MECHANISTIC DESCRIPTION OF RADIAL WATER ROUTE ACROSS THE ROOT

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A new multi-membrane model of radial water route from the soil to the xylem of the axial root cylinder is presented here. In this model, plasmalemmas of all cells of the root cortex are represented by the identical porous (heterogeneous) membranes M. Water crosses these membranes on its route from cell to cell (symplastic route).

It have assumed that all the cortex cells are in contact with the apoplast of cortex, by the semi-permeable membranes denoted M^{Ap}. Water and solute are both steadily exchanged between the cortex symplast and cortex apoplast, crossing these membranes. The cells of endodermis are the only ones, which are isolated from an apoplast. All the membranes M have been connected in series, while the membranes M^{Ap} in parallel. Apoplast of cortex acts as a membrane of filtration coefficient L_p^{At}, too.

According to the model, a total volume flow J_v across the root (given the existence of the mechanical pressure difference $\Delta P_{xg} = P_x - P_g$ and of osmotic pressure difference $\Delta\Pi_{xg} = \Pi_x - \Pi_g$) will be generated between the xylem (x) and a soil (g):

$$J_v = [L_{pa}^{Sym}(\Delta P_{xg} \quad \Delta\Pi_{xg}) + L_{pa}^{en}(\Delta P_{xen} \quad \Delta\Pi_{xen}) + [L_{pa}^{Ap}(\Delta P_{kA} \quad \Delta\Pi_{kA})] + [L_{pb}^{Sym}\Delta P_{xg} + L_{pb}^{en}\Delta P_{xen} + L_{pb}^{Ap}\Delta P_{kA} + L_p^{AT}\Delta P_{Ag}],$$

where: ΔP_{Ag} – mechanical pressure difference between the apoplast and the soil, ΔP_{xen}, Π_{xen} – mechanical-pressure and osmotic pressure differences between xylem and an inside of endodermis cells, respectively, ΔP_{kA}, Π_{kA} – pressure differences between root symplast and apoplast. „a" and „b" denote semi-permeable and impermeable pores of the membranes M, respectively.

The equation describes, i. a., two-way fluxes through the radial path of root, occurring simultaneously. It also explains an asymmetry in the root hydraulic conductivity (L_{pr}) of different species, found with the root pressure probe by Steudle and cooperates (Steudle, 1990, *Methods for studying water relations of plant cells and tissues, Measurment techiques in plant sciences*. Eds.: Y. Hashimoto I. *et al*., Academic Press, San Diego, 113).