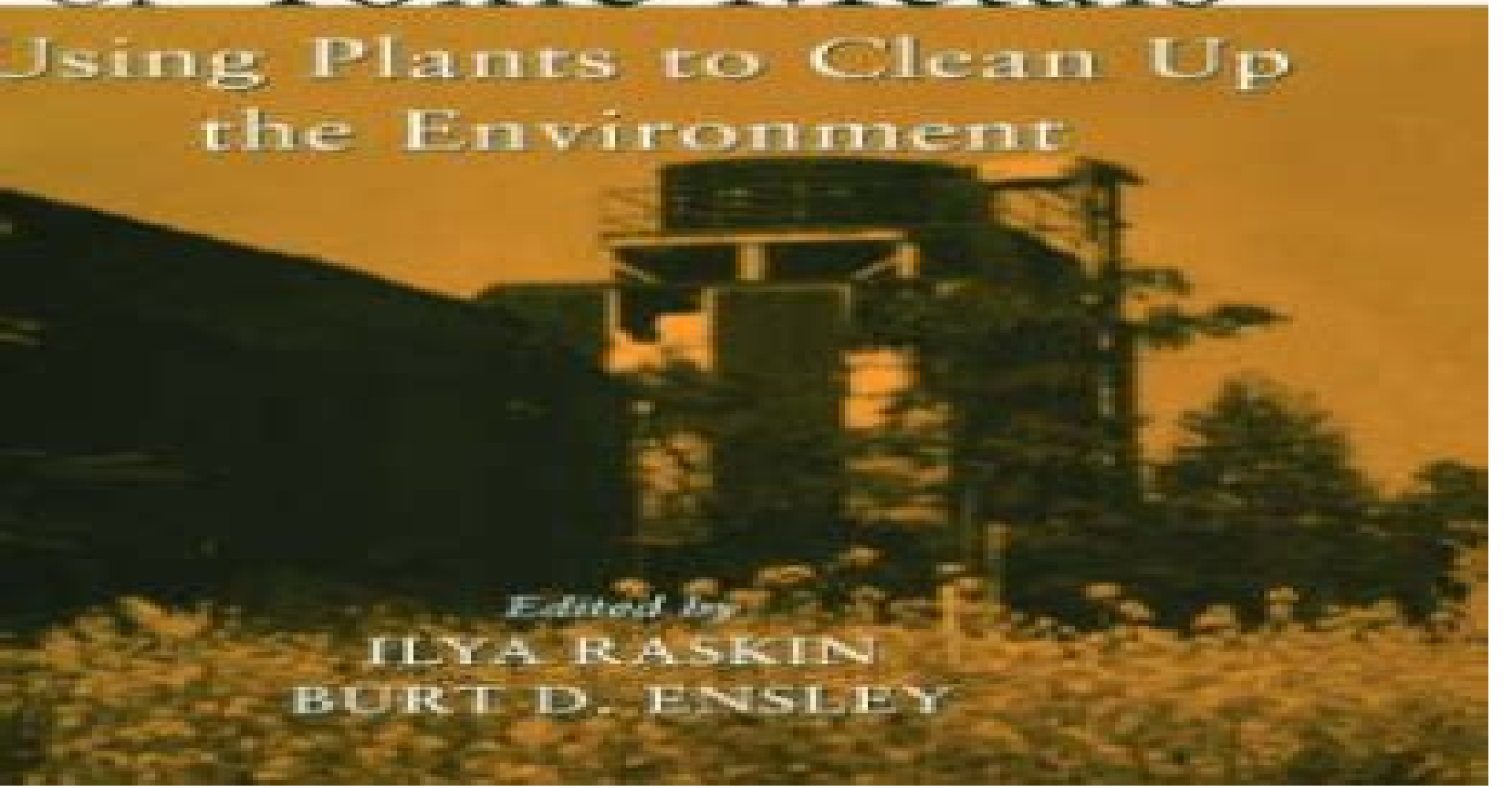
Phytoremediation of Toxic Metals

Using Plants to Clean Up the Environment



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Phytoremediation Of Toxic Metals

