Translating research

Areas of translating research and the associated staff:

Research into the risks of biocontrol approaches aids regulatory policy - Jeff Bale

Pest management through the use of biocontrol is an increasingly important strategy to reduce our dependence on pesticides. Sales of biocontrol agents are predicted to increase from 750M US$ in 2008 to 2.8bn US$ by 2015. Currently, around 170 species (mainly insects and mites) are in used in augmentative biocontrol with Europe accounting for 75% of the world market. The main method of biocontrol in the UK and Europe involves the release of non-native predators and parasitoids into glasshouses. These species are not intended to establish outdoors. Research by Prof Jeff Bale and colleagues into insect cold-tolerance is providing the basis for European regulatory control of biocontrol agents against glasshouse pests.

The adoption of new biocontrol species requires rigorous and effective risk assessment if potentially devastating effects on native species are to be avoided (e.g. the impact of the Harlequin ladybeetle on European ladybird species following its release in the 1990s as a biocontrol agent for aphids). However, by the late 1990s it became apparent that existing UK legislation for risk assessment was not fit for purpose, being based on the assumption that the climatic origin of potential biocontrol species would accurately reflect its cold-tolerance and ability to over-winter. Defra commissioned Prof Bale to assess the cold tolerance and overwintering ability of previously released non-native agents, as a possible means of predicting establishment potential. Accordingly, Defra modified the information requirements for applications to release non-native agents in the UK.

Subsequently, the team have collaborated with regulatory authorities and biocontrol companies in a number of European countries. They have developed laboratory methods to assess and, importantly, predict the likely winter survival of candidate agents. For instance, data from Bale's group on the predatory mite Amblyseius swirskii was the basis for successful release licence applications in the UK, Netherlands and Switzerland. These reliable laboratory-based methods for environmental risk assessment have not only been accepted by a number of European regulatory agencies but they provide for biocontrol companies, which are mainly SMEs with limited R&D budgets, methods that are more cost and time-effective than field studies.

Professor Jeff Bale profile (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=4287&Name=professor-jeff-bale)

A drug redeployment strategy for treating leukaemias and lymphomas - Chris Bunce

Professor Chris Bunce (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=4311&Name=professor-chris-bunce) and colleagues are developing new strategies to treat blood-related cancers based on the re-deployment of existing drugs. The development of new drugs to treat the various types of leukaemia and lymphoma continues to be a challenge (e.g. Acute Myeloid Leukaemia (AML) overall survival is poor, remaining unchanged for the past 20 years). Unsurprisingly, the situation in poorer countries is much worse as the most recently developed drugs are too expensive to implement. Prof Bunce has begun to tackle this problem by harnessing combinations of existing drugs that were not originally intended as anti-cancer treatments to improve survival and quality of life for patients with haematological malignancies. Importantly, this approach benefits patients in Western countries (e.g. UK) and also in less developed parts of the world (e.g. sub-Saharan Africa), where he is using it to treat Burkitts Lymphoma - an endemic cancer of children in this region.

Research in the Bunce laboratory identified an enzyme called aldo-keto reductase AKR1C3 as a crucial target, due to its' activity helping AML cells survive. Remarkably, they found that by application of the female contraceptive medroxyprogesterone acetate (MPA) combined with the lipid lowering drug bezafibrate (Bez), they could block the effect of AKR1C3 leading to the death of the AML cells in laboratory tests. Also, they realised that this approach could be effective against B-lymphoid malignancies including Chronic Lymphocytic Leukaemia, the most common leukaemia in the UK, as well as Burkitts Lymphoma.

The availability of Bez and MPA as currently used drugs of known high tolerability and low toxicity facilitated the translation of the laboratory studies into phase II trials using a combination of the two drugs (called BaP) as a potential novel anti-cancer therapy.

Professor Chris Bunce profile (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=4311&Name=professor-chris-bunce)

Commercial development of environmentally-benign antifouling coatings - Jim Callow

The Bioadhesion and Biofouling Research Group (BBRG) led by **Prof Jim Callow (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=4314&Name=professor-jim-callow)** and **Dr Maureen Callow (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=5142&Name=dr-maureen-callow)** has played a key role in the development of non-toxic micro- and nanostructured coating materials. Primarily aimed at solving problems arising from biofouling in the marine environment, these also have biomedical applications. Since its inception in 1996 BBRG has developed laboratory-based methodologies to evaluate and understand the performance of novel coatings against marine algae. BBRG has worked in collaboration with material scientists, receiving long term funding from the US Navy through the Office of Naval Research (ONR) and from the EU-funded '**AMBIO (http://www.birmingham.ac.uk/ambio)**' ('Advanced Nanostructured Surfaces for the Control of Biofouling') project supported through the NMP 'Nanotechnology' Directorate and coordinated by Prof Callow.

The research has had a number of economic impacts. First, ONR-funded work, in conjunction with the materials science group of Prof A. Brennan (University of Florida), has contributed to the formation of a US spin-out company 'Sharklet™ Technologies Inc.', which now offers products for both marine and biomedical applications.

