Internal and External Signals Controlling Radial Expansion of Root Systems

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As soon as a seed germinates, plant growth relates to gravity to ensure that the root penetrates the soil and the shoot expands aerially. Mechanisms of positive and negative orthogravitropism of primary roots and shoots are relatively well understood. In contrast, lateral organs show more complex growth behavior, which largely remains enigmatic. Root growth towards gravity is an important trait that ensures sessile plants to anchor and to cover the soil. Lateral roots (LRs) are important to increase the root soil surface and allow for radial expansion of the root system (plagiotropism). For such a radial exploration of the substrate, LRs seemingly suppress positive gravitropic growth and show a defined gravitropic set-point angle (GSA) (Ruiz Rosquete et al., 2013). We here illustrate that plants from diverse geographical origin have differences in GSA-derived root system architecture, suggesting importance of this trait for habitat compatibility. We quantitatively determined GSA of emerged lateral roots in naturally occurring *Arabidopsis* accession lines and have used genome-wide association (GWA) techniques to reveal novel molecular components involved in GSA determination. Based on this genetic screen, we provide molecular evidence that cytokinin metabolism plays an important role in the GSA establishment in lateral roots. Mechanistically, cytokinin counteracts the auxin transport-dependent angular growth of lateral roots, thereby promoting radial expansion of the root systems. We are currently investigating whether this mechanism guides to integrate cytokinin-reliant shoot apical meristem activity with auxin transport-dependent regulation of directional lateral root growth.