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Phytoremediation Of Toxic Metals:

Phytoremediation of Toxic Metals Ilya Raskin,Burt D. Ensley,2000 An in depth look at the most promising technology for metal remediation With current cleanup methodologies offering no real solution to the serious environmental implications of toxic metal contamination there is a growing need among remediation professionals for effective affordable nonpolluting alternatives to energy intensive engineering processes This book presents one such promising alternative the extraordinary new technology of phytoremediation Through first rate contributions from the top scientists in the field Phytoremediation of Toxic Metals surveys worldwide pioneering efforts in the use of plants to treat contamination of such metals as lead cadmium chromium and even radionuclides The authors explore all major aspects of the technology how it utilizes the metal accumulating properties of selected or engineered plants to remove toxic metals from soils and water how to transfer knowledge from the laboratory to the field and what methods are most viable for commercial application Complete state of the art coverage includes The economic advantages of plant based technology Regulatory considerations for future phytoremediation Phytoextraction phytostabilization and phytofiltration of toxic metals Photostabilization of metals using hybrid poplar trees Phytovolatilization for the special case of mercury and selenium The biological mechanisms of metal accumulating plants Phytoremediation of Toxic Metals Burt D. Ensley,Ilya Raskin,2000 Om jordrensning ved hj lp af planter rodzoneanl g nedsivningsanl g til rensning af jord for tungmetaller **Phytoremediation of Toxic Metals** ,2000

Recent Advances Towards Improved Phytoremediation of Heavy Metal Pollution David W.M. Leung,2013-11-08 Heavy metal pollution represents a global challenge to both public health and environmental sustainability Any means to reduce heavy metal pollution in the environment is of considerable economic significance The use of green plants to clean up heavy metal pollution is an environmentally friendly as well as a low cost approach to the problem This plant based biotechnology is commonly known as phytoremediation Presently there is limited application of this technology because useful plants with enhanced heavy metal resistance tolerance are still needed to assist remediation of environments polluted with heavy metals A key to improved phytoremediation of heavy metal pollution lies in research seeking for a better understanding of the mechanism s of heavy metal resistance tolerance in plants This E book presents a unique treatment of the topics that have never been comprehensively brought together before in a single advanced reference The volume explores aspects of plant biology that are critical for employing phytoremedation techniques to combat heavy metal contamination such as the specific plant biology seed biology plant tissue culture and enzymology This E book will be a useful reference to plant biologists biotechnologists and environmental engineers seeking information about phytoremediation of heavy metals from the environment **Phytoremediation of Contaminated Soil and Water** Norman Terry,Gary S. Banuelos,2020-11-25 Phytoremediation is an exciting new technology that utilizes metal accumulating plants to rid soil of heavy metal and radionuclides Hyperaccumulation plants are an appealing and economical alternative to current methods of

