Title:	WUSCHEL dynamically regulates auxin biosynthesis to promote stemness and progenitor cell differentiation in the shoot apical meristem of Arabidopsis
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Abstract:	One of the striking aspects of stem cells is their ability to self-renew to maintain the adequate pool over extended periods and differentiate into distinct cell types on demand to sustain the tissue growth and repair by supplying new cells. Arabidopsis plant harbors pluripotent stem cells in the central zone (CZ) of the shoot apex. The daughters of these cells upon cell division move towards the peripheral zone (PZ). At the flanks of the meristem, they get recruited to form lateral organs. The cells that get displaced underneath CZ become part of the rib- meristem (RM). RM gives rise to stem tissue and vascular cell types in higher plants. Despite the three decades of genetic research work, our understanding of how stem cells differentiate into PZ and RM cell types is inadequate. Stem cell daughters are recruited into organ primordia at a regular interval in PZ. Past studies have shown that auxin, which is polarly transported by its efflux carrier PIN FORMED1 (PIN1), is required for this transition (Gälweiler et al. 1998; Reinhardt et al. 2003; T. Vernoux et al. 2000). By combining genetics, molecular biology, and pharmacological treatments, studies have shown that auxin controls its transport by regulating the expression of PIN1 and downstream auxin signaling network genes. Genetic and molecular evidence collected thus far suggests, PIN1 is polarized toward the regions of high auxin concentrations, reinforcing a positive feedback loop between PIN1 and auxin signaling network genes (Benková et al. 2003). A recent study has shown that auxin response factor MONOPTEROUS (MP), which controls the polarity of PIN1 non-cell autonomously, expresses in the incipient primordia first, PIN1 polarization follows MP expression (Bhatia et al. 2016). This study raises an important question if MP expression is depended on auxin signaling, then how the expression of MP arise in the first place without auxin being transported efficiently in those cells in the SAM. Although, pin1 mutant plants produce cotyledons and leaves in vegetative phase of plantdevelopment (T Vernoux et al. 2000). None of the past models of phyllotactic pattern considered the role of locally produced auxin in organ primordia formation in SAM. .Auxin is mainly synthesized from L-Tryptophan (L-Trp) in plants (Ljung 2013). The enzyme encoded by TRYPTOPHAN AMINOTRANSFERASE OF ARABIDOPSIS 1 (TAA1) and its close homologue TRYPTOPHAN AMINOTRANSFERASE RELATED gene (TARs) catalyse the conversion of L-Trp into indole-3-pyruvic acid (IPyA); consequently, the YUCCA (YUC) monooxygenases convert IPyA to indole-3-acetic acid (IAA)(Zhao 2010). Experimental evidence suggests that TAA1/TARs and YUCCA class of enzymes are the primary producer of IAA in Arabidopsis. The single mutant of TAA1/TARs and YUCs does not give phenotypes owing to their high genetic redundancy. However, when higher order mutants are generated, they display a defect in embryonic and postembryonic development related to auxin signalling (Cheng, Dai, and Zhao 2007; Stepanova et al. 2008). Except for TAA1, it is not clear from present studies where and when the TARs genes are expressed in the SAM and whether their activity contributes in maintenance to local auxin maxima in the SAM is not explored. Here, we show that meristem patterning and lateral organ primordia formation, besides intercellular transport, are regulated by locally produced auxin in the PZ. WUSCHEL, a homeodomain transcription factor, negatively regulates auxin biosynthesis in the stem cell niche to maintain the long-term pluripotency of shoot stem cells, and thus, offsets auxin responses in the CZ cells. Our findings elucidate WUSCHEL mediated regulation of auxin biosynthesis, which is essential for the transition of stem cell progenitors into differentiated cell types in the Arabidopsis shoot apex
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