

Preface

Plants are exposed to rapid and various unpredicted disturbances in the environment resulting in stressful conditions. Abiotic stress is the negative impact of nonliving factors on the living organisms in a specific environment and constitutes a major limitation to agricultural production. The adverse environmental conditions that plants encounter during their life cycle disturb metabolic reactions and adversely affect growth and development at cellular and whole plant level. Under abiotic stress, plants integrate multiple external stress cues to bring about a coordinated response and establish mechanism to mitigate the stress by triggering a cascade of events leading to enhanced tolerance. Responses to stress are complicated integrated circuits involving multiple pathways and specific cellular compartments, and the interaction of additional cofactors and/or signaling molecules coordinates a specified response to a given stimulus. Stress signal is first perceived by the receptors present on the membrane of the plant cells. The signal information is then transduced downstream resulting in the activation of various stress-responsive genes. The products of these stress genes ultimately lead to stress tolerance response or plant adaptation and help the plant to survive and surpass the unfavorable conditions. Abiotic stress conditions lead to production of signaling molecule(s) that induce the synthesis of several metabolites, including phytohormones for stress tolerance. Phytohormones are chemical compounds produced in one part and exert effect in another part and influence physiological and biochemical processes. Phytohormones are critical for plant growth and development and play an important role in integrating various stress signals and controlling downstream stress responses and interact in coordination with each other for defense signal networking to fine-tune defense. The adaptive process of plants response imposed by abiotic stresses such as salt, cold, drought, and wounding is mainly controlled by the phytohormones. Stress conditions activate phytohormones signaling pathways that are thought to mediate adaptive responses at extremely low concentration. Thus, an understanding of the phytohormones homeostasis and signaling is essential for improving plant performance under optimal and stressful environments.

Traditionally five major classes of plant hormones have been recognized: auxins, cytokinins, gibberellins, abscisic acid, and ethylene. Recently, other signaling molecules that play roles in plant metabolism and abiotic stress tolerance have also been identified, including brassinosteroids, jasmonic acid, salicylic acid, and nitric oxide. Besides, more active molecules are being found and new families of regulators are emerging such as polyamines, plant peptides, and karrikins. Several biological effects of phytohormones are induced by cooperation of more than one phytohormone. Substantial progress has been made in understanding individual aspects of phytohormones perception, signal transduction, homeostasis, or influence on gene expression. However, the physiological, biochemical, and molecular mechanisms induced by phytohormones through which plants integrate adaptive responses under abiotic stress are largely unknown. This book updates the current knowledge on the role of phytohormones in the control of plant growth and development, explores the mechanism responsible for the perception and signal transduction of phytohormones, and also provides a further understanding of the complexity of signal crosstalk and controlling downstream stress responses. There is next to none any book that provides update information on the phytohormones significance in tolerance to abiotic stress in plants.

We extend our gratitude to all those who have contributed in making this book possible. Simultaneously, we would like to apologize unreservedly for any mistakes or failure to acknowledge fully.

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