soil recovery Phytoremediation of Contaminated Soil and Water is the most thorough literary examination of the subject available today The successful implementation of phytoremediation depends on identifying plant material that is well adapted to specific toxic sites Gentle remediation is then applied in situ or at the contamination site No soil excavation or transport is necessary This severely contains the potential risk of the pollutants entering the food chain And it s cost effective The progress of modern man has created many sites contaminated with heavy metals The effected land is toxic to plants and animals which creates considerable public interest in remediation But the commonly used remedies are ex situ which poses an expensive dilemma and an even greater threat Phytoremediation offers the prospect of a cheaper and healthier way to deal with this problem Read Phytoremediation of Contaminated Soil and Water to learn just how far this burgeoning technology has developed **Sustainable Management of Environmental Pollutants through Phytoremediation** Ananya Kuanar,Alok Prasad Das,Dattatreya Kar,Maulin P. Shah,2024-12-19 Traditional remedial technologies can be cost prohibitive and sometimes contribute to environmental contamination themselves In order to better manage the issues of global pollution phytoremediation a plant based cleanup method has gained attention as an efficient affordable and environmentally sustainable alternative to traditional remedial technologies for the cleanup of a variety of hazardous pollutants The demand for advanced technologies having potential to sustainably manage waste and pollutants in the environment will help to continue the quest for more novel treatment methods Sustainable Management of Environmental Pollutants through Phytoremediation discusses all the aspects of sustainable environmental management through phytoremediation making it a valuable resource for both academics and researchers in developing and developed countries Examines technology advancements made toward the recycling and management of waste Designed in a way to cover scientific principles modeling and methods designs and reference data Discusses the utilization of waste for renewable energy for economic growth and further social benefits Phytoremediation of Metal-Contaminated Soils Jean-Louis Morel,Guillaume Echevarria,Nadezhda Goncharova,2006-06-23 Phytoremediation the use of plants to remediate environmental media is being pursued as a new approach for the cleanup of contaminated soils and waters including groundwater Plant assisted bioremediation sometimes referred to as a type of phytoremediation involves the interaction of plant roots and the microorganisms associated with these root systems to re diate soils containing elevated concentrations of organic compounds These techniques could provide cost effective methods of remediating soils and groundwater contaminated with metals radionuclides and various types of organics with fewer secondary wastes and less environmental impact than would be generated using traditional remediation methods All plants extract necessary nutrients including metals from their soil and water environments Some plants called hyperaccumulators have the ability to store large amounts of metals even some metals that do not appear to be required for plant functioning In addition plants can take up various organic chemicals from environmental media and degrade or otherwise process them for use in their physiological processes

Phytoremediation technologies are in the early stages of development with laboratory research and limited field trials being conducted to determine processes and refine methods Additional research including genetic engineering is being conducted to improve the natural capabilities of plants to perform remediation functions and to investigate other plants with potential phytoremediation applications Large areas in Western and Eastern countries are polluted with heavy metals and radionuclides in natural rural urban or industrial areas Plant-Based Remediation Processes Dharmendra Kumar Gupta,2013-03-12 Phytoremediation is an emerging technology that employs higher plants for the clean up of contaminated environments Basic and applied research have unequivocally demonstrated that selected plant species possess the genetic potential to accumulate degrade metabolize and immobilize a wide range of contaminants The main focus of this volume is on the recent advances of technologies using green plants for remediation of various metals and metalloids Topics include biomonitoring of heavy metal pollution amendments of higher uptake of toxic metals transport of heavy metals in plants and toxicity mechanisms Further chapters discuss agro technological methods for minimizing pollution while improving soil quality transgenic approaches to heavy metal remediation and present protocols for metal remediation via in vitro root cultures **Phytoremediation Technology for the Removal of Heavy Metals and Other Contaminants from Soil and Water** Vineet Kumar,Maulin P. Shah,Sushil Kumar Shahi,2022-02-07 Phytoremediation Technology for the Removal of Heavy Metals and Other Contaminants from Soil and Water focuses on the exploitation of plants and their associated microbes as a tool to degrade detoxify stabilize toxic and hazardous contaminants and restore the contaminated site The book introduces various phytoremediation technologies using an array of plants and their associated microbes for environmental cleanup and sustainable development The book mainly focuses on the remediation of toxic and hazardous environmental contaminants their phytoremediation mechanisms and strategies advances and challenges in the current scenario This book is intended to appeal to students researchers scientists and a wide range of professionals responsible for regulating monitoring and designing industrial waste facilities Engineering consultants industrial waste managers and purchasing department managers government regulators and graduate students will also find this book invaluable Provides natural and eco friendly solutions to deal with the problem of pollution Details underlying mechanisms of phytoremediation of organic and inorganic contaminants with enzymatic roles Describes numerous successful field studies on the application of phytoremediation for eco restoration of contaminated sites Presents recent advances and challenges in phytoremediation research and applications for sustainable development Provides authoritative contributions on the diverse aspects of phytoremediation by world leading experts **Phytoremediation of Heavy Metals from Wastewater and Polluted Soil** Isaiah Debrah,Goergina Addae Boamponsem,2013 In most developing countries there is dependence on wastewater for vegetable production due to limited access to clean water Heavy metal pollution of aqueous streams soil and sediments is a major environmental problem globally Methods such as ion exchange chemical and microbiological precipitation that have been

