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

**Broad Section F**

# Title of Project： Frontiers in myco-immunity research and new development in relevant phytopathology

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## 【Purpose and Background of the Research】

There exist in fungi (eukaryotes) diverse and unique virus/host interplays, fungal antiviral defense responses herein defined as "**myco-immunity or fungal-immunity**" vs. "**viral counter-defense**". Research into **RNA interference** (RNAi or RNA silencing) as the major antiviral defense in plants has a relatively long history and has pioneered the studies on other virus/host pathosystems. Myco-immunity has two distinct mechanisms: 1, RNAi working at the cellular level to inhibit virus replication and 2, vegetative incompatibility functioning at the population level to impair horizontal virus transmission. In addition, the project leader's team recently discovered the third defense mechanism: **"symptom alleviation"**. This defense involves transcriptional up-regulation of many host genes leading to mitigation of symptom induction, which is mediated by **Dicer** (key player of RNAi) and the **SAGA** complex (general transcriptional cofactor) (Fig. 1). Thus, fungal Dicer plays dual central roles at the transcriptional and posttranscriptional levels. The RNAi and bi-layered cellular level antiviral defense have begun to be explored and is a new research area in fungi. This project was designed to investigate the three major problems below, mainly using the chestnut blight/virus pathosystem: 1, "**regulation and regulation mechanisms"** underlying the fungal antiviral RNAi and symptom mitigation; 2, "**viral counter-defense mechanisms"** against the two cellular defense responses; and 3**, "comparison between fungal and plant immunity"**.

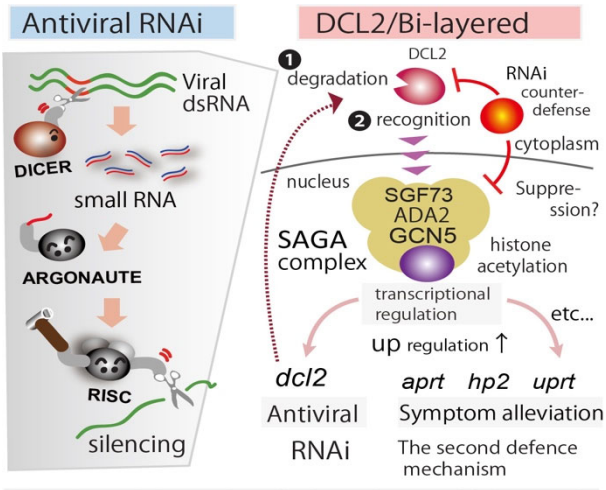


Fig.1. Dicer (DCL)-mediated bi-layered antiviral defense and viral counter-defense. Left, antiviral RNAi pathway; Right, newly proposed symptom alleviation mechanism

## 【Research Methods】

Six sub-projects and methodology are described below.

**1. Virus recognition and RNAi induction by a filamentous ascomycete.** Fungal host factors associated with the above steps will be identified.

**2. Functional roles of host genes involved in symptom alleviation.** Representative host genes under the control of Dicer/SAGA will be disrupted singly or multiply.

**3. Molecular action of RNAi suppressors.** Nucleic acids and proteins interacting with viral RNAi suppressors will be identified.

**4. Viral suppressors of the host symptom alleviation mechanism.** Viral factors interacting with host Dicer and SAGA components such as GCN5 will be identified.

**5. Fungal strains deficient in both cellular and populational antiviral defense responses.** RNAi- and vegetative incompatibility-deficient fungal strains will be prepared toward future use in myco-immunity research.

**6. SAGA-mediated plant defense in the plant.** Whether the SAGA/Dicer-mediated defense exists in rice will be explored.

## 【Expected Research Achievements and Scientific Significance】

This study will provide insights into **the multi-layered myco-immunity/viral counter-defense**, a research area untouched by modern virology, and establish the fungus/virus as **the third pathosystem for antiviral research** next to the plant/virus and animal/virus pathosystems. Furthermore, this project will contribute to **virocontol (biocontrol of plant fungal diseases using viruses)** study and **new advances in phytopathology** by comparative analyses of plant and fungal immunity.

## 【Publications Relevant to the Project】

· Andika, I. B., Kondo, H., and **Suzuki, N.** (2019). Dicer functions transcriptionally and post-transcriptionally in a multilayer antiviral defense. Proceedings of the National Academy of Science, U S A 116, 2274-2281.
· Andika, I. B., Jamal, A., Kondo, H., and **Suzuki, N.** (2017). SAGA complex mediates the transcriptional up-regulation of antiviral RNA silencing. Proceedings of the National Academy of Science, U S A 114, E3499-E3506.

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