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BBSRC is part of UK Research and Innovation and invests in world-class bioscience research and training on behalf of the UK public.

Our aim is to further scientific knowledge to promote economic growth, wealth and job creation, and to improve quality of life in the UK and beyond.

Funded by Government, BBSRC invested £498M in world-class bioscience in 2016-2017. We support research and training in universities and strategically funded institutes. BBSRC research and the people we fund are helping society to meet major challenges, including food security, green energy and healthier, longer lives. Our investments underpin important UK economic sectors, such as farming, food, industrial biotechnology and pharmaceuticals.

Further details about BBSRC, our science and our impact can be found at www.bbsrc.ukri.org

About BBSRC Business

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For regular news about BBSRC and the outcomes and impacts of BBSRC-funded research visit www.bbsrc.ukri.org/news
Introduction

My vision for BBSRC-UKRI

Melanie Welham, Executive Chair

This is the first edition of Business since I was appointed as Executive Chair of BBSRC within UK Research and Innovation. There is the usual mix of exciting news, developments and features but I would also like to take this opportunity to set out my vision for an exciting future.

BBSRC has a key role in providing leadership and support for UK bioscience research and enabling researchers to build on their discoveries through innovation. I want BBSRC to be an intelligent investor in research, supporting and enhancing the excellence of UK bioscience and maximising the generation of new knowledge and opportunities to deliver impact.

I see three key elements that will be fundamental to delivering my vision. First is for BBSRC to be strategic and forward looking. We will continue to build on strong foundations, developing the talent and infrastructure that are key for a vibrant research ecosystem. We will support discovery research and transformative technologies to advance the frontiers of knowledge. We will ensure that bioscience contributes to addressing the strategic challenges of the 21st century – sustainability of resources, of food and agriculture and of health.

Second is building strong strategic partnerships. We already partner in many different geometries, both at a national and international level. The creation of UK Research and Innovation provides the opportunity to do this more effectively, especially at a cross-Council level, a topic frequently raised with me by members of the community. To achieve this it will be important that BBSRC is an open, collaborative and collegiate organisation – I hope that we already are and under my leadership we will continue to build on this.

Of course to deliver, we will need to continue to invest in people, the third element underpinning my vision. Continuing to support research careers through studentships and fellowships is fundamental and the recently announced UKRI Future Leaders Fellowships offer an excellent new opportunity across all disciplines. It is also important that we nurture the talent within BBSRC and UK Research and Innovation – the people who provide the vital linkage between the bioscience community and the organisation. I originally joined BBSRC on secondment from my academic appointment at the University of Bath, bringing direct experience of the research environment with me. We are now exploring ways in which we can develop closer links with the research base to promote more of this type of knowledge exchange. When investing in the talent to deliver we must build on the principles of equality, diversity and inclusion.

Finally, I offer my personal reflection that the changes heralded by the creation of UK Research and Innovation offer bioscience an even greater opportunity to develop new knowledge that can make our world a more sustainable, secure and prosperous place – and that is an exciting prospect which I’m looking forward to help make happen.
Scientists and clinicians will gain greater understanding of the impact of food on health thanks to a £40M research investment in the new Quadram Institute.

Researchers and clinicians are being brought together in the Quadram Institute and will work closely with funding bodies and charities, collaborators and investors to ensure fundamental science benefits patients, consumers and wider society.

The four-year £40M investment in research is being funded by the Biotechnology and Biological Sciences Research Council (BBSRC), part of UK Research and Innovation.

The Quadram Institute, at the Norwich Research Park, is set to open later this year in a new state-of-the-art £75M building and will be home to a new gastrointestinal endoscopy unit, with capacity to conduct at least 40,000 procedures a year, making it one of the largest in Europe. A clinical research facility will further link health and nutrition science with clinical research under one roof.

Science Minister Sam Gyimah said: “Researchers funded by BBSRC are making a real difference: helping feed the world, keeping us healthier for longer, and making the UK a more prosperous place. Ten million Brits alive today are expected to live to 100, and this new £75M institute facility will help ensure more of us have a healthy, happy old age. Our investment in science is a vital part of our modern Industrial Strategy.”

Harnessing the power of biology – Impact Report 2017

BBSRC has published its latest Impact Report highlighting widespread impacts from investments, including impacts on industry, policy making, and research infrastructure and capacity.

World-class bioscience research drives the UK’s growing bioeconomy and lies at the heart of key areas of social policy. BBSRC is central to sustaining the UK bioeconomy by providing the knowledge and skills required to drive innovation and capture its benefits and every year BBSRC invests more than £450M in research, training, and capabilities. Read more about the impact of BBSRC investment across the UK and beyond.


Gene-edited pigs resistant to billion-dollar virus

Scientists have produced pigs that can resist one of the world’s most costly animal diseases, by changing their genetic code.

Tests with the virus – Porcine Reproductive and Respiratory Syndrome (PRRS) Virus – found the pigs do not become infected at all. The animals show no signs that the change in their DNA has had any other impact on their health or wellbeing.

PRRS costs the pig industry around £1.75Bn each year in lost revenue in the US and Europe. Vaccines have mostly failed to stop the spread of the virus – which continues to evolve rapidly.

The disease causes breathing problems and deaths in young animals and, if pregnant sows become infected, it can cause them to lose their litter. Researchers at the University of Edinburgh’s Roslin Institute used gene, editing techniques to remove a small section of the gene.

The research was co-funded by BBSRC and Genus PLC.

Professor Alan Archibald said: “Gene editing gives us a powerful tool to help reduce losses in the farming industry while improving the health and welfare of the animals themselves.”

Jef Grainger, Associate Director of BBSRC Science Strategy, said: “This is an exciting result that demonstrates the potential for genome editing to enable significant improvements to be made in the health and welfare of farmed animals.”
Healthy soil lifts animal weight

Managing soil by well-designed grazing is key to an animal’s growth and wellbeing according to new research linking soil health, pasture value and sustainable production.

Individual pastures on livestock farms yield surprisingly dissimilar benefits to a farm’s overall agricultural income, and those differences are most likely attributable to the varying levels of ‘soil health’ provided by its grazing livestock.

The study by Rothamsted Research evaluated how efficiently nutrients are used on a livestock farm, on a field-by-field basis for the first time, and links soil health to animal growth.

“The prospect that commercial livestock producers could improve their productivity by purely changing rotational patterns is exciting,” says Taro Takahashi, an agricultural economist at Rothamsted’s North Wyke Farm Platform (NWFP) in Devon, who led the study.

The majority of livestock farms in the UK operate rotational grazing, which involves moving animals from one field to another. While this practice supplies more fresh forage to animals throughout the season, it makes farming systems more difficult to monitor and optimise.

New solution to harmful algal blooms

A cheap, safe and effective method of dealing with harmful algal blooms is on the verge of being introduced following successful field and lab tests.

Moves to adopt use of hydrogen peroxide (H2O2) as an effective treatment against toxic algae are already underway following the results of new research by a team from the John Innes Centre and the University of East Anglia.

Successful trials last summer showed that H2O2 was effective against the golden alga, Prymnesium parvum, and that fish and macroinvertebrates were unharmed by the treatment.

Toxic algae are responsible for killing millions of fish worldwide each year and a threat to the £550 million economy of the Broads National Park in East Anglia, where trials are taking place.