developed to remove heavy metals have limited access due to the cost involved labour and energy This book therefore unveils the phytoremediation potentials of Lactuca sativa Brassica oleracea L var capitata and Daucus carrota var sativa irrigated with wastewater from Nagodi mining site in Ghana The concentration of heavy metals in the soil and the wastewater was also analysed Differential accumulation and translocation of copper lead iron manganese cadmium and zinc in the root stem and leaf of the vegetables were investigated during the experiment This book should serve as a guide to environmentalists scientists and all who may be interested in using plants for clean up of toxic metals and also helps to understand the mechanisms plants uses to remove heavy metals from our environment in order to guarantee a greener and cleaner planet for all of us **Heavy Metal Remediation** Dhamendra Kumar Gupta,Soumya Chatterjee,2014-01-01 Plants have a very specific and efficient mechanism to obtain translocate and store nutrients from the surrounding environment The precise mechanism that helps a plant in nutrient translocation from root to shoot also in the same way transfers and stores toxic metals within their structure Metal toxicity generally causes multiple direct or indirect effects on plants affecting nearly all of their physiological functions Plant tolerance to heavy metals depends largely on plant efficiency in uptake translocation and sequestration of heavy metals in specific cell organelles or specialized tissues The main purpose of this book is to present a holistic view of the recent advancement in the field of accumulation and remediation using plants the green solar powered alternative to ameliorate heavy metal from the polluted environment The key features of the book are related to metal transporters and metal accumulation mechanisms under heavy metal stress in plants plant transcriptional regulation and responses under metal contamination multiple toxic metal contaminations and its phytoremediation approaches etc Based on the advancement of research in recent years the information compiled in this book will bring an in depth knowledge on the bioaccumulation of metals their transportation in natural conditions or genetically modified plants and their strategy to cope with the toxicity to survive in the hostile environment **Phytotechnologies** Naser A. Anjum,Maria E. Pereira,Iqbal Ahmad,Armando C. Duarte,Shahid Umar,Nafees A. Khan,2012-10-23 Phytotechnologies Remediation of Environmental Contaminants highlights the use of natural and inherent traits of plants and associated microbes to exclude accumulate or metabolize a variety of contaminants with the goal of efficiently and sustainably decontaminating the biosphere from unwanted hazardous compounds Contributed by an internationa *Bioremediation of Toxic Metals* Kai-Him Matthew Cheung,□□□,2017-01-26 This dissertation Bioremediation of Toxic Metals by Kai him Matthew Cheung was obtained from The University of Hong Kong Pokfulam Hong Kong and is being sold pursuant to Creative Commons Attribution 3 0 Hong Kong License The content of this dissertation has not been altered in any way We have altered the formatting in order to facilitate the ease of printing and reading of the dissertation All rights not granted by the above license are retained by the author Abstract Traditional remediation techniques in removing toxic metal contaminants using physical and chemical methods are expensive and may cause other forms of damage to the environment comparing with these techniques bioremediation can

