Knowledge Transfer Network

Biosciences

Biosciences KTN, Plants & Crops Sector

Interest Group - *Crop Defence for Food and Feed Security*

workshop

13th December 2011, Institute of Physics, London

The Impact of reduced pesticide availability: Challenges for UK Agriculture & Horticulture

- report -

January 2012

Top right image courtesy of D. Nimmo and Oxitec Ltd.
"Feeding larva of *Tuta absoluta*, a devastating pest moth of tomatoes in the UK and the rest of Europe".

Executive summary

A workshop, focusing on issues and opportunities associated with the withdrawal of crop protection chemicals in Europe, was recently held in London on 13th December 2011.

The workshop was organised by the Biosciences Knowledge Transfer Network (BKTN) Plants & Crops Sector, as part of their activity for the Interest Group (IG) in ***Crop Defence for Food and Feed Security***. The meeting brought together around forty experts from universities, research institutes, industries, levy bodies, growers and end-users to review the challenges facing the agriculture sector and to explore opportunities to develop and apply new technologies to meet the challenges of realising crop yield potential to increase agricultural productivity with reduced pesticide availability.

In the first session, entitled "***Future challenges and opportunities for crop protection***", presentations reviewed the key issues currently facing the agriculture sector, such as the impact of reduced pesticide availability on UK crop productivity and the cost and regulatory process involved in developing new crop protection chemicals. The societal context surrounding public perception concerning the acceptability of using certain pesticides was also considered, and how this can influence regulation.

In the second session, leading researchers in the field described opportunities for "***New paradigms for chemical control***", including formulation and application technologies for pest management, opportunities for new active discovery from natural products and potential for new uses of agrochemicals to enhance crop yields and activate innate defence mechanisms against pests and pathogens.

The third session investigated the "***Alternative approaches to pest management***", with presentations focusing on a variety of topics including green chemical control, opportunities to use biocontrol to manage pests and pathogens, sensor technology and precision agriculture to combat invasive weeds, plant breeding and biotechnology approaches to combat crop losses to pests and parasites.

These presentations were followed by a breakout session, where workshop participants had the opportunity to discuss topics relevant to crop protection to help identify new project ideas that could be developed for future funding competitions. An overview of funding schemes relevant to these discussions was provided by the Biotechnology and Biological Sciences Research Council (BBSRC), including programmes such as Industrial Partnership Awards (IPA), LINK, and plans to launch a new initiative focusing on horticulture and potato research. The next competition as part of the Sustainable Agriculture and Food Innovative Platform (SAF-IP), led by the Technology Strategy Board (TSB), and focusing on *Food Processing and Manufacturing* was also described, including how elements of crop protection could be relevant to this next call.

A summary of presentations and a link to the accompanying slide decks presented at the meeting are provided below.

Please note: The presentation slide decks are hosted on the Biosciences KTN website, which is part of the TSB platform _connect.

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Programme

Follow this link to access the following presentation slide decks:

https://connect.innovateuk.org/web/biosciencesktn/crop-defence-for-food-security-ig

Introduction and Objectives

1. Introduction to the Biosciences KTN and the Interest Group in Crop Defence for Food and Feed Security
   Tom Jenkins, Biosciences KTN

The Biosciences Knowledge Transfer Network (BKTN) is the Technology Strategy Board (TSB) funded KTN working in the Plant, Animal, Food and Industrial Biotechnology sectors. The BKTN acts as an interface between UK research-base, industry, funders and investors to facilitate new collaborations and to provide them with the knowledge and funding opportunities they need to take new products and processes to market, for the benefit of business, the economy, the environment and society. Our activities are focused into priority themes to ensure impact and make the most of relevant cross-sector opportunities: (1) Food for Health; (2) Innovation in Animal & Plant Production and Performance; (3) Renewable & Sustainable Bioproducts; and (4) Sustainable Food Supply and Security.

