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Role of Biochar and Microbes in Remediation of Microplastics in Soil

Priyadarshani Rajput*, Tatiana Minkina, Anatoly Barakhov, Elizaveta Pulikova, Maria Kobtseva

Academy of Biology and Biotechnology, Southern Federal University, Rostov-On-Don, Russia

ABSTRACT

Rising presence of microplastics (MPs) in lakes and rivers, urban settings, and isolated wild locations are becoming global concern. MPs are non-biodegradable and remain in soils for decades, continuously accumulating due to ongoing plastic production and poor waste management. Soils are becoming a largest sink for MPs, with estimates suggesting it contain 4 to 23 times more than aquatic systems. It can alter the soil porosity, water retention, and aeration, negatively affecting soil health. MPs in the soil adversely affecting growth of crops, and variety of soil microbes, thereby compromising the sustainability of agriculture. Exposure to MPs lead oxidative stress in plants, resulting in reduced productivity, and disturb microbial diversity. Reduced microbial diversity leads to an imbalance in carbon, nitrogen, and phosphorus cycles, potentially exacerbating climate change and reducing ecosystem productivity. Considering an alarming threat imposed by MPs on soil microbial community, crop and human health, the present work aimed to address the contamination level, toxicity, degradation and remediation in soils. Addressing the MPs problem in soil is scientifically important due to its toxicity that affecting physical, chemical, biological properties of soils, plant growth and human health. Accumulation of MPs occurs in different plant species, affecting different tissues, causing physiological effects and damaging the biochemical processes. Thus, the various sizes of MPs are synthesized and incubated (spiking) in soils under controlled conditions for toxicity evaluation. Role of microbes (special microbes/tolerant) for MPs degradation in soil explored. Emerging sorbents such as biochar, nanobiochar, integrated biochar with microbes/ nanoparticles examined to alleviate MPs toxicity in soil and on plant indices in model experiment and field-testing system. The results helped to understand the state of soil microbes and plant responses under MPs pollution. The effectiveness of emerging sorbents opens new avenue in remediation of emerging contaminants. Therefore, this combined approach is significant, ecofriendly, sustainable, low-cost, adaptable and could be effective to eliminate contaminants.

Keywords: biochar, degradation, emerging contaminants, soil health, microbes

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***Corresponding Author:**

Priyadarshani Rajput, Academy of Biology and Biotechnology, Southern Federal University, 344090, Rostov-On-Don, Russia.
Email: radzhput@sfedu.ru