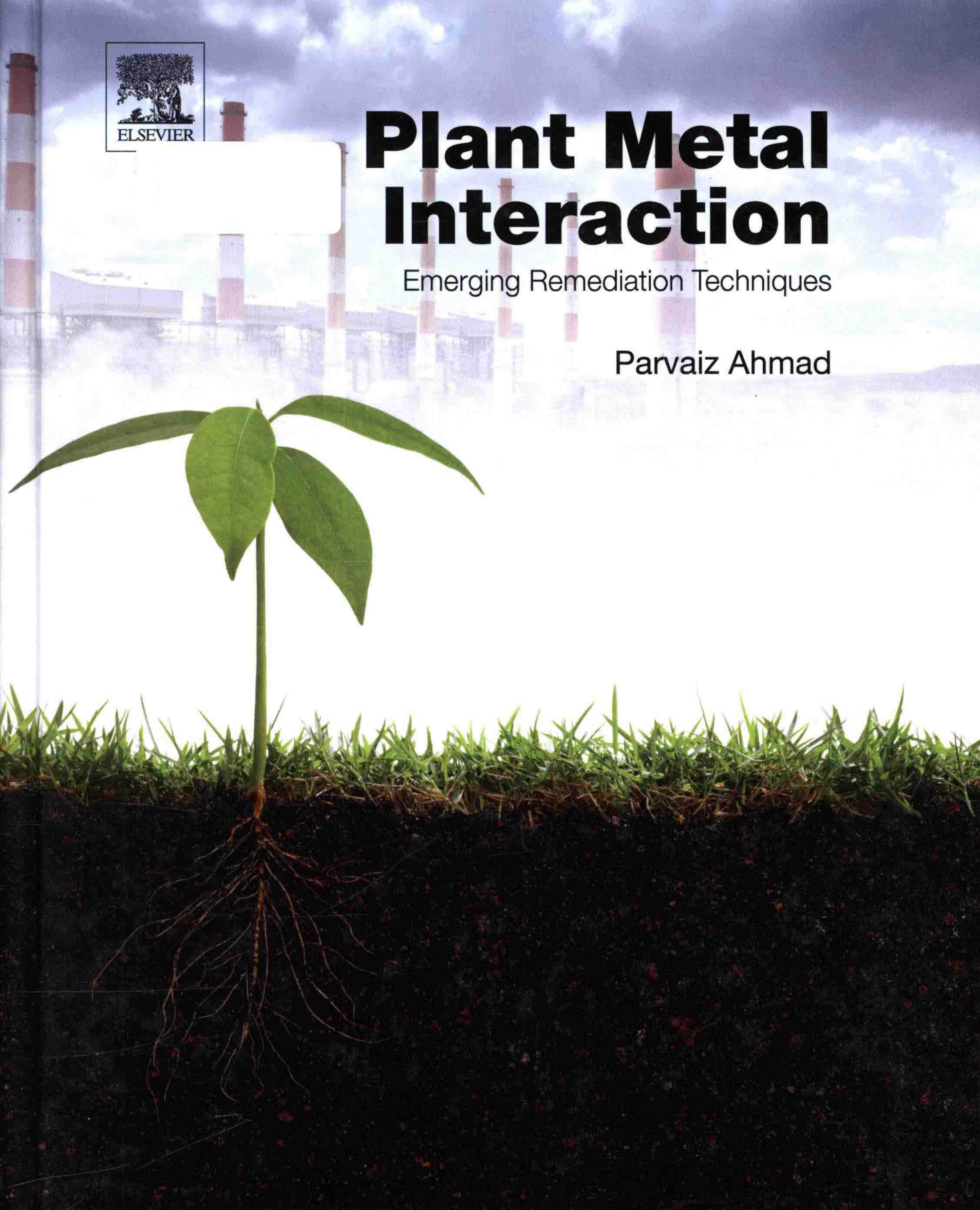
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Plant Metal Interaction
Emerging Remediation Techniques
Parvaiz Ahmad

