【Grant-in-Aid for Scientific Research(S)】
Biological Sciences (Agricultural sciences)

Title of Project： The Integrated Biology of Nanopathogens：towards understanding intracellular obligate parasites as a united living organism

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Research Area： Agricultural Sciences
Keyword： Plant-Pathogen Interactions

【Purpose and Background of the Research】

Phytoplasmas are biotrophic plant pathogenic bacteria that parasitize plant vascular systems. The phytoplasma genome is 600~900 kbp, far smaller than those of other bacteria. Phytoplasmas infect more than 700 plant species, including important agricultural crops, and induce characteristic symptoms seen as drastic morphological changes. Plant viruses are also biotrophic plant pathogens, but are non-living organisms that lack cellular structures and their own metabolism. Plant virus genomes are also very small, containing limited numbers and varieties of genes. They infect host plants and make the most of host proteins and metabolites. Viruses also induce various symptoms appearing as morphological abnormalities, producing considerable damage to crop production.

Although phytoplasmas are living organisms and plant viruses are non-living, they share characteristics as biotrophic plant pathogens infecting plants systemically via the phloem. Insects transmit phytoplasmas and many plant viruses. Phytoplasmas and plant viruses produce similar morphological symptoms, such as dwarfing, yellowing, witches broom, and phyllody. As phytoplasmas and plant viruses share several properties and are both nano-scale pathogens, we call them “nanopathogens”. Focusing on the fact that nanopathogens depend on their host plants for most of the materials they require, we plan to perform integrated biological studies of nanopathogens as the basis for a novel paradigm in plant pathology.

【Research Methods】

In this project, we plan to build the foundation for the research required for an integrated understanding of nanopathogens. For example, we will inoculate a large number of plants with nanopathogens to screen for resistant plant cultivars, to identify resistance genetic resources and analyze their roles. We will try to isolate and analyze the host genes required for the multiplication of nanopathogens. We plan to develop *in vitro* systems for multiplying nano- pathogens to identify th factors regulating their multiplication. We will attempt to identify the nanopathogen genes responsible for the in- duction of morphological changes in plants and elucidate their functions. We will design vector constructs for the transformation of nano-pathogens. Through these projects, we hope to elucidate the infection strategies of nanopathogens, the molecular mechanisms for the induction of their pathogenicity-inducing mechanisms, and the host resistance machinery for an integrated understanding of nanopathogens.

【Expected Research Achievements and Scientific Significance】

The estimated annual crop losses due to nano-pathogens are 1,000 billion Japanese Yen. However, no chemicals can inhibit nanopatho- gen infection. In-depth understanding of the plant resistance mechanisms to nanopathogens should provide a molecular basis for their control and treatment. Elucidation of the pathogenicity-inducing mechanisms will lead to novel plant breeding techniques using nano- pathogen genes as novel genetic resources. As this project will deal with viruses, prokaryotes, and eukaryotes comprehensively, it will provide a novel, general understanding of the interactions among living organisms, impacting broad fields of the life sciences.

【Publications Relevant to the Project】

・Yamaji Y., Komatsu K., Hashimoto M., Namba S. *et al.* Lectin-mediated resistance impairs plant virus infection at the cellular level. Plant Cell 24: 778–793, 2012.
・Hoshi A., Oshima K., Hashimoto M., Komatsu K., Yamaji Y., Namba S. *et al.* A unique virulence factor for proliferation and dwarfism in plants identified from a phytopathogenic bacterium. Proc Natl Acad Sci U S A 106: 6416–6421, 2009.

【Term of Project】 FY2013-2017

【Budget Allocation】 166,500 Thousand Yen

【Homepage Address and Other Contact Information】

http://papilio.ab.a.u-tokyo.ac.jp/planpath/index.html