Abstract

Axillary meristems (AMs) arise from pools of pluripotent cells in the axils of leaf primordia, develop into buds and can later grow into side shoots, which continuously elaborate plant morphology. In annual plants like Arabidopsis, all side shoots flower together with the main shoot, whereas in perennial plants some of the side shoots are kept vegetative for subsequent cycles of development. The aim of the work is to analyze axillary bud initiation in detail and to evaluate the function of *LATERAL SUPPRESSOR* (*LAS)* in the perennial model plant *Arabis alpina*.

Microscopic examination at different developmental stages showed that axillary meristem initiation followed an acropetal gradient both during vegetative and reproductive development. Analysis of the axillary bud initiation pattern in conjunction with the flowering pattern of the side shoots revealed, axillary buds that will remain dormant and vegetative are established before the onset of vernalization.At vegetative stage, AM initiation was inhibited in a set of leaf axils near the shoot apical meristem (SAM), which were gradually filled with axillary buds, as the plant underwent transition to flowering. RNA in-situ hybridization with meristem marker *SHOOT MERISTEMLESS* proved the presence of empty leaf axils near SAM. Arabidopsis wild type Col-0 also showed the presence of an inhibitory zone near SAM. Detailed scoring for number of empty leaf axils in auxin insensitive mutants (*axr1-3* and *axr1-12*) revealed a reduced number of empty leaf axils at vegetative stage in comparison to Col-0.

LATERAL SUPPRESSOR (LAS), a GRAS family transcription factor, which regulates AM formation in the vegetative stage, was analyzed in *A. alpina*. RNA in-situ hybridization showed that *AaLAS* transcripts accumulated at the adaxial side of the young leaf primordia similar to Arabidopsis. Phenotypic analysis of *AaLAS* knockdown plants showed that silencing of *AaLAS* affects axillary meristem initiation at vegetative stage. This leads to lack of the dormant bud zone, which serves as the repository for continuing the perennial life cycle. Still, the plants survived till the next season through the buds initiated during vernalization due to the reactivation of *PEP1* (FLC orthologue) after vernalization. Upon prolonged vernalization treatment, the *AaLAS* knockdown plants were compromised in AM initiation at vegetative stage

and in few plants long exposure to cold lead to flowering of all axillary buds initiated during vernalization. Altogether, this shows regulation of AM initiation by *LAS* plays an important role for the perennial trait.

Transcript profiles of very young axillary buds initiated at different developmental stages were analyzed by RNA-seq. The expression profiles showed differential expression of many genes especially of genes regulating dormancy and flowering time. The buds initiated at late vernalization stage were highly competent to flower soon after its initiation, due to high expression of positive regulators of flowering time like *SOC1*, *LFY* and *FUL*. Interestingly, buds that were initiated at the late vegetative stage, which corresponds to the position of dormant buds, showed high expression of dormancy associated genes. This indicates, that *Arabis alpina* determines the buds that stay dormant soon after their initiation.