**Molecular regulation of plant responses to low**

**temperature in *Arabidopsis***

Haibian Yang, Jingyan Liu, Shuhua Yang\*

State Key Laboratory of Plant Physiology and Biochemistry, College of Biological Sciences, China Agricultural University, Beijing 100193, China

\*Corresponding Author：Tel: (+8610) 62734838; Fax: (+8610) 62734838;

E-mail: yangshuhua@cau.edu.cn

Low temperature is one of environmental factors that restrict plant growth homeostasis and plant-pathogen interactions. Recent studies suggest a link between temperature responses and defense responses; however, the underlying molecular mechanisms remain unclear. Here we report the characterization of the *chilling sensitive 3* (*chs3-1*) mutant in *Arabidopsis*. *chs3-1* plants showed arrested growth and chlorosis when grown below 16°C. *chs3-1* plants also exhibited constitutively activated defense responses at 16°C, which were alleviated at a higher temperature (22°C). Map-based cloning of *CHS3* revealed that it encodes an unconventional disease resistance (R) protein belonging to the TIR-NB-LRR class with a zinc-binding LIM domain (Lin-11, Isl-1 and Mec-3 domains) at the carboxyl terminus. The *chs3-1* mutation in the conserved LIM containing domain led to the constitutive activation of the TIR-NB-LRR domain. Consistently, the growth and defense phenotypes of *chs3-1* plants were completely suppressed by *eds1, sgt1b* and *rar1*, partially by *pad4* and *nahG*, but not by *npr1* and *ndr1*. Intriguingly, *chs3-1* plants grown at 16°C showed enhanced tolerance to freezing temperatures. This tolerance was correlated with growth defect and cell death phenotypes caused by activated defense responses. To identify new components involved in the chs3-mediated signaling, suppressors of *chs3* (*suc*) were screened in the M2 population derived from EMS-mutagenized *chs3-1* seeds. *suc1* suppressed all *chs3*-conferred phenotypes. *SUC1* was found to encode a phosphatase by positional cloning and it was confirmed by genome DNA complementation. The possible role of SUC1 will be discussed. These findings revealed a role of an unconventional mutant R gene in plant growth, defense response and cold stress, suggesting a mutual interaction between cold signaling and defense responses.

**Key Words:** low temperature, defense responses, *CHS3* gene, suppressor of *chs3*