Follow-up lab tests have demonstrated that controlled doses of the versatile chemical compound could be even more effective in dealing with cyanobacteria commonly known as blue green algae – a major public health hazard and potentially fatal to dogs and livestock.

The research could have widespread implications for the way harmful algal blooms are managed in waterways worldwide.

How wheat can root out the ‘take-all’ fungus

A team of young researchers has now pinpointed a way of easing cereals’ risks from a deadly root pathogen.

In the soils of the world’s cereal fields, a family tussle between related species of fungi is underway for control of the crops’ roots.

‘Take-all’ is a devastating root disease of cereal crops worldwide caused by the fungal pathogen Gaeumannomyces tritici. Farmers struggle to control the disease because few chemical seed treatments are available, and current biological strategies are hindered by the variety of soil types.

But now a young team of scientists from Rothamsted Research, funded by BBSRC, has come up with some answers.

The team collected samples of the beneficial fungus from the fields of Rothamsted Farm and developed a laboratory test to explore their ability to colonise and protect the roots of barley, rye, wheat and the rye/wheat hybrid, triticale. In field trials, the team identified commercial cereal varieties that performed better than others.

Rothamsted’s take-all research group is part of one of the institute’s five strategic programmes, namely Designing Future Wheat, a multi-institute initiative that focuses specifically on improving overall crop value and resilience. It is funded by BBSRC.
Curapel, a finalist in the BBSRC Innovator of the Year competition in 2014, has launched its first product on the UK market, Pellamex, which helps restore the skin protective barrier in dry, sensitive and eczema-prone skin.

Curapel is a skin healthcare company that was spun out of The University of Manchester’s Dermatology Centre four years ago. Under the brand name Curapella, the company is developing a portfolio of natural, safe and innovative products for people with chronic inflammatory skin diseases such as eczema and psoriasis.

The patented technologies underlying Curapel’s product portfolio were originally researched by Dr Neil Gibbs and his colleague Dr Cath O’Neill who both received grants from BBSRC, helping to take the ideas out of the lab and towards the market.

Dr Neil Gibbs agrees the recent launch of Curapel’s first product was a pivotal moment: “It’s been really exciting to see an academic research concept transform into a tangible product that is now being very well received by people who have eczema.”
**Wheat research discovery could shape future crops**

A new study shows isolation of a gene controlling the shape and size of spikelets in wheat may help breeders deliver increased yields.

The findings discovered by the John Innes Centre give breeders a new tool to accelerate the global quest to improve wheat, and also highlight a range of next-generation techniques available for fundamental research into wheat.

The team focused on the genetics of floral architecture behind a specific mutant trait in bread wheat, allowing two spikelets to be grown instead of the usual one. This trait could lead to an increase in yield and could apply to other major cereals including corn, barley and rice.

The genetic identification of the relevant trait represents a significant milestone in research on wheat, a crop with a notoriously complex genome.

The Wheat Initiative, which coordinates global research for wheat, had identified floral architecture as one of the key traits which must be improved if a 1.6 per cent yield increase needed to feed a growing world population is to be reached.

**Green tea may prevent heart attacks and strokes**

Scientists from Lancaster University and the University of Leeds have discovered a compound found in green tea breaks up and dissolves potentially dangerous protein plaques found in the blood vessels.

Atherosclerosis is the build-up of fatty material inside arteries which can reduce the flow of blood to the heart and brain. In advanced stages of the condition, a protein called apolipoprotein A-1 (apoA-1) can form amyloid deposits. These deposits build up within atherosclerotic plaques. Here, they increase the size of the plaques, further restricting blood flow and making the plaques less stable, increasing the risk of a heart attack or stroke.

Researchers found that epigallocatechin-3-gallate (EGCG), most commonly associated with green tea, binds to the amyloid fibres of apoA-1. This converts the fibres to smaller, soluble molecules that are less likely to be damaging to blood vessels.

Now, the team are working on finding ways of introducing effective amounts of EGCG into the bloodstream without it being necessary to drink large and potentially harmful quantities of green tea.

The research was funded by the British Heart Foundation and also part-funded by BBSRC.

**Swine and Poultry Research Initiative**

Eleven projects are being funded by BBSRC through the Newton Fund’s UK-China-Philippines-Thailand Swine and Poultry Research Initiative to address microbiological diseases.

Asia accounts for more than one-third of the world’s chicken meat production and is the leading pork-producing region in the world. Diseases of livestock, such as foot and mouth, avian influenza and campylobacter, result in huge economic losses. To reduce the economic and human health impact of these diseases, and to increase food security, research is required to develop rapid diagnostics, novel therapeutics and vaccines.

Eleven collaborative projects are being funded, involving leading UK bioscience researchers and teams in China, the Philippines and Thailand. The Swine and Poultry Research Initiative brings together multiple countries to tackle core challenges for food security across regions.
UK Research and Innovation operates across the whole of the UK with a combined budget of more than £6 billion and is an independent organisation with a strong voice for research and innovation, both to government and internationally.

Funding principally comes from the Science Budget of the Department for Business, Energy and Industrial Strategy (BEIS).

The mission of UK Research and Innovation is to be a trusted partner and to ensure research and innovation continue to flourish in the UK. This will be made possible by supporting and helping to connect the best researchers and innovators with customers, users and the public. Every pound of taxpayers’ money will be invested wisely in a way that maximises impact for citizens, in the UK and across the world.

UK Research and Innovation will be working with partners and stakeholders in the research and innovation communities to:

- push the frontiers of human knowledge and understanding
- deliver economic impact and social prosperity
- create social and cultural impact by supporting society and others to become enriched, healthier, more resilient and sustainable.

Now part of UK Research and Innovation, the work of BBSRC will continue as before – investing in world-class bioscience research and training on behalf of the UK public.

BBSRC supports research and training in universities and strategically funded institutes: Babraham, Pirbright, IBERS, Quadram, The John Innes Centre, Roslin, Rothamsted and Earlham.

The research and the people being funded are helping society to meet major challenges, including food security, green energy and healthier, longer lives, and the investments in research underpin important UK economic sectors, such as farming, food, industrial biotechnology and pharmaceuticals.

Shortly before UK Research and Innovation was officially formed it was announced that Melanie Welham had been appointed Executive Chair of BBSRC, having previously been interim Chief Executive.

UK Research and Innovation was formally established on April 1st this year and is ideally positioned to promote the UK’s unrivalled strengths in research and innovation both at home and around the world.

UKRI will play a key role in delivering the Government’s Industrial Strategy and will ensure that we continue to make the most of our world-leading R&D sector and provide support for our researchers and scientists.

The excellent research, people and infrastructure that BBSRC invests in make a real difference to how we understand the world around us. Creatively exploring the frontiers of bioscience yields remarkable insights into how life works and will, in turn, improve our lives, giving us secure and nutritious food, renewable resources, and better health for us and our animals.

As a part of UKRI, I want BBSRC to be an intelligent investor in research, supporting and enhancing the excellence of UK bioscience and maximising the generation of new knowledge and opportunities to deliver impact. My vision for BBSRC has three key elements: BBSRC will:

- be strategic and forward looking
- build strong strategic partnerships
- continue to invest in people

You can read more about my vision for the future on page 3 or by reading my blog: [https://bbsrc.ukri.org/ecvision/](https://bbsrc.ukri.org/ecvision/)

I’m delighted to have the opportunity to continue to lead BBSRC in UKRI and to work in partnership to keep the UK at the global forefront of research and innovation.

