Fractional Modeling of Anomalus Difussion in Plants Cells

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Abstract

Changes of turgor pressure in plant cells could produced leaf or branch movements as consequence of ion diffusion. The phenomena occurs when the solutes actively accumulated in cells are release to interstitial space. The lower pressure in the cells reduce the mechanical properties of intracellular walls and weakens tissues. In inverse process, ions return to cells and the turgor pressure is maintained in plant structures. Moreover, the exchange of ions in the plant produces an electrical response that can be measured in the frequency domain by electrical impedance spectroscopy. The experiments shown an anomalous diffusive relaxation phenomenon that requires a fractional analysis to determine the parameters of the equivalent electric circuit. The effects of memory on the response of the plant indicate a process dependent on previous excitable stimuli, which is explained by fractional differential equations. The proposed model was fitted to experimental data and explain elements related to the processes of semi-infinite diffusion. This elements correspond to several kind of ions responsible for the propagation of the electrical impulse through the plant in transition between a capacitive and diffusive states.

References

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