Summary of Doctoral Dissertation

Degree requested Doctor of (Life Science) / Pharmaceutical Science / Soft Matter Science / Clinical Pharmacy Applicant's name Linnan Jie

Title of Doctoral Dissertation

Studies on histone chaperones and protein kinases involved in nutrient-responsive growth regulation in *Arabidopsis thaliana*
（栄養環境に応じた植物の成長制御に関与するヒストンシャペロンとタンパク質リン酸化酵素の研究）

Since plants are non-motile organisms, they have evolved sophisticated sensing and signaling systems that enable them to vigilantly monitor and appropriately react to the dynamic changes in their environment. Carbon (C) and nitrogen (N), among lots of environmental elements, are essential for plants to carry out routine and fundamental cellular functions. Both of C and N function as signaling molecules to reprograms global gene expression levels to optimize nutrient uptake and metabolism. Recently, several studies highlighted that histone chaperones and protein kinases play important roles in nutrient-responsive regulation, however, the detailed mechanism still largely unknown. In this study, I investigated the function of histone chaperones NUCLEOSOME ASSEMBLY PROTEIN1 (NAP1) proteins and protein kinases SNF1-related protein kinase 1 (SnRK1) in different C and N conditions, and aim to provide new insights into regulatory mechanisms of nutrient-responsive growth regulations in *Arabidopsis thaliana*.

1. Histone chaperone NAP1 proteins affect plant growth under nitrogen deficient conditions

N availability is one of the most important factors regulating plant metabolism and growth as it affects global gene expression profiles. Dynamic changes in chromatin structure, including histone modifications and nucleosome assembly/disassembly, have been extensively shown to regulate gene expression under various environmental stresses in plants. However, the involvement of chromatin related changes in plant nutrient responses has been demonstrated only in a few studies to date. In this study, I investigated the function of histone chaperone NAP1 proteins under N deficient conditions in Arabidopsis. In the *nap1;1 nap1;2 nap1;3* triple mutant (*m123-1*), the expression of N-responsive marker genes and growth of lateral roots were decreased under N deficient conditions. In addition, the *m123-1* plants showed a delay in N deficiency-induced leaf senescence. Taken together, these results suggest that NAP1s affect plant growth under N deficient conditions in Arabidopsis.

2. Plant fuel sensor SnRK1 functions in sugar responsive modulation of immunity in *Arabidopsis thaliana*

For plants, sugar does not only serve as an energy source and carbon skeleton, but also functions as signaling molecules to optimize plant growth and resistance to multiple environmental challenges. Plants often encounter pathogen challenge in nature, and thus available sugar resources need to be balanced between defense and growth. Recent studies claimed the crosslink between sugar and immune signals in plants, however the underlying molecular mechanisms are still largely unknown. In this study, I found that expression of several defense marker genes was enhanced when sugar availability is increased in *Arabidopsis thaliana*. In addition, I revealed that the plant fuel sensor SNF1-related protein kinase 1 (SnRK1) is involved in sugar responsive immune responses partly dependent on a phytohormone salicylic acid pathway. In the dexamethasone -induced *snrk1α1isnrk1α2* knockdown mutant (*snrk1*) plants, the expression levels of sugar-responsive defense marker genes were increased whereas the increasement was suppressed by mutation on SA-related genes. Besides, *snrk1* plants displayed a higher resistance against *Pseudomonas syringae* pv. *tomato* DC3000. Taken together, these results suggest that SnRK1 functions in sugar responsive modulation of defense marker genes' expression and is a negative regulator of plants defense response to pathogen attack in *Arabidopsis thaliana*.