

Preface

Nitric oxide (NO), a versatile gaseous free radical that diffuses readily through biological membranes, plays important role in diverse physiological processes in plants. A plethora of NO-generated events encompasses through germination to flowering and fruit ripening in a plant's life cycle. It alters flowering, stimulates germination, induces pollen tube re-orientation, breaks seed dormancy, triggers mitogen-activated protein (MAP) kinase signaling pathways, modulates the activity of certain enzymes, regulates stomatal closure, photosynthesis, cellular trafficking, cell death, expression of cell cycle genes, and other key metabolic processes. NO plays a key role as signaling molecule in biotic and abiotic stress signal transduction pathways in plants. NO acts as an antioxidant and confers resistance against detrimental consequences of stresses.

Acknowledging NO as a significant modulator of biological processes, renewed attention has been given to the mechanism of NO synthesis in plants. The reaction pathway of NO synthesis in animals has been employed to investigate the likely parallel in plants. In animal systems, NO is synthesized predominantly by the enzyme NO synthase (NOS) that converts L-Arginine into L-citrulline in a NADPH-dependent reaction, which releases one molecule of NO for each molecule of L-Arginine. Assays for Arginine to citrulline conversion and compounds that inhibit mammalian NOS have been used on several occasions to draw an analogy that NO synthesis by a NOS-type enzyme also occurs in plants. But still no direct homologs of any of the animal enzymes have been found in any of the fully sequenced plant genomes. This leaves us with many questions than answers related to NO biosynthesis, detection and mode of action in plants.

The research field of NO biology has transcended rapidly over the last few years, and a huge wealth of information has been accumulated in NO research arena. As a result, it became tangible that NO affects far more fundamental biological processes in plants, than originally anticipated.

Therefore, in our opinion, an overview of detection, biosynthesis and metabolism of NO and its role in stress physiology of plants is well timed.

This book "Nitric Oxide in Plants: Metabolism and Role in Stress Physiology" comprises of 17 chapters that covers the key features of NO molecule in a sequential manner starting from its metabolism, identification and detection in plants (Part I) to current understanding of NO molecule and its derivatives in terms

of chemical, physical, and biochemical properties, functional role, mode of action, signaling and interaction with phytohormones, mineral nutrients, biomolecules, ions and ion channels in plants under abiotic stresses (Part II).

Part I of the book comprises Chaps. 1–9. Chapter 1 presents an overview of NO metabolism with particular emphasis on the sources of NO in plants and their importance under abiotic stress conditions. Chapter 2 sheds light on the reductive and oxidative NO synthesis and their regulation. Chapter 3 discusses the peroxisomes as a source of NO and NO-derived species in response to abiotic stresses and detection of NO generation in peroxisomes. Chapter 4 is focussed on the role of mitochondrial NO homeostasis during hypoxic conditions. Chapter 5 deals with the detection methods and synthesis of NO in plants using marine unicellular red tide phytoplankton, *Chattonella marina*, as a model. Chapter 6 sheds light on the role of NO in nitrosylation of cystein thiol residues in proteins, and summarizes different methods developed to identify and quantify nitrosylated proteins. In this chapter authors also provided the first overview of plant nitrosylated proteome showing a wide range of functions and cellular compartments involved in NO signaling and/or targeting. Chapter 7 presents an overview of detection and measurement of NO and nitrosylated proteins, and various levels of regulation of NO on jasmonate signaling and biosynthesis pathway in response to abiotic stress. Chapter 8 sheds light on the function of *S*-nitrosoglutathione reductase (GSNO) as a natural reservoir of NO bioactivity and role of GSNO in plant development and stress response. Chapter 9 discusses nitro-fatty acids in the context of their biochemical activities and cell signaling actions.

Part II of the book includes Chaps. 10–17. Chapter 10 is focused on the properties of NO and its derivatives and their role as potent modulator of the redox regulation in various cell transduction pathways in response to abiotic stresses. Chapter 11 highlights the recent advances in NO signal transduction and its interactions with other signaling molecules in response to abiotic stress. Chapter 12 summarizes the role of exogenously applied NO on structural and functional parameters of plant cells under H₂O₂-induced oxidative stress. Chapter 13 focuses on the current knowledge of possible interactions between NO and phytohormones during plant abiotic stress responses. Whereas Chap. 14 presents an overview of the synergistic role of NO and calcium in the tolerance of plants to abiotic stress. Chapter 15 discusses functional links between the plant growth promoting action of humic substances and NO in response to abiotic stresses. Chapter 16 is focused on the role of chitosan-mediated induction of NO in plant defense responses against pathogen attack and crosstalk between abiotic and biotic stress responses is also discussed. Chapter 17 deals with the involvement of NO and other signaling molecules in signaling cascade and gene expression during biotic and abiotic stresses induced programmed cell death.

We collected contributions from various laboratories studying NO plant biology, and intended to present an overview of the contemporary challenges and possibilities in different areas of NO. We hope that this book will raise your interest in the field of NO research and will serve as a valuable reference.

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