Plant Metal Interaction

Emerging Remediation Techniques

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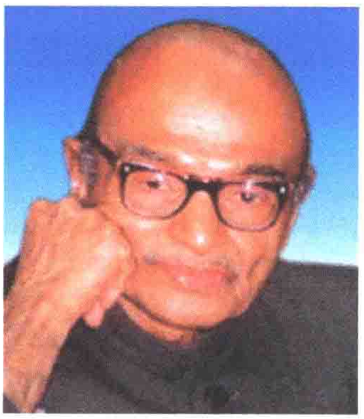

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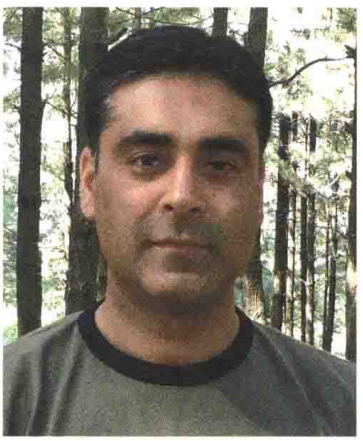

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Preface

PLANT METAL INTERACTION: EMERGING REMEDIATION TECHNIQUES

Plants are valuable resources for all living organisms existing on planet Earth. Plants provide food, medicine, regulate water cycle, produce oxygen, and reform climate. Any major change in environment has a negative impact on the growth and development of plants. It means change in climatic conditions is having a direct or indirect impact on human beings. Climatic change (environmental stress) has a drastic impact on crop yield. Food production for future generations is a major problem because of (1) exponential increase in human population and (2) reduction in farmable land due to environmental pollution, caused by natural and anthropogenic activities. The industrial revolution has brought immense comforts to man, but at the same time many problems have also been reported. Heavy metals (cadmium, chromium, copper (Cu), lead, mercury, nickel, arsenic, and zinc) produced from industries and factories are nondegradable and have accumulated in soil and water bodies. It is estimated that 60% of farmable land is suffering from mineral problems, such as metal toxicity and nutritional and metal deficiencies. Heavy metal toxicity has become a major threat to plant growth and crop yield globally. It is not limited to plants, soil, and water only—heavy metals have also entered the human body through the food chain and caused many diseases and disorders. The mechanisms of heavy metal detoxification, accumulation, and tolerance have become the basis for using plants for remediating heavy metal–contaminated soil and water. Phytoremediation is the use of plants to uptake pollutants from the soil and water. It is a sustainable environmental cleanup technology and is used worldwide.

This edited volume *Plant Metal Interaction: Emerging Remediation Techniques* includes 25 chapters that will shed light on different heavy metals, their impact on plants, and remedial approaches. Chapter 1 is an overview on aluminum toxicity in plants, in which the author describes the impact of aluminum on plants, nutrient uptake, gene expression, and so on. Chapter 2 is about the effect of copper stress on plant growth, photosynthesis, and signal transduction. Chapter 3 discusses the effect of lead on plant and human DNA and its damages and its impact on the environment. Chapter 4 describes resistance of plants to Cu stress (transgenesis) and includes a discussion of Cu as an essential element, the toxic effects of high concentrations of Cu, maintenance of intracellular Cu homeostasis, construction of transgenic plants resistant to heavy metals, etc. Chapters 5, 6, and 7 throw light on boron toxicity, chromium toxicity, and antioxidative properties of selenium on plants. Chapter 8 is about the mitigation of heavy metal stress by brassinosteroids in plants. Chapters 9, 10, and 11 are related to plant metallothioneins and phytochelatins; biosynthesis of phytochelatins, phytochelatins, mediated redox homeostasis, and metallothioneins are also well-documented. Chapters 12, 13, and 14 describe the role of plants in detoxification and tolerance of heavy metals such as mercury and trace elements from the soil and water. Chapter 15 is related to phytoextraction—the use of plants to remove heavy metals from soil. Chapters 16, 17, 18, and 19 explain the efficient role of different plants in accumulating heavy metals from water and soil. Genetic strategies for phytoremediation potential in plants are also thoroughly explained. Chapters 20 and 21 are related to phytoremediation of heavy metals in the presence of microbes and plant growth–promoting rhizobacteria. Chapters 22 and 23 are about the molecular mechanism and role of adenosine triphosphatase (HMA2, HMA3, and HMA4) in the