This workshop has been organised as part of the activity for the Interest Group in *Crop Defence for Food and Feed Security*, which is chaired by Professor Robert Edwards, Chief Scientist for the Food and Environment Research Agency (FERA) and Professor of Crop Protection at the University of York. As a society, we face some key challenges this century, with increased demands for food from a world population predicted to exceed 9 billion in 2050, aligned to growing demand for agricultural feedstocks for biorefining applications. These challenges are set in a context of climate change, limited natural resources, increasing energy costs and pressure to reduce emissions from the agriculture sector. In Europe, there is the additional challenge of maximising agricultural productivity in a regulatory environment where highly effective crop protection agents will be

withdrawn due to changing legislation. This specific challenge forms the focus of the workshop, which will identify new opportunities for bioscience-inspired innovation to help ensure farmers continue to produce a sufficient and affordable supply of food in the coming century and meet the global food security challenge.

Session 1: Future challenges and opportunities for crop protection

Chair: Robert Edwards, FERA

1. Consequences of EU pesticide legislation: an assessment of impact by crop for UK agriculture

Susan Twining, ADAS

The availability of pesticides in the UK is under pressure from a number of fronts, but one of the primary drivers is changes to EU pesticide legislation. The Annex 1 review process started in 1993 has resulted in a reduction in the number of approved active substances of almost 75%. The requirements to protect water have indirectly resulted in the withdrawal of several widely used pesticides such as simazine, cyanazine, isoproturon and trifluralin, and others are currently under close scrutiny. In addition, the new approvals Regulations (EC) No 1107/2009, which introduces new assessment criteria, is likely to lead to the withdrawal of several active substances commonly used in UK crop production, and make the process of registering new active substances more difficult and expensive. In addition, there are pressures from the food industry, consumers and crop protection manufacturers which reduce product availability. In a series of studies for the Agriculture and Horticulture Development Board (AHDB), with contributions from Defra, looking at the possible impacts of such changes, it was found that protecting water quality had the biggest potential impacts particularly due to reduced black-grass control in cereals and oilseed rape, which could cost the industry over £500 million in lost yield and additional control costs. Changes in the approvals legislation are most likely to affect horticulture and potato production with margins for onions and leeks reduced by up to 85% due to poor annual meadow grass control, and potatoes by 20% due to higher costs of alternatives for the control of potato blight.

2. Drivers and barriers to developing a new crop protection product

Ray Elliott, Syngenta

Agriculture is facing a number of challenges today. By 2030, global population will have grown from 6.8 billion to 8.3 billion and it is expected to grow by 40% to beyond 9 billion by 2050. The growing population and the increasing number of malnourished people, is putting agriculture under pressure to meet increasing demand for food, feed and renewable resources. There is a need to produce more food to nourish a growing population on the existing agricultural land base, while at the same time adapting to the impact of climate change, taking care of the environment and keeping high quality food affordable for all consumers. The concept of sustainability integrates three components: economical, environmental and social. All of these goals can be achieved as long as

agriculture becomes more efficient and agricultural productivity is increased. Crop protection chemicals have a critical and essential contribution to make to increasing agricultural productivity to ensure the production of a wide variety of high quality food at affordable prices, to protecting the environment and in helping to mitigate the effects of climate change. Although Europe is one of the advantaged agricultural production areas world-wide, the pressure on crop protection chemicals is compromising our ability to tackle these challenges, by the lack of recognition that: 1. food production is an ecosystem service, 2. there is a need to grade-off risks against benefits, 3. there is a lack of clarity around the effectiveness of different environmental and human protection strategies and 4. the need for good quality evidence on which to base decisions is paramount.

