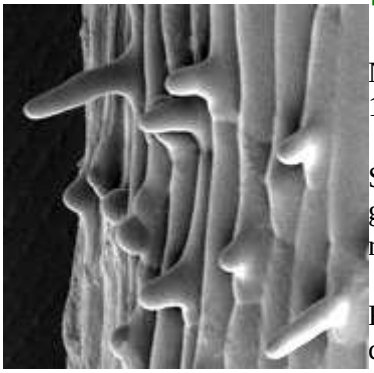
Discovery of the nutrient 'mining machine' in plants



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Scientists from the John Innes Centre and the University of Oxford have discovered which genes control the specialized nutrient mining machine that develops on the surface of plant roots.

Root hairs develop on roots and burrow into the soil releasing acids and other scouring chemicals that crack open rocky minerals releasing valuable nutrients such as iron and phosphate that are necessary for plant growth.

It has long been known that when crops such as barley and wheat are grown on soils containing small amounts of phosphate, those plants with long hairs give higher yields than those with short hairs.

Similarly long-haired beans grown on nutrient poor tropical soils of Central America do much better than short haired varieties.

The mechanism that controls the growth of these nutrient excavating cells has eluded scientists until now. This week a group of UK-based scientists shed light on the mystery in a paper published in Nature Genetics.

They discovered that a master regulatory gene called RSL4 acts like a switch; hair cells grow when the gene is turned on and growth stops when it is off.

When plants grow in conditions where there is insufficient phosphate they develop very long root hairs. This increases the amount of soil from which they can scavenge phosphate.

"When we discovered that RSL4 was a master regulator of hair growth we thought that perhaps the increased growth of root hairs in low phosphate soils might result from turning this gene on," says Professor Liam Dolan, leader of the JIC team that discovered RSL4.

Dolan and co-workers were right. Growing plants in phosphate-poor soils turned the gene on resulting in the growth of very long root hairs. This gene is therefore not only a key growth regulator but also a critical cog in the mechanism plants use to cope with a lack of nutrients.

Given the ability of RSL4 increase root hair growth this discovery has the potential to help breeders develop crops that can grow on poor soils.

Most soils in Australia, extensive regions of sub-Saharan Africa and 30 per cent of China are not productive because plants cannot extract sufficient phosphate and iron form these soils.

"Our hope is that in the future someone will be able to use this gene to develop cultivars which enhance yields on poor soils," says Professor Dolan. "This could have obvious benefits for developing world agriculture. Also as fertilizers become increasingly expensive we will need crops that are more efficient in nutrient uptake. This could have the added benefit of decreasing the amount of polluting phosphate that runs off into rivers and lakes."

"What excites me most about this research is that we set out to answer a fundamental question in biology – how organisms control the size of their cells. In the end we discovered something that could have an important impact on world agriculture".

Background

- Reference: Keke Yi, Benoit Menand, Elizabeth Bell Liam Dolan (2010) A basic-helix-loop-helix transcription factor controls cell growth and size in root hairs. **Nature Genetics** doi:10.1038/ng.529
- The **John Innes Centre**, www.jic.ac.uk, is an independent, world-leading research centre in plant and microbial sciences with over 800 staff. JIC is based on Norwich Research Park and carries out high quality fundamental, strategic and applied research to understand how plants and microbes work at the molecular, cellular and genetic levels. The JIC also trains scientists and students, collaborates with many other research laboratories and communicates its science to end-users and the general public. The JIC is grant-aided by the Biotechnology and Biological Sciences Research Council, www.bbsrc.ac.uk.
- **Intellectual property rights** in the root hair technology are assigned to and the subject of patent applications filed by **Plant Bioscience Limited** (PBL, www.pbltechnology.com). PBL is the IP management and technology transfer company of the John Innes Centre.
- **Future research**: Funding has been awarded under the BBSRC's Follow-on Fund Scheme to enhance nutrient uptake in crop plants such as wheat, oil-seed rape using RSL4. Further funding has been provided by a grant from PBL.

Website: http://www.jic.bbsrc.ac.uk

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