serve as an inexpensive effective and environmental friendly remediation method This thesis mainly discusses different bioremediation techniques and identifies possible areas in Hong Kong for bioremediation and suggests bioremediation methods for each potential area Bioremediation of toxic metals is the use of microorganisms plants or even larger sized organisms to decontaminate sites with toxic metals Bioremediation includes phytoremediation microremediation and vermiremediation which use plants microorganisms and earthworms to remediate contaminated environments respectively The 4 most common mechanisms in phytoremediation of toxic metals are phytoextraction phytofiltration phytovolatilization and phytostabilization Phytoremediation are used frequently for remediation around the world and its development includes using well understood technology and genetic engineering to increase its effectiveness Microremediation is another promising technology in bioremediation of toxic metals and consists of 6 major mechanisms which are biosorption bioaccumulation biotransformation bioleaching biomineralization and microbially enhanced chemisorption of metals Microremediation is mainly in research phase and its development includes identifying new species combining with phytoremediation and genetic engineering Vermiremediation is another rapidly developing technique in bioremediation of toxic metals assisting other bioremediation by burrowing actions of earthworms and its excretion and accumulating toxic metals inside their bodies Vermiremediation is also in research phase but it is rapidly developing Generally bioremediation is around 60% cheaper than traditional remediation methods and no pollutants are emitted during the process However the remediation process is slow and generally takes longer than a year Sources of toxic metals in contaminated areas in Hong Kong are mainly due to historic industrial discharge although present activities also contribute Potential areas include sites for electronic waste activities sediments of Kwun Tong typhoon shelter and sediments of Tolo Harbour DOI 10 5353 th_b5099049 Subjects Heavy metals Biodegradation **Remediation of Heavy Metals** Rangabhashiyam Selvasembian,Binota Thokchom,Pardeep Singh,Ali H. Jawad,Willis Gwenzi,2024-01-09 Remediation of Heavy Metals Meet the challenge of contaminated water with a range of sustainable tools The treatment of water which has been polluted by heavy metals is an increasingly significant environmental challenge in an industrialized global economy The ongoing revolution in green technologies however has seen a range of sustainable methods emerge for treating water soils and other parts of the environment polluted by trace metals By putting these methods into practice environmental researchers and industrial professionals can improve water quality and public health globally Remediation of Heavy Metals offers a clear accessible reference on these methods and their applications It offers an overview of the major effects of heavy metal contamination and works through each of the methods or protocols available to remediate soil and minimize pollution at the source Remediation of Heavy Metals readers will also find Comparison of different approaches for heavy metal removal Detailed discussion of physical chemical and biological remediation methods Case studies demonstrating proper remediation Remediation of Heavy Metals provides key knowledge for environmental scientists environmental toxicologists and other researchers or industrial

professionals working in heavy metal removal as well as advanced graduate students in these areas Rangabhashiyam Selvasembian PhD Associate Professor Department of Environmental Science and Engineering School of Engineering and Sciences SRM University AP Amaravati India Binota Thokchom PhD DST Inspire faculty member at the Centre of Nanotechnology Indian Institute of Technology Guwahati India Pardeep Singh PhD Assistant Professor in the Department of Environmental Science PGDAV College University of Delhi New Delhi India Ali H Jawad PhD Associate Professor in the Faculty of Applied Sciences Universiti Teknologi MARA Selangor Malaysia Willis Gwenzi PhD Leibniz Institute of Agricultural Engineering and Bio economy e V ATB Potsdam Germany and Universit t Kassel Witzenhausen Germany

Phytoremediation of Environmental Pollutants Ram Chandra,N.K. Dubey,Vineet Kumar,2017-12-14 Phytoremediation aids to augment bioremediation as it uses broad range plants to remediate soil sediment surface water and ground water that have been contaminated with toxic metals organic pesticides and radionuclides This book serves to disseminate detailed up to date knowledge regarding the various aspects of phytoremediation and plant microbe interaction The book highlights process and molecular mechanisms for industrial waste detoxification during phytoremediation in wetland plants role of endophytic bacteria for phytoremediation of environmental pollutants constructed wetland treatment system for treatment and recycling of hazardous wastewater amongst other relevant topics Key Features Focuses on phytoremediation process for different pollutants mainly heavy metal detoxification in the presence of other co pollutants Includes plant soil microbe interactions in phytoremediations and remediation of contaminated water Explores life cycle assessment of industrial waste contaminated site with organic pollutants Discusses hyperaccumulator versus non hyperaccumulator plants for environmental waste management Includes bacterial assisted phytoremediation and siderophore formation in specific environmental conditions *Metal Toxicity in Plants: Perception, Signaling and Remediation* Dharmendra K. Gupta,Luisa M. Sandalio,2011-09-15 Heavy metal accumulation in soil and water from natural sources or anthropogenic activities have produced severe environmental contamination in some parts of the world due to the persistence of metals in the environment by their accumulation throughout the food chain The purpose of this book is to present the most recent advances in this field mainly concerning the uptake and translocation of heavy metals in plants mechanisms of toxicity perception of metal and regulation of cell response under metal stress Another key feature of this book is related to the studies on signaling and remediation processes in recent years which have taken advantage of recent technological advances including omic approaches In recent years transcriptomic proteomic and metabolomic studies have become very important tools for analyzing both the dynamics of changes in gene expression and the profiles of protein and metabolites under heavy metal stress This information is also very useful for plotting the complex signaling and metabolic network induced by heavy metals in which hormones and reactive oxygen species ROS also play an important role Understanding the mechanism involved in sequestration and hyperaccumulation is very important to developing new strategies of phytoremediation which are reviewed

