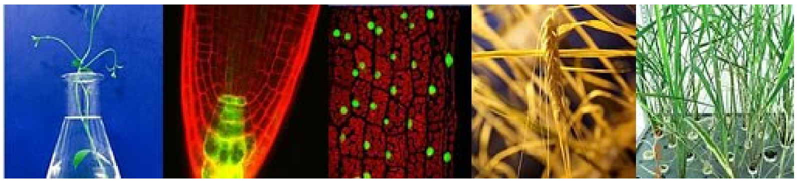
Food Security Research at Birmingham

All staff offer laboratory-based research projects at undergraduate and masters level. For more information visit the **Food Security Education page (/research/activity/food-security/education/index.aspx)** .



Conservation of Wild Crop Relatives

The world's plant genetic resources hold great value for world food security, but they are under considerable threat. Crop improvement depends on the genetic diversity existing in our plant genetic resources, which are arguably inadequately conserved and used. Biodiversity is at risk from multiple threats including climate change. The genetic diversity contained within plant genetic resources, particularly of species that are wild relatives of our crops, is essential to our ability to respond to the new stresses in the agricultural environment inherent with climate change. It is important to consider the genetic value of crop wild relatives, how they may be conserved, and what new technologies can be implemented to enhance their use.

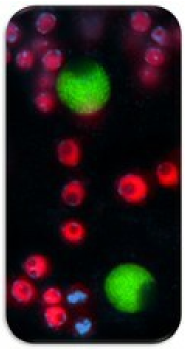
The research of **Dr Nigel Maxted (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=5400&Name=dr-nigel-maxted)** is committed to the conservation of genetic diversity in plants with a focus on species of agricultural value, using novel approaches to conservation and diversity management. To learn more about Dr Maxted's research **click here (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=5400&Name=dr-nigel-maxted)** .

See also: Dr Maxted's work on **Agrobiodiversity Conservation for Food Security (http://www.birmingham.ac.uk/schools/biosciences/research/translating-research.aspx#Res4)**

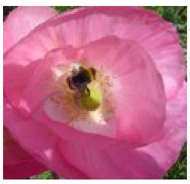
Our research also focuses new molecular technologies (genomics, transcriptomics and metabolomics), onto finding solutions to the problems of ensuring effective conservation of plant genetic resources and their enhanced use. The research of **Professor Brian Ford-Lloyd (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=3926&Name=professor-brian-ford-lloyd)** focuses on patterns of natural variation in crop plants and their wild relatives through the use of molecular techniques. Understanding how genes in different crop varieties impact their growth can be used to enhance crop performance in the field. To learn more about Professor Ford-Lloyd's research **click here (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=3926&Name=professor-brian-ford-lloyd)** .

Enhancing Breeding

Meiosis is the process by which DNA is mixed together during sexual reproduction, generating variation between individuals. The University of Birmingham has a long-standing reputation as a leader in the field of plant genetics and is now is a leading centre in plant meiosis research. The labs of **Professor Chris Franklin (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=5344&Name=professor-chris-franklin)** and **Dr Sue Armstrong (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=8814&Name=dr-sue-armstrong)** have made major contributions to the understanding of how meiosis is controlled in the model plant *Arabidopsis thaliana*. This knowledge is currently being transferred to crop species where the ability to modify meiosis will help plant breeders develop the new varieties needed to ensure global food security during the 21st century. Research at Birmingham has already solved particular problems associated with barley meiosis that hamper barley breeding.



Plant DNA is a highly complex and organised structure. **Dr Eugenio Sanchez-Moran (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=9667&Name=dr-eugenio-sanchez-moran)** studies the structural organisation of plant DNA and how it affects meiosis and other aspects of plant development. This knowledge will enable the manipulation of plant fertility and breeding and will also have far-reaching implications in the animal world, for example in the study of cancer, stem cells, inherited disease and human fertility.



Professor Noni Franklin-Tong (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=9723&Name=professor-noni-franklin-tong) investigates the cellular mechanisms that enable plant reproductive cells to recognise one another and decide whether to "commit suicide" to prevent inbreeding. This has high importance in relation to food security, and Noni's current research is transferring these recognition systems into model species and crop plants.

