United Kingdom

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Contacts:
Andrew Millar (University of Edinburgh)
Country contact: Ruth Bastow (University of Bristol)
Country contact: Sean May (University of Nottingham)
Email: andrew.millar@ed.ac.uk
ruth@arabidopsis.info
sean@arabidopsis.info

Arabidopsis Research in the UK

Over 300 research groups in the UK utilise the model plant Arabidopsis in their studies. Many of these groups are leaders in their field producing world-class research and publications in high impact journals. Arabidopsis research is largely project-focused, with work based in individual laboratories, multi-institutional collaborations or national Centres and Institutes; the UK also hosts one of the two international Arabidopsis stock centres. Theoretical approaches are receiving increased support, as illustrated by over £30 million investment in major Plant Systems Biology awards since 2005.

New Funding Programmes in the UK

BBSRC

In 2008, the Biotechnology and Biological Science Research Council (BBSRC), the major funder of Arabidopsis research, restructured its process for allocating grants in order to deliver its mission of 'excellence with impact'. There are four new BBSRC committees for UK researchers to apply for funding- A: Animal Systems, Health and Wellbeing; B: Plants, Microbes, Food and Sustainability; C: Technological and Methodological Development; D: Molecules, Cells and Industrial Biotechnology. All four committees will have the same remit of BBSRC research and policy priorities; including several areas that Arabidopsis research is well positioned to address: Bioenergy, Crop Science, Living with Environmental Change, Synthetic Biology and Systems Approaches to Biological Research.

The UK has established a Sustainable Bioenergy Centre; £27 million has been invested by the BBSRC and industry to bring together world-leading scientists and industrialists to make sustainable bioenergy an economically and socially viable alternative to fossil fuels. The Centre aims to address the key barriers to sustainable bioenergy by focusing on six research programmes; perennial bioenergy crops; cell wall sugars; cell wall lignin; lignocellulosic conversion to bioethanol; second generation, sustainable, bacterial biofuels and marine wood borer enzyme discovery. Arabidopsis researchers are involved in a number of these programmes. BBSRC has also launched a new national centre to analyse plant, animal and microbial genomes. The new Genome Analysis Centre (TGAC) will be based in Norwich. http://www.tgac.bbsrc.ac.uk

European Research Area for Plant Genomics (ERA—PG)

The second joint call of the ERA-Net for Plant Genomics (with an approximate budget of 16 Million €) funded 12 collaborative research projects in 2008 from 54 submitted proposals. UK researchers lead 5 of these 12 projects, and all but one involve a UK research group. http://www.erapg.org/everyone

Relevant UK 2008 meetings

- Genetics Society 2008 Arabidopsis Meeting
- GARNet – SEB 2008 Plant Symposium

Awards for Arabidopsis UK researchers in 2008

- Prof. David Baulcombe, University of Cambridge, was awarded the Lasker Prize for basic medical research.
- Prof. Ottoline Leyser, University of York, was awarded a CBE (Commander of the British Empire) in recognition of her pioneering work in plant biology.

Noteworthy breakthroughs published by UK researchers

- Specific targeting of a plasmodesmal protein affecting cell-to-cell communication. Thomas CL, Bayer EM, Ritzenthaler C, Fernandez-Calvino L, Maule AJ. PLoS Biol. 2008 Jan;6(1):e7. Unlike animals plants have to deal with a rigid cell wall, which prevents transport of molecules and communication between cells. To overcome this problem plants create tunnels through the cell wall known as plasmodesmata (PD). The complex nature of PD have made then historically difficult to isolate and characterise. In this paper, UK researchers describe the isolation of a novel class of PD-located proteins (PDLPs) that show class I membrane receptor-like properties. One of these proteins, PDLP1a, is shown to target PD via the secretory pathway and is able to alter cell-to-cell trafficking in GFP diffusion assays. Deletion analysis of PDLP1a shows that the transmembrane domain of PDLP1 is necessary and sufficient for PD targeting. This work represents a huge breakthrough in the search for PD constituents and describes the first identification of a PD localization signal.
- A developmental framework for dissected leaf formation in the Arabidopsis relative Cardamine hirsuta. Barkoulas M, Hay A, Kougioumoutzi E, Tsiantis M. Nat Genet. 2008 Sep; 40(9): 1136-41. This interesting study by a team of scientists at the University of Oxford reveals the power of

comparative analysis. By building on tools and resources regularly exploited in Arabidopsis, UK researchers have helped to develop it's relative Cardamine hirsuta into a powerful model. By utilising forward genetics and transgenic analysis to dissect the differences between the simple leaf shape of Arabidopsis and the compound shape of Cardamine, researchers have revealed that compound leaflet initiation is associated with auxin maxima along the margin of the leaf primordial similar to the process that result in leaf initiation from the shoot apical meristem. This work clearly illustrates how species-specific deployment of fundamental growth pathways can sculpt diverse plant forms.

- The circadian clock in Arabidopsis roots is a simplified slave version of the clock in shoots. James AB, Monreal JA, Nimmo GA, Kelly CL, Herzyk P, Jenkins GI, Nimmo HG. 2008 Dec 19; 322(5909): 1832-5. Researchers at the University of Glasgow have discovered that only a subset of circadian clock genes are rhythmically expressed in roots grown in the dark. Studies in light-grown shoots previously suggested that the properties of the plant circadian clock were cell-autonomous, and the TOC1 protein was considered a „core" clock component. However, TOC1 appears to have no role in the ‚dark root clock'. The researchers also noted that a shoot-root signal was central to the correct timing of the ‚dark root clock' when light dark cycles were applied to the shoot. The shoot-root signal depended on photosynthesis and was affected by exogenous sucrose. This paper illustrates the importance of long-distance metabolic signalling in coordinating plant organ functions.
- DELLAs control plant immune responses by modulating the balance of jasmonic acid and salicylic acid signaling. Navarro L, Bari R, Achard P, Lison P, Nemri A, Harberd NP, Jones JD, Curr Biol 2008 May 18(9): 650-5. Navarro and colleagues have discovered that DELLA proteins control plant immune responses by regulating salicylic acid (SA) and jasmonic acid (JA) dependent defence responses. The Arabidopsis quadruple-della mutant (gai-t6, rga-t2, rgl1-1, rgl2-1) is susceptible to the necrotrophic fungi Alternaria brassicicola and Botrytis cinerea, but more resistant to biotrophic pathogens such as Pseudomonas syringae DC3000 and Hyaloperonospora arabidopsidis. Corresponding activation of marker genes for SA and repression of a marker for the JA pathway, as well as opposite effects on the defence responses for DELLA overexpressors were observed in this paper. The likelihood that GA exerts these responses is reinforced in this work by the investigation of the effects of its exogenous application. This research contributes to understanding the complex mechanisms through which hormone cross-talk is modulated in plant defence and development.