B3 domain transcription factors regulate the embryonic resetting of vernalization in *Arabidopsis*

With the support by the National Natural Science Foundation of China, the research teams from Shanghai Center for Plant Stress Biology, Chinese Academy of Sciences, which are led by Dr. He YueHui (何跃辉) and Dr. Du JiaMu (杜嘉木) (now at the Southern University of Science and Technology), respectively, collaborated to discover the mechanism that regulates the embryonic resetting of parental vernalized state in *Arabidopsis* by B3-domain containing transcription factors. This work was published in *Nature Plants* (2019, 5(4): 424—435).

Flowering time regulation is a key biological process which guarantees the reproductive success of plants. Vernalization, which refers to the prolonged cold exposure before plants to flower, is an important flowering time regulating pathway. In *Arabidopsis*, the gene encoding MADS-box transcription repressor FLC (Flowering Locus C) is the key regulating locus in the vernalization pathway. The expression of FLC is able to repress flowering. Genetic and epigenetic regulations at this locus play important roles in fine-tuning flowering time.

Previous collaborative study by Dr. He's lab and Dr. Du's lab has identified a *cis*-element in the first intron of *FLC* locus, which was named Cold Memory Element (CME). CME can mediate the silencing of *FLC* by vernalization. They also identified two B3-domain containing trans-acting factors VAL1 (VP1/ABI3-LIKE1) and VAL2, which can directly bind to the CME and recruit PRC2 components to mediate Polycomb silencing at *FLC* locus. However, how this silencing of *FLC* is reset in plant embryoes remained unclear. In this new paper, the same collaboration teams led by Dr. Yuehui He and Dr. Jiamu Du found another pair of B3-domain containing transcription factors LEC2 (LEAFY COTYLEDON 2) and FUS3 (FUSCA3) which function at early embryogenesis and compete with VAL1/2 in CME binding. To understand the underlying mechanism, they solved the structures of VAL1, FUS3, and LEC2 in complex with the CME containing DNA, and found all three proteins adopt a typical β-barrel like fold, with a similar positively-charged DNA binding interface. They specifically bound CME DNA using a combination of hydrophilic and hydrophobic interactions. *In vitro* binding assay indicates that VAL1 and FUS3 bind CME with similar binding affinity. These results further consolidate the idea that VAL1/2 and FUS3/LEC2 compete in CME binding. Then, they further showed that FUS3/LEC2 recruits scaffolding protein FRI (FRIGIDA) to the *FLC* locus, which may further recruit gene activating complexes to the locus and promote *FLC* expression. Thus, competitive binding of FUS3/LEC2 resets the active expression state of *FLC* during embryogenesis and set up new vernalization requirements for the new generation plant. This study highlights the important role of B3 domain-containing proteins in flowering time regulation and give new insights into the molecular mechanisms underlying embryonic resetting of chromatin states.

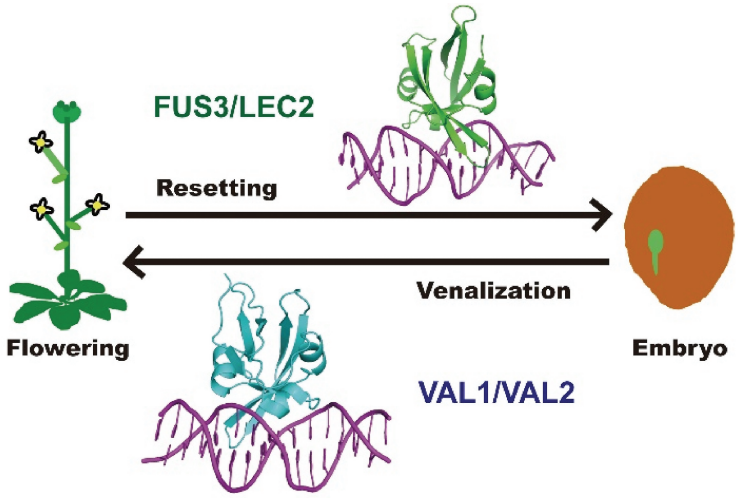

Figure B3-CME binding has distinct roles in different developmental stages.