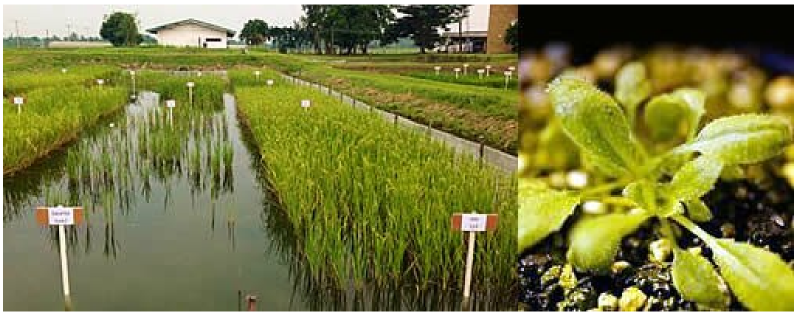
Breeding novel varieties of crops to stand up to the challenges posed by climate change requires knowledge of the genetic control of traits. Almost all traits important to breeders are complex traits, controlled by multiple genes as well as by the environment. **Dr Lindsey Leach (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=34326&Name=dr-lindsey-jane-leach)** and **Professor Zewei Luo (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=9229&Name=professor-zewei-luo)** develop novel methods for the genetic analysis of complex traits in plants, to enable the important genes controlling trait variation to be identified. Many of our most important food crops have complex, polyploid genomes containing multiple sets of chromosomes, including potato, sugarcane, coffee, wheat and cotton.

The Luo group develops statistical methods to enable genetic analysis of complex traits in tetraploid crops. These methods are being applied to enable breeders to dissect the genetic basis of traits such as disease resistance in our important tetraploid food crops such as potato.

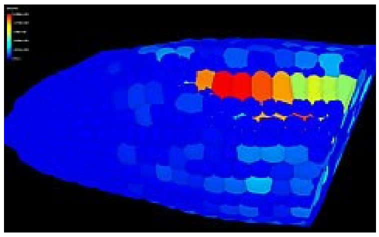
Dr Leach's work has developed tools to enable gene expression analysis in polyploid crops such as bread wheat, by exploiting the power of next generation sequencing technologies.

Understanding Plant Growth, development and Stress Responses

As weather patterns become increasingly unpredictable due to climate change, a detailed understanding of the mechanisms that plants have evolved to sense and respond to environmental stress (such as flooding or drought) is essential. **Dr Daniel Gibbs (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=69389&Name=dr-daniel-gibbs)** studies the cellular mechanisms that plants use to detect and respond to internal and environmental signals, and how they lead to alterations in growth, development and survival. The general aim of his work is to identify promising targets that can be manipulated in agriculturally important crops to improve growth, productivity and stress tolerance.

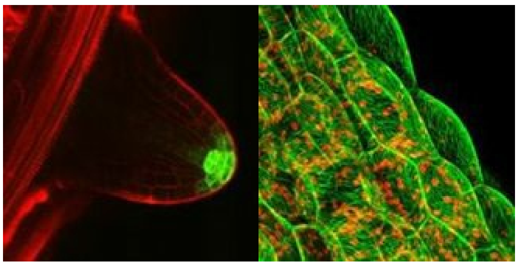


Plant growth is strongly influenced by the environment. Environmental cues can act to start or stop growth, and when environmental signals are outside the comfort range of a plant, they cause stress. The research of **Dr George Bassel (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=38785&Name=dr-george-w.-bassel)** is interested in understanding how plants make decisions during their life in response to the environment, using seed germination as a model system. As seeds are the starting and end point for the majority of the world's agriculture and 70% of the world's calories come directly from seeds, this work can be translated to a wide range of crop species.