Melanie Welham
Executive Chair, BBSRC
The Quadram Institute will be delivering innovative solutions to global challenges in food-related disease and human health. © Quadram Institute

Below from left:
Sir Mark Walport.
Sir John Kingman, Jennifer Rubin, Roly Keating, Greg Clark and Sir Mark Walport at the launch of UKRI.
The new Quadram Institute, Norwich – due to be completed later this year.

Right:
Dr Marko Hyvonen explains his project to Sir Mark Walport, Melanie Welham and Malcolm Skingle at the BBSRC Innovator of the Year awards.
Far right:
Science Minister Sam Gyimah is given a tour of the new Quadram Institute by Dr Simon Rushbrook.
Camelina: The quest for Omega-3

The oceans are under relentless pressure as the world population grows and we increasingly look to fish as an important food supply. Alongside this is our increasing reliance on fish to provide us with Omega-3, a polyunsaturated fatty acid that our bodies need to function.

This explains the quest to find a sustainable source of fish oils.

Omega-3 is good for our joints, brain and especially our heart. The most important types of Omega-3 are found almost exclusively in fish and seafood, although other types of Omega-3 are found in plant products like vegetable oils and nuts. In places like Japan and Iceland, where oily fish is much more part of the staple diet, people are much less prone to illnesses like heart disease and rheumatoid arthritis.

The unlikely solution to finding a sustainable source of fish oils could come from a plant called Camelina, commonly known as false flax. It’s a hardy plant that grows well in both cold and arid climate. Historically, Camelina has been grown in Europe for many centuries as an oilseed crop for lighting and more recently in North America as an industrial crop to make aviation fuel.

Johnathan Napier, a leading pioneer in plant biotechnology based at Rothamsted Research, has carried out field trials in the UK to create plants that can provide a sustainable source of fish oils. The crops have been genetically modified (GM) enabling them to produce these particular Omega-3 fatty acids in their seed oil, something no other plant can do.

New trial feed for salmon

Professor Jonathan Napier and leading fish nutritionist, Professor Douglas Tacher from Stirling University, have been collaborating for nearly twenty years on finding a sustainable solution to deliver novel sources of Omega-3 fatty acids.

Now, together, they are embarking on a new aqua feed trial delivering an alternative fish feed solution, using a GM oil ingredient, to Atlantic farmed salmon which they hope will relieve pressure on stressed marine resources.

Walking around the site where the trial will take place, it is clear Professor Napier is enthusiastic about the latest stage in this ongoing research using the Camelina plant: “This is the largest feeding trial to validate the efficacy of the project. It’s extremely significant because it will demonstrate the ability to use Omega-3 fish oils from plants across the whole production cycle of salmon, and as a total, drop-in replacement for marine-derived fish oils.”
GM fish – I think not!

Professor Napier makes clear the fish in this project are not GM, rather that, as part of their diet, they are being fed a novel ingredient derived from a GM organism. The project will serve as both a proof of concept and a potential solution to the sustainability issue in supplying fish oils to farmed fish.

The young fish have already been added to the pens in which they will be fed and monitored during the course of the trial. The pens are outside in sea water and are being fed and monitored by a team of experts. Nearby there are salmon that will be fed normal fish feed so that the two can be compared. Walking around the pens that have been prepared for the trial, Professor Napier is joined by Professor Douglas Tocher from Stirling University.

Professor Tocher explains about how the trial will work: “The joint project allows us to grow salmon to market size in sea pens while extracting data to confirm that the GM oils support good growth, feed utilisation and product quality.”

During the course of the trial, Dr Monica Betancor, a Research Fellow at Stirling University, plays a crucial role by checking on the salmon’s health and collecting data, “Collecting samples and analysing the data are imperative to the project. To test the performance of the fish, I’ll be measuring the weight and growth of the fish, but also looking at tissue and molecular samples comparing results of fish fed the GM Camelina fish feed to salmon fed the normal diet.”

Labour of love

Professor Napier has long been exploring how to develop a sustainable source of Omega-3 through the use of transgenic plants with several successful field trials in GM oilseed crops specifically in a flowering plant called Camelina.

They have isolated the genes in marine micro-organisms responsible for biosynthesis of Omega-3, identified a plant host and produced GM crops in experimental field trials at Rothamsted Research. The modified Camelina has high levels of the beneficial Omega-3 fatty acids, proving to be a safe and cost-effective source of these for aquaculture feeds.

“It’s taken a decade to develop plants able to produce the oils and be tested in aquaculture systems,” said Professor Napier.

The almighty omega-3 fatty acids

Omega-3 fish oils, also known as Omega-3 long-chain polyunsaturated fatty acids such as EPA and DHA, have been proven as beneficial to human health, reducing the risk of cardiovascular disease and other metabolic diseases such as obesity and type-2 diabetes. These oils are credited as being crucial for optimal human nutrition, but the wild fish stocks which provide them are at maximum levels of managed sustainability, meaning the current world fish stocks are simply not able to provide enough nutrition for a growing global population.

“A portion of farmed salmon today has about half the level of the Omega-3 fatty acids, EPA and DHA, compared to ten years ago,” advises Professor Tocher.

Sustainability and beyond

Both professors are determined to return levels of Omega-3 fatty oils in farmed fish to levels of a decade ago, and agree consumers should expect the purchased product to have sufficient amounts of healthy Omega-3 fish oils. Professor Napier is keen to stress that the results of the trial should complement and not replace existing aquaculture activities: “This GM technology shows great promise as a potential solution to help fish farming become more sustainable and continue growing as an industry.” He added “What we really want is to ensure that every person on our planet gets the Omega-3’s they need – and using our GM Camelina, we can take pressure of the oceans whilst delivering better nutrition from the land.”

Want to know more?

To find out more visit:
http://bbsrc.ukri.org/camelina
Watch our video report:

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“A portion of farmed salmon today has about half the level of the Omega-3 fatty acids, EPA and DHA, compared to ten years ago,” advises Professor Tocher.
Frontier research pushes the boundaries of existing knowledge making discoveries and providing new insight into the function of biological systems – at all scales. It is about supporting excellent fundamental research that is driven by curiosity rather than by BBSRC’s wider strategic priorities. Addressing fundamental questions about how the world works often provides the inspiration for innovation, expands the frontiers of knowledge, and has wide-ranging social and economic benefits. A number of excellent examples of frontiers research, recently funded through our Responsive Mode mechanism, are featured here.

Frontier Bioscience is central to the BBSRC-UKRI mission to advance knowledge and technology. Our long-standing commitment to excellence in discovery research has helped position the UK as a leading nation in bioscience. We are prioritising Frontier Bioscience through the 2018 strategic Longer Larger grants (sLoLa) call, making major investment in large-scale projects. This will enable potentially high-impact discoveries that advance our fundamental understanding of living systems and lead to a significant contribution to bioscience knowledge.

