Live Imaging of Cellular Differentiation in Shoot Apical Meristems and in Cellulose Synthesis

Elliot Meyerowitz and Christopher R. Somerville

2006 Balzan Prize for Plant Molecular Genetics

Balzan GPC Adviser: Marc Van Montagu
Main Researchers: Marcus Heisler, Wuxing Li, Paul Tarr (under Prof. Meyerowitz); Adisorn Chaibang, Seth DeBolt, Brad Dotson, Ying Gu, Patricia Bubner (under Prof. Somerville)
Affiliated Institutions: California Institute of Technology (Caltech); Carnegie Institution of Science; University of California, Berkeley

Period: 2006-2009

Elliot Meyerowitz is George W. Beadle Professor of Biology and Investigator of the Howard Hughes Medical Institute at the California Institute of Technology's Division of Biology. Christopher R. Somerville is Philomathia Professor of Alternative Energy and Director of the Energy Biosciences Institute at the University of California, Berkeley.

One novel suite of methods that is now being developed, both at Caltech and at Carnegie, involves live imaging of dynamic plant processes followed by computational image processing. Two key processes under study are cellular differentiation in shoot apical meristems and cellulose synthesis. Elliot Meyerowitz initially involved Marcus Heisler, a pioneer of the new live imaging method, who worked on the live imaging of growing shoot apical meristems and computational modeling of cell behaviour and cell-cell communication during meristem growth. After Dr. Heisler left Caltech to establish his own laboratory at the European Molecular Biology Laboratory in Heidelberg, the project involved two additional postdoctoral fellows, Dr. Wuxing Li and Dr. Paul Tarr, who carried the shoot apical meristem work forward by investigating the involvement of the plant hormones auxin and cytokinin in the control of cell expansion, division and gene expression, and therefore, the contribution of these growth hormones to the interaction of physical and chemical signaling that controls meristem cell behaviour.

The work done in this part of the project led to a new National Institutes of Health grant on the action of hormones in the shoot apical meristem, which allowed the work to continue.

Professor Somerville involved three postdoctorate students in studies concerning the molecular mechanisms associated with the synthesis or depolymerization of cellulose. The research program in the Somerville laboratory has been focused on understanding several aspects of the control of cellulose synthesis or depolymerization. In early 2013, postdoctoral fellow Patricia Bubner joined the Somerville groups following doctoral studies in Graz, Austria, and studied the role of glycosylation on enzyme activity by using genetic methods to modify the amount and location of glycans on proteins. Former postdoctoral fellow Ying Gu studied the role of the microtubule cytoskeleton in orienting the deposition of cellulose microfibrils by analyzing mutants in which the deposition is altered. Balzan funds were also used by Professor Somerville to support then postdoctoral fellow Seth DeBolt, who investigated the involvement of sterol glycosides in cellulose synthesis.

In December 2007, Professor Somerville moved his laboratory from Carnegie to the University of California, Berkeley. The project was inactive until the summer of 2009 due to administrative delays associated with moving the funds from one institution to another. Somerville's Balzan funds have been used to partially support two graduate students, Adisorn Chaibang and Brad Dotson. Chaibang examined the role of two laccase enzymes in lignin biosynthesis and Dotson explored the function of a family of proteins of unknown function that appear to play important roles in cell wall biosynthesis.

Publications

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