3. Societal and regulatory influences on agriculture and crop protection

Joyce Tait, Innogen

The phasing out of older pesticides due to resistance problems or because of unexpected health or environmental impacts has, in the past, been a major stimulus for innovation in pesticide development, leading to more effective products with a better health-related or environmental performance. However recently, rather than the previous evidence-based process, withdrawal of pesticides from the market or the placing of a range of other restrictions on pesticide use have been driven more by public opinion and political pressures than by evidence of harm. The technologies we have available today could already reduce pesticide use, either using GM crops or modern more targeted pesticides with reduced application rates. Integrated pest management (IPM) has reduced pesticide applications in many cases, but at a high cost in farmer management time and often without increases in yields. We need to bring a new, more imaginative and systemic form of decision making to bear on this question, linking: (i) understanding of technological options relevant to this top quality crop protection system; (ii) a more nuanced understanding of public responses and their motivations to enable the best societal conditions for its success; and (iii) creative approaches to regulation of technological options, based on a better understanding of interactions between regulation, stakeholder/societal perspectives, and innovation strategies. In addition to promoting integrated pest management at the farm level we need more effective integration at the policy level based on a better understanding of these interactions.

Session 2: New paradigms for chemical control

Chair: Rosie Bryson, BASF

1. Pesticide application: formulation and targeted application

Clare Butler Ellis, NIAB

The reduction in the availability of pesticides is providing new challenges for pesticide application, both in finding alternative ways to control pests when products are unavailable, and in ensuring that the remaining products remain available by minimising

their environmental impact. Optimising application can ensure pesticide usage is minimised, which can contribute to both a reduction in environmental impact and to reducing the risk of resistance. The interaction between formulation and application is key, and there is scope for developing application systems and formulations that work together to optimise pesticide performance under realistic field conditions. In addition, new technologies designed to address the loss of pesticides use very different spray characteristics, and may ultimately require specialist formulations. This presentation reviews the current knowledge of the interaction between formulation and conventional application technology, and considers the implications for potential future developments. There is a continuing need for formulation scientists to work with application technologists to ensure that we make the most of opportunities to make progress towards genuinely sustainable pesticide use.

2. Potential to develop new crop protection chemicals from natural products

Liam Evans, Hypha Discovery Ltd

This talk will focus on how natural products can be used by agrochemical discovery groups to search for active hit molecules to develop into new pesticides. The origins of some successful natural product-derived pesticides will be discussed and comparisons made with current discovery strategies. The process of discovering new bioactive natural products will be illustrated by highlighting Hypha's MycoDiverse™ library of higher fungal metabolites as a modern and convenient resource for drug discovery, and will include an examination of the technical and commercial barriers to the discovery of new pesticidal compounds from microbial extracts and fractions. Finally, Hypha will describe how it is supporting agrochemical and pharmaceutical development programmes through the application of its fermentation and natural products chemistry expertise to biotransform pesticides and drugs into environmental fate compounds and mammalian metabolites that are difficult to chemically synthesise.

3. Novel applications for agrochemicals

Robert Edwards, FERA

Currently, agrochemicals are predominantly used to protect crops from pests, diseases and competing weeds by acting directly on the targeted organism through direct application or systemic delivery. In addition, crops are also treated with plant growth regulators to control their development for optimal yield and quality. Recently, it has also become apparent that agrochemicals applied for protection purposes, can also elicit beneficial secondary effects in crops, including changes in natural defences against pests and pathogens, enhanced stress tolerance and increased yield. The mechanisms by which these secondary effects are invoked are largely unknown, with the synthetic compounds, or their metabolites, presumably interacting with endogenous signalling pathways. Based on the myriad of biochemical and physiological processes which are controlled by small molecule signalling in plants, these observations suggest that new generations of agrochemicals may be developed which can selectively enhance desirable

traits in stress tolerance, yield and quality in our major crops, as an alternative approach to plant breeding. In this presentation, some of the diversity of plant signalling processes controlled by small molecules will be reviewed using the work arising from the author's lab on the chemical biology of safeners as an illustration of the potential for this approach.