Causal brain connectivity: Brain stimulation combined with optically pumped magnetometers

Professor Ole Jensen, University of Birmingham

Professor Jensen’s team at the University of Birmingham is using a new type of magnetic sensor called optically pumped magnetometers to investigate connectivity in the human brain. Jensen is developing optically pumped magnetometers that can be combined with transcranial magnetic stimulation allowing the assessment of brain connectivity by stimulating one region and measuring the response in another region. This research has the potential to provide capabilities needed for understanding the brain as a network, shedding light on brain function.

These magnetic sensors, and the techniques developed through this research, have the potential to revolutionise human electrophysiology and, in future, could be used in the clinical setting for diagnostic purposes.
Non-classical protein secretion by bacteria
Professor Frank Sargent, Newcastle University

Professor Frank Sargent, from Newcastle University, is spearheading frontier research to discover how a little-understood bacterial enzyme system works to use chitin as a source of carbon and nitrogen for growth.

Chitin is, after cellulose, the second-most abundant natural polymer on Earth. Present in insect and crustacean exoskeletons, as well as in fungi, it is completely insoluble and incredibly tough and stable. However, some bacteria have figured out how to use chitin as a carbon and nitrogen source for growth. Sargent’s team is working to find out how they do it.

Findings from this research have the potential to enable us to process food waste into biofuels or other chemicals or prevent pathogenic bacteria infecting their host.

Investigating how genes are switched on to make internal organs
Dr Fiona Wardle, King’s College London

Dr Wardle, from King’s College London, is leading research to understand how gene activation is coordinated during embryogenesis.

Each organ in the body is made up of different types of specialised cells that perform particular functions, such as liver cells that clean the blood and pancreas cells that secrete insulin. However, during the earliest stages of embryonic life, these cells have not yet become specialised and must go through several steps before forming into different organs. Dr Wardle’s team will use cutting-edge techniques in developmental biology and genomics to better understand the regulation of embryonic development.

Findings from this work could be applied to the generation of endodermal cells in the lab with the aim of treating diseases of endodermal organs, such as liver failure or diabetes, in the future.

(Re) design of the chloroplast genome
Professor Alison Smith, University of Cambridge

At the University of Cambridge, Professor Alison Smith is driving synthetic biology research of fundamental importance to globally important areas such as food and feed production, biofuel generation, sustainable production of phytochemicals and novel bioactives, and biological carbon capture.

Plants and algal cells contain a compartment, or organelle, not found in animal cells – the chloroplast. This is the site of photosynthesis and other important biosynthetic processes, and it contains its own genetic system, the circular genome of the chloroplast – the ‘plastome’. Smith’s team, together with that of Prof Saul Purton from the University College London, is seeking to understand and optimise the plastome as a platform for future engineering efforts, such as production of high-value products in the chloroplast or re-engineering the photosynthesis process.

This research has the potential to contribute to the development of sustainable solutions in the global challenge to provide food, feed, fuels and pharmaceuticals to an ever-increasing population.
Artificial intelligence & machine learning

Artificial intelligence or AI is best described as intelligence demonstrated by machines, where the machine mimics learning – potentially making mistakes and using that mistake to correct future behaviour or problem solving.

Machine learning is a part of artificial intelligence, using computers that can themselves improve upon the task they have been set to perform. Computers are able to handle huge amounts of data, and being able to ‘learn’ from that data makes them particularly good at exploring and analysing large amounts of complex information and data.

Here are a few examples of the exciting work where birdsong could help tackle human disease, food security is being delivered through a mobile phone and big brother is bringing improvements in animal health and welfare. All made possible by artificial intelligence and machine learning.

Professor Liangxiu Han, Manchester Metropolitan University
Early accurate detection and identification of crop diseases play an important role in effectively controlling and preventing diseases for sustainable agriculture and food security.

Using advanced image processing, machine learning and cloud computing approaches, Professor Han’s team has developed an innovative automated machine vision system for efficient crop disease diagnosis from images.

Through a BBSRC-GCRF Translation Award, the team will now take this technology forward, working closely with partners in China, aiming to develop a tool that can run on mobile devices and enable farmers to perform immediate potato disease diagnosis. This machine vision system will dramatically speed up diagnosis, giving growers more accurate information on which to base their disease control strategies and stop yield loss from being reduced by infection.

This technology can help make a significant impact on agricultural productivity and farmer incomes, ensuring food security, and deliver highly cost-effective, long-term economic and social impact in China.

Food security delivered through a mobile phone

Dr Robert Francis Lachlan, Queen Mary, University of London

Songbirds, such as chaffinches and great tits, share an unusual ability with humans: vocal learning. Like us, birds need to hear and imitate others in order to develop their vocal communication signals.

Research from a number of disciplines has uncovered links between human speech and bird song, and bird song currently represents the best animal model we have for understanding the biology of speech. Using machine learning approaches to study bird song syllables, Dr Lachlan’s research seeks to train ‘machine learning’ computer algorithms using birds’ perceptual judgments of song similarity and investigate how birds learn their songs.

By introducing the first biologically validated method to compare songs, this research will enable a large change to the methods used by the research field as a whole, benefiting research in fields from neuroscience and human disease to biotechnology and food security.

From tweets to human disease: the power of learning songs

Professor Ilias Kyriazakis, Newcastle University

Subclinical and clinical disease is the main factor responsible for pig system inefficiency and reduction in productivity and welfare. Currently disease detection is done through human observation or diagnostic surveillance, but monitoring continuously involves significant costs and effort.

Through a UKTI Agri-Tech Catalyst funded by BBSRC and Innovate UK, researchers at Newcastle University have been developing and validating technology to automatically monitor performance and behaviour in groups of growing pigs.

The work exploits the fact that health and welfare challenges lead to changes in behaviour long before clinical signs arise. Individual pig growth and group movements are automatically captured and analysed using low-cost camera installations and computer vision and machine learning techniques, thereby providing information about pig performance, behaviour and group-dynamics so as to allow rapid intervention to improve health and welfare and increase farm efficiency.

Big brother: bringing improvements in animal health and welfare

Professor Paul Rees, Swansea University
Research funded through the UK BBSRC-US NSF-BIO Lead Agency pilot has enabled UK researchers of Swansea University to collaborate with colleagues at the Broad Institute of Harvard and MIT, Cambridge, USA, to develop software with the potential to unlock hidden information within images of cells.

The project will develop and demonstrate software to mine data from imaging flow cytometers – instruments that capture thousands of images of cells per second. The research seeks to analyse these images to precisely measure hundreds of features related to cell or morphology. This project will develop advanced machine learning software to accomplish this, using few or indeed no fluorescent markers, eliminating the need to perturb cells.

The resulting open-source software will be freely available to scientists worldwide providing a valuable resource for both biological and biomedical researchers.

The resulting open-source software will be freely available to scientists worldwide providing a valuable resource for both biological and biomedical researchers.

To read more about AI visit: www.bbsrc.ukri.org/ai

Professor Jonathan Ashmore FRS, Director LIDo, Training Programme

The London Interdisciplinary Doctoral Programme (LIDo) is a BBSRC-sponsored project supporting over 190 four-year PhD studentships across six London universities: University College London, Kings College London, Birkbeck College, Queen Mary University of London, London School of Hygiene and Tropical Medicine and the Royal Veterinary College.

The highly competitive places on the programme draw students with a range of biology, engineering and physical sciences backgrounds and so highly motivated to engage with applications of Artificial Intelligence (AI) and Machine Learning (ML) technologies at the start of their careers. Drawing on the wide range of computer science research at the institutes as well as established industrial collaborations with, amongst others, Google, LIDo is able to offer projects with strong AI and ML components.

