal solid waste (MSW)composting sites in Tier-I and Tier-II cities of India i.e. Delhi and Bareilly (Uttar Pradesh), while soil samples were taken from agricultural fields in villages of Jhabua (Madhya Pradesh) and Gaindikhata (Uttarakhand). MPs were first analyzed using a stereomicroscope, which revealed diverse shapes, including fibers, fragments, beads, and films. They were also identified in various colors such as transparent, yellow, red, blue, green, white, pink, grey, and black, indicating multiple contamination sources. Further, different polymers were identified using micro-Raman spectroscopy such as polyethylene terephthalate (PET), low-density polyethylene (LDPE), polypropylene (PP), and polyethylene (PE). Finally, Scanning Electron Microscopy (SEM) analysis provided detailed insights into the surface morphology of the identified MPs. To assess soil health, key physico-chemical properties, including pH, electrical conductivity (EC), nitrogen, phosphorus, potassium, organic carbon and water-holding capacity, were analyzed. The presence of MPs led to variations in soil pH and EC, potentially disrupting nutrient availability and microbial activity. MPs also influenced soil water retention, which could impact plant root development and overall soil characteristics. These changes may contribute to soil degradation, affecting its long-term fertility and productivity. The impact of MPs on plants was evaluated by measuring chlorophyll content and heavy metal uptake. A decline in chlorophyll content indicated stress in plants exposed to MP-contaminated soil, potentially affecting photosynthesis and growth. Additionally, increased heavy metal accumulation in plant tissues suggested that MPs could act as carriers for toxic elements, further affecting plant metabolism. These findings highlight the risks associated with MPs in agricultural systems, as they can compromise soil health and plant development.