Preface

Research on the plant hormone auxin has a long history, starting with Charles Darwin's studies of phototropisms. Now, we know that virtually all plant growth and developmental processes rely on controlled levels of, and response to, this hormone. As such, auxin has claimed center stage in many areas of plant research. This volume highlights the latest insights into the control of auxin synthesis and transport, mechanisms of cellular responses, and auxin-dependent plant growth and development.

The first four chapters of this volume discuss the history of auxin research and highlight general mechanisms of auxin synthesis, transport, and response. Abel and Theologis give an account of the amazing rise of auxin research. Since its discovery about a century ago, much progress has been made in understanding auxin action. Many of the historical landmarks on the way are discussed in this chapter. Normanly reviews the complex pathways that lead to biosynthesis of indole-3-acetic acid, the major naturally occurring auxin. In addition, this chapter discusses recent important improvements in the resolution and sensitivity of auxin measurements in plant tissues. Auxin has long been known to be directionally transported in plant tissues, and this transport underlies several growth responses. Zažímalová et al. review the mechanisms of active auxin transport, focusing on the latest insights in the action of three families of transporter proteins, and their functional interactions. One of the more recent landmark discoveries was the identification of an auxin receptor for the pathway leading to altered gene expression. Calderon-Villalobos et al. describe the research leading up to the identification of this receptor, and they discuss what has been learned from the recent determination of the crystal structure of this protein.

The next section of this volume is dedicated to the cellular consequences of auxin action. Perrot-Rechenmann discusses a long-standing problem: Auxin promotes cell division, as well as cell elongation, presumably through different pathways. Perrot-Rechenmann describes both pathways and discusses the interconnections that may exist between the two. Krupinski and Jönsson describe the progress that has been made by using formal approaches involving computer modeling to understand auxin-controlled growth and development.

Auxin plays important regulatory roles throughout plant life, which is highlighted by the next six chapters that each discuss in depth how individual developmental processes are controlled by auxin. Möller and Weijers review the role of auxin in the earliest phase of plant life, embryogenesis. During this stage, the initial meristems that produce the post-embryonic plant body by repeated formation of new leaves, flowers, branches, and roots are established. Vernoux et al. discuss how auxin promotes the continuous formation of new primordia at the shoot apical meristem. Overvoorde et al. discuss the action of auxin in controlling growth of roots and establishment of root branches (lateral roots). After the initiation of new organs, auxin also plays a crucial role in determining the (internal) structure and pattern of these organs. Scarpella et al. discuss auxin-dependent leaf development, focusing on the formation of continuous vascular tissues and the elaboration of leaf complexity. Sundberg and Østergaard describe the many functions of auxin in patterning the fruit and its tissues during reproductive growth. While much physiological research related to auxin has been done in monocotyledonous species, most of the recent molecular biological and biochemical work focused on dicotyledons, typically *Arabidopsis*. McSteen discusses similarities and differences in auxin biology between monocotyledonous and dicotyledonous plants. These differences include the resistance to certain auxin-based herbicides in monocotyledons.

Plants use many signals, both internal and external, to coordinate growth between cells, organs, and plant parts, but also with their (a)biotic environment. It has emerged that such signals often converge on, or regulate, auxin activity. The final four chapters discuss aspects of signal integration within the auxin pathway. Stewart and Nemhauser, and Del Bianco and Kepinski, present a discussion of the interactions and overall logic of the auxin pathway, while the remaining chapters discuss specific examples.

Halliday et al. show how light, one of the most important environmental signals, interacts with auxin to regulate diverse growth processes. Spaepen and Vanderleyden describe some of the ways that microbes make and utilize auxin to regulate their interactions with plants. In addition, they discuss instances where auxin acts as a signal in the microbe, suggesting that auxin is an ancient signaling molecule.

We hope this book provides an informative and stimulating introduction to the complex and surprising world of auxin biology. Of course, the most important purpose of such a volume is to illustrate what we don't know, and by doing so, provoke new questions from the next generation of curious scientists. We hope that we have succeeded in this respect as well. We are grateful to Richard Sever and Joan Ebert from Cold Spring Harbor Laboratory Press for their encouragement and patience, as well as to Kaaren Kockenmeister for her assistance with production. Finally, we would like to sincerely thank all the authors for the time and thoughtfulness they committed to these chapters.

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