As examples, well aligned with the Key Challenges framework of the BBSRC, there are projects which will be using the next protein synthesis design by combining AI and synthetic biology at University College London and Babcock and at the other end of the biological scale, an AI/ML project at the Royal Veterinary College for studying dynamic locomotor behaviour to improve poultry welfare using realistic musculoskeletal models (a collaboration with DeepMind).

Industrial Strategy Challenge Fund studentships within the Grand Challenge theme of Artificial Intelligence and Data-Driven Economy

The Future of AI

UK\US partnership provides a resource to unlock secrets within cells

To read more about AI visit: www.bbsrc.ukri.org/ai

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Celebrating research and discoveries in biological sciences, the BBSRC Innovator of the Year competition has been awarding innovation for a decade, and the climax of the 2018 event took place at the Mermaid on the banks of the Thames in the heart of London.

The judges evaluated submissions from candidates before interviewing the finalists on the day. Twelve finalists in four categories competed for the prestigious title BBSRC Innovator of Year 2018.

The categories include commercial impact, social impact, international impact and early career impact. The winner of each category receives £10,000 with the overall winner receiving an additional £10,000.

A range of diverse research had been delivered by the finalists, including: behavioural neuroscience that helped shape new guidance for emergency services, the development of novel fungicides to combat fungal resistance, and building resilience in the vanilla supply chain to help protect the world’s favourite flavour.

Before the winners were announced Professor Sir Mark Walport, the Chief Executive of UK Research and Innovation, the organisation that includes all the research councils including BBSRC, took the opportunity to speak with the finalists. Sir Mark was enthusiastic about the event: “There’s a fantastic array of innovators assembled here. I’ve had a lot of fun talking to them, they have great energy, there’s a complete range of ideas from soil science to firefighting to bee ecology, an amazing array of innovation with a group of people who have a real interest in applying it too.”

In front of invited guests the Executive Chair of BBSRC, Professor Melanie Welham, and Professor Malcolm Skingle, BBSRC council member and Director of Academic Liaison at the British pharmaceutical company GlaxoSmithKline, announced the winners.

Dr Sabrina Cohen-Hatton and Professor Rob Honey from Cardiff University collected the Social Impact Award and went on to become overall winners of the title BBSRC Innovator of the Year 2018.

Speaking after collecting the award, Professor Rob Honey said he was surprised: “I’m flabbergasted, I have to say. Given the competition I thought it was extraordinary. We are both very, very happy.”

Doctor Sabrina Cohen-Hatton added, “For us, from day one this has been a real labour of love and we’ve really focussed on what we can do to practically change a situation to make the working environment for firefighters better. When we came here and saw the sheer diversity of the work that’s been done and the impact that it’s had, even to be categorised within that group was a privilege – but to be winners, honestly, I am lost for words.”

The international impact winners were Professor Martin Broadley and Doctor Louise Ander from the University of Nottingham and the British Geological Survey. Doctor
The winners from left to right: Ben Dolman, Dr James Winterburn, Dr Neil Gibbs, Professor Rob Honey, Dr Sabrina Cohen-Hatton, Dr Louise Ander and Professor Martin Broadley.

Louise Ander said, “We are absolutely delighted, of course, and completely didn’t expect it. Really surprised but thrilled, so thank you.”

Professor Martin Broadley added, “I almost fell off my seat, it was really unexpected. We are working in an area that is sometimes quite challenging to explain in a few short moments and so we are delighted that the panel has selected us.”

The Early career winners were Ben Dolman and Doctor James Winterburn from the University of Manchester. Ben Dolman was excited by the win: “It’s a really great feeling and it’s been an amazing opportunity to meet all of the other teams and see some really interesting ideas. It’s really great to have won.”

Doctor James Winterburn added, “For me, at least, it was a genuine surprise and it’s been nice talking to everyone and the networking opportunities.”

After the awards, BBSRC’s Melanie Welham praised all finalists: “Once again the Innovator of the Year awards provided the perfect opportunity for researchers to receive the recognition that they and their teams so justly deserve. They are a credit to UK research and I am delighted that BBSRC within UK Research and Innovation continues to support and encourage them in their work. I hope their success will enable them to maximise the benefits of their work and they will continue to use their talents to innovate.”

To watch our news story from the event visit bit.ly/Ioy2018video

The winners

Commercial impact
Dr Neil Gibbs, The University of Manchester

Social impact
Dr Sabrina Cohen-Hatton and Professor Rob Honey, Cardiff University

International impact
Professor Martin Broadley and Dr Louise Ander, The University of Nottingham and British Geological Survey

Early career impact
Ben Dolman and Dr James Winterburn, The University of Manchester

Overall winner
Dr Sabrina Cohen-Hatton and Professor Rob Honey, Cardiff University
Now celebrating its 10th year, BBSRC’s Innovator of the Year recognises and rewards individuals and small teams who have harnessed the potential of their excellent research. Since 2009 the awards have recognised a wealth of talent making important discoveries with their research. Here are the winners – a decade of BBSRC celebration.

**Professor Stephen Jackson**  
*University of Cambridge*  
Stephen had made a series of key discoveries around DNA damage and its repair that led to a range of anti-cancer drugs being used in clinical trials.  
Speaking at the time he said, “It’s a tremendous honour to receive this prestigious award. It really reflects that science can yield both exciting science and commercial and social applications. I think this award is a showcase for how funding of science by BBSRC is able to provide major tangible benefits to not only the UK science base but also the biotech and pharmaceutical industries.”

**Professor Jason Swedlow**  
*University of Dundee*  
Jason founded The Open Microscopy Environment – an open-source software tool, used by thousands of labs worldwide for managing biological images.  
Speaking at the time he said, “It is a great honour to accept this award. Our vision has always been to create a global standard for imaging software and the community that has grown up around the open-source development is extraordinary. In reality I am receiving this award on behalf of a large group of extremely talented people who share a common commitment to innovation through team work, collaboration and the process of creating something new and exciting as a community.”

**Professor Shankar Balasubramanian**  
*University of Cambridge*  
Shankar was the inventor of an ultrafast DNA sequencing method. Building the system into a chip enables simultaneous sequencing of hundreds of millions of DNA fragments.  
Speaking at the time he said, “I am delighted to accept the award of BBSRC Innovator of the Year and I do so on behalf of many people who have made important contributions at many stages of the project. None of this would have happened without the support of BBSRC. Their backing was essential for the blue skies research that gave rise to our original inventions.”

**Professor George Lomonossoff**  
*John Innes Centre*  
George and his team have developed a practical system for safe, efficient, and high-yielding protein expression in plants which can be used in drug development.  
Speaking at the time about winning the award he said, “You want to hope but you don’t dare. It’s a big surprise; rather like winning an Oscar.”

**Dr Ryan Donnelly**  
*Queen’s University Belfast*  
2009  
2010  
2011  
2012  
2013
Celebrating 10 years of Innovator of the Year

Professor Luke Alphey
Pirbright Institute
Luke developed an innovative solution for insect control using modern biotechnology and advanced genetics, to provide safe and sustainable control of insect pests.