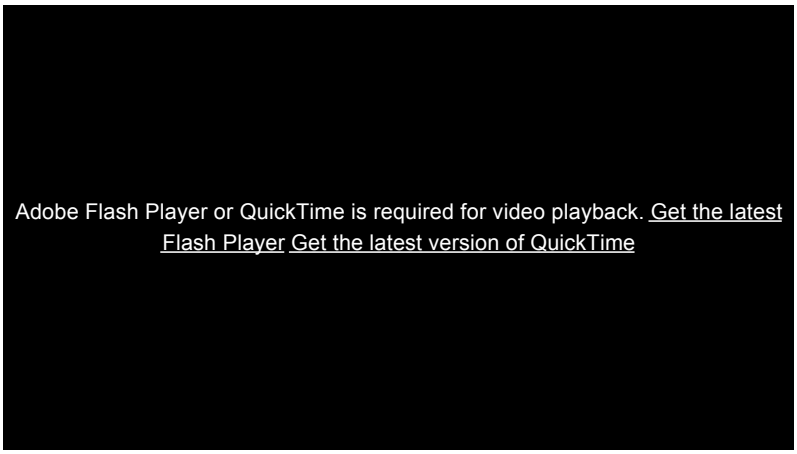
Secondly, BBRG work in the AMBIO project with materials scientists from the University of Mons-Hainaut and the company, Nanocyl, revealed that silicone fouling-release coatings could be improved by the incorporation of carbon nanotubes. Nanocyl patented the invention supported by data from BBRG and now market 'Biocyl™', a product based on this research.

Thirdly, BBRG (through the AMBIO project) have collaborated with a Small Medium Enterprise (SME), Teer Coatings Ltd, in the development of a hydrophobic, nanostructured silicon oxide-like coating with good antifouling properties; being optically transparent, it was particularly suited to optical windows of marine sensing devices. The deposition technology and its' application to antifouling was the subject of a patent application and is now commercially available within the Teer technology

portfolio.

Most recently, International Paints, a multinational paint company, has developed and launched a marine anti-fouling paint following testing by BBRG.

NanoTV video



This video was made for non-specialist audiences to illustrate how nanotechnology can aid in the development of a useful, environmentally-friendly coating technology. It illustrates the general problem of biofouling for ship hulls, how a novel amphiphilic coating technology developed in the project works, in simple terms, and aspects of the testing of coatings.

Further information

- **Professor Jim Callow profile (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=4314&Name=professor-jim-callow)**
- **Dr Maureen Callow profile (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=5142&Name=dr-maureen-callow)**
- Sharklet™ Technologies Inc. - **http://sharklet.com/ (http://sharklet.com/)**
- Nanocyl Biocyl™ - **www.nanocyl.com (http://www.nanocyl.com/en/Products-Solutions/Products/BIOCYL)**
- Teer Coatings Ltd - **www.teercoatings.co.uk (http://www.teercoatings.co.uk/)**
- International Marine Coatings - **www.international-marine.com (http://www.international-marine.com/marinehome.aspx)**

Agrobiodiversity Conservation for Food Security - Nigel Maxted

Dr Nigel Maxted's (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=5400&Name=dr-nigel-maxted) work on genetic conservation of crop wild relatives and landraces (traditional farmer-bred crop varieties) is providing a template for the conservation of agrobiodiversity and other plant species in the UK, Europe and many countries around the globe. Ensuring Food Security is one of the major challenges that confronts humankind in the 21st century. It is now widely recognized that the extant of genetic diversity found in the wild species related to domesticated crops is an important reservoir of genes that are required to develop new varieties suited to meet the dual challenges of climate change while feeding a rising human population. Crop wild relatives are being increasingly mined for and providing novel resistance to pests and diseases, and drought and soil salinity.

International and national agencies are obliged under treaty commitments to promote agrobiodiversity conservation as a basis for food security. This requires more effective strategies for both *in situ* and *ex situ* plant conservation. Research based on the expertise of Dr Maxted and **Professor Brian Ford-Lloyd (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=3926&Name=professor-brian-ford-lloyd)** in conservation, genomics and policy is providing the foundation for regulatory agencies to improve genetic diversity maintenance and so sustain food security. For example, the UN Food and Agriculture Organisation's 2013 decision to establish a global network of crop wild relative *in situ* conservation sites was based on evidence generated by the research group. Dr Maxted's role as Chair of the Defra Plant Genetic Resources Group, together with his Chairing of European and global committees for the Species Survival Commission and Biodiversity International, has resulted in the implementation of agrobiodiversity policy and conservation in the UK, Europe, Africa, Far East and South America. An important recent outcome is the establishment of the first global priority inventory of crop wild relative species based on their value as trait donors for breeding and climate change mitigation, it is now being used international to guide *in situ* and *ex situ* conservation action.

Further information

- **More details about this research and its impact (/schools/biosciences/research/showcase/agrobiodiversity-conservation-for-food-security.aspx)**
- **Dr Nigel Maxted profile (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=5400&Name=dr-nigel-maxted)**
- **Professor Brian Ford-Lloyd profile (http://www.birmingham.ac.uk/schools/biosciences/staff/profile.aspx?ReferenceId=3926&Name=professor-brian-ford-lloyd)**

Development and commercialisation of a stopped-flow cuvette for fast reaction studies of proteins and enzyme reactions by FTIR spectroscopy - Chris Wharton

Professor Chris Wharton and his research group developed a commercialized device that can be used to measure fast biological reactions using rapid scanning Fourier Transform Infrared Spectroscopy. Their interest in enzyme kinetics led them to analyse a wide range of enzyme-catalysed reactions in conditions that were as near to physiological conditions as possible. The demanding technical challenge was to develop a robust reaction cuvette that enabled the delivery and even mixing of enzymes and substrates within a few milliseconds. This proved to be a significant engineering problem but after numerous iterations a reliable system was developed. The market potential for the cuvette was recognized by TgK Scientific who distribute Fourier Transform Infrared Spectroscopy equipment. They now combine the cuvette with their stopped-flow drive system as part of a complete apparatus expanding their product line and capability. Steady growth in customer demand for the system is seeing applications in studies of protein folding and enzyme catalysis as well as applications in inorganic chemistry.

http://www.tgkscientific.com/ (http://www.tgkscientific.com/)