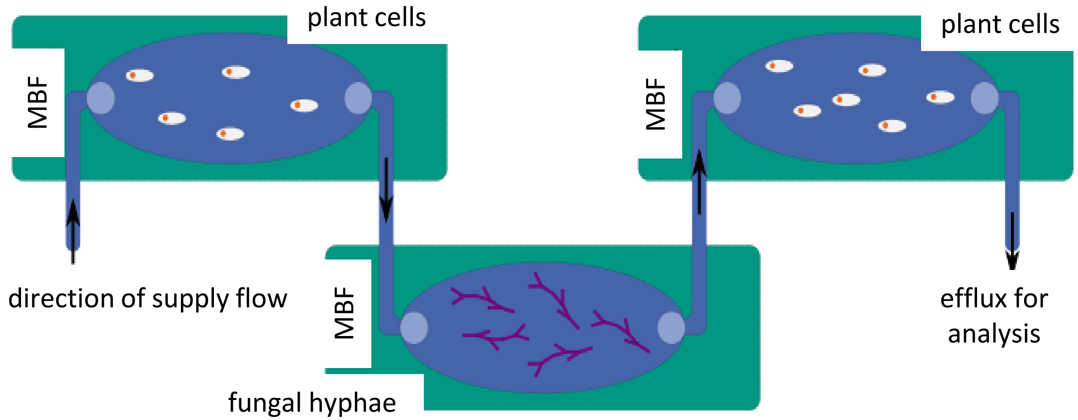
Why microfluidic systems?

- **Biology happens on microscale:** Numerous important biological processes run on the microscale or even smaller. Microfluidic systems can simulate that.
- **Differentiation and precise regulation:** It is not easy to dissect factors and causal chains in the context of living organisms, because all processes are interwined in a complex manner. Microsystems help to reduce complexity to reach a defined biological system that allows both, precise regulation as well as precise measuring.
- **High throughput:** Miniaturisation allows more efficient work and saves resources. By parallelisation, the throughput of analysis can be increased, including simultaneous investigations under the microscope.



DialogProTec

Achievements using the microfluidic biofermenter:

- Using the microfluidic biofermenter (MBF) we could detect *quorum sensing* in plant cells. Plant cells can sense the density of the colony and adjust their development to this.
- Combining plant and fungal cells in two MBFs, the underlying chemical communication could be investigated and the formation of phytotoxins could be analysed.
- Vindoline is an important precursor of the anti-tumour compound Vincristine. By combining two cell lines in two MBFs, for the first time, vindoline synthesis in cell culture could be achieved.

Contact

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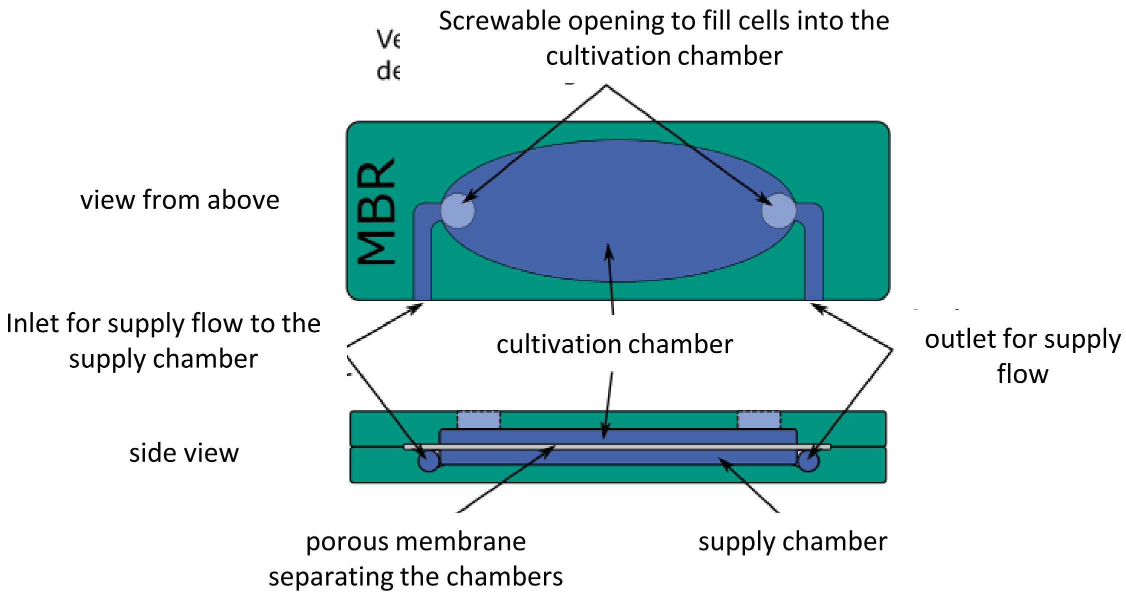
Der Oberrhein wächst zusammen: mit jedem Projekt Dépasser les frontières, projet après projet

Microfluidic Biofermenter (MFB)

The MFB harbours two chambers: one chamber with the supply stream (➔ supply chamber), and one for the actual cultivation of the cells (➔ cultivation chamber). Both chambers are separated by a porous, permeable membrane that allows for exchange of nutrients and signal compounds between supply and cultivation chamber. The plant cells themselves are prevented from leaving their chamber.

The special feature of the approach is the fluidic connection of several MFBs in a modular manner. This allows cultivation of different cell types in different chambers, such that they can interact, for instance, by exchanging metabolites or regulatory signals. Thus, the interaction between different cells can be investigated by molecular biological and chemical analytics.



Root Chip

To transfer the conclusions obtained from the MFB to a real plant requires a transitional system level. For this purpose, we have developed a chip to investigate the behaviour of the root. Roots are far more than the organs that provide the plant with water and nutrients from the soil. It is also a central factor in the communication of plants with their environment and a central factor for stress resilience. Upon germination, the root is emerging first and defines the subsequent development of the plant.

The Root Chip had been developed at the IMT and harbours three channels of egal length what allows to follow three roots in parallel. Each channel contains an inlet and an outlet for the supply flow. In addition, each channel holds an entry opening, where the root to be investigated can enter. These openings are aligned in an angle of 45° with respect to the supply flow, such that the root, upon entering, follows a preferential direction into the observation channel.