Session 3: Alternative approaches to pest management

Chair: Calum Murray, Technology Strategy Board

1. IPM – and the role of biological control

   Rosemary Collier, Warwick Crop Centre, University of Warwick

The concept of Integrated Pest Management (IPM) has been 'around' for more than 50 years. There are many definitions of IPM, but in essence the aim is to use a systematic approach to pest control that combines a diversity of complementary crop protection practices, which are carefully targeted through an understanding of the biology of pests and their natural enemies. There is an implicit assumption that the adoption of IPM strategies will reduce pesticide use, and an expectation that an IPM approach can provide solutions where effective pesticidal control methods are unavailable. Given that the concept of IPM has been around for so long, some people would argue that progress in the development and uptake of IPM strategies has been limited. Indeed, in industrialised countries such as the UK, most pest control strategies are highly-dependent on the availability of effective pesticides. However, there have been huge changes in practice in some sectors, for example the use of biological control agents in protected tomato crops, which are widely recognised as very good examples of IPM. There are a number of reasons why the development of IPM strategies for certain crops has been neither rapid nor straightforward, and the constraints range from huge scientific challenges, to the economics of food production. This talk will briefly consider several of the constraints and highlight some possible opportunities.

2. BioPesticide Control - the leading edge

   Nigel Back, Barrier Biotech Ltd

This brief talk is designed to bring people who may be unfamiliar with the biocontrol industry up to speed with the fast paced developments taking place at the moment within the plant extracts part of the biocontrol industry. After a brief review of the current state of the "chemical" pesticides industry outlining some of the challenges that industry now faces, I will talk through how the same objectives can be achieved with the same degree of performance and reliability but with the added bonuses available from using the different biocontrol mechanisms now becoming available. Safe, efficacious and cost-effective pest control in the final analysis will only be achieved from making use of those solutions that are most appropriate for the particular pest in the particular environment, climate, soil type and crop for which the control is designed. This is no different in essence from the targeting by the current "chemical" options which are gradually being withdrawn. The key to successful controls will lie in the combinations of various solutions

each working with the other to provide the overall solution, as is implied by the holistic approach required Integrated Pest Management programs we have just heard about. What is very different is not simply the actives being used but it is more the manner in which the understanding gained from the past is being reinterpreted and applied as we replace the current "chemical" control products with new formulations, all of them being lower risk, without side-effects, with minimal or no residues, low carbon impact and all sourced from sustainable cropping regimes.

3. Automated weed mapping in arable fields for precise applications of herbicides

Carl Flint, Masstock Arable Ltd

While there have been significant recent advances in spraying technology required for patch spraying, there remains the challenge of delivering a functional automated detection system that can create geo-referenced weed maps for each field. The automated mapping of weeds would enable precise targeting of the patches with herbicides. This could reduce the cost of weed control to the farmer and the quantity of active ingredient being applied to fields, benefiting the environment. It could also help retain key residual herbicides that are under threat of losing their approval due to water quality issues. By detecting failure to control target weeds, it could provide an early warning of herbicide resistance. Recently, work at Reading University has used a digital camera to capture high resolution (12 MP) geo-referenced images of cereal and inseed fields containing black-grass and wild-oats in June/July. The images have been processed with software developed to identify and map black-grass in the fields. Completed in 2010, the HGCA Proof of Concept Project 471 clearly demonstrated the feasibility of using a machine vision system based on standard digital cameras to detect blackgrass heads in winter wheat. This work has now been taken forward in a new four-year research project co-funded by the Technology Strategy Board. A consortium of commercial and academic members started work in October 2010. Key objectives of the project are to develop a pre-commercial vision system, using novel software approaches to identify and estimate weed density and geo-locate and map patches of target weeds (black-grass, rye-grass, wild-oats, brome, cleavers and thistles).

4. Genetic control of pest insects

Neil Morrison, Oxitec Ltd

Oxitec's core technology, RIDL®, is a chemical-free, species-specific method of pest insect control. RIDL® is based in principle on the sterile insect technique (SIT), in which pest insects are mass-reared, sterilised and released into the wild. With sustained releases of steriles, mating between fertile pests is reduced and the wild population drops. SIT has been successful in suppressing populations of many pest species around the world, most notably in the eradication of the cattle pest fly, the New World screwworm from the USA and most of Central America. The method does, however, suffer from a number of limitations. For example, by sterilising insects with radiation, the quality of the released insects is compromised and SIT becomes inefficient and expensive. SIT also

