December 2009. Edition 12

GARNish

The official GARNet Newsletter

Plant Phenomics

Also in this issue; Plant Science Education, Tools for Teaching and ELIXIR

Editorial

Welcome to the winter issue of GARNish, the GARNet newsletter. Amongst the numeorus hot topics to warm up your winter readings, this issue features an article on the Australian Plant Phenomics (the genome-wide study of gene dispensability by quantitative analysis of phenotypes) Facility. This is an excellent example of a new cross-institutional facility involving two research centres - The Plant Accelerator at The University of Adelaide, and the High Resolution Plant Phenomics Centre at CSIRO Plant Industry and The Australian National University in Canberra. This article on page 9 highlights the state of the art facilities that are available across the world to relieve the 'phenotyping bottleneck', accelerate plant scientific advances and their application.

In this issue we have an update on ELIXIR, which aims to develop a sustainable infrastructure for biological information in Europe to support life science research and its translation. ELIXIR is currently in the preparatory phase and is funded by the EU. To find out more turn to page 26.

With the continuing aim of ensuring plant science is adequately funded, GARNet recently provided a response to BBSRC'S proposal for a new 5-year strategic plan (2010-2015). The consultation document from the BBSRC set out a range of plans and priorities to strengthen UK future economic competitiveness and address some of the major societal needs such as low carbon solutions to bioenergy and biorenewables, a sustainable food supply and improved health. GARNet's response (summary on page 7) together with others submitted to BBSRC will help to shape the final document prior to its release in late 2009.

Contents

Front cover image kindly supplied by APPF.

Many thanks to all who contributed to this issue, particularly Helli Meinecke, Cath Brooksbank, Mary Williams, Ginny Page, Thorsten Hamann, Anna Amtmann, Andrew Chapple Aurora Levesly and Alessandra Devoto.

If you have any comments about GARNish or if you would like to contribute an article to the next issue please e-mail ruth@arabidopsis.info.

As ever, the GARNet committee is changing. We thank the departing members, Miltos Tsiantis (University of Oxford) and Philip White (SCRI) for their help and support over the last three years. The election for new committee members is currently under way and with 7 excellent candidates to choose from it will be a hard fought contest. In the next issue of GARNish we will introduce the newly elected members and the new chair of the GARNet committee, Alex Webb (University of Cambridge).

Continuing our outreach and education feature, we have an article on the current challenges and opportunities in science education. Plant biology, food production and ecology were the least popular topics amongst A level scientist surveyed recently. To ensure that the next generation of plant scientist actually exists, there is an urgent need to coordinate efforts to increase enthusiasm for, and uptake of, plant science amongst those individuals that are considering a future in bioscience. Details on the action taken by Science and Plants for Schools (SAPS) (funded by the Gatsby Charitable Foundation) to investigate the extent of the deficit in the uptake of plant science in the UK and possible mechanisms to revert this, are outlined on page 4 of this issue.

The spotlight falls in this issue on the excellent research carried out at the University of Glasgow, Imperial College London and the Institute of Food Research. To learn more turn to page 13.

In light of the sad losses of the plant community in 2009, we would like this issue to become a symbolic cenotaph in honour of the lives and brilliant research careers of Professors Mike Gale and Christopher Lamb; two eminent plant scientist who sadly died in 2009.

Last but not least, many thanks to Ruth for being the driving force behind yet another informative and thought-provoking GARNish issue.

Wishing everyone a Merry Christmas and a successful 2010.

Alessandra Devoto

News and Views

Teaching Tools for Plant Biology

The American Society of Plant Biologists has announced the launch of "Teaching Tools in Plant Biology" in its high-impact journal The Plant Cell. Teaching Tools is a monthly, online-only feature of the journal that offers regularly updated sets of teaching materials on important themes in plant biology. Each Teaching Tool includes a short essay introducing the topic, a PowerPoint lecture with notes, and suggested further readings.

Tools will be "off-the-shelf" modules but easily customizable by the instructor. They are designed with an audience of upper-level undergraduates in mind, but subsets of slides can be incorporated into lectures designed for introductory biology courses, public lectures, or even graduate-level courses. Teaching Tools are peer reviewed by leaders in the field and updated as new developments arise. Teaching Tools topics that will be covered over the coming months will include: - Why Study Plants? (October), Leaf Development 1 (November), Leaf Development 2 (December), Epigenetics (January) and The Small RNA World (February).

The first six Tools are free to anyone with access to the internet at http://www.plantcell.org/. Starting in April 2010, Tools will be available only via a subscription to The Plant Cell (www.plantcell.org/subscriptions). Teaching Tools is being developed by Mary Williams.

A new TREE for Plant Science Lectures

Aurora Levesly, Steve Paxton and Celia Knight

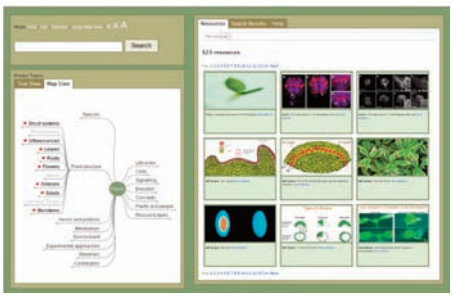
Centre for Plant Sciences, University of Leeds, Leeds, LS2 9JT

Gatsby Plants is set to launch a new plant science teaching resource: the **Gatsby Plants TREE** (**T**eaching tool for **R**esearch **E**ngaged **E**ducation). This new facility will offer plant science educators the ability to browse and search a **hierarchical plant science tree structure** and select dynamic and relevant research-informed teaching slides and movies for their lectures. A key strength of this facility is that it is being developed by the research community - as is evident from the list of contributors. This new teaching tool will also incorporate the popular Gatsby Plants Summer School lectures, which are on-line lectures delivered by leading plant scientists, deliberately pitched at a level to engage and enthuse undergraduates with the emphasis being on scientific thought and the nature of discovery.

The Gatsby Plants TREE builds upon the existing Gatsby Plants Teaching Resource http://www.gatsbyplants.leeds.ac.uk/. Our experience is that most lecturers prefer to make use of individual lecture slides or content, from which they build their own custom made lectures or learning resources, rather than pre-packaged learning materials. The challenge therefore, for this ambitious project, was how to create an interlinked hierarchical structure that would incorporate all aspects of modern plant science to act as a browsable framework for individual lecture slides. In 2009, a small group of research scientists spent a weekend in Derbyshire to crack this problem (see picture). Together the group had expertise in research and in teaching of plant development and all brought along their undergraduate lecture slides. After extensive but enjoyable discussion about how to organise this and other content and how to link the various aspects of plant science, a hierarchical structure emerged.

Left to right: Liam Dolan, Ottoline Leyser, Aurora Levesley, Keith Lindsey, Jane Langdale, Celia Knight, Enrico Coen and Brendan Davies

In Leeds, the Gatsby Plants team set about refining and converting this hierachical structure into a user friendly, easily updateable and accessible on-line resource. The structure is by no means exhaustive yet, but forms an extensive initial framework for content. In the next phase of development of the resource, Gatsby Plants will be approaching other research experts to expand the content and further develop the TREE structure.



Screen shot of The Gatsby Plants TREE

The Gatsby Plants TREE will be launched in January, all content will be high quality examples of teaching slides contributed by researchers and copyright cleared for educational use. For more information please visit: http://www.gatsbyplants.leeds.ac.uk/tree/

The Gatsby Plants teaching resource is funded by the Gatsby Charitable Foundation and access to its resources is password protected but free to lecturers.

Plant Science – The Next Generation
Challenges and opportunities in science education

Ginny Page, Science and Plants for Schools (SAPS), UK
http://www.saps.org.uk

In 2008 the Gatsby Charitable Foundation commissioned a team from the University of Warwick to investigate the extent to which there was a shortfall in the uptake of plant science in the UK. The investigators sought both quantitative and qualitative evidence from secondary school through undergraduate degrees to research institutes. They concluded that plant science research in the UK is surviving but vulnerable due to a lack of interest from the next generation and a minority position within university research departments.

Science as a subject is often reported as being unpopular among young people in the UK when compared to other countries, despite their relatively high achievement in it. Within biology, some topics are more unpopular than others - plant biology, food production and ecology being bottom of the heap with A level students when questioned a few years ago. But if we are still producing adequate plant science researchers at the end of the day, does it matter what teenagers think?

The Warwick investigators warned that there are concerns regarding the capacity of the UK to respond to an increased demand for qualified plant scientists. New facilities like the Sainsbury Laboratory being built in the grounds of Cambridge University Botanic Garden create ongoing demand for world-class talent in plant science. Pressing environmental and global challenges like food security need the contributions not only of plant science researchers, but also politicians, lawyers, journalists, farmers, manufacturers, patent officers, managers, technicians, teachers and many others to assist in the generation and application of relevant scientific knowledge.

What can be done? The Warwick report makes a number of recommendations, including further investment in programmes and resources for plant biology education at all levels in schools and colleges. Also recommended are actions to develop and sustain better links between the plant science community and the education system; directly with schools through established programmes; with organisations like the Science Learning Centres who train and develop science teachers; and with agencies who develop curricula and qualifications. More broadly, the report recommends ‘a significant effort should be made to raise public awareness about the vital role of plants and plant science in relation to the major challenges facing human populations’.

The next generation of scientists able to further our understanding of plants and their role in securing a healthy future for humanity will certainly not appear automatically. Student feedback from the Gatsby Plants Summer Schools for end of first year undergraduates shows that the school curriculum simply does not make them aware of the importance and potential of plant science. We need talented teachers, an engaging curriculum, relevant qualifications, and opportunities for all young people to be fascinated by plants and excited by plant science. We must not let plants be the bit of biology dismissed as boring or irrelevant - there is no excuse for science education which actively turns young people off plant science. We should promote the value of plants and instil an enthusiasm for plant science, particularly in those who are considering a future in the biosciences. This is what Science and Plants for Schools (SAPS) aims to help achieve, alongside Gatsby Plants, and in partnership with other individuals, organisations and institutions who share this mission.

If you want to be involved, there is a lot you can do. Find out if your university or workplace already has schemes which engage students and teachers, maybe through an outreach, school liaison or widening participation officer, as you may be able to join in. If not, look to national schemes such as Researchers in Residence or STEM Ambassadors. Maybe your funder offers advice on working with schools and colleges, or you could let your professional body know you want to support their education work? Consider offering a project to a keen teenager through the Nuffield Bursaries for Schools and Colleges scheme, or getting involved in National Science and Engineering Week. If you think you have the science X-Factor you could enter the Famelab competition! Maybe you have your own ideas, or would prefer to support schools more indirectly by contributing to the development of educational activities and resources. SAPS welcomes the interest and suggestions of all plant scientists, so feel free to contact us (saps@botanic.cam.ac.uk).

The Science and Plants for Schools (SAPS) programme (www.saps.org.uk) and Gatsby Plants programme (http://www.gatsbyplants.leeds.ac.uk/) are funded by the Gatsby Charitable Foundation.

Plant Science – The Next Generation
Challenges and opportunities in science education

For more information

BBSRC Local School Co-ordinators	www.bbsrc.ac.uk/society/schools/coordinators.html
Researchers in Residence	www.researchersinresidence.ac.uk
STEM Ambassadors	www.stemnet.org.uk/ambassadors.cfm
Nuffield Bursaries for Schools and Colleges	www.nuffieldfoundation.org/scb
National Science and Engineering Week	www.britishscienceassociation.org/web/NSEW/index.htm
Famelab	www.famelab.org/

References

1. Stagg,P., Wahlberg, M., Laczik, A. and Huddlestone, P. (2009) The Uptake of Plant Sciences in the UK – A Research Project for the Gatsby Charitable Foundation by the Centre for Education and Industry, University of Warwick.
2. Stagg P, Stanley J, Leisten R (2004) Life Study: Biology A Level in the 21st Century, The Wellcome Trust.

