Agri Mirror: Future India
Vol 1 Issue 1: May 2020

Bioremediation: A potential tools for Microplastic degradation in global concern

Abhishek Sen
Article ID: 13
Department of Soil Science and Agricultural Chemistry, U.B.K.V, Pundibari West Bengal. 736165
Corresponding author: connectabhishek1@gmail.com

Introduction

Microplastics become a contaminant and gradually increasing concern in soils and terrestrial ecosystem globally which was estimated that the contamination on land might be 4 to 23-fold higher than that in the ocean, could account for as high as 7% of soil weight (et al., 2016; Rillig *et al.,* 2017). Many researchers are reported that agricultural soils might be the important microplastic sink (Rillig, 2017) because of the most prominent use of sewage sludge as fertilizer and second microplastics yielded from plastic mulching degradation (Nizzetto *et al.,* 2016). It can be found throughout the globe including in remote locations, such as sub-Antarctic islands or deep seas, transfer from discharge areas to deposition zones. It is a great challenge now in our future generation for these ecological threats, we have to find out a solution with the sustainability property of the environment, therefore bioremediation is the potential tools for the degradation which is the global concern toward the remediation (degradation) of microplastic.

Microplastic

National Oceanic and Atmospheric Administration (NOAA) define Microplastics, according to them, plastic particles with a diameter of 5mm, while those 1 μm called microplastics (GESAMP, 2015; NOAA, 2015). It can be classified according to their origin as either primary or secondary microplastics where in the form of pellets, plastic-based granulates in the cosmetics industry, vector for drugs in medicine are called primary and fragmentation of larger plastic particles including macro and mesoplastics such as glass bottles and plastic bags are secondary. Microplastics have a higher specific surface area with their small size, ability to adsorb pollutants becomes stronger that makes the toxicological effects of microplastics more complicated.

Bioremediation a potential tool without misbalancing the ecology

It is defined as the process used to treat contaminated media including water, soil and subsurface material, by altering environmental conditions to stimulate growth of microorganisms and degrade the target pollutants. In some cases it is less expensive and more sustainable than other remediation alternatives. Biodegradation capacity generally define as strains of microorganisms to utilize a synthetic polymer as the sole source of carbon and energy where some types of plastics such as polyhydroxyalkanoates (polyhydroxy butyrate PHB), and polylactic acid (PLA) are highly biodegradable, while synthetic polymers such as polyethylene (PE) polycaprolactone (PCL) , polystyrene (PS) have low biodegradability. It is the technologies utilize naturally occurring microorganisms, such as bacteria, fungi, and yeast to degrade hazardous substances into non-toxic or less toxic substances. The microbial degradation of plastics has been reported by some studies where they have addressed the abiotic and biotic (microbial) degradation of a wide array of synthetic polymers. Fungus like *Theactinomycete*, *Rhodococcus ruber* and the *Penicillium simplicissimum* was shown to produce extracellular enzymes which are able to degrade PE, PHA, mostly belong to Basidiomycetes, Deuteromycetes (Penicillium and Aspergillus). It is also observed that fungal strains of *Fusarium moniliform* and by *Penicillium roqueforti* are easily degraded Polycaprolactone (PCL) synthetic polyester as compared to other polymers. Polyurethane is degraded by several fungal species whereas *Fusarium solani, Aureobasidium pullulans* sp., although its biodegradation is frequently faster than other spp, but Polyvinylchloride (PVC) is degraded by the bacterium *Pseudomonas putida*, polystyrene by the actinomycete *Rhodococcus ruber*. Bacterial species like *Brevibacillus parabrevis* (PL-1), *Acinetobacter baumini* (PL-2, PL-3) and *Pseudomonas citronellolis* (PL-4) have ability to degrade the resistant LDPE. The mechanisms involved in the plastic degradation are explored in which there are two different processes a direct action, where the deterioration of plastics provides a tropic resource for microbial growth another is indirect action, in which metabolic products of microorganisms affect the plastic structure. Microorganisms with their degradative pathway are involved in polymer degradation that is depending on environmental condition enzyme secretion and the ecological interaction.

Conclusion

- Microbial degradation of plastic is a promising eco-friendly strategy that is represents a great opportunity to manage e-waste
- It provides potential ability that could help the natural bioremediation processes in favouring the natural ecosystems.
- It create a opportunity through the advances of biochemistry and biotechnological fields that could offer new perspectives of bioremediation where plastic contamination and should be encouraged to select the most active microbial consortia in the plastics degradation process.

References

- Rillig, M.C., Ziersch, L., Hempel, S., 2017. Microplastic transport in soil by earthworm. Sci. Rep. 7, 1362e1368.
- Nizzetto, L., Futter, M., Langaas, S., 2016. Are agricultural soils dumps for microplastics of urban origin? Environ. Sci. Technol. 50, 10777e10779.