works best if males are separated and females are not co-released, which is difficult in large numbers when an automated method is not available. RIDL® relies on transgenic technology to overcome these and other problems with the SIT. The engineered insect strains carry a lethal system that is repressible with an antidote supplied in the insects' feed. In the absence of this antidote – for example in the field - the RIDL® phenotype is activated. This could include death of progeny (in effect, genetic sterility) or female-only death (to permit male-only mass-release). These phenotypes also provide in-built bio-containment, as the strains are not able to establish in the wild. In agriculture, RIDL® strains of the Mediterranean fruit fly, the olive fly, diamondback moth and pink bollworm - all major global pests – are available now for field use. I will describe this technology in more detail and discuss how we aim to apply it to pest control in UK agriculture.

5. Plant breeding approaches to combat crop pathogens

Sarah Holdgate, RAGT Seeds Ltd

The UK is widely considered to be one of the highest yielding wheat growing areas of the world. This is in part due to our favourable climate but also our reliance on crop protection chemicals. With forthcoming EU legislation threatening to withdraw a number of key active ingredients, it is timely to consider other methods for protecting our crops whilst at the same time increasing food production. In this respect, plant breeding will play an important role in the future of food production. Plant breeding has historically been important for driving yield increase, with an average rise of 0.5% per year solely attributed to plant breeding. Other aspects of plant breeding will now also become important in light of the forthcoming changes. Disease resistance is routinely selected by breeders but is generally considered less important than yield due to the wide availability of chemical control methods. Conventional breeding methods relying solely on field selection have provided varieties with exceptional levels of disease resistance. Over time however these exceptional levels of resistance can suddenly become ineffective as the pathogen evolves to break through the plant defences. With this in mind the aims of more modern breeding programmes not only seek to increase yield year on year but also to introduce disease resistance which will be more durable. This has called for a technology shift and we now look to both laboratory and field methods to produce this new set of varieties, details of which will be discussed.

6. Plant biotechnology approaches to compact crop pests

Peter Urwin, University of Leeds

The strategic focus of our research is to investigate novel mechanisms to control plant parasitic nematodes. Nematodes utilise cysteine proteinases for digestion and this proteinase activity is inhibited in female cyst nematodes after incubation with a cystatin. A gene encoding a rice cystatin, *Oc-I*, was engineered to have enhanced inhibitory activity and conferred higher levels of resistance against nematodes than the unaltered molecule when expressed in plant roots. Transgenic expression of cystatin was the first technology shown to work against both root-knot and cyst nematodes. Resistance has also been

shown against *Rotylenchulus reniformis* and to be effective in rice and banana. The work has culminated in five successful field trials of transgenic potatoes showing nematode resistance. Promoters have been identified that limit transgene expression primarily to the roots with preferential expression at nematode feeding sites in both potato and rice. A transgenic cystatin-expressing rice line resistant to root-knot nematode has been produced and this work is continuing with RCUK funding to develop nematode-resistant rice for India. A second, novel approach to nematode control has been developed that disrupts nematode chemo-attraction and invasion of roots. Peptides secreted from roots are taken up along nematode sensory neurons to interfere with neurotransmitter signalling. Nematode resistance of >80% can be achieved when a root-tip promoter is used to deliver the defence. The technology has been proven in the field. We have also advanced RNAi technology for the control of nematode pests and its utility has been demonstrated in UK field trials.

Breakout Session

The information below highlights the key points that were identified during discussions between delegates in small groups of 6-8 people. There were several groups and the key summary points from each group to the following questions are summarised by topic areas in the bullets below. Please note, the order does not reflect a prioritisation of the key areas identified during discussions.

Question: "From what you've heard during the presentations today, where do you see major opportunities for new crop protection methods?

a) through chemical control strategies
b) through biological approaches"

Please also consider the technical and operational opportunities to using approaches identified in a) and b) above during your discussions.

1. Natural Products and crop protection

- Linking natural products discovery to synthetic crop protection chemicals – identify the active component from synthetics and link to natural products discovery to develop a "catalogue" of active parts.
- More effective pipeline and funding for screening and developing new crop protection products, i.e. from natural products.
- Not much scope for new herbicides in the foreseeable future; maybe some new fungicides.