International Conference on Arabidopsis Research - ICAR 2010

We are pleased to announce that the 21st International Conference on Arabidopsis Research (ICAR 2010) will be held on June 6 – June 10, 2010 in Yokohama, Japan. Arabidopsis research has provided many breakthroughs in plant science in the last decade. The ICAR 2010 will highlight recent advances in Arabidopsis research and its translational using crops and trees.

Confirmed speakers include :- Kathie Barton, David Baulcombe, Phiip Benfey, Michael Bevan, Joe Ecker, Dirk Inzé, Tetsuji Kakutani, Steve Kay, Maarten Koornneef, Cris Kuhlemeier, Chentao Lin, Olivier Loudet, Makoto Matsuoka, Peter McCourt, Elliot Meyerowitz, Seung Yon Rhee, Kazuki Saito, Satoshi Tabata, Keiko Torii, Detlef Weigel, Shinjiro Yamaguchi, and Qifa Zhang

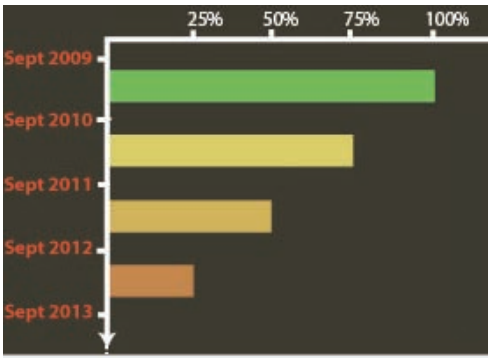
Early-bird Registration starts on December 1, 2009. For a programme and to register visit http://arabidopsis2010.psc.riken.jp/.

A series of workshops will be organized within, or as satellites to ICAR. A workshop on 'Inference and modelling of regulatory networks in multicellular systems' will be held at RIKEN Plant Science Center, Yokohama. The principal aim of the workshop is to explore the problems that must be overcome in modelling and inference for multicellular systems. Invited contributions will include examples of successful studies in this area (for example, in inferring and analyzing the transcriptional network underlying early segmentation in the Drosophila embryo) and details of emerging methodologies in inference and modelling. This is funded by BBSRC and Tokyo Embassy. Be alert for details soon to be released via the ICAR website.

Funding for TAIR to be removed by 2014

The US National Science Foundation (NSF) has funded the Arabidopsis Information Resource (TAIR) since its inception 10 years ago. However, funding by the NSF is being phased out over the next 4 yrs. In 2010 TAIR will receive 100% funding, 75% in 2011, 50% in 2012, 25% in 2013, and 0% 2014. TAIR is requesting users to express their views on the plight TAIR via the TAIR website http://www.arabidopsis.org/doc/about/tair_funding/410.

The Multinational Arabidopsis Steering Committee (MASC), which will be coordinated by the UK until 2012, will be holding a series of workshops in 2010 to assess the informatics needs of the Arabidopsis community and find potential solutions for these needs. It is hoped the outcomes from these workshops will be presented at ICAR 2010 in Yokohama, Japn.



Graph representing TAIR funding until 2014

PRAGUE 2010

THE SOCIETY FOR EXPERIMENTAL BIOLOGY

30th June - 3rd July 2010

www.sebiology.org

PLANT SESSIONS

Ubiquitin and plant cell signalling
Organised by: Ari Sadanandom (University of Glasgow)
Speakers: Andreas Bachmair (Max Planck Institute)
Malcolm Bennett (University of Nottingham)
Pascal Genschik (CNRS, Strasbourg)
Mike Hasegawa (Purdue University)
Richard Napier (Warwick University)
Claus Schwechheimer (Universität Tübingen)
Richard Vierstra (University of Wisconsin-Madison)

Redox regulation and associated signalling in photosynthesis and respiration
Organised by: John Allen (Queen Mary University, London)
Christine Foyer (University of Leeds)
Speakers: John Allen (Queen Mary University, London)
Jean Greenberg (University of Chicago)
Stanislaw Karpinski (Stockholm University)
Graham Noctor (Université de Paris sud XI)
Thomas Pfannschmidt (University of Jena)
Anna Rychter (University of Warsaw)
James Whelan (University of Western Australia)

Plant Temperature Response Networks
Organised by: Kerry Franklin (University of Leicester)
Heather Knight (Durham University)
Speakers: Patrick Achard (Institut de Biologie Moléculaire des Plantes)
Steven Penfield (University of York)
Michael Thomashow (Michigan State University)
Philip Wigge (John Innes Centre)

Small GTPases, their regulators and effectors
Organised by: Ian Moore (Oxford University)
Viktor Žárský (Charles University Prague)
Speakers: Wei Guo (University of Pennsylvania)
Suzanne Pfeffer (Stanford University)
Marino Zerial (MPI Dresden)

Plant Responses to Belowground Stresses
Organised by: Glyn Bengough (SCRI)
Philip White (SCRI)
Speakers: Glyn Bengough (SCRI)
Tim Colmer (University of Western Australia)
Robert B. Jackson (Duke University)
Alexander Lux (Comenius University)
Loïc Pagès (INRA Avignon)
Peter Ryan (CSIRO)
Eric Visser (Radboud University Nijmegen)
Philip White (SCRI)

DNA Repair and Recombination
Organised by: Karel Angelis (Institute of Experimental Botany, Czech Republic)
Andy Cuming (University of Leeds)
Speakers: Chris Franklin (University of Birmingham)
Michael Lisby (University of Copenhagen)
Holger Puchta (Universität Karlsruhe)
Karel Riha (Gregor Medel Institute)
Stephen C. West (Cancer Research)
Charles White (Clermont Université)

Alternative Splicing and its Impact on Gene Regulation in Plants
Organised by: Andrea Barta (Max F Perutz Laboratories)
John Brown (SCRI)
Artur Jarmolowski (Adam Mickiewicz University)
Speakers: Brad Barbazuk (University of Florida-Gainesville)
Anireddy Reddy (Colorado State University)
Motoaki Seki (RIKEN Plant Science Centre)
Gordon Simpson (University of Dundee)
Chris Smith (Cambridge University)
Andreas Wachter (University of Tübingen)

Carbon Assimilation under Drought
Organised by: Martin Parry (Rothamsted Research)
Christine Raines (University of Essex)

Young Scientists in Plant biology
Organised by: Christine Raines (University of Essex)

CELL SESSIONS

Polar adaptations and challenges
Organised by: Simon Morely (British Antarctic Survey)
Hans-Otto Pörtner (Alfred Wegener Institute)
Lloyd Peck (British Antarctic Survey)
Speakers: Christina Cheng (University of Illinois)
Pete Convey (British Antarctic Survey)
Bill Davison (University of Canterbury, NZ)

Molecular Biology of Thermal adaptation
Organised by: Melody Clark (British Antarctic Survey)
Magnus Lucassen (Alfred Wegener Institute)
Speakers: Gretchen Hofmann (University of California, Santa Barbara)
Volker Loeschcke (Aarhus University)

The plant cell cycle and its interaction with plant hormones
Organised by: John Bryant (University of Exeter)
Dennis Francis (Cardiff University)
Helena Lipavska (Charles University Prague)
Speakers: Christian Chevalier (INRA)
Marina Dermastia (Czech National Institute of Biology)
Dénes Dudits (Hungarian Academy of Sciences)
Pascal Genschik (CNRS)
Helena Lipavska (Charles University Prague)
Janusz Maszewski (University of Łódz)
Jim Murray (Cardiff University)
Bill Thompson (University of North Carolina, Raleigh)
Alicja Ziemienowicz (University of Lethbridge, Alberta)

Immunity across the kingdoms
Organised by: Adam Benham (Durham University)
Speakers: Thomas Boehm (Max Planck Institute)
Jonathan Jones (Sainsbury Lab)
Pete Kaiser (Compton Institute of Animal Health)
Jim Kaufman (Cambridge University)

Plant Cell Biology
Organised by: Patrick Hussey (Durham University)
Speakers: Gero Steinburg (University of Exeter)
Nick Talbot (University of Exeter)

Chromosome Organization and Cytogenomics
Organised by: Jaroslav Dolezel (Inst. Of Exp. Botany, Czech Republic)
Trude Schwarzacher (University of Leicester)
Speakers: Raquel Chaves (Institute for Biotechnology and Bioengineering)
Thomas Cremer (Ludwig Maximilian University, Munich)
Paul F. Fransz (University of Amsterdam)
Andreas Houben (Leibniz Institute of Plant Genetics)
Andrew Leitch (Queen Mary, University of London)
Jiri Macas (Biology Centre ASCR)
Jennifer A. Marshall Graves (The Australian National University)
Mirislav Plohl (Ruder Boskovic Institute)
Boris Vyskot (Czech Academy of Sciences)

Plant and Animal Circadian Clocks
Organised by: Hugh Piggins (University of Manchester)
Alex Webb (Cambridge University)

General Thermal Biology
Organised by: Hans-Otto Pörtner (Alfred Wegener University)

BBSRC Strategic Plan 2010-2015

This Summer BBSRC launched a consultation of their proposed strategic plan for 2010 - 2015. BBSRC prepared a 25 page document summarising the proposed Strategic Plan. Interested parties were asked to reply with written responses to a series of questions. This is a short summary of the essential features of the GARNet response.

Strategic Priorities

BBSRC proposed three new strategic priorities, "Bioenergy and Biorenwables", "Food Security" and "Bioscience for Health". These priorities will be supported by five enabling themes "Integrative and Systems Biology", "Exploiting Big Data", "Tools Technologies and Facilities", "Translation, Innovation and Skills" and "National and International Partnerships". GARNet welcomed the strategic themes, though considered that less emphasis should be placed on "Bioscience for Health" because a range of agencies already funds this area. GARNet emphasized that plant science receives considerably less funding (and has fewer funding sources), yet is being asked to tackle problems of greater scale to those being faced by the medical community. GARNet suggested that one possible mechanism for providing additional investment into plant science would be to make plant science research VAT exempt. To ensure the UK is internationally competitive in areas such as food security and bioenergy, GARNet stressed the need for reestablishment of the UK's plant breeding capability, genetic resources, the crop science and agronomy skills base, the application of next generation sequencing technologies and the promotion of collaborations between UK researchers and international plant breeding companies. The response from GARNet also highlighted that the generation of an efficient pipeline from high quality research to practical output is a substantial challenge requiring large financial investment from BBSRC and others. Food security is a global challenge requiring solutions that are larger in scale than can be addressed by a single country. Given the urgent need to increase food supply, GARNet would advise that BBSRC does not support bioenergy and biorenewables research where impact would depend ultimately on taking significant areas of arable land out of food production.

GARNet welcomed BBSRC's broadening the impact of its science to the economy, society and knowledge. However, GARNet emphasized the need to educate the user community as to the meaning of 'impact', and that assessment models will need to focus on broader measures of impact than just scientific publication. GARNet recommend that BBSRC include the inherent cultural value of scientific endeavour and understanding to the listed outcomes. GARNet welcomed BBSRC's focus on areas where it can have most impact due to constraints in public funding. Funding constraints will be compounded by the increasing costs of "big data, systems biology".

GARNet supports a focus on responsive mode funding. GARNet recommended that BBSRC develop an effective strategy to fund multidisciplinary grant applications and increase the diversity of its portfolio by enabling small-scale projects (e.g. to support people not trained to postdoctoral level or equipment only).

GARNet considered that the following areas should be also supported to meet the strategic remit; maintaining and increasing the UK's strong basic plant science, combating pests and diseases, supporting pollinators, maintaining soil function, minimising agricultural inputs and accelerating translation of research into practice.

