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## Modelling auxin transport in root provascular tissues

All vascular plants are called so because they have special vascular or conductive tissues providing effective transport of water, dissolved minerals and organic substances, including phytohormones. Root apical meristem (RAM) contains vascular initials from which protoxylem and protophloem differentiate further producing xylem and phloem, respectively. Acropetal flow of auxin along root provascular tissues is required for normal functioning of the RAM. Auxin distributes in plant tissue by means of diffusion and active transport through the number of membrane transporters (PINs, AUX/LAX etc). In protoxylem, auxin active transport is mediated by PIN efflux transporters that are polarly localized at the basal side of cell membranes. In protophloem, additionally to PINs efflux transporters, AUX1 influx carriers are localized at the apical side of the membranes provide for auxin transport. Thus, protoxylem and protophloem differ in the mechanisms of auxin active transport. To study how these differences in transporters affect the auxin distribution in these tissues we have created mathematical models of auxin transport in root protophloem and protoxylem. Both models use as a prototype the published model of auxin transport along the central axis of the root [Mironova et al., 2010]. In the protoxylem model, the active auxin efflux is determined by PIN transporters, where auxin influx from the intercellular space is provided only by diffusion. In the protophloem model, both PIN and AUX1 transport systems are active. Initially, in both protoxylem and protophloem simulations we used the same set of parameters. Parameter values were (1) taken from the prototype model [Mironova et al., 2010], (2) adjusted using the experimental data on the comparative efficiency of auxin active transport and diffusion [Yang and Murphy, 2009] and (3) estimated using the microarray data [Paponov et al., 2008]. The protoxylem model solutions represented the experimentally observed auxin distribution along the central axis of the root tip. The protophloem model provided these solutions only if the values of some parameters were significantly changed. Based on this, we proposed the following hypotheses about the differences in the mechanisms of auxin transport in protophloem and protoxylem: 1. Auxin-dependent PINs degradation in protophloem occurs at higher levels of auxin concentrations; 2. Auxin-dependent activation of PINs synthesis in protophloem occurs at lower auxin concentrations; 3. Auxin transport via PINs in protophloem is more efficient than in protoxylem. The latter hypothesis was indirectly confirmed by the recently published experimental data [Scacchi et al., 2010], where expression of protophloem marker gene BRX was shown to be activated by ARF5, the transcription factor of the primary auxin response. In its turn, BRX activates the PIN3 expression. One may assume

that BRX-mediated PIN3 expression provides the additional facility that makes protophloem auxin transport more effective. On the basis of the numerical simulations we conclude that the same pattern of auxin distribution in provascular tissues provides for by the quite different mechanisms.

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