2. Resistance management

- Resistance management will be increasingly important
- There is a need to better understand what triggers resistance in a plant pathogen to ensure the efficacy of new approaches.

3. Formulation and targeting technology

- There may be opportunities to use both natural products and synthetic chemicals in future agricultural applications, as they often work synergistically in their action in relation to crop protection.
- Targeted delivery of actives is desirable, e.g. through seed treatments.
- There is a need to improve formulations, e.g. to improve shelf-life of active compounds.
- Opportunities to develop controlled release technology for spraying.
- Opportunities for improving existing formulations.
- Opportunities to develop targeted approaches – time and space precision farming.
- Sharing best practice across market sectors, e.g. technology from pharmaceuticals sector could be exploited in development of agrochemical formulations to enhance efficacy of delivery.
- Improvements in application technology are likely to be part of new solutions – making much better use of chemicals, and also being developed specifically for biologicals where there is currently a lack of understanding of the interactions with application & environment.

4. Integrated Pest Management (IPM), Integrated Crop Management (ICM) and precision agriculture

- Use of pesticides in a holistic farming approach, e.g. intercropping to suppress growth of competing weeds is an old technique but effective; increasing natural predators to decrease pests.
- Opportunities to develop better control strategies through sensor technologies and precision farming will provide future prospects for a more effective use of crop protection chemicals.
- IPM strategies would always be of benefit, i.e. new chemicals...maybe less efficacious but more environmentally friendly, together with GM approaches, but not discounting new varieties and other current practices.
- While biological control strategies (trap and cover crops) may be easier to sell to the public than chemical means of controlling pests, it may be more challenging to get these to work in the field situation, especially for biocontrol.
- Other approaches, apart from breeding and chemicals, have been marginalised. Need to do more to exploit, e.g. manipulation of the rhizosphere, mycorrhiza, suppression soils, biofumigation, etc… but effects must be proven before technology can be commercialised.
- Better nutrition and water. Plant growth to resist pests and diseases. It is to be noted that organics resist diseases in some cases.
- There should be a third point to consider besides chemistry and biological controls – i.e. cultural controls. In fact we should be considering all of these together in integrated crop management (ICM) which is where the best opportunities are likely to be found.
- To make progress in ICM, we will need good multidisciplinary research, which currently isn't happening – everything is compartmentalised, including much of the funding.

- The economic component is missing, so that novel solutions are developed which will never be taken up because they are not economically viable. This is one of the reasons why IPM hasn't really delivered so far.
- Biological control tools are only just becoming available and are more expensive and less effective, and so will probably only become successful as part of ICM.

5. Chemical genetics and plant breeding/biotechnology

- Linking the beneficial effects of chemicals to plant breeding programmes, e.g. to better understand the biological mechanisms underlying yield increases observed through the greening effect following application of strobulins – can this inform future plant breeding or biotechnology programmes to increase crop yield?
- Biological approaches/ biocontrol may have more immediate opportunities in the current regulatory framework.
- GM provides significant opportunities but there are political/regulatory barriers to deployment. In the future, technology development should link to social science to enable a route to deployment - need for better knowledge exchange and communication around GM technologies.
- Xenobiotic (*i.e. chemicals foreign to the organism*) metabolism of target organisms that would lead to the promotion of new pesticides. This was reflected in the need to understand the metabolism of chemicals by plants to underpin the next generation of herbicides.
- Herbicide safeners
- There is a lot of knowledge in genetics and genomics information – the current bottleneck is high-throughput phenotyping methods.

6. Regulation

- Future productivity may be threatened by a lack of active ingredients (AIs) or development of resistance from a more limited range of crop protection chemicals resulting from EU legislation.
- Having no market for GM crops in Europe is a constraint – GM crops may become acceptable to the general public if they have a major consumer benefits, e.g. low acrylamide potato chips. Maybe they will be better accepted in the future if new GM crops carry genes originating from within the Plant kingdom, rather than from animals / insects? One other foreseen problem is that the lead-in time is long to obtain new GM crops.
- In the future, should link to social science to enable a route to deployment - need for better knowledge exchange and communication around biotechnologies.
- The role of the regulator can have a huge impact on whether research can be applied in practice – they are not sufficiently involved in the research (even though they manage some of the funding).

