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Microplastic Menace: The Ecological Impacts on Crop and Soil Health

Rupam Das[1] and Soham Maiti[1]
[1]Student, School of Agriculture, Brainware University

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Introduction

Plastic pollution has always been a widespread issue of concern for agriculture. The issues multiplied significantly when microplastic comes into being. Microplastic refers to plastic particles ranging from 1µm to 5mm in size which occurs through degradation of primary plastic by biotic or abiotic reasons. Smaller particles have more potential in generating toxicity in the soil and disrupt the microbial biome. These particles have also infiltrated our aquatic bodies and food supply in huge extent [1]. The sources of these microplastic includes mulching plastic, plastic wares used in agriculture, films, packaging materials, irrigation tubing, pesticide containers etc which eventually breaks down into micro pieces [2]. Hence one of the primary objectives in enhancing soil health and crop production should be the concerned endeavour to diminish the presence of microplastics.

Fate of Microplastic in soil

The unbridled increase of plastic pollution is adversely affecting the physio-biochemical properties of the soil which includes enzymatic activities, soil structure, microbial activities and plant growth [4]. Ramos et al. (2015) found that roughly 10% of agricultural lands contains residues of plastic films. Due to their extended life span, plastics persists enduringly, seldom undergoing total decomposition, while bioturbation process transpires. It has been found that microplastics are responsible for reduction of infiltration rate and water holding capacity of the soil which ultimately causes disruption in soil nutrition cycle and micro-biome [5].

Interaction with Soil Organisms

One of the most troublesome effects of microplastics is the disarray of the soil microbes, where beneficial soil microbes faced challenges due to the changes in the soil structure and chemical properties which posed a adverse and detrimental effect on soil health [4]. It was found that after the instigation of increasing microplastic levels, certain populations of worms

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and microarthopods decreased, which led to poor nutrient cycling in the soil[6]. The microplastics also affect the microbial metabolism which shifts the functions of particular microbes in the soil. It was also noticed that microplastics may change the gene expression of the soil microbes, increase of Reactive oxygen species (ROS) , increased biofilm production and increased colonies of pathogenic microorganisms(7).

Repercussions on Crop Health

Microplastic showed many adverse effects on the plant's growth such as, closing of pores in roots and seeds which disrupts nutrient and water uptake mechanisms simulating a drought condition [8]. It also showed modifications and hormonal imbalances, reduction in the content of chlorophyll and reduction in photosynthesis rate.[8] As the crop plants were obtained from lands containing significant amounts of microplastic, the grains or vegetables showed traces of microplastic which is very troublesome for Human health. Thus, it is advisable to limit the use of plastic in the agricultural field or properly discarding the plastic wastes.

Conclusion

The widespread problem of plastic pollution, specifically the rise of microplastics, presents a significant danger to both agriculture and the health of ecosystems. Various sources of microplastics in agriculture, such as plastic used for mulching, packaging materials, and irrigation tubing, contribute to the deterioration of soil quality and disrupt the delicate balance of microbial communities. The continuous presence of microplastics has a detrimental effect on soil properties, enzymatic activities, and the growth of plants, resulting in a series of negative consequences for crop health and subsequently, human well-being. The destiny of microplastics in soil is characterized by their persistent nature, as only a small portion undergoes decomposition. These particles hinder the nutrient cycles in soil, reduce the rate of water infiltration, and have a negative impact on the soil's ability to hold water. This disruption also extends to the interaction with soil organisms, particularly beneficial microbes and invertebrates, leading to a decline in nutrient cycling and changes in microbial metabolism. The effects on crop health are evident, as microplastics cause physiological disruptions in plants, including hormonal imbalances, reduced chlorophyll content, and decreased rates of photosynthesis. Moreover, the infiltration of microplastics into the food supply raises concerns about potential health risks for humans who consume crops grown in contaminated soils. Therefore, it is crucial to address this issue by implementing measures to reduce the use of

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plastic in agriculture and adopting proper waste disposal practices. Ultimately, mitigating the presence of microplastics in the agricultural ecosystem is essential for preserving soil health, sustaining crop production, and safeguarding human well-being.

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