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Advances

JIC providing global solutions, securing our future

Science Spotlights

JIC researcher named Innovator of the Year

Professor George Lomonossoff has won “Most Promising Innovator” and the overall “Innovator of the Year” prize at this year’s national BBSRC Innovator of the Year Awards, for his work with Dr Frank Sainsbury on the development of a system for the rapid production of vaccines and pharmaceutical proteins in plants. The technique is faster than current methods and so it offers an extremely effective way of creating vaccines. His work is already being used by Medicago, a Canadian biotechnology company, to develop a vaccine for the H5N1 avian influenza virus.

Blood on the menu

New research could make it easier to grow health-promoting blood oranges. For the red pigmentation to develop, blood oranges normally require a period of cold as they ripen. The only place to reliably grow them on a commercial scale is in the Sicilian area of Italy around Mount Etna. Here, the combination of sun and cold, sunny days and warm nights provides ideal growing conditions. Professor Cathie Martin and Dr Eugenio Butelli have identified the gene responsible for blood orange pigmentation, naming it Ruby, and have discovered how it is controlled. “Blood oranges contain naturally-occurring pigments associated with improved cardiovascular health, controlling diabetes and reducing obesity,” said Professor Martin. “Our improved understanding of this trait could offer relatively straightforward solutions to growing blood oranges reliably in warmer climates through genetic engineering.”

Plant Cell, doi:10.1105/tpc.111.095232

Plant research reveals new role for gene silencing protein

Professor Caroline Dean’s research group has found that a DICER protein, known to play a part in gene silencing, also helps complete an important step in gene expression, according to research on *Arabidopsis thaliana*.

The expression of a gene, when an organism’s DNA is transcribed into a useable product, requires activation via a promoter or an external trigger. Research published in Science has shown that later stages of transcription are just as important. Where effective termination through the normal mechanisms has not occurred, DICER-LIKE 4 (DCL4) steps in to tidy up. This is likely to apply to other organisms, including humans. “Our research shows that for successful expression the end of a gene is just as important as its beginning,” said Professor Dean.

Science, doi:10.1126/science.1214402

First model of how buds grow into leaves

Leaves come in all shapes and sizes. JIC scientists have discovered simple rules that control leaf shape during growth. Using this 'recipe', they have developed the first computer model able to accurately emulate leaf growth from a bud. "The model is not just based on drawings of leaf shape at different stages," said Professor Enrico Coen. "To accurately recreate dynamic growth from bud to leaf, we had to establish the mathematical rules governing how leaf shapes are formed." With this knowledge programmed into the model, developed in collaboration with Professor Andrew Bangham's team at the University of East Anglia, it can run independently to build a virtual but realistic leaf.

Science **335** (6072) 1092-1096 doi:10.1126/science.1214678

Legumes give nitrogen-supplying bacteria special access pass

A 120-year debate on how nitrogen-fixing bacteria are able to breach the cell walls of legumes has been settled. New research led by Professor Allan Downie has shown that plants themselves allow bacteria in. Once inside the right cells, these bacteria take nitrogen from the air and supply it to legumes in a form they can use, ammonia. Whether the bacteria breach the cell walls by producing enzymes that degrade it, or the plant does the work for them, has been contested since an 1887 paper in which the importance of the breach was first recognised. "Our results are so clear we can unequivocally say that the plant supplies enzymes to break down its own cell walls and allow bacteria access," said Professor Downie.

PNAS **109** (2) 633-638 doi:10.1073/pnas.1113992109

Why spring is blooming marvellous (and global warming makes it earlier)

Dr Philip Wigge and Dr Vinod Kumar have identified the switch that accelerates flowering time in response to temperature. At normal temperatures, over-expression of the switch caused a massive induction of flowering. But at low temperatures this affect was disabled. The switch is called PIF4 and was already known to trigger changes in plant architecture in response to temperature, whereby plants develop longer stems when it is warmer. Previous research had also identified a gene essential to flowering, florigen. It is activated by many pathways, including the longer days of spring. The current paper shows the connection between this gene and temperature.

Nature doi:10.1038/nature10928

Fine mapping wheat genes

The use of new genomic techniques and increased sequencing power promise to help breeding crops, but for wheat the pipeline from the laboratory to the field is held up by wheat's complex genome and the lack of the kind of detailed genome sequence available for simpler plants. Dr Martin Trick and Dr Cristobal Uauy have recently published a new study that applies next generation sequencing techniques to wheat and shows how it can aid in fine mapping genes to the level needed by the plant breeding community more quickly and efficiently than has been possible before.