Five enabling themes

GARNet supports the five enabling themes. However, there will be substantial components of the three strategic priorities, which do not fit into these five themes and other approaches will be equally likely to achieve excellence with impact.

Tools, Resources and Resources - Focus should be placed on creating resources that are accessible to the whole research community. Coordination of funding should be at international level. A coherent relationship with DEFRA is critical. If the potential of 'big data and predictive science' is to be realised, then informatics and data management solutions such as 'omics' integration, standards and archives for data and models must be addressed at the national and international level. Increasing sequence information has to be accompanied by increases in high-throughput quantitative phenotyping requiring expansion of controlled growth space.

Integrative and systems biology - A major impediment to systems approaches is that the function of only 10% of genes in Arabidopsis has been demonstrated experimentally. Fundamental curiosity driven research will be essential to elucidate the function of all genes and should therefore be included as a central underpinning component of systems research.

Exploiting 'big data' - International co-ordination will be required to ensure there is open and timely access to data generated across the globe.

Translation, innovation and skills - BBSRC needs to clarify the role(s) of the individual, the PI and the institution in graduate and postgraduate training and how this will be funded. GARNet welcomes the Concordat as a positive move in this direction. GARNet emphasized the problems of broader training due to a lack of UK industrial partners and the constraints of project-based funding mechanisms.

Partnerships - New mechanisms for international funding need to be investigated and joint funding programmes broadened to ensure that BBSRC gains the best value from its investment. Internationally, BBSRC should seek to lead the setting of research priorities.

Outcomes and Impact - GARNet supports the use of a broad range of metrics to assess impact and recognises that assessment might vary between institutions of different types.

The Australian Plant Phenomics Facility – New opportunities for plant scientists worldwide

Mark Tester[1], Robert Furbank[2] and Helli Meinecke[1]
1 The Plant Accelerator, University of Adelaide, SA 2 High Resolution Plant Phenomics Centre, CSIRO Plant Industry, Canberra, ACT
http://www.plantphenomics.org.au/

Improvement of crops must be accelerated - crops that are higher quality, more disease resistant and productive in marginal conditions. To achieve this quickly requires a new capability in plant phenomics. Australia has traditionally excelled in plant physiology, crop genetics and breeding, but only limited efforts had been made to bring together these fields of expertise.

To address this weakness, the Australian Plant Phenomics Facility (APPF), a new cross-institutional facility has been established. This involves two quite different, but highly complementary, research centres - The Plant Accelerator at The University of Adelaide, and the High Resolution Plant Phenomics Centre (HRPPC) at CSIRO Plant Industry and The Australian National University in Canberra.

The objective is for the two nodes to provide state-of-the-art capabilities for plant phenotyping, with controlled environments and field-based plant growth monitoring, using high throughput robotics, automated imaging and computing technologies. These are integrated with the ongoing adaptation and application of emerging phenomics measurement technologies. The APPF headquarters is based at The Plant Accelerator.

The scheme is funded by the Federal Government, together with local Government and host institution support. So far, over $50m has gone into the Facility. This large investment was initiated after a review of scientific infrastructure needs in Australia identified a requirement for more focused plant research infrastructure and collaboration across scientific disciplines. It found that existing organisations have highly variable, and generally low quality, infrastructure dedicated to the growth of experimental plants within conventional glasshouses and plant growth cabinets. There are pockets of high-level capability, but they are distributed around the country in a series of unconnected plant breeding and research programs. The Australian Plant Phenomics Facility provides the opportunity to significantly increase plant science research in Australia, providing the chance to bring together genetics and physiology to open new areas of research and accelerate progress in established areas. Importantly, the facilities are also available for use by international researchers and for-profit companies.

What is Phenomics?

Phenomics is the field of study concerned with the characterisation of phenotypes as a whole (the “phenome”). The suffix “-omics” is used by a wide array of other large-scale quantitative biology fields, and commonly involves high throughput technologies.

A phenotype is any observable characteristic or trait of an organism such as its morphology, development, biochemical or physiological properties, or behaviour.

Phenotypes result from the expression of an organism’s genes as well as the influence of environmental factors and possible interactions between the two.

Phenomics enables researchers to understand and relate the performance of particular plants with their genetic make-up, resulting in the ability to accelerate progress in improving crops – generating crops that are more productive, disease tolerant and viable on marginal soils.

Phenomics improves our genetic understanding of yield, and increases a breeder’s confidence in selecting new and improved breeding lines. It is an emerging area of plant science, which we hope will contribute not only to basic plant science but also to its applied outputs.

Why Phenomics?

The need to increase global food production has never been more critical. Current UN forecasts estimate world output will need to double by 2050. With most arable land already being farmed and climate change threatening existing agriculture, the challenge is massive.

Australia faces its own unique issues with long periods of drought and increasing salinity undermining farm productivity. Substantial government and industry investments in recent years have enabled Australia to make numerous advances in plant genomics and modern breeding technologies. Globally the stage has been reached where every crop plant genome is likely to have been sequenced within 10 years.

The Australian Plant Phenomics Facility – New opportunities for plant scientists worldwide

But science has hit a bottleneck in its ability to understand and relate the performance of particular plants with their genetic make-up. Progress on translating the huge database of genome knowledge into improved agricultural products has fallen behind. We are able to study genes and manipulate them, but the study of processes at the level of the whole plant has not been able to keep pace with these advances. As a result we are falling behind in our ability to measure the effects and consequences of those manipulations. This is termed the 'phenotyping bottleneck'. Relieving this bottleneck could significantly accelerate plant scientific advances and their application, as described in the recent article on plant phenomics by Elizabeth Finkel (2009: Science 325: 380-381). The opportunity to relieve this bottleneck is available due to rapid advances in imaging technology, robotic handling and cheap, powerful computers.

1st International Plant Phenomics Symposium

The Canberra node of the APPF organised the 1st International Plant Phenomics Symposium, which was held on 22-24 April 2009. The symposium was a timely meeting of plant biologists focused on using plant phenomics and functional genomics to address crop productivity.

The Symposium was attended by 128 registrants (including 46 international participants). Registrants came from all the major phenomics centres, including the Director of the Scottish Crops Research Institute, Dundee, Scotland; the Director of Phytosphere and the Deputy Head of the Forschungszentrum Jülich, Germany; as well as researchers from the University of Sheffield, Sheffield, UK; New York University, New York, USA; University of Dundee, Dundee, Scotland; Washington State University, Washington, USA; and Stanford University, Stanford, USA. There were also presentations and representation by commercial groups, including Monsanto, Bayer Crop Science and BASF / Crop Design.

The geographic spread of plant scientists underscored the level of global interest in plant phenomics as a source of techniques for the better understanding of plant growth, performance and yield at the whole plant and population level. It was evident from presentations by extant and prospective plant phenomics centres (http://www.plantphenomics.com/partners/) in the UK, Europe and America that the levels of investment taking place are very high.

Nonetheless, the Australian Plant Phenomics Facility is acknowledged to be at the cutting edge in many ways, and to be taking a leadership role in encouraging collaboration.

The Symposium was structured to reflect scientific questions the technology addresses, with sessions on biotic stress (including fungal pathogens), abiotic stress (including screening for drought tolerance), growth and yield, ecosystem dynamics and climate change. Papers covered the range of techniques used in phenotyping – including visible and hyperspectral imaging for growth and disease analysis, chlorophyll fluorescence imaging,iInfra-red thermography screening, and the use of radar reflectance to study soil and roots and others. These will be published in a special issue of Functional Plant Biology (http://www.publish.csiro.au/nid/102.htm)

Looking to the future, it was agreed at the Symposium that a stronger vehicle for international collaboration should be established – and the International Plant Phenomics Initiative (http://www.plantphenomics.com/) was launched. The Initiative will, over the coming months, develop an agenda and confirm priorities and actions at a meeting later in 2009. The agenda will likely include exchanging protocols, validating systems, exchanging staff for technical education and developing collaborative funding bids. The initiative is being led by the Forschungszentrum Jülich and the Australian Plant Phenomics Facility.

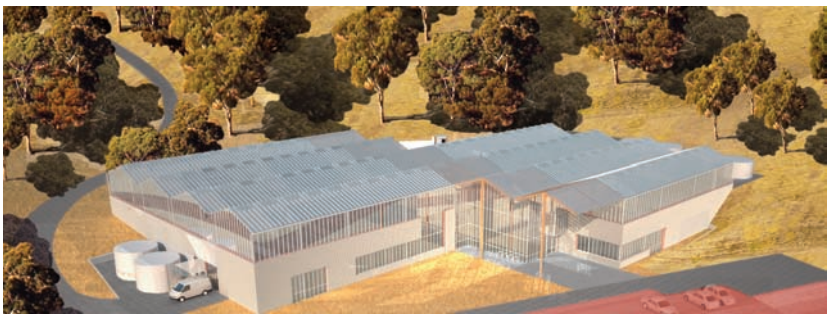
There was significant industry and commercial support and sponsorship. Official proceedings were launched by David Papps, Chief Executive of the ACT's Department of Environment, Climate Change, Energy and Water, on behalf of the ACT Government, a major supporter of the APPF and the Symposium.

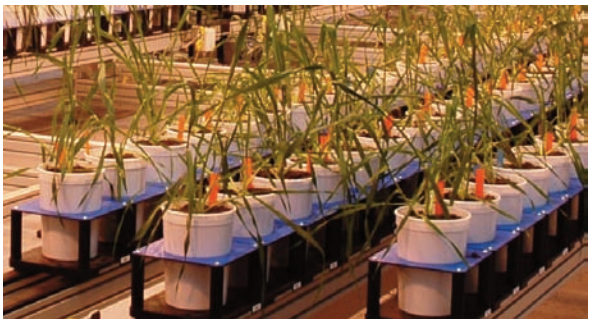
The Australian Plant Phenomics Facility - New opportunities for plant scientists worldwide

About the Australian Plant Phenomics Facility (APPF)
The APPF has two nodes, The Plant Accelerator at the University of Adelaide and the High Resolution Plant Phenomics Centre (HRPPC) at CSIRO Plant Industry and the Australian National University in Canberra.

The Plant Accelerator – Adelaide
The Plant Accelerator (http://www.plantaccelerator.org.au/) is headquarters of the APPF and is located at the University of Adelaide's Waite Campus. The Plant Accelerator is a purpose built plant phenomics facility, which offers a range of greenhouses, high-throughput imaging stations, growth rooms, laboratories and seed storage space. Its double glazed UV permeable acrylic skin provides good insulation properties and allows for UV penetration. The facility offers:

- A range of controlled growth environments in new, high quality facilities.
- Over 1 km of conveyors delivering radio-tagged plants automatically to state-of-the art imaging stations controlled by high capacity computing equipment.
- Equipment to image shoots in visible, near-infrared and far infrared spectra.
- Equipment for fluorescence imaging of shoots.
- Equipment to allow near-infrared imaging of pots to obtain a measure of water content in the soil.
- Automatic programmable watering to weight of plants on the conveyor system.
- Dedicated bioinformatics support to help manage and analyse data.

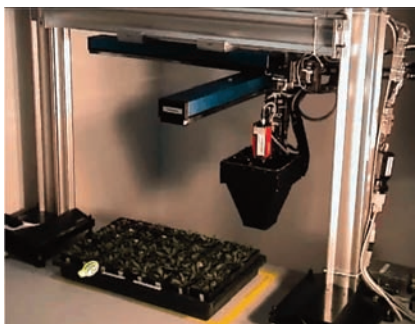




The Plant Accelerator will open its doors in January 2010 and will be available for Australian and overseas researchers undertaking public-good research as well as commercial organisations. View our brochure (http://www.plantaccelerator.org.au/about/TPAbrochure.pdf).

