MODELLING AND COMPARATIVE ANALYSIS OF AUXIN TRANSPORT MECHANISMS IN SHOOT AND ROOT

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Motivation and Aim: Plants compared to the most animals do not complete establishment of their body plan in embryogenesis but continually produce new lateral organs in the course of postembryonic development. A general mechanism of new lateral organ initiation is common for both shoot and root apical meristems (SAM and RAM, respectively) and consists of local accumulation of auxin at the margin of stem cell niche [1]. In the case of RAM these local maxima appear on the way of the auxin stream coming from the shoot along the root longitudinal axis. In the SAM local auxin maxima occur in the peripheral zone lying as a ring surrounding the SAM summit. Polar auxin transport machinery producing these local maxima consists of the influx and efflux carriers. Previously we have developed the 1D model (1), for studying of auxin distribution along the longitudinal axis in the plant root [2].

Methods and Algorithms: We converted the model (1) into the model (2r) attempting to present auxin stream in the SAM: we replaced column cell ensemble by the ring cell ensemble, made the auxin stream within the ring bidirectional and excluded from the model (2r) auxin input and dissipation. All other parameters and conditions in the model (2r) were kept the same as in the model (1).

Results: The model (2r) did not give rise to any local maximum of auxin in the ring. We changed the equation according to [3], where regulation of auxin transport from the cell depends on auxin concentration in the neighboring cell. This model (2s) demonstrated local auxin maxima similar to [3].

Conclusion: Numerical simulations of models (1) and (2) showed that each of them is effective in only one case: model (1) in RAM and model (2s) in SAM This provided insights into the difference in auxin maximum formation in SAM and RAM borders related to the difference in the regulation of polar auxin transport. It's allowed to suggest that in the shoot apex there is an auxin absorption mechanism and the cell with highest auxin level works like "vacuum cleaner", but in the root auxin extrusion mechanism is prevalent and each cell works like "spray".

References:

1. De Smet I, Jürgens G. Patterning the axis in plants--auxin in control. (2007) *Curr Opin Genet Dev.*, **4**:337-43.
2. В.А. Лихошвай, Н.А. Омельянчук, В.В. Миронова, С.И. Фадеев, Э.Д. Мелснесс, Н.А. Колчанов Математическая модель паттерна распределения ауксина в корне растения (2007) *Онтогенез*, **6**: 446-456.
3. Jonsson et al. (2006) An auxin-driven polarized transport model for phyllotaxis *PNAS*, **103**: 1633–1638.