Data-driven investigation of quorum sensing during plant cell regeneration

B.Sc. project in Applied Mathematics - Mathematical Biology (Applied Analysis)
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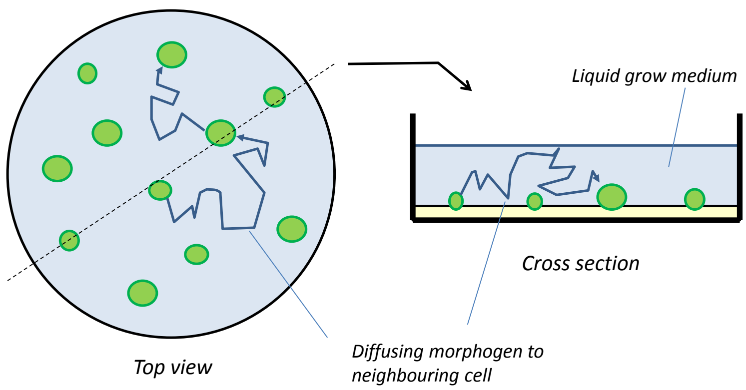
In plant biology techniques have been developed by breeders to obtain a full-grown plant from a micro-spore. In normal sexual reproduction a micro-spore will grow out to a male gamete (a pollen) that upon fertilization of a female gamete (an egg cell) yields in the end a plant embryo. The spores and egg cells are haploid, i.e. the have one chromosome of each pair in mature (diploid) plant. To obtain a 'normal' embryo from a micro-spore the chromosomes are doubled in the growing technique. This results in a diploid plant that has the same genetic code at each gene locus on a pair of homologous chromosomes. This offers interesting opportunities for breeding.

Breeders would like to optimize the yield of this regeneration technique: not every micro-spore grows out to an viable embryo. Experiments lead to the conclusion that regeneration is cell density dependent. The objective of this project is to develop a mathematical model for this density dependence, based on experimental observations of the regeneration process in tissue culture dishes, such that an optimal growing strategy can be obtained. Data is provided by the innovative company Fytagoras

Mathematically, it requires the modeling of diffusion of chemical compounds, so-called morphogens, through the liquid medium in the tissue culture that surrounds the treated spores by means of a diffusion partial differential equation. The specific compounds involved have not yet been identified, nor is their effect on neighboring cells, i.e. is it stimulating or inhibiting growth. Results from grow experiments are fitted to the developed model and the results are interpreted biologically, possibly leading to further experiments to validate a suggested breeding strategy. Depending on the students skills and interest in programming images from grow experiments may be analyzed automatically and fit automatically to the developed model.

An introduction of the required mathematical background to e.g. diffusion equations is provided during the project. A biological background is not required. The necessary biological understanding will be learned in discussions during the project.

Tissue culture dish with treated micro-spores



A detailed presentation of this project cannot be given in the last week of January, unfortunately. ***Please contact the lecturer by email if you are interested and want further information*.**