HRPPC – Canberra
The High Resolution Plant Phenomics Centre (HRPPC) (http://www.plantphenomics.org.au/HRPPC) is located in Canberra at CSIRO Plant Industry and the Australian National University. This Centre focuses on "deep phenotyping" (delving into metabolism and physiological processes within the plant), in both controlled environments and in the field, and Reverse Phenomics (dissecting traits to discover their mechanistic basis).

Next generation research tools are being developed and applied to probe plant function and performance at medium and high throughput, under growth cabinet conditions and at managed field sites. It is also intended to deploy new technologies developed at the HRPPC in The Plant Accelerator.



Recent advances in robotics, imaging and computing are used in applying these technologies and scaling them from the single plant to the ecosystem level. Two levels of service are provided in the HRPPC.

First, projects can be housed in the "Research Hotel" environment where screening systems can be developed using facility staff and resources then deployed in the facility and in the user's home institution.
Second, users' material can be screened for specific attributes using one or more of the modules housed at CSIRO or the ANU. This node of the facility focuses on flexibility from cereals to dicots and woody perennials at all stages of development.

The HRPPC opened in July 2009 and welcomes Australian and overseas researchers undertaking public-good research as well as commercial organisations.

For further information about both facilities please visit http://www.plantphenomics.org.au/

Fifth epso Conference

Plants for Life

Olos (Lapland), Finland

18-22 April 2010

Plant science in Europe and beyond - Science policy

Science and society

Food security and safety – challenges ahead

Achieving sustainability

Crop genomes for sustainable agriculture
Breeding tools and strategies

Achieving quality

From plant architecture to traits
From photosynthesis to solar fuels
Tree biology for multiple uses
From metabolites and recombinant proteins to plant-made-pharmaceuticals
Plants with improved nutritional quality and value

Strengthening the functioning of ecosystems

Plant health
Climate change and plant production
Climate, Ecosystems and Genomics
Biodiversity

Confirmed speakers

James Barber, Pascal Bergeret, Michael Bevan, Wout Boerjan, Jörg Bohlmann, Thomas Boller, Paula Bramel, Barbara Burlingame, Reinhart Ceulemans, Paul Christou, Philippe Ciais, Thierry de l'Escaille, Jean-Christophe Glaszmann, Wilhelm Gruissem, Timothy Hall, Richard Hobbs, Jaana Husu-Kallio, Dirk Inzé, Stefan Jansson, Jonathan Jones, Cris Kuhlemeier, Jane Langdale, Leena Manonnen, Stephen Mayfield, Jenny McElwain, Karin Metzlaff, Theo Meuwissen, Franco Miglietta, Maurice Moloney,Kirsi-Marja Oksman-Caldentey, Riita Puupponen-Pimiä, Bill Rutherford, Kazuki Saito, Bernhard Schmid, Ulrich Schurr, Anker Sørensen, Eva Stöger, Chiara Tonelli, Jan Traas, Gerald Tuskan, Robbie Waugh, Tom Whitham, Rod Wing, Ian Woodward, Dani Zamir

Coordinators: Karin Metzlaff, EPSO and Kirsi-Marja Oksman-Caldentey, VTT, Finland

Information and registration at www.epsoweb.org

21ST INTERNATIONAL CONFERENCE ON ARABIDOPSIS RESEARCH

"2010 and beyond"

June 6-10, 2010
Pacifico Yokohama
Yokohama, Japan

Early Registration Deadline: March 3, 2010

KEYNOTE SPEAKERS

Maarten Koornneef and Elliot Meyerowitz

PLENARY SPEAKERS

Motoyuki Ashikari, Kathryn Barton, David Baulcombe, Philip Benfey, Michael Bevan, Joseph Ecker, Ikuko Hara-Nishimura, Inhwan Hwang, Koh Iba, Dirk Inzé, Tetsuji Kakutani, Steve Kay, Cris Kuhlemeier, Chentao Lin, Olivier Loudet, Makoto Matsuoka, Peter McCourt, Seung Yon Rhee, Kazuki Saito, Satoshi Tabata, Keiko Torii, Detlef Weigel, Shinjiro Yamaguchi, Qifa Zhang

ORGANIZING COMMITTEE

Kazuo Shinozaki and Kiyotaka Okada (Co-Chairs)

http://arabidopsis2010.psc.riken.jp/

UK Plant Science

There are over 350 plant research groups in the UK, in 42 institutions scattered from Aberdeen to Exeter. Many of these groups are international leaders in their field. To promote the breadth of plant science throughout the UK, and increase awareness of the different types of research being undertaken, GARNet is focusing on geographical areas and institutions across the UK. In this issue we continue our tour around the country highlighting the outstanding research being undertaken at the University of Glasgow, Imperial College London and the Institute of Food Research.

Spotlight on the University of Glasgow

UNIVERSITY of GLASGOW

A major challenge for mankind in this century will be to obtain enough food and energy under the constraints of global and regional climate conditions and a growing population. Sustainable increase in crop yield requires the concerted effort of plant scientists and breeders to identify and exploit the inherent mechanisms that plants possess to cope with abiotic and biotic stress for improving crop performance under suboptimal conditions of light, water, temperature, nutrients, pollutants and diseases. Plant science at Glasgow University reflects this spectrum of endeavor and employs a wide range of experimental approaches. Most of the over 50 active scientists are housed in the newly refurbished Bower Building which is equipped with state-of-the art facilities for molecular and cell biology, biochemistry and physiology. Research is supported by the EU, UK research councils, trusts, charities and industry.

Name Anna Amtmann
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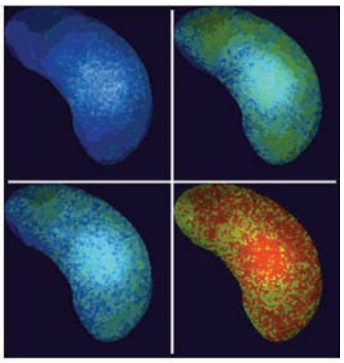
Research Area Plant adaptation to salt and nutrient stress

Research Activities

Too much salt (Na) and too little potassium (K) are common problems in human and plant nutrition. K is an essential macronutrient for plants whereas Na, similar to K in size and charge, is potentially toxic. The Amtmann lab investigates how the ions enter plant cells and how plants discriminate between them. Biophysical methods (voltage clamp and radiotracer studies) are employed to measure the relative ion selectivity of different ion channel proteins in roots and leaves of barley, the model plant Arabidopsis and its salt-tolerant relative Thellungiella (salt cress). Comparison of microscopic ion fluxes (in the range of pico-Amperes) with whole-plant ion content has led to new insights into the role of specific ion transporters in plant growth and stress resistance. The group is now investigating whether structural (epigenetic) modifications of DNA and chromatin can explain the observed differences in the expression of salt-stress responsive genes in different species and conditions. In a separate line of research the Amtmann lab has employed 'omics' and robotic approaches to correlate transcript and metabolite levels with enzymatic activities. These studies have identified several molecular components that link plant K status with specific metabolic pathways. Recently the group developed EZ-Rhizo, a computer program that automatically detects roots and quantifies their development in space and time. The software is now used to investigate the variation of root system architecture in different genotypes and environments.



Name Mike Blatt
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Research Area Membrane transport and trafficking

Research Activities

Mike Blatt's laboratory follows the related themes of membrane biophysics and cell signalling in plants. Mike has a long-standing interest in stomatal guard cells and much of his work these past 25 years has addressed their mechanisms for controlling water use by the plant. With the ever-growing pressure on the use of water resources around the world, this knowledge is now of vital importance. Mike is also quick to point out that guard cells are one of the best-characterized plant cell models for studies of membrane transport and signalling. His work contributed significantly in establishing the guard cell as the premier cell model it is today. The Blatt laboratory is currently using systems modelling and single-cell recordings to explore emergent behaviours in membrane transport and understand how plants control their use of water as well as offering a new handle on some fundamental, and very old problems. The group also focuses on membrane vesicle trafficking, following the discovery of a trafficking (so-called SNARE) protein associated with water-stress and ion channel regulation by the hormone abscisic acid. Recent studies have shown that the SNARE binds directly with K+ channels, altering channel gating. These SNARE-channel interactions demonstrably affect K+ uptake and growth in Arabidopsis, suggesting an evolutionary adaptation as a 'molecular governor' analogous to the mechanical invention of James Watt. A significant challenge now lies in characterising this function in vesicle traffic as well as K+ transport, and its impact on water and nutrient balance.

Spotlight on the University of Glasgow

Name John Christie
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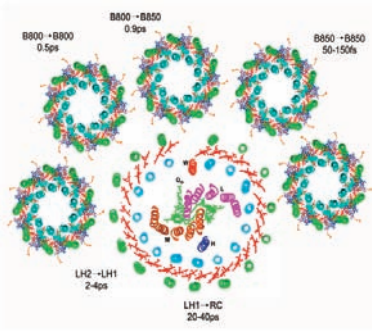
Research Area Photoreceptor function and application

Research Activities

Solar radiation is arguably the single most important environmental factor for life and directs the development, morphogenesis and physiology of plants as well as animals and microorganisms. In addition to its role as an energy source for photosynthesis, sunlight controls plant growth, affects root orientation in soils and determines flowering and life cycles of the most evolutionarily primitive to the most advanced plant species. Consequently, plants have evolved a suite of photosensory mechanisms to detect and respond to changes in light intensity, quality, direction and duration. Research in the Christie lab is focused on understanding the mechanism of action of a set of photoreceptor kinases known as the phototropins. In plants they play pivotal roles in controlling photosynthetic light capture, protecting against photolytic damage and in developmental processes including phototropism and solar tracking. Understanding how light activates these kinases and elucidating their cellular signalling mechanisms will ultimately provide avenues for manipulating plant biomass for agriculture, both for the production of sustainable food supplies and alternative fuel sources. Research is also directed at exploiting knowledge gained from the study of photoreceptors to engineer novel protein-based biosensors and photo-switches that can be used to non-invasively track and regulate the activities of target entities in living cells.



Name Richard Cogdell
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Website http://www.gla.ac.uk:443/ibls/staff/staff.php?who=PPQ|ed
Research Area The structure and function of the light harvesting complexes and reaction centres from purple photosynthetic bacteria.
Artificial photosynthesis.

Research Activities

Research in the Cogdell lab aims to understand the detailed molecular mechanisms involved in the very early reactions of photosynthesis, that is, those involved in harvesting solar energy and the initial conversion of that energy into useful chemical energy. Purple photosynthetic bacteria are employed for these studies as a very convenient model system. Research in the lab uses x-ray crystallography to determine the structure of the antenna complexes and the reaction centres, both of which are membrane proteins. Their functions are investigated using a wide range of biophysical methods, including single molecule and fs spectroscopies. Recently work has been extended into the area of artificial photosynthesis; utilising the information from photosynthesis to design novel approaches for the conversion of solar energy into fuels.

Name Alan Crozier
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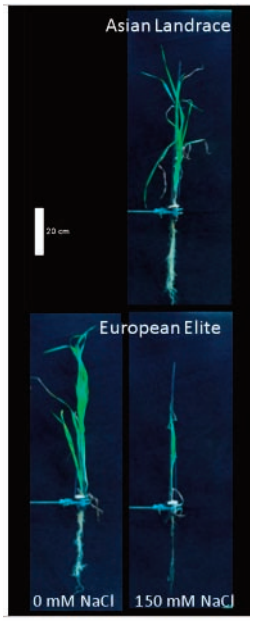
Research Area Plant products and human nutrition

Research Activities

Long-term consumption of a fruit and vegetable-rich diet is associated with a reduced incidence of cardiovascular disease, cancer, and other non-communicable diseases. The plant products and human nutrition group is interested in dietary secondary metabolites, in particular of phenolic compounds and flavonoids, and their effects on human health. The group have discovered a number of produce, especially berries, teas and fruit juices, that are unsually rich sources of phenolic antioxidants and have identified the compounds involved. These include ellagitannins and anthocyanins in pomegranates and raspberries, dihydrochalcones in apples, flavanones in oranges and other citrus fruits, caffeoylquinic acids in coffee and several fruits, and a diversity of flavan-3-ol-derived structures in teas, cocoas and chocolates. The group has developed novel HPLC-MS methodology to monitor the fate of these compounds in the human body following the ingestion of fruits, cocoa and teas by healthy human subjects and volunteers with an ileostomy. Detailed information has been obtained on metabolites that are absorbed into the blood stream from the small intestine. There is increasing interest in those which pass from the small to the large intestine where they can modify the colonic microflora as well as being broken down to phenolic acids which enter the circulatory system.