Speaking at the time he said, “It is such a great honour to win Innovator of the Year – particularly when there is such stiff competition. This really showcases how innovations from UK bioscience are tackling such a huge range of challenges.”

Dr Shelby Temple
University of Bristol
Shelby developed a new tool for examining how eyes perceive polarised light, a device that can be used to help spot age-related macular degeneration (AMD), the leading cause of incurable blindness in the developed world.

Speaking after his win Shelby said, “I was overwhelmed with excitement and pride that all the hard work had led to this fantastic recognition, but I also felt bashful because there were so many great and deserving projects.”

Professor Ian Givens
University of Reading
Ian and his team altered the diet of cows to help reduce both saturated fats in dairy products and the carbon footprint of these foods, benefitting both the UK dairy farmers and the milk processors.

Speaking at the time he said, “I am honoured and very surprised to be named the BBSRC Innovator of the Year. Innovation is at the heart of research at Reading, and I am lucky enough to work in one of the best possible research environments of its kind.”

Professor Tom Brown
University of Oxford
Tom’s entrepreneurial activities have turned novel forensic, diagnostic and therapeutic applications of nucleic acids into successful products and companies. His BBSRC-funded research has been patented and has many applications in synthetic biology, biotechnology and drug discovery.

Speaking at the time he said, “I’m amazingly proud to have been chosen for this award given the remarkable array of innovators who were finalists – I was particularly impressed by the global nature of some of the innovations up for the award.”
Professor Sarah Cleaveland  
OBE, FRS, FRSE  
Veterinary surgeon and Professor of Comparative Epidemiology at the University of Glasgow  
A large part of her Sarah’s research has focused on the epidemiology of zoonotic diseases in northern Tanzania, including rabies. Her work has involved the initiation of mass rabies vaccination programmes for domestic dogs in the Serengeti, indirectly preventing hundreds of human deaths and protecting wildlife species such as the endangered African wild dog.  
Speaking about the role of women in research and innovation Sarah says, “My successes have been achieved only because of teamwork, and these teams have all been marked by the creative leadership and contributions of many women scientists, particularly younger women, with whom I have had the privilege to work over the years”

Professor Melanie Welham  
BBSRC Chief Executive and Visiting Professor at the University of Bath  
Melanie has a well-developed understanding of the requirements and demands of delivering BBSRC research and the interface between the Council and the wider research and innovation community.  
Melanie is keen to encourage women in research and innovation: “Advancing knowledge requires the engagement of the widest and most diverse pool of research talent. Women often bring valuable and different perspectives and approaches to research, so it is important that across the biosciences we are encouraging and supporting female researchers at all stages of their careers”.

Professor Dame Nancy Rothwell  
FRS, FMedSci  
President and Vice-Chancellor, University of Manchester  
Professor Dame Nancy Rothwell, FRS, President and Vice-Chancellor, leads by example. Her own research in the field of neuroscience has contributed towards major advances in the understanding and treatment of brain damage in stroke and head injury.  
Nancy takes a strong and active interest in the public communication of science and acknowledges there is still progress to be made: “Female representation in science, particularly at the most senior levels, has certainly improved, but we still have much work to do to gain full equality.”

Samantha Fox  
Researcher at John Innes Centre and Director of the Youth STEMM Award  
Samantha is Director of the Youth STEMM Award and a researcher in the Enrico Coen lab at the John Innes Centre. In addition to her research she is the John Innes Centre Youth Aspiration Champion and is passionate about broadening young people’s horizons about STEM (Science, Technology, Engineering and Maths).  
Samantha is keen to promote the interest of young people in science: “I have launched several initiatives to help inspire young people about STEMM and I am passionate about broadening young people’s horizons and increasing the diversity of those who go on to study those subjects post 16.”
Women in science have changed the world. Members of our research community have played an important role in shaping the course of history with their commitment to the bioscience world. Here are just some of the women that have worked with BBSRC and continue to provide inspiration to us all.

Professor Eleanor Riley, BSc, BVSc, PhD, FRSB, FMedSci
Director of the Roslin Institute and Dean for Research and Professor of Immunology and Infectious Disease, Royal (Dick) School of Veterinary Studies

Professor Eleanor and has more than 30 years’ experience of research in the UK and Africa.

Eleanor highlights that more women should hold senior positions in research and innovation. “It has been said that ‘women hold up half the sky’. In the 21st century, female postgraduate students and post docs hold up at least half of the life science research in the UK but have far too few role models in senior positions to give them the assurance that their contribution is valued. It is up to those of us in these senior roles to work to change that, by inspiring and encouraging our female colleagues and giving them the opportunities they have earned”.

Professor Dame Athene Donald, DBE, FRS
Master of Churchill College, Cambridge

Professor Donald has been at the Cavendish since 1983, and became a professor in 1998.

The unifying theme throughout Athene’s career has been understanding structure-function-processing relationships. Her activity sits within the sector of Biological and Soft Systems, and focuses on using the ideas of soft-matter physics to study a wide range of systems of both synthetic and biological origin.

Athene is a supporter of diversity in research and innovation: “Diversity of ideas comes from a diversity of people. Innovation does not come easily from group think. We need more young women entering scientific careers to provide the necessary pool of diverse and excellent talent for innovation, and to enable each and every one of them to fulfil their potential and not be stifled or deterred early on.”

Professor Ottoline Leyser
Director of Sainsbury Laboratory, University of Cambridge

Ottoline is Director of The Sainsbury Laboratory, a world-leading research institute working on the science of plant-microbe interactions. The Laboratory has developed an enviable reputation for the quality of its fundamental scientific research but is also committed to delivering science solutions that reduce crop losses to important diseases.

Ottoline agrees that research and innovation benefits from a diverse science community: “Progress in science depends on looking at questions from different perspectives. A highly effective way to do this is to collaborate with a diverse group of people. Put simply, science needs diversity. A top priority is to embed an inclusive research culture that supports and welcomes difference and challenge.”

Professor Polly Roy, OBE, MSc PhD FMedSci
Professor of Virology, London School of Hygiene & Tropical Medicine

Professor Polly Roy is a leading virologist who has received one of India’s most prestigious academic awards and is recognised for her studies of Blue Tongue, a gnat-borne virus that affects sheep, cattle and goats in hotter parts of the world.

Polly’s advice for men or women in research and innovation is exactly the same: “Always be focused on your science, do not let distractions get in the way, and be put off by any hurdles. Be persistent, have tenacity and be patient. These are attributes that will allow you to achieve your goal. Do not be put off, keep going!”
Scientists from the Scottish Association for Marine Science (SAMS) have developed an early warning system for toxin-producing ‘harmful algal blooms’ (HABs), to protect human health and minimise risk to the UK aquaculture industry.

Some blooms of phytoplankton, so-called ‘harmful algal blooms’, can be detrimental to humans through the production of biotoxins that become concentrated in the flesh of filter-feeding shellfish.

The accumulation of toxins presents a health risk if these shellfish are eaten by humans. Other HABs can kill farmed fish, resulting in serious financial consequences for the aquaculture industry.

Professor Keith Davidson and his team from SAMS used a combination of satellite remote sensing, free-floating and moored instruments measuring properties of the water column and mathematical modelling to better understand where these harmful blooms develop and under what conditions they will be transported to the coastal fjords where aquaculture is practiced.