BMC Plant Biology 2012, **12**:14 doi:10.1186/1471-2229-12-14

First plants caused ice ages

Research rooted in Norwich science has revealed how the arrival of the first plants 470 million years ago triggered a series of ice ages. Scientists from JIC and the University of East Anglia, now at the Universities of Exeter and Oxford, set out to identify the effects that the first land plants had on the climate during the Ordovician Period, which ended 444 million years ago. During this period the climate gradually cooled, leading to a series of 'ice ages'. This global cooling was caused by a dramatic reduction in atmospheric carbon, which this

research, published in Nature Geoscience, now suggests was triggered by the arrival of plants. Among the first plants to grow on land were the ancestors of mosses that grow today. The team used the modern moss, Physcomitrella patens for their study.
Nature Geoscience **5**, 86–89 doi:10.1038/ngeo1390

Current Research Snippets

Natural factories

Plants and microbes produce a wide spectrum of natural products, which give them their huge range of colours, flavours and scents. These chemicals are used to repel pests, diseases or competitors or to attract pollinators, but for humans they represent a potential source of new medicines, flavourings, antimicrobials or other useful compounds. A major area of study at JIC is in understanding how and why plants and microbes make these natural products. With this knowledge, we are looking at ways of exploiting them to help maintain our health, to improve crops plants and to maintain a safe, nutritious food supply.

Feeling the heat

Plant scientists are starting to gather evidence on the exact ways in which plants will be affected by climate change. Increasing temperatures, rising sea levels, increased salinity and decreased soil moisture will all affect crops and their yields. Researchers at JIC and the Sainsbury Laboratory are starting to unravel how plants respond to temperature and how their interactions with pests and diseases are likely to change. This knowledge will show us if anything can be done to help plants cope. It may show us if it's possible to breed crop varieties that are able to adapt.

The first UK PlantSci Conference helps realise the potential of basic plant science

Academic research and large scientific businesses are sometimes seen as opposites, but together they are key to ensuring the economy gets maximum benefit from Government-funded research. On 18th-19th April the first UK PlantSci conference, held at the John Innes Centre in Norwich, helped to cross the gulf between pure research and the commercial world. The UK PlantSci conference is organised by the newly-founded UK Plant Sciences Federation (UKPSF), a Special Interest Group of the Society of Biology.

New Research Targets

Investment in cereal genomics to breed better varieties

Professor Michael Bevan and Dr Cristobal Uauy with Dr Andy Phillips of Rothamsted Research are to work on a new project that will use the genome of wheat to unlock useful variation from different varieties to support breeding and gene discovery. Professor Bevan commented "This project builds on the strong foundation of wheat genomics made with past BBSRC support as, by identifying useful genetic traits, it will enable the benefits of wheat genome analysis to be directly used by breeders and researchers." This is part of a £7 million investment in cereal genomics by BBSRC that will use the expertise at The Genome Analysis Centre to crack the genomes of wheat and barley, the two most widely grown UK crops.

Adapting wheat for a changing climate

Dr Simon Griffiths has received over £500,000 of funding from the European Commission to investigate ways that wheat can be adapted to cope with climate change. The project, which involves working with plant breeders, will focus on the way wheat times when it flowers, and look at how variations in this could be exploited to produce crops adapted to our climate in the future. This will be vital in ensuring food security in the future.

New light on medicinal benefits of plants

A group of scientists have made publicly available all the data they have so far

on the genetic blueprint of medicinal plants and what beneficial properties are encoded by the genes identified. The release of the resources follows a $6 million initiative to study how plant genes contribute to producing various chemical compounds, some of which are medicinally important. Project partner Dr Sarah O'Connor will work with her research group at the John Innes Centre towards the first full genetic sequence of a medicinal plant and will experiment with combining beneficial properties from different plants to create the first new-to-nature compounds derived from plants. A priority focus will be compounds with anticancer activity. Dr O'Connor is a JIC/UEA Synergy Lecturer in Chemical Sciences at the University of East Anglia

Science into Practice

Patent issued for root-specific promoters

Plant Bioscience Limited have been issued with a US patent on root-specific promoters (US 7,982,096), from research led by Professor Anne Osbourn that cloned genes involved in synthesising a protective antimicrobial compound in oat roots. These genes were found to be tightly regulated and restricted to expression in the epidermal cells of the root tip and lateral roots. The promoter regions of these genes, which are responsible for this specificity, were characterised and shown to work in rice, legumes and the model plant *Arabidopsis*. The promoters would be useful genetic tools for directing the targeted expression of genes relating to nutrient uptake, drought tolerance and disease resistance specifically in the roots of different plant species, and various companies are testing these promoters for commercial uses.
www.pbltechnology.com/cms.php?pageid=298

