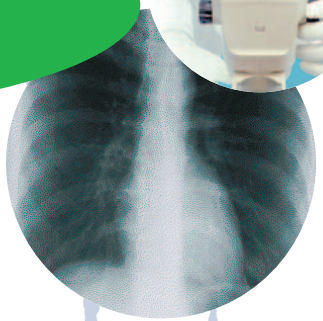
Research



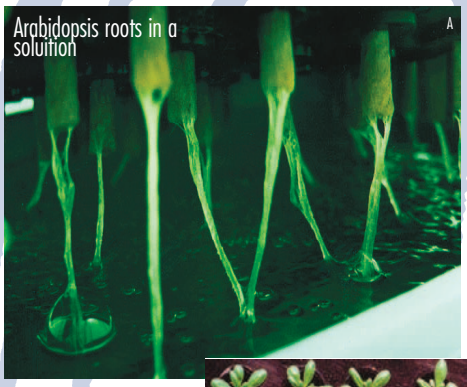
Project

Growing in curves - how Gravity makes Plants bend

Gravity is one of the few constants in the evolution of life on Earth - it is the only force that in the course of history was never subdued to major changes or fluctuations. Therefore, gravitational force played a role in the development of flora and fauna on Earth.

Though obviously, there is a huge difference between animals and plants, they share a broad basis of genetic material related to developmental and physiological processes. This makes plants the perfect research object as for the effects of gravity on living beings: they can't move, the effect of gravity can be more easily monitored. So research in plants is the basis of understanding how gravity is perceived by living beings, and which molecular signaling system constitutes the foundation of this perception. Though it is clear that the gravitational force has a crucial influence on a number of biological processes, little is known about the molecular mechanism with which living beings perceive gravity and about how gravity influences the substances that transmit the information within the organism. To find out more about this mechanism, research was done on Arabidopsis thaliana. This plant was chosen because of its many advantages for large scale molecular research: short generation time, large number of offspring and a small genome make it ideal for research.

> Gravity had a crucial influence on the Development of Life on Earth



Three week old Arabidopsis thaliana grown in solution culture

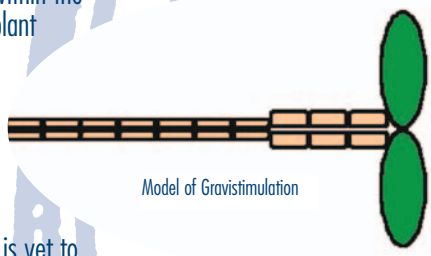
> Auxin controls the plants' curving caused by gravity and light

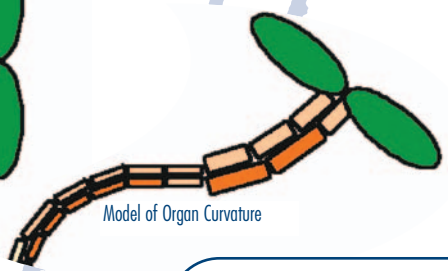
An important 'plant hormone' - Auxin - controls the curving of plants. Light and gravity are the forces that determine in which direction a plant grows. The physical signals of

gravity build up 'messenger substances' - so-called transmitters - and spread them throughout the plant.
Research results show that the plants only curved, if Auxin was clustered in certain regions. The challenge is to identify all of the transmitters, which ship big amounts of Auxin to these regions. One of these transport-substances has been identified already: PIN3. This protein controls the transportation of Auxin out of the side of the plant's cells and therefore is part of the process of curving the plant.
The complete molecular mechanism of the Auxin-transportation - that is: the question how Auxin actually spreads within the plant - is yet to be fully undestood.
Understanding the signal transduction pathways of gravity will provide important markers for breeding. This will also help to improve resistance towards a variety of other environmental factors including touch, light, gradients in temperature, humidity, ions, chemicals, and oxygen. Breeding more resistant varieties of important crops is a priority for agricultural research. To do so, knowing how plants react to gravity is crucial, because plants use it as a cue to orient shoots and roots. Gravity helps them position leaves for maximum light and roots for maximum water and nutrient uptake. Understand how the gravity pathway works, it helps to be able to turn off gravity - and that is something that can only be done for sustained periods in the weightlessness of orbital spaceflight. ■

SPACE RESERACH WILL HELP BREEDING MORE RESISTANT CROPS

One of the advantages of research with Arabidopsis thaliana is the small genome. Here: isolated Arabidopsis chromosomes


Model of Gravistimulation


Model of Organ Curvature

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Photographs:
C: http://mips.gsf.de/proj/thal/ens/index.html
A & B: http://www.og.unr.edu/cramer/hydroponic.html

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