Spotlight on the University of Glasgow



Name Peter Dominy
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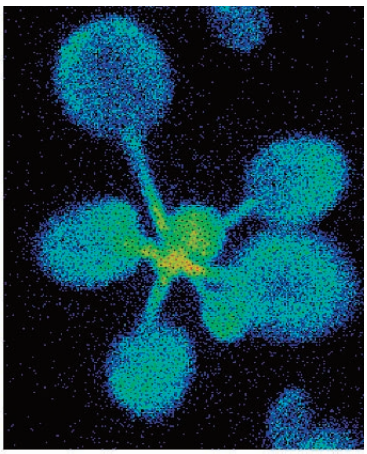
Research Area Tolerance of crops to abiotic stress

Research Activities

To ensure global food security the performance of crops exposed to stress factors such as high salinity, extremes of temperature and drought will have to be improved. Many wild plants and uncultivated crop landraces are considerably more tolerant of these stress factors than the elite domesticated cultivars now grown. The team in Peter Dominy's laboratory have taken a dual approach to meet this challenge: (1) Gain-of-function (gene activation) screens in the model plant *Arabidopsis thaliana* have been used to identify sequences that switch on stress response mechanisms. (2) Through collaborations with colleagues in China and Pakistan, local cereal landraces that thrive in arid zones have been isolated. Work on gene activation in Arabidopsis has identified 'molecular switches' that activate stress responses. These include stress-activated proteins that control growth (a kinase) and autophagy (early senescence), activate the synthesis of several stress tolerance proteins (a MYB transcription factor), modify the biochemical activity of other (stress response) proteins (a SUMO protease), and those involved in mediating responses to known cellular signals such as nitric oxide and ABA. These findings are now being used to direct research into stress responses in crops. Over 300 poorly characterized landraces of barley that grow in rain-fed, arid regions in Asia have been screened through international collaboration. At Glasgow improved levels of performance over elite lines have been confirmed in some landraces when exposed to high temperatures and salinity. Work is now underway to establish the molecular basis for this improved tolerance.



Name Gareth Jenkins
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Research Area Responses to UV-B

Research Activities

Photosynthetic plants are continually exposed to UV-B wavelengths in sunlight. UV-B regulates numerous processes in plants, including biosynthetic activities, the priming of defence responses and several aspects of morphogenesis. Moreover, UV-B modifies responses to various abiotic and biotic factors. Importantly, UV-B regulates UV-protective responses, including phenolic biosynthesis and the stimulation of antioxidant and DNA repair activities that enable plants to survive in sunlight. The numerous effects of UV-B are due to the regulation of hundreds of genes through several signalling pathways. Research in Gareth Jenkins' laboratory aims to understand the molecular mechanisms of plant UV-B perception and signalling involved in the regulation of gene expression and, more generally, the role of UV-B responses in plant growth and development. The present focus is on the UVR8 (UV RESISTANCE LOCUS8) protein, which is the only known UV-B-specific regulator. UVR8 orchestrates gene expression responses involved in UV-protection and regulates aspects of morphogenesis. UVR8 is a 7-bladed propeller protein that interacts with chromatin via histones. UV-B promotes rapid nuclear accumulation of UVR8 and is required to activate UVR8 function in the nucleus. The latter involves interaction with the COP1 (CONSTITUTIVE PHOTOMORPHOGENESIS1) protein. The aim of present projects is to understand how UV-B regulates UVR8 and how UVR8 together with COP1 regulates transcription. The Jenkins group is also investigating how UV-B signalling modulates responses to other abiotic stimuli and the significance of these interactions.

Spotlight on the University of Glasgow

Name Barbara Mable
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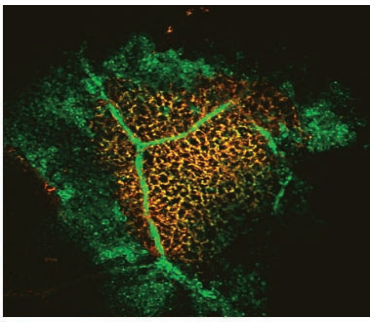
Research Area Evolutionary genetics/plant mating systems/conservation genetics

Research Activities

The reproductive strategies that plants employ have important consequences for how much genetic diversity they maintain and thus for their potential to adapt to changing environments. Research in the Mable lab is focused on understanding the genetic and ecological consequences of mating system variation (outcrossing or inbreeding) in natural populations. The plants used as a model are a predominantly outcrossing species (*Arabidopsis lyrata*; *Brassicaceae*) that have experienced a shift to inbreeding in some populations. The plants grow on threatened habitats such as sand dunes and limestone pavements and so this provides an opportunity to understand how habitat fragmentation affects plant reproductive strategies and what consequences this might have for the fitness and survival of the species. Research is focused on studying the gene families that control outcrossing, along with changes in genetic diversity at neutral loci, population structure, fitness and ability to respond to pathogens in diploid and polyploid populations.



Name Joel Milner
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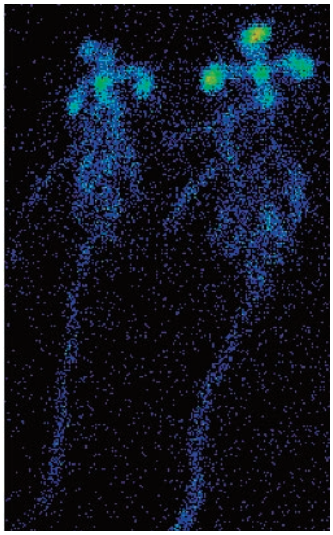
Research Area Plant-pathology, plant-virus interactions

Research Activities

Plant diseases are a major constraint on agricultural production and are responsible for worldwide losses running into hundreds of billions of dollars. Plants have evolved mechanisms to recognize and defend themselves against pathogens, which in turn have evolved mechanisms to evade recognition and suppress defence responses; this results in an arms race between plants and pathogens. Research in Joel Milner's laboratory aims to understand how plants respond to infection, and in particular the mechanisms by which plant viruses (which are the simplest of pathogens) can overcome these responses. Work is focussed on two defence mechanisms, gene-silencing (whereby the plant develops the ability to recognize RNA from the virus as foreign and target it for destruction) and salicylate signaling (whereby salicylic acid acts acting as a hormone, triggers a defence responses aimed at restricting spread of a wide variety of different pathogens). The work is concentrating on understanding the mode of action of a single protein produced by a virus, that can target both of these defence responses and nullify them.



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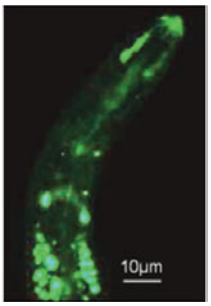
Research Area Plasticity of the plant circadian clock

Research Activities

Life has evolved on a rotating earth. As a result, many (perhaps most) organisms, irrespective of type, exhibit circadian rhythms in which some aspects of their physiology or behaviour oscillate persistently in constant conditions with a period of about 24 hours. These oscillations are driven by a molecular 'circadian clock' present in all cells. In plants the circadian clock controls many different functions, for example photosynthesis, and provides a significant fitness advantage. Molecular genetic studies of whole seedlings have provided great insight into the genes and proteins that comprise the machinery of the circadian clock. Work in the Nimmo lab has introduced a new level of understanding by showing that the machinery of the clock must be inherently plastic since it differs between shoots and roots. Moreover timing information can be communicated between these organs. Current work is aimed at identifying the causes and functions of plasticity in the clock and defining the nature of the signals that transmit timing information between organs. Both model and crop plants are studied, and the resulting information will help to allow the development of crop varieties that can grow in different latitude ranges, maintaining crop yield in a time of rapid climate change.

Spotlight on the University of Glasgow



Name Susan Rosser
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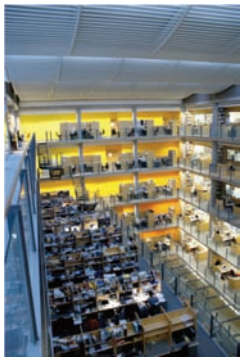
Research Area Phytoremediation, abiotic stress, synthetic biology

Research Activities

Susan Rosser has long standing interest in environmental remediation and the use of bacteria and plants to degrade pollutants and monitor environmental toxicity via the use of biosensors. Aspects of this research focus on the cellular mechanisms underlying phytoremediation and the use of genetic engineering to enhance them. Recently she has become involved in the emerging research discipline of synthetic biology which aims to use a rigorous engineering approach to design and build new biological parts, devices and systems or to reconfigure existing ones to be more efficient or to carry out new functions. The second major area of interest in the Rosser lab is in the impact of abiotic stress on signalling, plant chromatin modification and transcription via the NAD dependent histone deacetylases (or sirtuins) and NAD utilising PolyADP Ribose Polymerases (PARPs). NAD is a ubiquitous coenzyme, required for both anabolic and catabolic pathways. NAD derivatives have been implicated in intracellular signalling pathways through the action of calcium releasing metabolites, cADPR and NAADP, modification of proteins through mono-ADP-ribosylation and control of gene expression through polyADP-ribosylation and histone deacetylation via sirtuins. Many of these pathways are well characterised in animal systems but little is known about them in plants.

Spotlight on Imperial College London



Plant sciences research at Imperial College London takes place on the South Kensington campus in central London and at the Silwood Park campus near Ascot. While the research at Silwood Park is focussed on ecology and evolution, groups at South Kensington work mainly on molecular and cellular plant processes, with a strong emphasis on Arabidopsis and other models such as tomato, Medicago, brassica and pea. In the context of the recent relocation of the plant scientists from the Wye campus to South Kensington the College has invested ~£3M in state-of-the-art plant growth facilities and upgrades to existing infrastructure. The plant sciences section in South Kensington has particular strengths in plant chemistry (metabolomics, chemical ecology, photosynthesis and plant-derived products); plant development and cell biology, and interactions between the plant and its biotic and abiotic environment. Several of these strengths are integrated into the College´s initiatives into bioenergy research such as the Porter Alliance (http://www.porteralliance.org.uk/) and the BBSRC Sustainable Bioenergy Centre (http://www.bsbec.bbsrc.ac.uk/).

Name Gerard Bishop
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Research Area Tomato: its sequence, systemins and steroid hormones

Research Activities

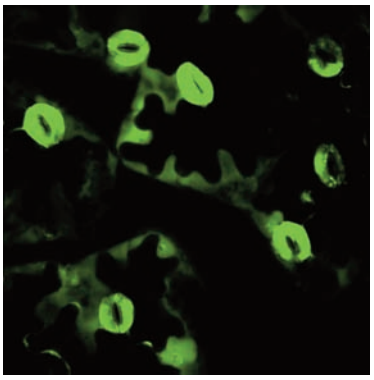
Research in the Bishop Lab falls into three main areas, all focused on using tomato as the key research tool because it is both a model system for fruit ripening and development and because it is a highly valuable crop worth ~$87 billion USD (2006).