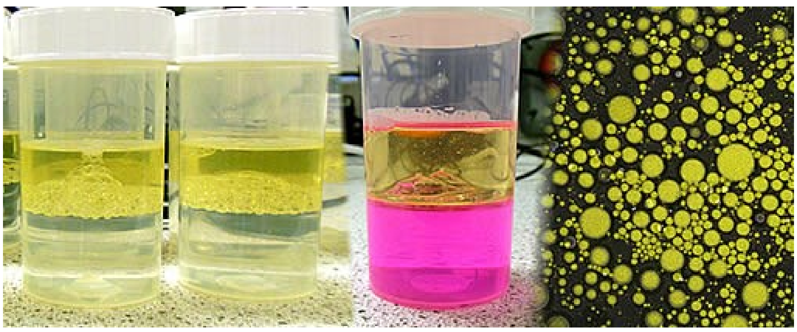
Dr Jeremy Pritchard (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=9728&Name=dr-jeremy-pritchard) analyses how plants respond to stresses, particularly drought, salt, pollution and pest attack. His research utilizes a range of plant species including thyme. This work can be used to enhance stress tolerance in this and other species.

The domestication of crop plants from their wild relatives is a form of controlled selection by humans. Similarly, the crop plants that we eat today evolved from earlier progenitor species. **Dr Juliet Coates (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=4301&Name=dr-juliet-coates)** is interested in understanding how this process of evolution occurred in land plants and also green seaweeds, which represent a largely untapped food resource. Understanding the evolution of plant and algal growth and development along with drought- and stress-resistance strategies will enable transfer of this knowledge to food crops in the future.



Food microbiology, quality and safety

Dr **Kostas Gkatzionis (http://www.birmingham.ac.uk/schools/chemical-engineering/people/individual.aspx?ReferenceId=54040&Name=dr-kostas-gkatzionis)** research group takes a multidisciplinary approach in investigating food microbiological applications and the control of pathogens and spoilage microorganisms for the improvement of food quality and safety.



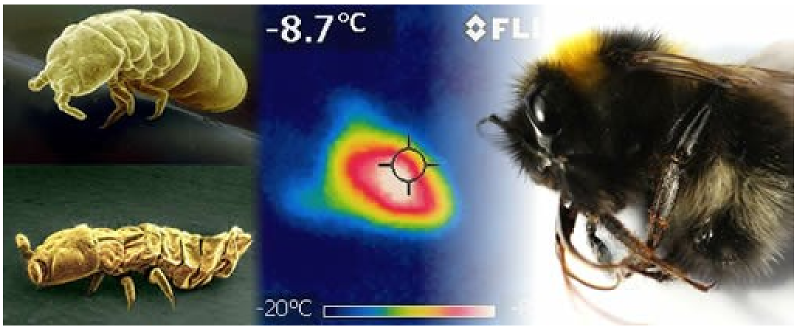
Key areas of focus in research include: The effect of food formulation, structure and processing on microorganisms in complex food matrices. Responses of mixed microbial communities and multispecies biofilms, to antimicrobials and stress during processing. Microbiological applications of nanomaterials/nanotechnology with emphasis on carbon-based nanomaterials. Prediction of product safety, quality and shelf-life (**www.sophy-project.eu (http://www.sophy-project.eu/)**). The effect of microorganisms on food properties, for example, aroma production and interactions between starter cultures and spontaneous microflora.

The group is based in ACDP category 2 laboratories at the **School of Chemical Engineering (http://www.birmingham.ac.uk/schools/chemical-engineering/index.aspx)** benefiting from state-of-the art research facilities for food characterisation and expertise in modelling and predictive microbiology.

Insect responses to environmental change

Insects and other terrestrial invertebrates are crucial to food security, providing key ecosystem services such as pollination and biocontrol of pests. Several species, however, represent a huge burden to mankind, destroying crops directly through feeding or by transmitting plant diseases. Understanding what factors influence the distribution and abundance of insects is therefore extremely important. **Dr Scott Hayward (/staff/profiles/biosciences/hayward-scott.aspx)** is interested in understanding how insect life histories and stress physiology (survival) are influenced by environmental change across rapid, seasonal and longer term timescales.

The Hayward lab uses a systems biology approach to understand the molecular mechanisms underpinning how insects detect environmental change, and respond to stress. In particular this research focuses on insect diapause, an environmentally adaptive dormancy which allows insects to survive periods of adversity such as winter. Understanding diapause is also critical to the commercial production of insects used for pollination, biocontrol and sterile insect technique (SIT).



See also: Professor Jeff Bale's **research into the risks of biocontrol approaches aids regulatory policy (http://www.birmingham.ac.uk/schools/biosciences/research/translating-research.aspx#Res1)**