Preface

In 1991, John Walker and Ren Zhang reported the identification of the first plant receptor protein kinase gene (1). Based on its predicted structure of an extracellular domain related to the Self-incompatibility (S)-locus secreted glycoprotein, and a cytoplasmic serine/threonine kinase domain, Walker and Zhang predicted that the discovery of these novel plant proteins "provides a unique opportunity to gain fresh insights into signal transduction in higher plants".

Twenty years after Walker and Zhang's initial findings, it is difficult to imagine plant biology without receptor kinases coming to mind. The next decade saw the emergence of additional receptor kinases through forward genetic screens and through molecular biology. As alluded to above, the S-locus in Brassica also encoded receptor kinases with extracellular domains related to the S-locus glycoproteins. Developmental functions for various receptor kinases included epidermal differentiation for the CRINKLY-4 gene in maize, morphogenesis for the ERECTA gene in Arabidopsis, and maintenance of stem cells in the shoot apical meristem for the CLAVATA-1 gene in Arabidopsis. A role for receptor kinases in recognition of pathogens was first revealed by the identification of Xa21 in rice. A big surprise came with the finding that the BRI1 receptor kinase was the receptor for the plant steroid hormone brassinosteroids.

The emerging genome sequence of Arabidopsis was also uncovering hundreds of receptor kinases, ultimately more than 600. In the report of the NSF-Sponsored Workshop: "New Directions in Plant Biological Research" in April of 1999 (http://www.arabidopsis.org/carnegie_rep.html), the authors asked: "What are the roles of the hundreds of these proteins? Their existence implies a massive network of cell–cell and environment–plant communication, via a series of ligands yet to be discovered. Understanding this network will give us an entirely new view of plant development, environmental response, and organismal integration." Analysis of other genomes, including rice, which has more than 900 receptor kinases, indicates that the large number of receptor kinases in Arabidopsis was not an anomaly.

This book focuses on the momentum created within the plant biology community since Walker and Zhang's initial discovery. Thanks to a combination of collaborative "omics" projects, as well as the deep research efforts of many labs, portions of this "massive network" are emerging. This book opens with a view of the evolution and conservation of receptor kinases in plants, focusing on the rapid expansion of this gene family. After the first chapter, the following seven chapters update the known functions of receptor kinases in various biological contexts, extending the initial discoveries mentioned above. The second half of the book focuses on the diverse ligands, signaling mechanisms, and regulation of receptor kinases. The authors of all of these chapters reveal the amazing results from the past 20 years, and hint at the discoveries that may come in the next 20 years.

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