Firstly the lab is involved in the tomato genome sequencing programme that is aimed at underpinning worldwide research into this important crop. The genome sequence has been obtained in collaboration with the international community using both clone contig Sanger based sequencing and Next Generation shotgun sequencing approaches. Current interest in the Bishop Lab is centred on transcriptome analysis of tomato and related Solanaceae species using the next generation sequencing technologies. The lab also helps organise annual meetings for the those UK researchers interested in the Solanaceae (tomato, potato, tobacco, aubergine petunia etc.). See www.uk-sol.org for the next meeting.

Secondly the lab works on improving tomato architecture towards enhancing yield. Brassinosteroids (BRs) are plant steroid hormones that have an essential role in plant development. Analysis of tomato dwarf mutants involved in brassinosteroid biosynthesis has indicated a cytochrome P450 that is specifically expressed in fruits. Currently more detailed analysis of this and related genes are being carried out.

Lastly, the novel finding that the tomato receptor for BRs, BRI1, also binds the wound-induced Solanaceae-specific peptide hormone systemin has led the lab to clone and analyse tomato's BRI1 co-receptor BAK1.

Spotlight on Imperial College London



Name Radhika Desikan
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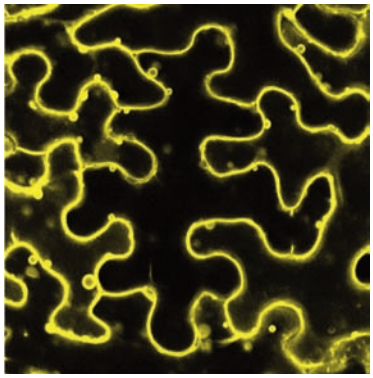
Website http://www3.imperial.ac.uk/people/r.desikan/research
Research Area Reactive oxygen species signalling during abiotic and biotic stress

Research Activities

The Desikan lab focuses on understanding how reactive oxygen species (ROS) act via signalling proteins to mediate various defence responses in plants. ROS are produced in plant cells via unique mechanisms in response to different abiotic and biotic stimuli. Plants utilise ROS to mediate physiological processes such as stomatal closure, root growth and pathogen defence. Using genetic and mathematical approaches with rice and Arabidopsis as model systems, the lab aims to elucidate the function of histidine kinase proteins in ROS signalling and also to delineate signal transduction in response to multiple stimuli.



Name Bart Feys
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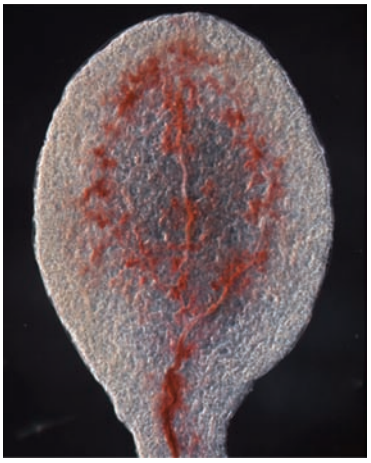
Research Area Signalling and perception in plant-microbe interactions

Research Activities

Plants are under constant attack from a variety of microbial organisms in their environment. As sessile organisms, plants have necessarily developed a sophisticated first line of defence against would-be intruders that relies on the perception of highly conserved microbial 'molecular signatures' (or MAMPs) by cell surface plant receptors. A paradigm for this process is the recognition of the bacterial protein flagellin by the plasma membrane localized Arabidopsis leucine-rich repeat receptor kinase FLS2. Surprisingly few MAMPs (Microbe- associated molecular patterns) have so far been identified and chemically characterized. The Feys group is currently studying MAMPs produced by both gram-negative and gram-positive bacteria and their recognition in Arabidopsis. This research involves molecular genetic analysis of both the plant host and the bacterium to identify the players in both organisms. The lab is also collaborating with structural biology groups to elucidate the chemical structure of newly identified MAMPs. Recently, the lab has started to investigate the function of a novel group of integral plant membrane proteins, called GAAPs for Golgi localized anti-apoptotic proteins. The founding member of this group was isolated as a virus protein capable of inhibiting apoptosis in human cells. Researchers are testing whether plant orthologues of GAAP play a role in the regulation of cell death in plants, a process that is known to operate at key developmental stages and, importantly, is involved in host defence against pathogens. With the Powell lab, the group are also pursuing a map-based cloning approach to isolate a novel aphid resistance gene from the model legume *Medicago truncatula*. As both the pea aphid and Medicago genomes have been sequenced, this system is poised to help unravel the intricacies of plant defence against sap-sucking insects.



Name Thorsten Hamann
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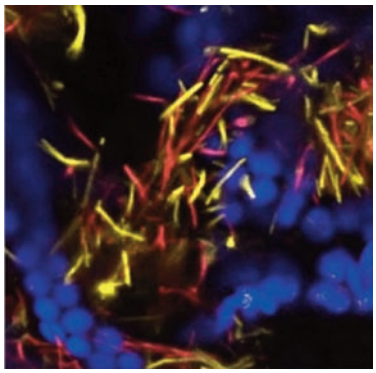
Website http://www3.imperial.ac.uk/people/t.hamann/research
Research Area Signalling mechanisms regulating plant cell wall structure and composition

Research Activities

Plant cell walls are involved in different biological processes like cell morphogenesis and defense against pathogen infection. In order to fulfil the different biological requirements cell walls change their structure and composition to meet the particular functional requirements. A mechanism exists in plants that (similar to *S.cerevisiae*) monitors the functional integrity of the wall and brings about changes in structure and composition to maintain this integrity. The Hamann group is studying how the initial monitoring / perception occurs, how the resulting signal is translated and which genes ultimately bring about the changes in cell wall composition and structure in *Arabidopsis thaliana*. The first part addresses the fundamental question of how a (probably) physical event like cell wall distortion or stretching of the plasma membrane is translated into a signal enabling the plant cell to respond to external stimuli. Recent research from the lab has shown that reactive oxygen species and jasmonic acid mediated signalling processes underly the early signal transduction events. Understanding the mode of action of the cell wall modifying genes will permit the knowledge driven optimisation of plant cell walls. This is of particular interest since the characteristics of the cell walls determine biomass quality, which is one of the main factors determining efficiency of bioenergy production.

Spotlight on Imperial College London



Name John Mansfield
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Website http://www3.imperial.ac.uk/people/j.mansfield
Research Area Plant pathogen interactions

Research Activities

In the Mansfield laboratory projects are in progress on a range of topics related to plant innate immunity. Analysis of bacterial type III effector function and evolution focuses on suppression of host defences by VirPphA homologues and the mobility of avrPphB from its location on a genomic island in *Pseudomonas syringae*. The inheritance of different levels of basal defence in Arabidopsis accessions is being explored. The group continue to use metabolomics particularly HPLC- MS based approaches to examine changes in biochemical pathways in Arabidopsis and bean after bacterial and aphid challenge. A project on the spatial dynamics of bacterial colony development and activation of defence responses in adjacent and distant cells has been initiated with the long term aim of modelling the influence of inoculum levels on the outcome of interactions.

Name Richard Murphy
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Website http://www3.imperial.ac.uk/people/r.murphy
Research Area Biofuels and plant-based materials, plant cell wall structure and decomposition, environmental Life Cycle Assessment (LCA)

Research Activities

The structure and development of plant cell walls is investigated with a view to using for biofuel, bioenergy and other applications. Research in the group is concerned with the conversion of plant material (particularly lignocellulosics) into biofuels (enzymatic and whole organism approaches), the microbial decomposition of plant cell wall materials (softwood, willows, Miscanthus, other lignocellulosics such as bamboo, coir, hemp), the physiology and ecology of wood decay fungi and the preservation of wood using biocides and other means. Collaborative links are in place with CTBE and EMBRAPA in Brazil on sugarcane processing research; Sichuan Academy of Forestry on *Jatropha curcas*; Tsinghua University, Beijing on lignocellulose processing; ORNL and Georgia Tech, USA on lignocellulose processing and Technological University Pereira, Colombia on bamboos and their utilisation. A speciality interest of the lab has been the anatomy of culm development in bamboos and the development of their cell wall architecture, continued fibre wall thickening and lignification with colleagues at University of Periera, Colombia (EU Project Guadua Bamboo), University of Science, Malaysia, Forest Research Institute, Malaysia, University of Freibourg, Germany and Oprins Plant BV, Belgium. The group are also investigating silicaceous deposits in bamboo culm material with Dr Paul Lickiss in Chemistry, Imperial College London. The environmental and sustainability aspects of plant-based bio-energy, bio-fuel and material products is investigated in parallel with the laboratory research using Life Cycle Assessment (LCA) methods (since 1992). The work of the group is conducted jointly with the Porter Alliance and the Centre for Environmental Policy at Imperial College.

Name Glen Powell
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Website http://www3.imperial.ac.uk/people/g.powell
Research Area Aphid-plant interactions

Research Activities

The Powell lab is investigating interactions between plants and aphids. Aphids are important crop pests, causing substantial losses to agriculture by draining plant nutrients, injecting salivary elicitors, and transmitting pathogenic viruses. As phloem-feeding insects, aphids insert their stylets directly into sieve elements to ingest sap, having initially pursued an intercellular pathway through epidermal and mesophyll cell layers. Active mechanisms of plant defence against aphids are poorly understood but on aphid-resistant plants the insects are apparently affected after phloem contact, when their attempts to initiate sustained sap ingestion are often unsuccessful. Such observations have been made on aphid-resistant cultivars of several crop species, but the legume *Medicago truncatula* also possesses highly effective resistance to aphids and has recently become an important model to investigate biological resistance mechanisms and their genetic control. The group has recently identified a locus conferring resistance to certain biotypes of pea aphid, *Acyrthosiphon pisum*, in *M. truncatula* and is currently using this system to dissect the mechanisms determining specificity in plant-aphid interactions. Current approaches, in collaboration with Bart Feys and John

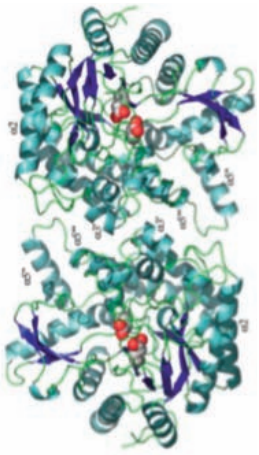
Spotlight on Imperial College London

Glen Powell Continued

Aphid-plant interactions

Research Activities

Mansfield, combine studies of insect stylet penetration behaviour with changes in plant transcriptional responses and production of metabolites to characterize incompatible interactions. Some of the lab's activity is also closely linked with John Rossiter's group, using Arabidopsis as a model to explore the role of secondary metabolites in plant defence against herbivores and in tritrophic interactions with beneficial natural enemies



Name	John Rossiter
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Website	http://www3.imperial.ac.uk/people/j.rossiter
Research Area	Natural products in plant systems

Research Activities

The current research focus is the myrosinase-glucosinolate system in plants, insects and humans. The lab is currently developing a model for the side chain modification of aliphatic glucosinolates using immunocytochemistry and a range of analytical techniques. The role of the myrosinase-glucosinolate system is also being investigated in plant-insect interactions in collaboration with Glen Powell. In particular transgenic Arabidopsis plants with modified glucosinolate and hydrolysis profiles are being used to study tritrophic interactions in collaboration with Rothamsted Research. In parallel studies of the metabolism of glucosinolates by human gut bacteria are being carried out in collaboration with the Institute of Food Research. At a structural level investigations are under way into the mechanism of both myrosinases and dioxygenases involvement in the degradation and biosynthesis of glucosinolates respectively.

