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Journal of Cell Signaling

Editorial

Role of Brassinosteroid Signaling in Modulating Tobacco Mosaic Virus

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EDITORIAL NOTE

Plant steroid hormones, brassinosteroids (BRs), show essential roles in plant development and stress responses. However, mechanisms by which BRs delay with plant resistance to virus remain largely indistinct. In this study, we used pharmacological and genetic approaches in mixture with infection trials to investigate the role of BRs in plant defense in contradiction of Tobacco Mosaic Virus, MEK2-SIPK cascade activated while BES1/BZR1 inhibited RBOHB-dependent ROS production, defense gene expression and virus resistance induced by BRs. Thus, our results revealed BR signaling had two opposite effects on viral defense reply. On the one hand, BRs enhanced virus resistance through MEK2-SIPK cascade and RBOHB-dependent ROS burst. Phytohormones are increasingly recognized to play essential roles in plant-pathogen interactions. The stress connected jasmonic acid (JA), phytohormones salicylic acid (SA) and ethylene (ET) are known to participate in defense responses to mitigate biotic stress in plants. BRs are a class of steroid phytohormones that regulate many aspects of plant growth and development5. BR biosynthesis and signaling are well understood in Arabidopsis. In some crops, identification of a series of BR signaling components that are orthologous to those in Arabidopsis, suggesting that the BR signaling pathway is largely conserved among plants. Mitogen-activated protein kinase (MAPK) cascades are highly preserved signaling pathways that transduce extracellular stimuli into intracellular responses in eukaryotes. MAPK cascades are calm of three protein kinase modules: MAPK kinase kinases (MAPKKKs), MAPKs, MAPK kinases (MAPKKs) which are related in various habits to downstream targets and upstream receptors. Alike to WIPK and SIPK, virus-induced gene silencing (VIGS) of several other MAPK components NPK1 (MAPKKK), MEK1 (MAPKK), or NTF6 (MAPK) attenuate N gene- and Pto-mediated resistance against TMV, indicating that the NPK1-MEK1-NTF6 pathway is another MAPK cascade involved in TMV resistance. These studies designated that at smallest two MAPK cascades contributed in disease resistance in tobacco plants. Roles of BR signalling pathway in modulating TMV resistance in N.Benthamiana. Chemical treatment and VIGS method established that BRI1, BSK1 and GSK3-like kinases positively while BES1/BZR1 negatively mediated BR-induced virus resistance. Loss-of-function analyses showed that MEK2-SIPK cascade and RBOHB frolicked key roles in BR-induced virus resistance. We also showed that MEK2-SIPK cascade induced by BRs mediated RBOHB-dependent oxidative burst in N. benthamiana plants response to TMV. Tested control and treated N. benthamiana plants for their resistance against infection of TMV, which was tagged with green fluorescent protein (GFP) N. benthamiana plants were pretreated with water, brassinolide (BL, the most active BR) and brassinazole (BRZ, a specific inhibitor of BR biosynthesis) before TMV-GFP inoculation. Virus buildup was long-established by direct observation of GFP fluorescence, as well as by quantitative real-time polymerase chain reaction (qRT-PCR) and western blotting analysis of viral replication 3, 5 and 7 days post-inoculation (dpi), respectively. N. benthamiana plants treated with BL showed weak GFP fluorescence as compared with water-treated plants. The conclusion is consistent with qRT-PCR and western blotting analysis of viral buildup. However, plants preserved with BRZ appeared to have the strongest GFP fluorescence and the highest viral replication level in comparison with water and BL treatment. These results indicate that BRs play a positive role in plant resistance to TMV.

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Received: January 28, 2020; **Accepted:** February 12, 2021; **Published:** February 19, 2021

Citation: Pie G, (2021) Role of Brassinosteroid Signaling in Modulating Tobacco Mosaic Virus. J Cell Signal. 6:220.