FROM THE DESK OF RATTAN LAL

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Sub: Soil Pollution

Dear Fellow Soil Scientists,

Soil pollution, presence of a higher than normal concentration of organic and inorganic contaminants with adverse effects on non-targeted organisms, is aggravated by anthropogenic activities including agriculture, urbanization, mining, war, nuclear programs, petroleum-based products, landfills and waste disposal. Predominant pollutants comprise of heavy metals (Pb, As, Cd, Mn, Cr), polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), persistent organic pollutants (POPs), industrial pollutants (e.g., radionuclides, fossil-fuel and related compounds), and agro-chemicals (e.g., pesticides). Thus, remediation of polluted soils is important to sustainable management of soils, water and biotic resources. Potentially toxic elements (i.e., heavy metals) cannot be degraded and thus tend to accumulate in the environment (i.e., soil, water, vegetation, ecosystems) and jeopardize human health. Among important techniques of remediating polluted soils are: phytoremediation, bioaugmentation, chelates, and acidifying agents. Phytoremediation involves growing of the hyperaccumulating plants compromising of as many as 10 or more families. The Brassicaceae has the largest number of taxa (11 genera and 87 species) of hyperaccumulating plants. For example, Indian mustard (*Brassica juncea*) can preferentially accumulate several heavy metals in its roots (Cd, Cr, Cu, Ni, Pb and Zn). Similarly, sunflower (*Helianthus annuus*) can accumulate Pb, U, ^{137}Cs and ^{90}Sr in its roots. Enhancing biodiversity, above and below ground, is an important strategy of remediating a polluted soil. In addition to growing site-specific agricultural and horticultural crops, increasing biodiversity by promoting the growth of several wild plants is also appropriate to decontaminating polluted soils. Bioaugmentation, an important component of phytoremediation, involves the improvement of the degradative capacity of soils by introducing specific micro-organisms. A range of micro-organisms, including mycorrhizal and non-mycorrhizal fungi, and some enzymes, (laccase from *Trametes villosa*) are effective in remediating soils polluted with organic contaminants. The strategy of phytoremediation is in accord with the "Gaia Hypothesis" that life creates and enhances pro-biotic environments. Glomalin, a protein produced by arbuscular mycorrhizal fungi (AMF), is also a useful strategy of phytoremediation. Several humic substances, contained in compost and manure, are natural surfactants and can wash way or leach out pollutants. Humic substances play an important role in binding and transport of several organic (petroleum-based products) and inorganic contaminants. Most naturally occurring organic compounds, often associated with appropriate plants and micro-organisms, are cost-effective and natural systems of remediation of polluted soils. Among inorganic compounds useful for soil remediation are chelates which can bind and immobilize pollutants. Important among cholates are naturally occurring zeolites and some synthetic compounds (e.g., hydrogels, polyacrylates, ammonium thiocyanate and EDTA and DTPA). Chelates immobilize pollutants by complexation, adsorption and precipitation of pollutants. Soil pollution is a self-inflicted wound. **It pollutes us by weakening the critical ecosystem services essential to human wellbeing and nature conservancy.**

Sincerely,

Rattan Lal,
President, International Union of Soil Sciences

International Decade of Soils 2015-2024