Name	Vincent Savolainen
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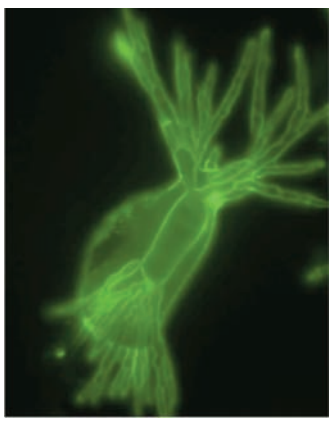
Website	http://www3.imperial.ac.uk/people/v.savolainen
Research Area	Speciation and conservation genomics

Research Activities

The origin of species diversity has challenged biologists for more than two centuries, but despite the large amount of literature on the subject, pivotal questions about speciation remain unanswered. For example, we know that the origin of species must involve genetic separation, most often followed by phenotypic differentiation. Geographic isolation and subsequent genetic separation gives rise to the uncontroversial allopatric mode of speciation. But in theory, populations can become genetically separated without geographical isolation, resulting in the more disputed sympatric mode of speciation. In 2006, Prof Savolainen provided strong evidence for sympatric speciation in a case study of two species of Howea palms on Lord Howe Island, Australia. Extending this study to other taxa and islands, he is currently assessing what combinations of ecological conditions and genomic architectures lead to the evolution of new species?



Name	Pietro Spanu
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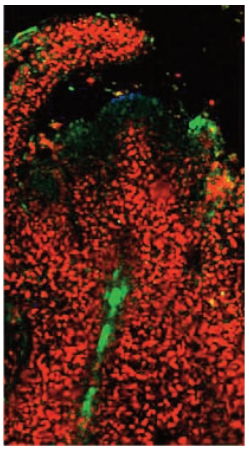
Website	http://www3.imperial.ac.uk/people/p.spanu
Research Area	Plant pathogen interactions, pathogen genomics

Research Activities

What are the molecular processes that enable some pathogens – particularly the obligate biotrophs - to enter an exquisitely intimate relationship with their hosts? How do fungi which penetrate the plant cells avoid recognition and immune defences? These fundamental questions are being addressed in two main thrusts of research in the Spanu laboratory: 1) the sequencing and annotation of the *Blumeria graminis* f sp hordei genome; 2) the functional characterisation of powdery mildew protein effectors and their interacting targets in the barley host. This research is funded by the BBSRC and forms part of a wide collaborative network of laboratories within the UK (University of Reading, John Innes Centre, Oxford University and Exeter University) in Europe (France, Germany, Switzerland) and the USA.

Spotlight on Imperial College London



Name Colin Turnbull
e-mail c.turnbull@imperial.ac.uk
Website http://www3.imperial.ac.uk/people/c.turnbull
Research Area Systemic signals that regulate flowering time and shoot architecture

Research Activities

Optimal shoot development and timing of flowering are key processes that contribute to success in native and cultivated plants. The Turnbull lab focuses on the underlying hormonal signals, and has been instrumental in developing techniques for analysing systemic movement, especially via micrografting and sap collection for Arabidopsis.
One focus of the lab is shoot branching architecture, using both Arabidopsis and pea as models. The extent to which a shoot will branch is partly genetically determined but substantially influenced by the local environment: abundant branching in benign environments, and repressed in nutrient- or light- limited conditions. Auxin and cytokinin have well known roles, but recently a third hormone, strigolactone, has been identified that acts as a systemically mobile branching inhibitor. The lab is studying how the different hormones interact, especially the relationship between strigolactones and cytokinins, both of which are massively regulated in branching mutants.
The second area of interest is systemic regulation of flowering time. The lab contributed significantly to the identification of FT protein as the likely mobile florigen hormone, demonstrating movement and bioactivity of FT across a graft union. The group is presently examining additional genes upstream of FT that confer altered flowering time, and using proteomics screening to detect further photoperiod-dependent mobile proteins. Finally, the molecular features of the FT protein that confer mobility and bioactivity are being analysed by structural biology approaches.

Spotlight on the Institute of Food Research

IFR is a world leader in research into harnessing food for health and controlling food-related diseases. IFR is a key fulcrum that links research in the area of food science, diet and health between the major Universities / Institutes and Research Associations in the UK, Europe and worldwide. IFR is addressing the grand challenges of obesity and healthy ageing by defining the relationship between food, diet and health.

Name Tim Brocklehurst
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Website http://www.ifr.ac.uk/profile/tim-brocklehurst.asp
Research Area Effects of food microstructure on food-borne bacteria

Research Activities

The current focus of Tim Brocklehurst's work is on the attachment of food-borne pathogenic bacteria to the surfaces of fruit and vegetable tissues, either as standing crop, prepared products, or as waste streams, and the adaptation of bacteria to organic acids encountered in the meat food chain and its contribution to persistence. The group studies food microbiology, especially the effects of food microstructure on the inactivation, survival and growth of food-borne pathogenic and other bacteria. As well as basic research, Tim Brocklehurst is strongly interested in the application of IFR research to the food industry; he leads the Food and Health Network, which helps with the exchange of information between IFR scientists and industry, generating competitive advantage through early access to the latest research.

Spotlight on the Institute of Food Research

Name Paul Kroon
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Website http://www.ifr.ac.uk/profile/paul-kroon.asp
Research Area Dietary polyphenols and health

Research Activities

Polyphenols are a very large class of compounds that are widespread in many fruits and vegetables. Certain types of polyphenols provide the bright colours of many fruits while others contribute to the taste of foods (e.g. the 'mouthfeel' of wine and bitterness of dark chocolate). When tested in the laboratory, many of these polyphenols have been shown to be potent antioxidants and to possess various other potentially health promoting properties. Diets rich in polyphenols have been associated with the maintenance and promotion of vascular health and with prevention of certain cancers. However, it is not known which of the several classes of polyphenols are important, or their mode of action, largely because these compounds are altered during absorption from the gut and the compounds that reach the blood and tissues are different from those in foods and beverages. Paul Kroon's research is focussing on linking the metabolism that occurs during absorption of these plant compounds to the biological effects of the metabolites, and the impact of ingesting polyphenol-rich foods or beverages on cardiovascular disease risk. Specific interests include elucidating how plant polyphenols are absorbed from the gut, identifying and quantifying levels of metabolites in human plasma and urine, and clinical trials to assess effects of consumption on established and emerging biomarkers of cardiovascular health. The group is also researching the mechanisms of action at the cellular level in relation to gene expression patterns, signalling pathways, vascular function and inflammation.

Name Richard Mithen
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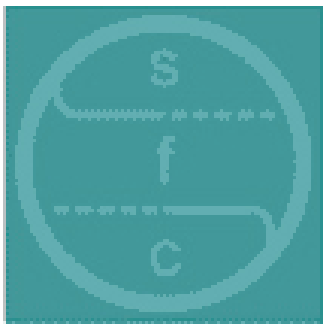
Website http://www.ifr.ac.uk/profile/richard-mithen.asp
Research Area Dietary phytochemicals, health and disease

Research Activities

Richard Mithen's group is studying the role of dietary phytochemicals in maintaining and promoting health, and prevention of the onset and progression of chronic disease. In particular, the biology of glucosinolates is being investigated. Glucosinolates are sulphur containing glycosides that accumulate in tissues of cruciferous crops. Following consumption, deglycosylation occurs due to the action of plant or microbial thioglucosinases ('myrosinases') leading to unstable compounds that rearrange, resulting in the formation of isothiocyanates, indoles and a small number of other products. Epidemiological studies have consistently reported a reduction in incidence of chronic disease such as cancer and myocardial infarction through the consumption of one or more portions of cruciferous vegetables per week. The group is interested in obtaining evidence for health benefits of cruciferous vegetables and elucidating fundamental mechanisms through the use of short and long term human dietary intervention studies. Much of the basis of the current research is founded upon the development of broccoli lines with enhanced levels of glucosinolates. Through comparing the biological activity of these lines with that of standard broccoli it is possible to distinguish the activity of glucosinolates and their degradation products to that of the phytochemical background.

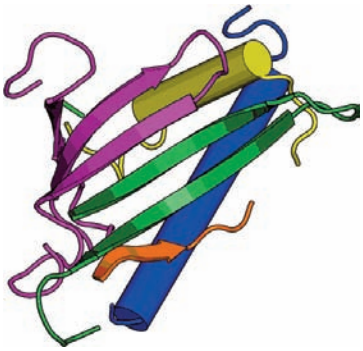


Name Keith Waldron
e-mail keith.waldron@bbsrc.ac.uk
Website http://www.ifr.ac.uk/profile/keith-waldron.asp
Research Area Exploitation of food chain biomass by characterising cell walls

Research Activities

Keith Waldron's research is based in the area of plant cell walls, and the interpolymeric cross-links and texture of plant-based foods. In particular the work is directed towards achieving a greater understanding of how to disassemble plant structures into marketable ingredients, seeking to enhance the exploitation of food-chain residues and co-products. Through the Sustainability of the Food Chain Exploitation platform, the research is aiming to develop combination approaches (biochemical, chemical and physical) for selectively extracting and modifying cell-wall and intracellular components and exploit higher value components as functional ingredients including nutritionally and pharmacologically functional biopolymers and oligomers, high-value rheologically-active polymers, and structuring agents. The work is also evaluating the potential for exploitation of non-food-grade components and elucidating and exploiting the biodegradation of non-food-grade co-products with special reference to the composting process, and the interactions between micro-organisms and plant structure.

Spotlight on the Institute of Food Research



Name Clare Mills
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Website http://www.ifr.ac.uk/profile/clare-mills.asp
Research Area Food structure and health

Research Activities

Clare Mills' research is focussed around protein biochemistry and physical biochemical approaches to understanding the relationship between biophysical properties of proteins and their structural attributes. This is set in the context of biochemical and biophysical events in the gastrointestinal tract. Different types of foods may elicit a variety of physiological and psychological responses which will have a direct impact on our health and well being. Clare Mills' group seeks to gain an understanding of the rules governing the assembly of natural and fabricated food structures (including nanoscale structures), their subsequent disassembly during digestion and uptake by the gut epithelium. One of the model biological responses which they are using to investigate this is the role the physicochemical behaviour of food structures play in the development and manifestation of food allergy. A particular aim is to discover why certain protein scaffolds dominate known allergens from foods, how the structural and biological properties conferred by these scaffolds may predisposes a protein to becoming a food allergen, and how this may be altered by food processing and the food matrix.

Reaping the Benefits - Royal Society Food Security Report

The Royal Society report Reaping the Benefits: Science and the Sustainable Intensification of Global Agriculture was published in October.

The world population is projected to rise to 9 billion by 2050 and food production will have to increase by 50% in the next 40 yrs if we are to prevent world hunger. Food security is therefore one of the key challenges currently facing the world and to reflect this the Royal Society conducted a landmark study to examine the contribution of the biological sciences to food crop production.

The study was conducted by a working group of experts on agriculture, international development, conservation biology and plant science and chaired by Sir David Baulcombe. The report discusses the need for sustainable intensification of global agriculture and makes twelve recommendations to help meet the challenge of food security. Some of the recommendations are highlighted below.

Research Councils UK (RCUK) should develop a cross-council grand challenge on global food crop security as a priority. This needs to secure at least £2 billion over 10 years to make a substantial difference.

UK research funders should support public sector crop breeding and genomics programmes.

RCUK should increase support for ecosystem based research and agronomy.

RCUK, and BBSRC in particular should support 'high risk approaches to high-return targets in genetic improvement of crops'. Such as GM crops for improved photosynthetic efficiency or nitrogen fixation.

Universities should work with funding bodies to reverse the decline of skills in areas such as agronomy, plant physiology, pathology and general botany, soil science, environmental microbiology, weed science and entomology.

Prof David Baulcombe who chaired the report commented " We need to take action now to stave off food shortages, if we wait five to ten years it may be too late. In the UK we have the potential to come up with viable scientific solutions for feeding a growing population, and we have a responsibility to realise this potential".