7. General comments

- Difficult to separate chemical from biological control solutions when looking to identify new opportunities.
- With climate change prediction models, the UK will be a good place to produce crops – yields are generally predicted to increase in UK and northern Europe.

- Development of user-friendly systems (not too high tech).
- Seeing it from a UK perspective – global perspective will lead new market development of crop protection products.
- Development of mechanisms to better finance commercial plant breeders, e.g. to the level of agro-chemical companies. Plant breeders currently rely on Plant Breeders Rights and Royalties paid by sales of seeds to growers – issues with farm saved seeds?
- Could we cope with major disease outbreaks without chemistry / genetics?
- Biggest opportunity will be to linking everything together – holistic approach such as IPM with strategy. Problem: no clear funding mechanism currently in place to take this type of approach forward.
- Neither chemistry, biology nor cultural controls are going to provide the total solution. Biologicals are much more 'niche' solutions than chemical controls have been in the past (but this may change in the future).
- End-users need to be involved from the start, so that solutions are practical and workable.
- In developing new solutions, currently financial reward is one of the main drivers (e.g. TSB funding) which means solutions that don't end up with a 'product' to sell are finding applied research funding difficult to obtain (e.g. developing cultural controls).
- If the main beneficiaries of the research are farmers, it is difficult to draw them into research. Knowledge transfer to farmers remains difficult – only the best growers come to conferences and meetings – how do we engage the rest? Many researchers are encouraged only to publish work academically, not to interact with users. The involvement of agronomists is key, as they have the necessary links to farmers.

Conclusion and next steps

The workshop has brought together a network of technology providers, industrialists, agronomists, and end users that have a common interest in developing new crop protection solutions to benefit agricultural productivity.

The Interest Group in ***Crop Protection for Food and Feed Security*** has been established to support this community in a practical way to take forward research ideas towards grant applications in the UK, for example through small meetings to further develop themes or project ideas arising from the workshop that could result in grant proposals to relevant BBSRC or TSB funding initiatives. The *Crop Defence* Interest Group is keen to support future meetings in 2012 to promote further links between the research-base and industry to help take new technology developments towards market.

The workshop also highlighted the need for social scientists to work with researchers and industrialists to create an environment where the public are better informed about agricultural products and technologies, such as agrochemicals and plant biotechnology, which have been used to positively impact on food security and biodiversity. We will also investigate opportunities for joint research council funding programmes to develop social science research and outreach strands alongside new technology development.

Forthcoming event

'Novel Field Based Diagnostics' international workshop

14th – 15th March 2012, the Food and Environment Research Agency (FERA), York

Issues relating to the need for improved diagnostics for crop protection applications were also highlighted during the meeting, and there could be opportunities to take forward discussions to help formulate new ideas for the development of new biosensors for rapid and quantitative detection of threats (pathogens, toxins, pesticides, hormones and antibiotics) and useful traits (metabolites, intermediates, proteins) in the agriculture and environment sectors, at the 'Novel Field Based Diagnostics' meeting.

More information and details about the workshop, contact Dr. Tom Jenkins (*details below*).

Contact us

If you are interested in being involved in follow-up activities, please contact the Biosciences KTN Plants & Crops Sector team:

- Dr. Tom Jenkins, Assistant Director and Plants & Crops sector Lead

e: tom.jenkins@biosciencektn.com| m: 07931 511 641

- Dr. Aurélie Bovi, Knowledge Transfer Manager

e: aurelie.bovi@biosciencektn.com |m: 07702 713 805

- Dr. Aurora Piñas-Fernández, Knowledge Transfer Manager

e: aurora.pinas-fernandez@biosciencektn.com |m: 07825 727 626

- For Administrative enquiries, please contact Jean Phillips:

e: jean.phillips@biosciencektn.com | t/f: +44(0)1430 871549

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