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IN BRIEF

YABBY Genes and the Development and Origin of Seed Plant Leaves

The leaves of seed plants (known as Spermatophytes and including angiosperms and gymnosperms) typically are flattened blades, called laminae (singular lamina), characterized by polar growth along a dorsal-ventral (adaxial-abaxial) axis. Numerous genes are known to function in establishing and maintaining dorsal-ventral polarity in seed plants. Most of these genes have homologs in the lycophyte *Selaginella* and the moss *Physcomitrella*; thus, the origin of their functions predates the evolution of seed plant leaves. One family, however, that of the *YABBY* genes, stands out for being unique to the genomes of seed plants (and present in all seed plants that have been examined). Current work by **Sarojam et al. (pages 2113–2130)** delves into the role of *YABBY* genes in regulating laminar leaf development in seed plants through loss-of-function mutational analysis in *Arabidopsis*.

The *Arabidopsis* genome contains six *YABBY* genes. Four of these (*FIL*, *YAB2*, *YAB3*, and *YAB5*) show expression is vegetative tissues, whereas expression of the remaining two (*CRC* and *INO*) is restricted to floral organs. Sarojam et al. investigated the function of the vegetative YABBYs by characterizing *Arabidopsis* plants lacking the function of all four of the vegetative *YABBY* genes simultaneously. Triple and quadruple mutant plants lacking or greatly reduced in vegetative YABBY activity produced lateral organs that showed marked loss of lamina expansion and polarity defects, ranging from organs with some lamina to fully radialized structures (see figure). Analysis of the expression of various marker genes associated with lamina development versus shoot development suggested that mutant leaf primordia failed to activate early lamina development and instead reactivated shoot meristem genetic programs. This was accompanied by marked changes in the distribution and flow of auxin.

Although the triple and quadruple mutant phenotypes were highly pleiotropic, the authors used marker gene and global gene expression data to conclude convincingly that YABBY activity is not required for the initial establishment of leaf polarity, but rather for initiating outgrowth of the lamina, maintenance of polarity, and establishment of the leaf margin. The authors propose that *YABBY* genes act to transform an ancestral shoot-specific genetic program into a leaf-specific program that includes changing patterns of auxin flow and distribution concomitant with development of the flattened lamina, suppressing meristem activity, and activating a maturation program directing determinate growth. This work provides significant insight into leaf morphogenesis and the role of *YABBY* genes and supports the hypothesis (reviewed in Floyd and Bowman, 2010) that the origin and evolution of the *YABBY* gene family has played a significant role in the evolution of seed plant leaves.

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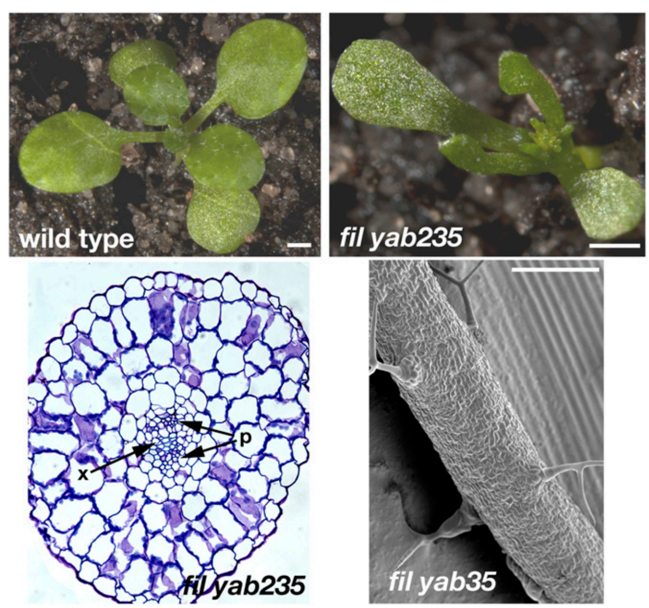

Loss of vegetative *YABBY* function in *Arabidopsis* is associated with development of radialized leaf structures and loss of dorsal-ventral polarity. p, phloem; x, xylem at bottom left. Bars = 1 mm (top two panels) and 250 μm (bottom right panel). (*Figure adapted from Figure 2 of Sarojam et al. [2010].*)

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