



Research review paper

Elicitor signal transduction leading to production of plant secondary metabolites

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Abstract

Plant secondary metabolites are unique sources for pharmaceuticals, food additives, flavors, and other industrial materials. Accumulation of such metabolites often occurs in plants subjected to stresses including various elicitors or signal molecules. Understanding signal transduction paths underlying elicitor-induced production of secondary metabolites is important for optimizing their commercial production. This paper summarizes progress made on several aspects of elicitor signal transduction leading to production of plant secondary metabolites, including: elicitor signal perception by various receptors of plants; avirulence determinants and corresponding plant R proteins; heterotrimeric and small GTP binding proteins; ion fluxes, especially Ca^{2+} influx, and Ca^{2+} signaling; medium alkalization and cytoplasmic acidification; oxidative burst and reactive oxygen species; inositol

Abbreviations: ACC, 1-aminocyclopropane-1-carboxylic acid; ADPR, ADP-ribose; AFLP, amplified fragment length polymorphism; AOS, allene oxide synthase; CDPK, Ca^{2+} -dependent protein kinases; CHS, chalcone synthase; DAG, diacylglycerol; ERF, ethylene response factors; EST, expressed sequence tags; G-proteins, GTP-binding proteins; GSH, glutathione; HPL, hydroperoxide lyase; IP_3 , Inositol-1,4,5-trisphosphate; JA, jasmonic acid; MAPK, mitogen-activated protein kinase; lysoPC, lysophosphatidylcholine; MeJA, methyl jasmonate; OPDA, 12-oxo-PDA; PA, phosphatidic acid; PAL, phenylalanine ammonia lyase; PC, phosphatidylcholine; PKC, protein kinase C; PLA, phospholipase A; PLC, phospholipase C; PLD, phospholipase D; PMT, pinosylvin-O-methyltransferase gene; ROS, reactive oxygen species; SA, salicylic acid; STS, stilbene synthase.

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triphosphates and cyclic nucleotides (cAMP and cGMP); salicylic acid and nitric oxide; jasmonate, ethylene, and abscisic acid signaling; oxylipin signals such as allene oxide synthase-dependent jasmonate and hydroperoxide lyase-dependent C12 and C6 volatiles; as well as other lipid messengers such as lysophosphatidylcholine, phosphatidic acid, and diacylglycerol. All these signal components are employed directly or indirectly by elicitors for induction of plant secondary metabolite accumulation. Cross-talk between different signaling pathways is very common in plant defense response, thus the cross-talk amongst these signaling pathways, such as elicitor and jasmonate, jasmonate and ethylene, and each of these with reactive oxygen species, is discussed separately. This review also highlights the integration of multiple signaling pathways into or by transcription factors, as well as the linkage of the above signal components in elicitor signaling network through protein phosphorylation and dephosphorylation. Some perspectives on elicitor signal transduction and plant secondary metabolism at the transcriptome and metabolome levels are also presented.

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Keywords: G-protein and Ca²⁺; Cytoplasmic acidification; Reactive oxygen species; Cyclic nucleotides and inositol triphosphate; Nitric oxide and salicylic acid; Jasmonate and ethylene; Transcription factors; Protein phosphorylation

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