The resulting early warning system allows industry to better plan their husbandry and harvesting to minimise business risk from HABs.

One of the most important harmful blooms is *Karenia mikimotoi*, which can kill farmed fish and, in this project, blooms of *Karenia* were detected by satellite. This triggers the SAMS model to generate a ‘HAB alert’ for potentially impacted sites.

SAMS maintains cultures of *Karenia* and other phytoplankton species in-house via the Culture Collection of Algae and Protozoa (CCAP) – Europe’s largest collection of algae and protists, with around 3,000 strains. CCAP supports the aquaculture industry by delivering training courses that teach businesses to identify and enumerate toxic phytoplankton in their own water samples.

Detailed HAB risk assessment bulletins have been developed for shellfish growers in Shetland as a case study for wider UK activity, due to 50 per cent of Scottish shellfish industry being based in the area. These bulletins are produced weekly for use by aquaculture practitioners and this is the first time that modelled ocean current forecasts have been interpreted to provide forecasts of the likelihood of these damaging biological events.

The bulletins also include a Food Standards Scotland (FSS) toxin alert status, relating to bloom events. These alerts are available to shellfish growers across the whole of Scotland and will soon be made available across Ireland, Scotland, England, Spain, Portugal and France in a new project which builds on the success of the BBSRC-funded research at SAMS: [www.shellfish-safety.eu](http://www.shellfish-safety.eu)

This international project seeks to improve the HAB forecast resolution and automate a new index-based risk assessment for policy makers, risk regulators, food safety authorities and the shellfish and fin-fish industry in these countries.

The latest risk assessment bulletins can be found at: [www.habreports.org](http://www.habreports.org)
Hidden Hunger: Biofortified wheat and zinc deficiency in Pakistan

Millions of people around the world still remain malnourished through lack of adequate micronutrients in their diet. Micronutrient deficiencies are also known as ‘hidden hunger’ – a form of malnourishment that often goes unnoticed.

Zinc deficiency affects around 17 per cent of the world’s population, mostly in developing countries. In Pakistan, the most recent national nutrition survey indicated that over 40 per cent of women are zinc deficient. Stunted growth and development in children, increased susceptibility to infections, and complications during pregnancy and childbirth are just some of the consequences of zinc deficiency.

In May 2017, the researchers began investigating whether a newly developed strain of biofortified wheat could increase dietary zinc intake in Pakistan by integrating the wheat into normal eating habits.

The biofortified zinc wheat in our trial was developed by HarvestPlus, and approved for cultivation and distribution in Pakistan in 2016. We recently completed a double blind, randomised controlled trial to examine the impact of consuming flour made from biofortified wheat on the zinc status of zinc-deficient women. The biofortified flour is used to make chapattis – a staple food in the brick kiln communities of Peshawar.

Field experiments are also being conducted to determine the value of adding zinc-enriched fertilisers to wheat production in Pakistan, in terms of both yield and potential health benefits. It is important to demonstrate the cost-effectiveness of genetic and agronomic biofortification, to encourage farmers to invest in new seeds and zinc fertilisers, and persuade governments to invest in scaling-up biofortified zinc wheat.

One of the key challenges in measuring zinc status is the lack of a sensitive biomarker that is suitable for use in remote settings. So we are using this study to compare established biomarkers of zinc status (plasma zinc concentration) with novel indicators, including markers of DNA damage and a new laser technique for measuring nail and hair zinc concentration.

The success of a biofortification strategy requires that the intervention achieves wide and sustained uptake at production and consumption stages. The next phase of the project will therefore explore the cultural context, traditions, knowledge and attitudes of local stakeholders to biofortified zinc wheat and zinc fertilisers.

Ultimately, we hope that our research will help to establish biofortified zinc wheat as a sustainable and cost-effective solution to zinc deficiency in Pakistan and around the world.

Dr Heather Ohly
Heather is a Research Fellow in Global Nutrition at the University of Central Lancashire. Heather enjoys working on international and interdisciplinary projects like this one, which involves experts in nutrition, global health, agriculture and plant science.

The Project

Discover more about GFS: www.foodsecurity.ac.uk
Bee survival computer model adopted by industry

A computer model, called BEEHAVE, developed to help gain a better understanding of the causes of bee declines, is now being recommended to industry users to assess threats to bees.

The model has been developed by Professor Juliet Osborne and colleagues at the University of Exeter. Agriculture companies Syngenta and Bayer are both using BEEHAVE to assess how their pesticides affect bee colonies, and are promoting it to the worldwide agrochemical industry.

Understanding pollinator declines is extremely important but carrying out experiments on pollinators, including bees, is very difficult, as so many factors affect them. Laboratory-based experiments cannot accurately replicate the situation in the real world, while experiments in the field are influenced by many factors that make it hard to interpret the results.

BEEHAVE and Bumble BEEHAVE allow scientists to study threats to bees in a virtual world based on everything that is currently known about bee biology, and to hone their experiments on real bees. Researchers enter into the model information about available sources of pollen, presence of pesticides, and any diseases affecting a bee colony, and BEEHAVE predicts the eventual colony size, whether it will survive the winter, and the amount of honey it will produce. BumbleBEEHAVE produces similar results regarding the fate of multiple colonies of different species of bumblebee.

Dr Pernille Thorbek, Ecological Modeller at Syngenta, said, “BEEHAVE will help us improve our understanding of how bee colonies respond to different environmental stressors. It will be a valuable additional tool for pesticide risk assessment, for example for different crops and different regions.”

The European Food Safety Authority (EFSA) are using this model as the basis for creating a regulatory model, which they will recommend industry and other users employ when assessing threats to bees, for example from pesticides.

BEEHAVE was developed using a BBSRC Industrial Partnership Award, part-funded by Syngenta. A further BBSRC grant, awarded jointly to Osborne and scientists at the University of Sussex, allowed the researchers to create BumbleBEEHAVE, an equivalent model predicting effects on bumblebees.

Karen Lewis, Executive Director, Innovation at BBSRC, says, “I am delighted that once again BBSRC has been able to support groundbreaking research that in this case will help develop a better understanding of the causes of bee declines. The fact that agriculture companies are already using the BEEHAVE computer model is a great credit to the researchers and the hard work that enabled this technology to be developed for everyone to benefit from.”

Professor Juliet Osborne, Chair of Applied Ecology in the Environment and Sustainability Institute, said, “These are complicated models that required at least three years of dedicated work to put together, with fieldwork going on at the same time to validate them.”

BEEHAVE is freely available and user friendly, allowing a range of stakeholders to benefit from it, including beekeepers and farmers as well as scientists.

Professor Osborne continues, “We were really keen to make it openly available and as easy for people to access as possible. We designed it with a user-friendly interface, so you don't need any modelling experience to run the model and you can see very clearly what’s going on as you run it.”

Professor Juliet Osborne won the BBSRC Social Innovator of the Year 2017 award for creating these models.
Wheat breeding companies benefit from new molecular tools

Wheat breeders and researchers around the world are using molecular markers developed by Professor Keith Edwards at the University of Bristol to improve the efficiency of their breeding programmes.

The molecular markers, developed by BBSRC-funded researchers, are being used routinely by major wheat breeders to develop varieties of wheat that incorporate beneficial new traits such as disease resistance or increased yield.

