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Soil Augmentation by Humus: Replenishing lost soils and supplementing new ones

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Earth's regolith consists of a vital component that is lacking on other planets – the pedosphere or soil body – that is rich in organic matter, soil fauna, minerals, water, gases, that together support life and is thus essential for plant growth. In stark contrast to our blue planet, Martian regolith is devoid of organic matter and contains crushed volcanic rocks, with high mineral content and toxic chemicals like perchlorates. Nevertheless, Martian and Lunar regolith simulants formulated by NASA, have been experimented for crop growth by addition of organic matter suitable to bind xenobiotics and provide ample nutrients, as an essential step towards expanding our horizon in the extensive field of soil sciences.

Soil is an ecosystem as a whole and acts as a modifier of planet Earth's atmosphere. The organic matter present in it originates mainly from plant metabolites with the onset of senescence and humification. Humic substances thus formed in the pedosphere exhibit exceptional characteristics for soil conditioning. Besides providing nutrients and aeration to the soil, they interact and bind with toxic heavy metals, radionuclides, pesticides, industrial dyes, and other xenobiotics that may be present as pollutants in the ecosystem, thus acting as natural sieves. As top soils have maximum organic matter, essential for plant growth, phenomenon like soil erosion leave the soils devoid of humic substances. Another major reason for soil degradation is excessive salinity, leading to osmotic and ionic stress in plants, eventually reducing their growth. Addition of humic acid in soils provides protection against high saline stress and minimizes yield losses. In India, one of the leading agrarian countries, it is a common practice to enrich soils with manure, which is an inexpensive form of humus-boost for the crops. Such practices aid the cyclic flow of organic matter in the environment, against the background of widespread soil degradation.

Another global form of soil degradation is radioactive contamination of soils which occurs mainly due to nuclear accidents and improper practices of radioactive waste disposal. In order to explore such interactions with humic acid following Green technique, batch biosorption studies were performed over a range of parameters, with radionuclides Cs and Sr that are found in low level radioactive wastes. Biosorption percentages of $91\pm 2\%$ and $84\pm 1\%$ were obtained for Cs and Sr respectively. The technique is chemical-free and emphasizes the 'nature for nature' outlook of solving environmental problems. Humic acid and its various forms thus act as traps for radionuclides and work as excellent restorative soil stimulants that supplement depleted soils, boost plant growth, and play a vital role in sustaining life on Earth.

