Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants

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Edited by

M.N.V. Prasad
University of Hyderabad, Hyderabad, India

and

Kazimierz Strzałka
Jagiellonian University, Krakow, Poland

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Preface

Metals impose great influence on various aspects of life at all levels of its organization. Several metals are the essential constituents of biomolecules and participate in many important biological processes. However metals can be harmful when present in excess amounts, while a few of them are toxic to biota even at extremly low concentration.

Phytotoxicity of metallic compounds dates back to 1896, when the French farmer applied "Bordeaux mixture" (copper sulphate, lime and water) to control fungal pests. A few years later, spraying of iron sulphate solution on a cereal crop dominated with weeds resulted in killing of only the weeds.

Plant-metal interactions are complex and depend on many factors. The most important being the plant species exposed, its developmental stage and the chemistry of metal including its concentration. Plant-metal interactions may have beneficial, harmful or will have no effect on the plant, depending on metal species and concentration.

Various physiological and biochemical processes in plants are affected by metals. The contemporary physiological, biochemical and molecular investigations on toxicity and tolerance in metal stressed plants are prompted by the growing metal pollution in the environment. In order to understand as how plants survive and accumulate metals from the contaminated and polluted environment, the physiology, biochemistry and molecular biology of plants under metal stress need critical investigation to ascertain answers about the underlying processes of acclimation (short term) and adaptation (long term).

Metal toxicity to plants has great impact and relevance not only for plants but also to the ecosystem in which the plants form an integral component. Plants growing in metal polluted locations exhibit altered metabolism, growth reduction, lower biomass production and metal accumulation and these functions are of human health concern. Edible plants with high doses of accumulated toxic metals are harmful not only to humans but also for the animals when used as animal feed.

Metals affect numerous biochemical and physiological processes in plants. On the other hand, plants developed various defence mechanisms to counteract metal toxicity. Only detailed study of these processes and mechanisms would allow scientists to understand the complex plant-metal interactions. Therefore, the aim of this book is to give an overview of the most important aspects of physiological and biochemical basis for metal toxicity and tolerance in plants. Thus, the contents of the book encompass the mechanisms of metal uptake and transport in plants, influence of metals on vital processes such as biosynthesis of the photosynthetic pigments, light and dark phases of photosynthesis, respiration and gas exchange, nitrogen metabolism and interaction of metals with plant nutrients. Special emphasis is given to genotoxicity and mutagenicity of metals, importance of plant genotype and their interaction with metals, capability of selected plant genotypes to hyperaccumulate certain metals, and the function of enzymes

in metal exposed plants. Similarities and differences between vascular and non-vascular plants in their responses to metals are also dealtwith. The defence mechanisms against metal toxicity, including the role of organic acids, glutathione, metal chelating peptides and proteins as well as adaptive strategy involving proline accumulation are also included. The last chapter deals with the role of phytomass in metal detoxification.

The book was intended to provide the reader with the state-of-the-art-knowledge about the selected topics *supra vide*. In different chapters, the experimental data and the current trends were reported and some general conclusions were also drawn.

It is believed that this book might serve as reference for plant physiologists, plant biochemists and molecular biologists who have interest in the biology of heavy metal toxicity and tolerance. It will also be of great interest to university and college teachers and students of environmental biotechnology, environmental botany, agriculture, horticulture, silviculture , soil science and plant ecophysiology.

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Editors

Contributors

Editors

M.N.V. Prasad
Department of Plant Sciences
University of Hyderabad
Hyderabad 500046, India

K. Strzałka
Department of Plant Physiology and Biochemistry
The Institute of Molecular Biology
Jagiellonian University
7 Gronostajowa Street, PL 30-387 Kraków, Poland

Contributors

E. Cseh
Department of Plant Physiology
Eötvös University
Budapest, H-1445 P.O.Box 330, Hungary

M. Greger
Department of Botany
Stockholm University
Stockholm, S-106 91, Sweden

M. Jordan
Departamento de Ecología, Facultad deCiencias Biológicas
Pontificia Universidad Católica de Chile, Casilla 114-D
Santiago, Chile

G. Kłobus
Marek Burzyński and Józef Buczek
Department of Plant Physiology, Institute of Botany
Wrocław University, PL 50–328 Wrocław, Poland

Z. Krupa
Department of Plant Physiology
Maria Curie-Skłodowska University
Akademicka 19, PL 20-033 Lublin, Poland

S. Lindberg
Department of Plant Biology
Swedish University of Agricultural Sciences
Uppsala, S-75007, Sweden

W.Maksymiec
Department of Plant Physiology
Maria Curie-Skłodowska University
Akademicka 19, PL 20-033 Lublin, Poland

N. Mallick
Department of Agriculture and Food Science
Indian Institute of Technology
Kharagpur India

H. Matsumoto
Research Institute for Bioresources
Okayama University,
Chuo, Kurashiki, Okayama, 710-0046, Japan

B. Myśliwa-Kurdziel
Department of Plant Physiology and Biochemistry
The Institute of Molecular Biology
Jagiellonian University
7 Gronostajowa Street, PL 30-387 Kraków, Poland

S. Ottonello
Department of Biochemistry and Molecular Biology
University of Parma, Parma, Italy

B.B. Panda
Genecology and Tissue Culture Laboratory
Department of Botany
Berhampur university, Berhampur 760 007, Orissa, India

K.K. Panda
Genecology and Tissue Culture Laboratory
Department of Botany
Berhampur university, Berhampur 760 007, Orissa, India

L.C.Rai
Department of Botany
Banaras Hindu University
Varanasi-221005, India

E. Romanowska
Department of Plant Physiology
University of Warsaw
02–096 Warszawa, Miecznikowa 1, Poland

L. Sanità di Toppi,
Department of Evolutionary and Functional Biology
Section of Plant Biology
University of Parma, Parma, Italy

P. Pardha Saradhi
Department of Environmental Biology
University of Delhi
Delhi 110 007, India

P. Sharmila
Department of Environmental Biology
University of Delhi
Delhi 110 007, India

A.Siedlecka
Department of Plant Physiology
Maria Curie-Skłodowska University
Akademicka 19, PL 20-033 Lublin, Poland

E. Skórzynska-Polit
Department of Plant Physiology
Maria Curie-Skłodowska University
Akademicka 19, PL 20-033 Lublin, Poland

K. Strzałka
Department of Plant Physiology and Biochemistry
The Institute of Molecular Biology
Jagiellonian University
7 Gronostajowa Street, PL 30-387 Kraków, Poland

B. Tomaszewska
Adam Mickiewicz University
Institute of Molecular Biology and Biotechnology
Department of Plant Metabolism
Fredry 10, 61–701 Poznań, Poland