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How plants conquered the land

Biologists at Freiburg University play a leading role in deciphering the moss genome

One of the simplest plants in the world can help with the production of new medication in a safe and cost-effective way and with making crop plants resistant against the negative effects of global climate change.

The moss *Physcomitrella patens* is similar to the first plants which began to grow on land around 450 million years ago.
In order to survive they had to adapt to withstand extreme temperature changes, drought, high UV-radiation and high salinity.
A better understanding of these protection mechanisms means they can be applied to crop plants making them more resistant to the ever-growing challenges posed by global warming.

An international consortium of 70 scientists in 45 laboratories predominantly from Germany, Japan und USA have sequenced the *Physcomitrella* genome and published their results in the Science journal (online publication 13th December 2007).
At the international ”Moss 2004” conference in Freiburg, organised by the Chair Plant Biotechnology (Professor Ralf Reski), an international consortium of moss researchers gathered, comprised of Ralf Reski and Stefan Rensing (University of Freiburg, Germany), Andy Cuming and David Cove (University of Leeds, UK), Mitsuyasu Hasebe (National Institute for Basic Biology, Japan), Brent Mishler (University of California, Berkeley, USA), Tomoaki Nishiyama (Kanazawa University, Japan) and Ralph Quatrano (Washington University in St. Louis, USA).
It was the aim of the consortium to decipher the gene sequences of *Physcomitrella patens*. Moss would be the first non-flowering plant among few plants with sequenced genes.

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Moss researcher consortium (left to right): Stefan Rensing, Andy Cuming, Tomoaki Nishiyama, Ralf Reski, Mitsuyasu Hasebe, Ralph Quatrano, Brent Mishler, David Cove

Sequencing took place at the Joint Genome Institute (JGI) in Walnut Creek, California, a facility of the US Department of Energy.
The highly complex annotation of the gene sequences was accomplished under the leadership of Lecturer Dr. Stefan Rensing at the Chair Plant Biotechnology of Professor Ralf Reski using state-of-the-art bioinformatic techniques.
This research was financed substantially by the German National Science Foundation (DFG Deutsche Forschungsgemeinschaft).

"The moss genome lies between algae and flowering plants, separated by a billion years of evolution. With a fully sequenced genome moss has at last become a model plant" says Stefan Rensing.
"When I started research on *Physcomitrella* over 20 years ago, moss had a very small research window, but we always had financial support from the DFG. I never for a moment thought that one day we would actually sequence the whole moss genome" explains Ralf Reski.

Unlike humans and flowering plants the moss genome does not have a "backup" for its genes. It is also possible for scientists to specifically

intervene in the genome. This hitherto for plants unique technology means scientists can very quickly determine the function of unknown genes.

BASF AG was the first company worldwide to recognise the enormous potential of this research und invested an 8-figure sum in Ralf Reski's work from 1999 onwards. "This very successful cooperation between a global company and Freiburg University probably provided the impetus for other national funding organisations in the USA, England and especially in Japan to finance moss research on a large scale", says Reski with hindsight.

Moss Biotechnology also has many local sponsors. Freiburg University as well as domestic industrial organisations such as BioRegio Freiburg / Biovalley supported Reski when he founded "greenovation Biotech" with colleagues in 1999.
Over the years greenovation has concentrated its development on the moss bioreactor, which enables the safe and inexpensive production of valuable proteins for medicinal purposes, such as antibodies for diagnostics and therapy. Optimisation of this technology is supported by the German Federal Ministry of Science (BMBF), which assists in joint projects between the Universities of Freiburg and Karlsruhe and "greenovation".

"With the moss genome we now have a blueprint to safely and efficiently adopt plant biotechnology for the benefit of mankind" says Reski.
And Rensing adds "The annotated moss genome is an elementary prerequisite for the modelling of life processes in these primitive plants". This line of research is also supported by the BMBF, within the Freiburg Initiative for Systems Biology (FRISYS).