Preface

Nitric oxide (NO), a small gaseous signaling molecule, has attracted huge interest during recent times. The journey of nitric oxide, which started as a harmful air pollutant to the molecule of the year in 1992, has been both interesting and arduous. The discoveries of the enzymes that produce NO with NADPH and L-arginine have altogether shifted the NO paradigm from being a toxic air pollutant to a prolific signaling molecule. Now it is acclaimed to be involved in the modulation of various physiological processes during the entire life of the plant. Several studies have revealed the involvement of NO as a control signal during various abiotic stress responses, including salinity and osmotic stress, temperature, UV light stress, and anoxia. Enhanced NO production by plant tissue has been noted in response to various abiotic stresses. Recent developments in the field of NO biology in plants have indicated that NO closely interacts with several signaling molecules linked with plant adaptive stress responses, such as ABA, cytosolic Ca^{2+}, and H_2O_2.

Abiotic stresses, such as drought, flood, problem soils (salinity and alkalinity), extreme temperatures, and heavy metal toxicity, impose a serious threat to sustainable agricultural production. The production of reactive oxygen species is a unifying commonality in a large number of abiotic stresses. NO interacts with ROS in various ways and might serve as an antioxidant during various stresses. Modulation by NO of superoxide formation and inhibition of lipid peroxidation also illustrates its potential antioxidant role.

This book “Nitric Oxide Action in Abiotic Stress Responses in Plants” is a collection of 15 chapters and is divided into two parts. Part I of the book comprises Chaps. 1–4, which vividly describes the properties of NO and gives an au courant information available on the mitigating effect of NO in stress-induced alterations in plants. Part II, which includes Chaps. 5–15, mainly focuses on the role of NO in environmental- and soil-related abiotic stresses including postharvest stress and wounding.

Chapter 1 describes the current recognition of the roles of reactive nitrogen species such as peroxynitrite or *S*-nitrosothiols in the plant metabolism under both physiological and stress conditions as these molecules are known to react with a wide spectrum of biomolecules and may act as a transporter and reservoirs for NO in a broad range of plant cell signaling affairs.

Chapter 2 elucidates the significance of nitric oxide as phytohormone and its involvement in alleviation of various abiotic stresses such as drought, salinity, heavy metal stress, high or low temperature stress, and ultraviolet radiation.

Chapter 3 illustrates the antioxidant role of NO and its ability to maintain the cellular redox homeostasis and regulate the toxicities of oxidative stress-induced ROS. Chapter 4 manifests the involvement of nitric oxide in stress-induced morphogenic response (SIMRs). However, the precise nature of involvement of nitric oxide in SIMRs must await clarifications from the likely complex interactions among NO, auxin, and possibly with other plant hormones and reactive oxygen species.

Chapter 5 delves into the current understanding of the involvement of NO in high temperature stress and in the mechanism of thermotolerance. This chapter also highlights the significance of nitric oxide, abscisic acid, H_2O_2, Ca^{2+}, and calmodulin (CaM), as signaling cues in heat stress response in plants.

Chapter 6 highlights the physiological and molecular basis of plant adaptive response to drought regulated by the NO. The chapter discusses how NO aids the regulation of the antioxidative systems, stomatal closure, and adventitious root formation under drought conditions. Additionally, the involvement of NO in plant acclimation to water deficit by activating stress defense genes via post-translational modifications is also elucidated.

Chapter 7 emphasizes the function of plant hemoglobin with particular emphasis on nonsymbiotic hemoglobin and their role in hypoxic tolerance in plants and the involvement of NO. It has also been postulated that class 1 nonsymbiotic hemoglobin (nsHb-1s) possibly acts as NO dioxygenase in the nsHb/NO cycle which consumes NADH and maintains ATP levels via an as yet unknown mechanism.

Chapter 8 provides a synthetic view of our current knowledge on the biology of NO in the context of plant response to low temperature. This includes the specific features of NO production in cold-stressed plants and the functions it may undertake during cold acclimation. A particular attention is paid to the involvement of cold-induced NO in the regulation of cold-responsive gene expression.

Chapter 9 addresses the cytoskeleton-related nitric oxide signaling events under ultraviolet-B (UV-B) exposure. The putative biochemical mechanisms of the protective effects of exogenous NO donors on plant cells and the input of NO-synthase-like activities and nitrate reductase under UV-B exposure are also highlighted.

Chapter 10 describes the effect of transition metal stress on endogenous NO level and how it alters the cellular and metabolic responses. The biological actions of NO and its derivatives exerted through the binding to transition metals of metalloproteins and covalent modifications of cysteine and tyrosine residues. Furthermore, it also examines the effect of exogenous application of NO on transition metal stress responses.

Chapter 11 presents an overview of the current knowledge on the involvement of NO in plant response to nutritional stress, with special emphasis on salinity, calcium and iron homeostasis, and heavy metal stress.

Chapter 12 reviews the effects of heavy metals (HMs) on endogenous NO content. It also provides insight into the enzymatic and nonenzymatic pathways of nitric oxide generation. In addition, the role of exogenous-applied NO in alleviating HMs toxicity is summarized and discussed.

Chapter 13 underlines the current state of the art of the physiological and molecular aspects of NaCl-induced NO signaling in plants and discusses the roles of endogenous and exogenous NO in NaCl toxicity and salt tolerance mechanisms. Particular attention is paid to the role of NO and NO-induced protein modifications in the activation of specific steps of PCD during salt stress.

Chapter 14 illustrates the prospects of managing postharvest handling of horticultural produce by exogenous application of NO. The chapter portrays the beneficial effects of exogenous NO application in lowering the ethylene level, ion leakage, and lipid peroxidation and enhancing natural antioxidant defense systems. It suggests that postharvest application of NO may be a potential new technology to reduce losses in horticultural produce during handling and marketing.

Chapter 15 contrives the current knowledge on the possible role of nitric oxide as a modulator in response to wounding. Furthermore, it is elucidated the involvement of extracellular ATP (eATP) and NO in a complex sequence of events occurring downstream wounding in plants. A brief discussion of the interplay between ROS/RNS and Ca^{2+} as counterpart signal molecules is also presented.

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