

Chapter 2

Cell signaling mediated by plasma membrane-bound receptors in plants

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2.1 Introduction

Plants as multicellular and sessile organisms fascinatingly carry various biological functions for their growth, development and defense activities. For this, plants have definite signaling mechanisms toward intercellular and intracellular responses. Plants carry out these responses and regulates signaling mechanisms by various plasma membrane-resident receptors at upstream level along with at downstream level which includes receptor-like kinases (RLKs), receptor-like proteins (RLPs), somatic embryogenesis receptor kinases (SERKs), pathogen-associated molecular patterns (PAMPs) and damage-associated molecular patterns (DAMPs) i.e., more than 600 RLKs and 57 RLPs in *Arabidopsis* and in excess of 1000 RLKs and 90 RLPs in rice at upstream level and receptor-like cytoplasmic kinases (RLCKs), mitogen-activated protein kinases (MAPKs) and nucleotide binding-leucine rich repeat proteins (NB-LRR) at downstream level (Shiu and Bleecker, 2003; Shiu et al., 2004; Fritz-Laylin et al., 2005; Lehti-Shiu et al., 2009; Tör et al., 2009; Kemmerling et al., 2011; He et al., 2018). These receptors are actively involved in numerous signaling mechanisms to regulate growth, development (De Smet et al., 2009) and defense (Couto and Zipfel, 2016; Tang et al., 2017) functions in plants toward intercellular and intracellular signals (Fig. 2.1).

Moreover, the RLKs and RLPs are largest subfamilies among all receptors which have an extracellular leucine-rich repeat (LRR) domain, viz., LRR-RLKs and/or LRR-RLPs. For instances, *Arabidopsis* having 200 plus numbers of LRR-RLKs and LRR-RLPs are the significant receptors and regulates various functions of phytohormones, endogenous peptides and pathogen-derived molecules toward growth, developmental and defense activities of the plant (Shiu and Bleecker, 2001; De Smet et al., 2009; Couto and Zipfel, 2016; Tang et al., 2017). However, the somatic embryogenesis receptor kinases (SERKs) are one of subgroups of the LRR-RLKs which act as co-receptors and convergent modulator involved in various signaling mechanisms via hetero-dimerization with specific receptor of the LRR-RLKs (Ma et al., 2016). The RLCKs and MAPK cascades are close associate with RLK receptor complexes. They have the ability to stimulate various signaling mechanisms through phosphorylation and regulates intracellular signaling mechanisms for mitigation of various developmental and defense functions in plants (Nimchuk et al., 2011; Lin et al., 2013; Zhang et al., 2013; Bessman et al., 2014; Ben Khaled et al., 2015; Martins et al., 2015; Xu and Zhang, 2015; Mbengue et al., 2016; Ortiz-Moreno et al., 2016; Erwig et al., 2017; Hohmann et al., 2017; Wang et al., 2017; Zhou et al., 2018).

In this chapter, we discussed various pathways and functions of plasma membrane-resident receptors at upstream cellular levels (RLKs, RLPs, and SERK) and at downstream cellular levels (RLCKs and MAPKs) to mediate signaling mechanisms toward intercellular and intracellular responses. Moreover, we focus mainly on receptors-co-receptors-ligands association functions toward receptor mediated signaling mechanisms. Furthermore, we summarized how receptor mediated signaling mechanisms help to regulate the plant growth, development and defense functions against intercellular and intracellular responses.