

Sergey Nikolaev

THE INSTITUTE OF CYTOLOGY AND GENETICS THE SIBERIAN BRANCH OF THE
RUSSIAN ACADEMY OF SCIENCES

e-mail: nikolaev@bionet.nsc.ru

Spatial Distributed Genetic Mechanism for Stem Cell Niche Structure Control in the Shoot Apical Meristem

There is a qualitative hypothesis of interplay between CLV and WUS genes as a mechanism for the SAM compartmentalization into central zone (CZ stem cells), organizing center (OC), and peripheral zone (PZ). The following is an important moment of the hypothesis: CLV3 expression occurs in the central cells of 3 upper layers (CZ), while WUS expression occurs in the cells of OC, just below CZ; and CLV3 by means of binding with putative receptor CLV1/CLV2 inhibits WUS expression, while WUS activates CLV3 expression. This interplay is believed to be able to regulate stem cell niche structure in the SAM.

We developed a mathematical model of spatial distributed molecular-genetic mechanism of such a compartmentalization of the SAM to test the above hypothesis. We added a hypothetical gene expressing in the uppermost cells. And we supposed regulatory molecules propagate across the SAM by diffusion. A resulting system of differential equations was numerically solved to obtain a stationary solution on a 2D domain representing vertical cut of the SAM.

Obtained model parameters supply a stationary solution for spatial distribution of the modeled genes expression in qualitative accordance with experimentally observed data on vertical cuts of the SAM.

The hypothesized mechanism for stem cell niche structure control in the SAM grasps main features of interaction between the compartments experimentally observed.