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Editorial: Vermiremediation in contaminated soils: An approach for soil stabilization

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Editorial on the Research Topic
Vermiremediation in contaminated soils: An approach for soil stabilization

Introduction

Soil is the most important asset to the farmer because it is where all agricultural activities invariably take place. In the last 2-3 decades, soil has been contaminated by a multitude of contaminants; these include traditional contaminants, such as agrochemicals (pesticides and insecticides), and new emerging contaminants, such as microplastics, polycyclic aromatic hydrocarbons (PAHs), persistent organic pollutants (POPs), etc., which discharge potentially toxic elements and other poisonous material into the soil (Maddela et al., 2022). Potentially toxic elements in soil include both metals and metalloids, e.g., arsenic (As), cadmium (Cd), mercury (Hg), lead (Pb), and antimony (Sb) or micronutrients, e.g., chromium (Cr), copper (Cu), nickel (Ni), selenium (Se), and zinc (Zn). These elements cause toxicity when their concentrations exceed tolerance limits (Bhatti et al., 2018). Therefore, the protection of the soil against depletion is a positive step towards the sustainable management of its biological properties that determine long-term stability and productivity. In this regard, several types of remediation technologies are available for soil clean-up, including adsorption, microbial remediation, phytoremediation, etc. Among these remediation technologies, vermitechnology is one of the most successful, easy, cost-effective, and sustainable (Datta et al., 2016).

Earthworms are considered soil engineers because of their influence on the physico-chemical and biological qualities of soil. The most noticeable physical changes caused by earthworms are enhanced soil porosity, water infiltration, soil aeration, plant root development, and enhanced soil fertility (Xiao et al., 2022). The impact of earthworm species on contaminant degradation is widely variable, which could be related to their feeding habits and microhabitats. Molecular docking studies have provided evidence in support of binding organic molecules with agrochemicals. The activity of earthworms is likely to induce the growth of aerobic microbes capable of contaminant degradation. The earthworm's yellow tissues help to bio-accumulate and store contaminants, which facilitates the survival of earthworms in soil with high contaminant concentrations (Zeb et al., 2020).

The aim of this Research Topic is to provide vermiremediation-based techniques and solutions for managing waste, soil fertility enhancement, and decontamination of already contaminated sites. Presently, this Research Topic has eight publications from diverse fields. The contributions to this Research Topic are focused on the research areas highlighted above, which is evidenced by the following references to the papers published therein.

Vermiremediation effectiveness for diverse contaminants

In order to enhance the phytoremediation potential of *Brassica campestris* for Pb, Tibihenda et al. (2022) used two earthworm species, i.e., native earthworm species, *Amynthas aspergillum* and the epigeic species, *Eisenia fetida*. It was observed from the study that earthworm inoculation in soil strongly influences soil properties and results in higher Pb accumulation in *B. campestris*. Tikoria et al. (2022) analyzed the effect of neem-based vermicompost on the growth of tomato plants under stress caused by root-knot nematode (RKN) *Meloidogyne incognita*. They observed that the application of vermicompost has a significant positive effect on reducing nematode stress and promoting plant growth by enhancing the different bioactive components in plants. The effect of wheat straw vermicompost on the growth of wheat plants under drought stress was analyzed by Ahmad et al. (2022a). The results of the study revealed that the application of the wheat straw vermicompost enhances the performance of wheat cultivars by promoting drought tolerance and increasing growth, physiology, and the antioxidative defense system. In another study, Ahmad et al. (2022b) observed that the application of rice straw vermicompost (produced by *Eisenia fetida*), enriched with cellulolytic microbes, positively influences the growth of both drought-sensitive and drought-tolerant wheat species in drought stress conditions.

The effectiveness of vermitechnology in the remediation of soils affected by Polychlorobiphenyls (PCBs), polychlorodibenzo-p-dioxins, and furans (PCDDs and PCDFs) (from Brescia-Caffaro, Italy) was analyzed in a study conducted by Remelli et al. (2022). PCBs, PCDDs, and PCDFs fall into the category of Persistent Organic Pollutants (POPs) in soil. The observations of the study show that earthworm (*Eisenia fetida*) treatment is the most effective method for the bioremediation of POPs. The traditional approach of using cow dung for vermiremediation with an earthworm species (*Eisenia fetida*) was slightly modified in a study by Surendrakumar et al. (2022) for the treatment of diesel-contaminated soils. The modification was the use of ZnO nanoparticles mixed with cow dung for enhancing the remediation process. The study gave promising results, such that in 70 days, 50% of the diesel contamination in the soils was reduced under vermiremediation treatment. Mishra et al. (2022) conducted a thorough review under this Research Topic, analyzing the efficacy of vermitechnology for the remediation of pesticide-contaminated agricultural soils. The observations from this global review suggest that earthworms can act as promising agents for the degradation of persistent soil contaminants, such as pesticides. Earthworms can use a dual approach for the degradation of pesticides in soil, which may include the release of detoxifying enzymes in their gut or the exertion of positive influence on microbial populations, which could degrade pesticides. Among the different species of earthworms, *Lumbricus terrestris*, *Perionyx excavates,* and *Metaphire posthuma* showed the most promising results in pesticide degradation in soils.

In a slightly different type of study under this Research Topic, Farooq et al. (2022) analyzed the various dynamics of litterfall (including litterfall production, litter decomposition rate, and associated nutrient return) in three forest types in subtropical China. The forest types under observation were a camphor tree forest (CTF), a Masson pine forest (MPF), and a camphor tree and Masson pine mixed forest (CMF). The results of this completely randomized design (CRD) study indicate that the litter fall from the mixed camphor tree and Masson pine forest significantly enhanced the nutrient litter production and nutrient returns in forest soil, which ultimately helps to restore soil fertility.

The papers published under this Research Topic provide new insights into the use of vermitechnology for a diverse and emerging range of contaminants. We sincerely believe that the readers will find this Research Topic useful and interesting and that it will add to their existing knowledge on vermiremediation.

Author contributions

All authors listed have substantially contributed to the work and approve this manuscript for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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