【Grant-in-Aid for Scientific Research (S)】

Biological Sciences (Agricultural Sciences)

Title of Project： Molecular elucidation of plant-pathogen interactions

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Research Project Number：17H06172　Researcher Number：20425630
Research Area：　Agricultural science, Boundary agriculture, Applied molecular and cellular biology
Keyword：　Molecular interactions, Biological interactions

【Purpose and Background of the Research】

The plant immunity system is shaped by millions of years of coevolution between plants and their pathogens such as viruses, bacteria, fungi, and nematodes, resulting in enormous complexity at the molecular level. The invading pathogens thus need special weapons to conquer the established immune system of their corresponding host, as the host would defend itself like a fortified castle. These weapons are known as effectors, which modulate plant immunity and enable parasitic infection. For example, some effectors attack the first layer of the plant immune system conferred by cell surface pattern-recognition receptors. To detect such effectors, plants have evolved other types of receptors called Resistance proteins, which recognize the presence of pathogen effectors directly or indirectly and launch strong counter attack, known as effector-triggered immunity. However, the functions of many plant immunity signaling proteins and most pathogen effectors remain elusive.

In this study, we aim to identify plant and pathogen proteins that are important for plant-pathogen interactions and isolate their complex to provide a unified view of how plants defend themselves against pathogens.

【Research Methods】

Main focus will be on the reactive oxygen species (ROS) producing enzyme and sensor complexes, kinase complexes, superoxide complexes, and ubiquitin ligase complexes that have been isolated in our laboratory. Using highly sensitive mass-spectroscopy, we aim to identify their interacting proteins. We also aim to isolate plant immunity related proteins downstream of such protein complexes. We will perform genetic and biochemical analyses, as well as various omics approaches to analyze function of novel proteins involved in plant immunity. In addition, to understand how pathogens overcome the immunity, we will determine de novo genome sequences of various pathogens and their expression profiles. This approach will provide a strong research base for studying pathogens at the molecular level.

【Expected Research Achievements and Scientific Significance】

A number of immune receptors and sensors against various pathogens have been identified by mainly genetic analyses. However, the diversity of pathogens is extremely high and plants should have much more receptors and sensors to fight against such enemies. Immune signals generated by such receptors and sensors should merge in the cell and go out the cell but the exact mechanism remains highly elusive. In our study, we aim to understand how the immune signals merge, especially by elucidating the key ROS-mediated pathway. We compare plant and animal innate immune systems to find commonalities and differences. Our data may reveal a novel signaling mechanism and its biological significance.

【Publications Relevant to the Project】

- Gan, P., et al., Genus-wide comparative genome analyses of Colletotrichum species reveal specific gene family losses and gains during adaptation to specific infection lifestyles. (2016) Genome Biology and Evolution. 8: 1467-1481.
- Kadota, Y., et al., Direct regulation of the NADPH oxidase RBOHD by the PRR associated kinase BIK1 is required for ROS burst and plant immunity. (2014) Mol. Cell 54: 43-55.

【Term of Project】

FY2017-2021

【Budget Allocation】

156,100 Thousand Yen

【Homepage Address and Other Contact Information】

http://plantimmunity.riken.jp