People

Investment in bioscience skills and training to help meet economic and social challenges

JIC is leading a group of research institutes on the Norwich Research Park that are to receive almost £4million of funding from BBSRC to support the training of the next generation of scientists. The investment will fund 39 PhD students through a Doctoral Training Partnership (DTP) award, coordinated by the JIC, and involving the University of East Anglia, the Sainsbury Laboratory, the Institute of Food Research and the Genome Analysis Centre. The scope of the DTP award will be substantially enhanced by a commitment over the next three years of an additional £2million from the partners. JIC Director Professor Dale Sanders FRS, said: "The award is a strong endorsement of the world-leading research in Food Security and Industrial Biotechnology not only at JIC but across the Norwich Research Park. This new PhD studentship programme provides an exciting opportunity for research training and development in a framework of inter-institutional and inter-disciplinary collaboration."

Poster prize for student at international conference

PhD student Ruth Bryant was awarded third prize in a poster competition at the 2011 CropWorld Global Congress. The conference is an international platform to debate and discuss the critical issues surrounding crop production industry. It brings together colleagues from government, the farming community, scientists, the private sector and strategists from the public sector from over 75 countries worldwide. 2011 saw the launch of a brand new R&D platform on the exhibition floor and an award winning scientific poster session with prizes presented by Government Chief Scientific Adviser Sir John Beddington. Ruth received the prize for her work on temperature effects on wheat defence against yellow rust.

John Innes Centre researcher wins Bronze for Biology display in Parliament

John Innes Centre researcher Dr Christopher Burt has won Bronze at a competition in the House of Commons, for the excellence of his biology research, walking away with a £1,000 prize. Christopher presented a poster on research into eyespot, a fungal disease of wheat, which was judged against dozens of other scientists research in SET for Britain, the only national competition of its kind.

Biochemical Society award for JIC Microbiologist

Professor Mervyn Bibb has been awarded the Heatley Medal and Prize by the Biochemical Society. “The JIC is proud to congratulate Merv Bibb on his award of the Heatley Medal. This prestigious award was last won by Nobel Laureate Sir Venki Ramakrishnan and reflects Merv’s enormous contribution to the discovery and development of novel antibiotics,” said JIC Director Professor Dale Sanders. “At a time when antibiotic resistance in bacteria is becoming a serious health concern, Merv’s innovative approaches – based on knowledge of genomes and unlocking the expression of normally-quiescent genes – promise major health benefits that emerge from front-rank basic research.”

Public Engagement

Science and Art in a Box

GCSE art students from Hethersett High School and scientists from the John Innes Centre were asked to consider the question “How will genetic modification influence the future of our planet?” Their visual responses were contained in a series of boxes that were on display at JIC following a successful viewing at the Hethersett Library in December 2011.

Scientists and teachers unite to bring cutting-edge science to Lynn Grove High School

Lynn Grove High School in Gorleston, Norfolk, has been chosen by The Royal Society, the UK’s national academy of science, to receive a Partnership Grant that will enable local scientists to work with teachers from the school to implement an innovative science project. JIC’s Dr Paul Nicholson will be working with the school during the next year on a project that grew out of an ongoing partnership with the Teacher Scientist Network. The project, called “*E.coli* on the move,” aims to investigate the distribution of *E.coli* and other coliform bacteria within a school.

Science in Norwich Day

JIC scientists took part in Science in Norwich Day, the annual celebration of the wealth and breadth of science that calls Norwich its home. Thousands of people came to The Forum in Norwich and found out what seed banks are for and why they are so important, and also got a chance to meet the most important weed in the world – *Arabidopsis thaliana*.

Sowing the seeds for a fascination of plants

The John Innes Centre and the Teacher Scientist Network celebrated National Science and Engineering Week by planting a seed of interest in plant biology in Norfolk schools. In fact they helped to plant over 40,000 seeds, by sending every Norfolk school 100 wheat seeds to help inspire a fascination of plants in the next generation. Dr Phil Smith MBE, co-ordinator of the Teacher Scientist Network, which is based at the John Innes Centre, hand-delivered seeds to over 500 pupils across Norfolk on one day. The seeds can be used for a variety of experiments to learn about plant

biology and agriculture. The JIC set a challenge to see which school could grow the tallest plant by May 18th, which is International Fascination of Plants Day.

For more information, and the full stories, please visit our website at www.jic.ac.uk

John Innes Centre

About JIC

JIC's mission is to generate knowledge of plants and microbes through innovative research, to train scientists for the future, and to apply our knowledge to benefit agriculture, human health and well-being, and the environment. It is a company limited by guarantee. Registered in England No. 511709. Registered Charity No. 223852

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