in several chapters of this book The information included yields very stimulating insights into the mechanism involved in the regulation of plant responses to heavy metals which in turn improve our knowledge of cell regulation under metal stress and the use of plants for phytoremediation **The Use of Plants for the Removal of Toxic Metals from Contaminated Soils** Mitch M. Lasat,2000 Phyto and Microbial Remediation of Heavy Metals and Radionuclides in the Environment Rym Salah-Tazdaït,Djaber Tazdaït,2022-02-24 This book examines the role that bioremediation can play in the detoxification of soil water and air to improve environmental and human health with a specific focus on heavy metals and radionuclides Environmental pollution whether by natural or human causes with industrial activities being a key player is a challenge facing all nations across the world While treatment has typically required the use of expensive technology one promising solution is the use of phytoremediation in which plants act by metabolizing or sequestering pollutants This eco friendly solution is a good alternative to the standard methods of soil and water treatments This book provides not only the basic definitions and classification of technologies used for contaminant remediation but also the most recent studies dealing with the selection of new promising microbial stains and plant varieties involved in the treatment of radioactive and heavy metal contaminants It provides a detailed description of the biochemical mechanisms and genes involved in the bioremediation of radionuclides and heavy metals offering a clear insight for academics and practitioners interested in in vitro and in situ biological treatment This book will be of great value to students and scholars interested in environmental pollution and environmental health from across a range of different disciplines including environmental microbiology and chemistry ecology and environmental science biological and environmental engineering and biotechnology **Metal-Contaminated Soils** Jaco Vangronsveld,Scott D. Cunningham,1998-11-20 An unfortunate by product of industrialization is the contamination of soil and water resources with toxic metals which becomes an environmental concern when the concentration in soils begins to affect human health Current remediation methods applicable to contaminated soils are expensive and environmentally invasive since they are based primarily on civil engineering techniques This book represents an overview of efforts in exploiting biological and chemical processes to reduce the inherent risk associated with metal contaminated soils It presents a comprehensive up to date analysis of in situ immobilization and inactivation of toxic metals by means of plants microorganisms and invertebrates *Detoxification of Heavy Metals* Irena Sherameti,Ajit Varma,2011-09-01 Heavy metals are severe environmental pollutants and many of them are toxic even at very low concentrations With industrial development soil pollution with heavy metal elements have dramatically increased The uptake of heavy metals via plants that are exposed to contaminated soils is a risk for human health and a major hazard for the ecosystem as a whole including soil microorganisms On the other hand plants may be used in the decontamination of soils The topics presented in this book include sources of heavy metals contaminants in soils plant species that can grow on contaminated soils the phytoremediation of contaminated soils tolerance accumulation and detoxification mechanisms of zinc

copper arsenic cadmium and vanadium in plants the critical role of sulfur metabolism in heavy metal tolerance the role of aquatic macrophytes plant growth promoting bacteria sugar crops and earthworms in detoxification and heavy metal stabilization by promoting zeolite synthesis in soils

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