In 2017, UK farmers produced 14.8 million tonnes of wheat, worth around £2Bn. It is our most widely grown crop, and the second most widely grown agricultural crop in the world (behind rice). It is most commonly milled into flour for bread, cakes, and other baked goods and provides 40-60 per cent of the calories in our diets.

In 2018, Edwards and Professor Graham Moore at the John Innes Centre, which receives strategic funding from BBSRC, shared the 2018 Rank Prize for nutrition for their pioneering research.

BBSRC funding has enabled Professor Edwards to identify molecular markers, using unique bioinformatics tools developed at Bristol. The markers can be used to determine the presence of specific genes in a wheat variety and, as wheat has a very complex genome, this is a powerful tool for wheat breeding.

Breeders may want to introduce a gene from a different variety of wheat that is not adapted to UK conditions into a new variety bred specifically for the UK. To do so, they use the markers to select plants containing the gene of interest in a process known as backcrossing.

All of the marker data is published online on the CerealsDB website, where it can be freely accessed by the wheat breeding community. Since May 2012 there have been more than 1.5 million unique visits to the website, and it currently receives more than 50,000 unique visits per month.

Professor Edwards worked with companies KBioscience (now LGC) and Affymetrix (now owned by Thermo Fisher Scientific) to develop two new technologies; KASP markers and Axiom genotyping arrays. Together, these provide breeders with cost-efficient and effective tools to harness the power of the markers in their breeding programmes.

There have been substantial efficiency improvements seen by seed companies that are now using the tools to create new wheat varieties better adapted to growing conditions and our changing environment.

The work is aimed at developing new wheat varieties more rapidly, as well as more reliably selecting the wheat lines that are better-adapted to their environment, able to resist pests and disease, or which produce a higher yield. The markers are being used in breeding programmes for the UK, across Europe and further afield.

Dr Chris Burt from RAGT Seeds says, “We’re breeding Europe-wide, not just for the UK. The work we’re doing with the markers here is being applied in a UK programme and into a very big French programme and a big German programme.”

Successful new varieties are incorporated into the Recommended List managed by the AHDB, the levy body for the cereals breeding industry, and used by farmers to select the best-performing seeds for their local conditions.

DATA BREAKOUT

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<td>Value of annual UK wheat harvest</td>
<td>Number of unique visits to CerealsDB website, where wheat data is published</td>
<td>Efficiency increase seen by one company using the new markers</td>
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A low-cost, easy-to-use arsenic sensor to test drinking water has been developed by researchers at University College London (UCL) and Imperial College London, with BBSRC funding.

Simple arsenic sensor could save lives

140 million people worldwide drink water containing unsafe levels of arsenic, according to the World Health Organisation. In one region of Bangladesh, one of the worst-affected countries, around 20 per cent of all deaths are attributable to arsenic poisoning.

With BBSRC support, researchers have created a small, sensitive and accurate sensor which produces an immediate measure of the arsenic level in water, at a cost of less than $1 per test. It is suitable for testing multiple sites in rural areas in low- and middle-income countries where the problem of arsenic poisoning from contaminated drinking water is greatest, potentially saving lives.

Dr Joanne Santini, Reader in Microbiology at UCL, had the idea of developing a sensor to detect arsenic in water when she discovered a microscopic organism that eats arsenic. Follow-on funding and a CASE studentship from BBSRC allowed Joanne Santini and Tony Cass, Professor of Chemical Biology at Imperial College London, whose work led to development of the first electronic blood glucose monitor, to begin work on an arsenic sensor.

Bio Nano Consulting, a spin-out from UCL and Imperial College London, has patented the sensor design and, using a Smart Award from Innovate UK, created a prototype which it can produce in batches of up to 100.

Universities and Science Minister Sam Gyimah says, “This sensor to detect harmful levels of water contamination will make a huge difference across developing nations, potentially saving millions of lives. Too many people are exposed to dangerous levels of arsenic and this product is a clear demonstration of our Industrial Strategy in action, creating the technology of tomorrow and supporting the high-value, high-skilled jobs that will make Britain fit for the future.”

Dr David Sarphie, CEO of Bio Nano Consulting, adds, “Arsenic contamination of water is a hugely important issue, and the technology hasn’t existed to enable it to be addressed properly. We feel that a user-friendly, cheap and rapid test could be extremely beneficial in terms of revolutionising how the problem might be addressed.”

This new sensor resembles the blood glucose meters used by diabetics. Once a drop of water hits the test strip, which is inserted into the sensor, it produces a digital reading of the arsenic level in one minute. This simple design means it could be used by local people in rural areas in low- and middle-income countries, where access to healthcare and technology is limited.

Currently available tests for arsenic either need to be carried out by scientists in a laboratory or use chemical test kits that produce toxic chemicals, and take up to half an hour to give a result.

David Sarphie continues, “We were doing some early-stage field trials a few months ago in Bangladesh and a lot of the villagers were actually pleading with us to come and measure their well, because they had no idea how much arsenic was in their water.”

DATA BREAKOUT

140 million people worldwide drinking water containing unsafe levels of arsenic

20% of deaths in one region of Bangladesh are attributable to arsenic poisoning

Less than $1 the cost per test using the new device
Understanding spinout companies

As part of UK Research and Innovation, BBSRC champions, challenges and supports bioscience research and enables researchers to build on their discoveries through to innovation. A key aspect to enabling impact is through the creation of spinout companies, although this is just one of the many ways to realise impact from research.

To better understand how the outcomes of research can lead to early stage, viable commercial companies, BBSRC has developed more rigorous and systematic approaches to understanding, monitoring and engaging with the portfolio of companies arising from the Council’s diverse investments.

The intention is not for BBSRC to claim ‘ownership’ of specific companies but to better understand how these early stage companies operate, their research, and how BBSRC investments have facilitated their emergence, development and growth. With information submitted by BBSRC researchers to the web-based system researchfish®, we have identified 388 spinout companies, of which 64 per cent are still active after five years of operation.

Biosciences spinout companies operate in many different sectors of the UK economy from agriculture, food and drinks to chemicals, to digital, manufacturing (including Industrial Biotechnology), healthcare and pharmaceutical and medical biotechnology.

BBSRC investments also underpin the creation of spinout companies across many research organisations throughout the UK, with spinout companies often anchored in close proximity to the institutions that generate them, creating clusters of excellence and industrial critical mass. Collecting data on spinout companies allows us to better understand the business contexts in which they operate, the business models they might use and the different investments underpinning their creation and growth.

Being part of UK Research and Innovation offers us tremendous opportunities. With Innovate UK, Research England and the other research councils, we can build on our experiences in business, technology transfer and knowledge exchange to better understand how our different interventions, engagements and support have the potential to help turn excellent research into commercial realities.

We are also working with colleagues in other Government agencies such as the UK Intellectual Property Office to understand the relationships between research activities, spinout creation and patent filing. Some spinout companies do not rely on patent protection to grow and be successful because they employ different business and investment models... but that’s a story for another time! In time our collective understanding of spinout companies will help inform the development of UK Research and Innovation strategy and how we support and facilitate emerging companies.

I would like to take this opportunity to thank all BBSRC-funded researchers that have returned their spinout data to researchfish®.

Alex Chaix PhD, joint Head of Knowledge Exchange and Commercialisation, BBSRC-UKRI
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