A full copy of the report can be downloaded from http://royalsociety.org/Reapingthebenefits/

24th New Phytologist Symposium

Plant respiration and climate change: scaling from mitochondria to the globe

St Hugh's College
University of Oxford, UK
11–14 April 2010

Confirmed speakers

Owen Atkin ANU, Canberra, Australia
Margaret Barbour Landcare Research, Lincoln, New Zealand
Hans-Peter Braun Leibniz Universität, Hannover, Germany
Nina Buchmann ETH Zürich, Switzerland
Alisdair Fernie Max Planck Institute, Golm, Germany
Alastair Fitter University of York, UK
Jaume Flexas Universitat de les Illes Balears, Palma, Spain
Kevin Griffin University of Columbia, USA
David Macherel Université d'Angers/INH/INRA, France
Harvey Millar UWA, Perth, Australia
Sandra Oliver CSIRO Plant Industry, Canberra, Australia
Kurt Pregitzer University of Nevada, USA
Peter Reich University of Minnesota, USA
Miquel Ribas-Carbo Universitat de les Illes Balears, Palma, Spain
Stephen Sitch University of Leeds, UK
Lee Sweetlove University of Oxford, UK
Guillaume Tcherkez Université Paris XI, France
Robert Teskey University of Georgia, USA
Mark Tjoelker Texas A&M University, USA
Susan Trumbore University of California-Irvine, USA
Matthew Turnbull University of Canterbury, New Zealand
Jim Whelan UWA, Perth, Australia
Lisa Wingate INRA-Ephyse, France

Organisation

Owen Atkin, ANU, Canberra, Australia
Harvey Millar, UWA, Perth, Australia
Matthew Turnbull, University of Canterbury, New Zealand

Contact

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New Phytologist Central Office, Bailrigg House, Lancaster University, Lancaster, LA1 4YE, UK.

New Phytologist Trust
The New Phytologist Trust is a non-profit making organisation dedicated to the promotion of plant science.

Complete details and registration at
www.newphytologist.org

New Phytologist

25th New Phytologist/ Colston Research Society Symposium

Colonization of the terrestrial environment

University of Bristol, UK
21–22 September 2010

Confirmed speaker

Jody Banks Purdue University, USA
David Beerling University of Sheffield, UK
Robert Berner Yale University, USA
Liam Dolan University of Oxford, UK
Allan Downie John Innes Centre, UK
Paul Falkowski Rutgers University, USA
Paul Kenrick Natural History Museum, UK
Conrad Labandeira Smithsonian Institution, USA
Jane Langdale University of Oxford, UK
Jonathan Leake University of Sheffield, UK
Euan Nisbet Royal Holloway University of London, UK
Rémy Petit INRA, France
Ralph Quatrano Washington University, USA
John Raven University of Dundee, UK
Charles Wellman University of Sheffield, UK
Ian Woodward University of Sheffield, UK

Organisation

David Beerling (University of Sheffield, UK)
Mike Benton (University of Bristol, UK)
Liam Dolan (University of Oxford, UK)
Phil Donoghue (University of Bristol, UK)
Chris Hawkesworth (University of St Andrews, UK)
Alistair Hetherington (University of Bristol, UK)
Ian Woodward (University of Sheffield, UK)

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New Phytologist Trust

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Complete details and registration at
www.newphytologist.org

New Phytologist

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ELIXIR: Securing the future of Europe's biological data

Article provided by Cath Brooksbank EBI

Biological research is generating information at previously unprecedented rates, which creates new challenges. How do you back up hundreds of petabytes of data? How do you exchange data with collaborators when it uses the entire capacity of the academic network for days? How do you compare the genomes of thousands of different plants to each other? And how do you then present this information in a way that allows agricultural researchers to extract meaningful information from it? Europe's life scientists are already facing up to these issues, but to do so sustainably requires a new infrastructure – called ELIXIR – built to withstand constant battering by a tsunami of data.

What is ELIXIR?

The purpose of ELIXIR is to develop the plan for a sustainable infrastructure for biological information in Europe. ELIXIR will provide: data resources; bio-compute centres; infrastructure for data integration, software tools and services; support for other European infrastructures in biomedical and environmental research; training and standards development. This will enable ELIXIR's users to meet the European Grand Challenges, which are almost all biological, namely: healthcare for an aging population, a sustainable food supply, competitive pharmaceutical and biotechnology industries and protection of the environment. ELIXIR is one of 44 preparatory phase projects that comprise the European Strategic Forum for Research Infrastructures (ESFRI) Roadmap (http://cordis.europa.eu/esfri/). During its preparatory phase ELIXIR will (1) determine its structure through consultation with a wide range of different stakeholders and (2) secure future funds for the establishment of ELIXIR.

What will ELIXIR look like?

ELIXIR's structure will be based on a hub and nodes (see Figure 1). The hub will be at the European Molecular Biology Laboratory's European Bioinformatics Institute (EMBL-EBI), based just outside Cambridge, UK. The hub will: provide central coordination of ELIXIR's activities; provide core data resources; host registries of bioinformatics tools; host the main data centre; ensure back up of core data resources; and coordinate user training and information dissemination.

There will be additional nodes located throughout Europe, selected through an open invitation. We envisage that some (but not all) of these will be at national bioinformatics centres, with the important distinction that an ELIXIR node will serve researchers throughout Europe, not just in the host country.

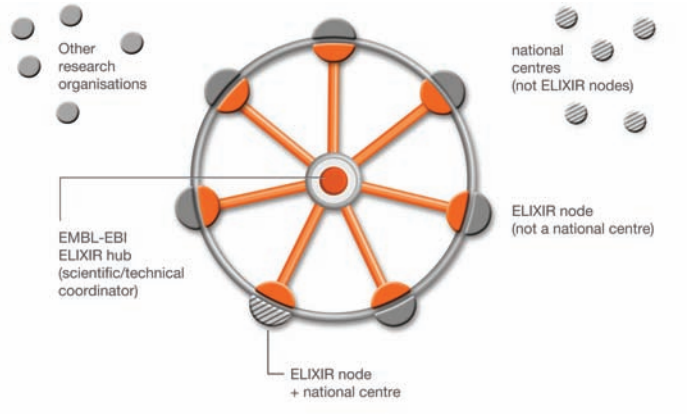

Figure 1
ELIXIR's hub and node structure. The hub will be at the EMBL-European Bioinformatics Institute. Some ELIXIR nodes will be at national bioinformatics centres, which will have two separate sets of activities (one national, one European) with distinct funding streams. Others will be at other centres of excellence that can offer pan-European bioinformatics services.

How will ELIXIR be funded and governed?

There will be several funding streams, including pan-European (e.g. the European Commission), national governments, charities and international (non-European) funding bodies. The mechanism for delivering this flow of funds has yet to be determined, and the proportions of funds to come from each stream need to be agreed. ELIXIR's target is to secure matching pan-European and national funding, with pan-European funding based on an international agreement. The UK and Sweden have committed funds towards the construction of ELIXIR. During the preparatory phase ELIXIR will focus on gaining similar support from other European countries.

The initial governance structure for ELIXIR is likely to be a 'special', ring-fenced project of the European Molecular Biology Laboratory (EMBL). As an intergovernmental organisation involving 20 European countries and governed by a council of representatives from each of those countries, EMBL has the necessary legal and financial framework in place to accommodate ELIXIR as a special project.

ELIXIR's coordinator and secretariat will report to an independent ELIXIR Council elected by ELIXIR's member states. The ELIXIR Council will be independent of EMBL Council and it will not be necessary to join EMBL to join ELIXIR. The ELIXIR Council will elect a scientific advisory committee and a grant committee, which will provide strategic direction and oversee the allocation of central funds to the hub and nodes.

Why should the plant research community care about ELIXIR?

ELIXIR will not make funds available for specific research projects; instead it will focus on building a biological data infrastructure that will enable life science researchers to answer important biological questions. For example in the case of plant scientists this could mean ready access to the genomic information of a number of plant species, insect pests and pathogens to enable the community to understand the genetic basis of resistance to adverse environmental conditions such as drought or high salt, and resistance to pests and plant pathogens. This information would in turn lead to researchers

ELIXIR: Securing the future of Europe's biological data

breeding healthier, more productive crops that will enable us to safeguard or enhance food production, and mitigate some of the negative effects of climate change and the growing global population.

Over the past 18 months ELIXIR's workpackage on Interdisciplinary Interactions with Chemical, Plant, Environment and Agriculture Databases (workpackage 10) has dedicated significant time to identify the bioinformatics needs of this community. The report from this work package is available on the ELIXIR website (http://www.elixir-europe.org/page.php?page=reports) and will be incorporated into ELIXIR's business plan, which will be used to engage with research policymakers to fund ELIXIR's construction. We would ask the plant research community to support this process, which will enable Europe to stay at the forefront of life science research.

To discuss how you can help to make ELIXIR a reality, contact ELIXIR's project manager, Andrew Lyall (elixirpm@ebi.ac.uk; +44 (0)1223 494444) or visit our website: www.elixir-europe.org for more information.

Obituaries

Professor Chris Lamb died on the 21st August 2009, aged 59. Prof. Lamb was a world-leading plant scientist, as director of the John Innes Centre in Norwich, as regius professor of plant science at Edinburgh University, and as director of the plant biology laboratory at the Salk Institute in La Jolla, California.

His research aimed to understand how plants defend themselves against pathogens. In a series of highly insightful and influential publications over the past 20 years, Prof. Lab focused on how plants establish an intricate and effective series of defences.

Chris Lamb obtained a first-class degree from Fitzwilliam College, Cambridge and earned a PhD there. After completing his PhD, he became a research fellow at the Queen's College, Oxford, before moving to the Salk Institute in 1982 to become its Director and to set up a plant research programme. In his 17 years in southern California, Prof.Lamb built one of the most highly regarded and visible programmes in plant biology.

Prof. Chris Lamb was appointed director of the John Innes Centre in Norwich in 1999. By fostering scientific interactions Chris drove forward the development of the Norwich Research Park into a powerhouse for scientific understand focusing on areas including underpinning sustainable food production, the interactions of organisms in the changing environment, and the complex interactions between diet and health. During his time at the John Innes Centre, Prof. Lamb also developed substantial programmes for promoting science education and for providing opportunities for training the next generation of young scientists.

Lamb's scientific excellence was recognised by election to fellowship of the Royal Society in 2008 and in June this year he was appointed CBE.

Professor Mike Gale died on July 18th, 2009, aged 65. Professor Gale was a world-leading plant geneticist. His research into wheat genetics at the John Innes Centre was ground-breaking but he was also an inspirational promoter of international agricultural science policy.

Mike Gale, went to Birmingham University and studied for his PhD at Aberystwyth before joining the Plant Breeding Institute at Cambridge in 1968. He moved to the John Innes Centre Norwich, in 1990 as head of cereals research and in 1992 became director of the Cambridge Laboratory. He was the JIC's interim director in 1999 but later became associate director.

Gale contributed to unravelling the genetics of the Green Revolution semi-dwarfing genes and of pre-harvest sprouting resistance in wheat. He mapped the molecular structure of bread wheat, which has enabled plant breeders to develop higher yielding varieties. His contributions to agricultural research led to the award of the Royal Agricultural Society of England's gold medal for research in 1994.

Prof. Gale, who was elected a Fellow of the Royal Society in March 1996, was also honoured by the world's scientists for his outstanding contribution to cereal genetics and to crops such as wheat and millet. Two years later, he was jointly awarded the Royal Society's Darwin Medal with colleague, Dr. Graham Moore. Since 2004, he was a member of the science council of the Consultative Group of International Agricultural Research, which represents about 2,000 scientists from 100 countries and helps to coordinate global research policies.

Prof. Gale was a director of the Rockefeller Foundation's biotechnology program, which transformed rice research from a scientific "orphan" into a world-beater. Prof. Gale officially retired from JIC in 2003, but became an Emeritus John Innes Foundation Professor in the Crop Genetics Department.