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News from Council – winter/spring 2014/5

Council met on Wednesday 19 November 2014 and Wednesday 18 March 2015 at the Conference Centre, Warwick Enterprise Park, Wellesbourne. The November Council is the meeting at which the budget for the year ahead is agreed and is often the final meeting for some trustees, who will hand over their responsibilities at the end of the year. This year Council expressed its thanks for the work of Peter Shewry, who has handed over the role of President (to Bill Davies). Council looks forward to working with the new President-Elect, Professor Christine Watson over the next two years. Council also approved applications for membership from 59 new applicants in November and 45 in March, and noted the breadth of interest amongst applications for membership. We also look forward to working with these new members in the months and years to come.

Council thanks all members who attended the AGM at Harper Adams University, as well as those who sent apologies, proxy votes and those who contributed to discussions via Email. The full Annual Report for members including Accounts was approved and so we were able to fulfil our legal requirements through reports to the Charity Commission.

The overall aim of the budget for 2015 is to deliver a range of conferences and publications including on-going investment in the new *Food and Energy Security* journal. The overall budgeted position is for a net deficit of £29K. The Strategy and Budget sub-group had reviewed the budget in detail ahead of the Council meeting and worked through the assumptions underlying the decisions made about cost allocations. To the treasurer's relief no flaws were found in the assumptions or

calculations and Council approved the Budget for 2015.

Bill Davies led a discussion on the strategy that will underpin his term as President (2015-2016) and his vision to ensure a successful future for the AAB, building from effective integration of its activities in supporting members, organising conferences and producing peer-reviewed publications. The final strategy was presented to Council in July and will then be published for members.

Council noted with pleasure the commitment of the publishers (Wiley) to the continuing development of the new *Food and Energy Security* Journal. This has allowed a number of initiatives to be taken forward including the reduction in the publication fee for AAB members to £500 (previously £1200). Council welcomed the new Editor-in-Chief of *Annals of Applied Biology*, Simon Leather, to the Council meeting. Simon presented his thoughts on the developing strategy for *Annals* and welcomed Council's proposal for a closer working relationship including an annual international conference sponsored by *Annals* and a clearer route for papers presented at AAB conferences to full peer review publications in either *Annals* or *Food and Energy Security*. Council thanked Simon for his evident enthusiasm for the role he is taking on and looked forward to working with him in the future. The editors of *Annals* and *Food and Energy Security* will be invited to Council annually (November meeting) to support a more integrated approach.

The latest Council meeting was held on Wednesday 15 July at the Novotel, Edinburgh and the next one will be held at the Wyndham Garden Grantham hotel on 18 Nov – if you

Agronomic Decision Making in an Uncertain Climate - Post Conf Report

It is sometimes said that climate is what you expect whereas weather is what you get. But what climate can you expect when the climate is changing? This is an important question to arable farmers. While financial imperatives underpin key arable decisions, an understanding of local climate influences both short and long term decisions, from crop selection and sowing date, through crop nutrition and crop protection strategies, to key investment decisions associated with soil management, crop cultivation and logistics.

It is clear that the climate is changing and the rate of change is likely to accelerate. In North West Europe this is reflected in higher mean temperatures, earlier springs and increasing frequency of extreme events. Many of those extremes are seasonal (e.g. the hot, dry summer of 2003 and the stormy wet winter of 2013/14). However, we are also beginning to experience unseasonal extremes, such as the exceptional dry first quarter of 2012 and the subsequent record levels of rainfall, with consequential summer and autumn flooding. Clearly, effective farm planning becomes more challenging as uncertainty increases.

The aim of this conference was to explore the problems that are already evident, what the near future may hold and what short to medium term adaptive strategies are available to arable farmers. It was surprising, given the recent history of extreme weather events, that the initial call for papers was met with a distinctly underwhelming response. Feedback suggested that agronomists thought it was a conference about climate change (and therefore not relevant to them) and it seems likely that climate change professionals saw it as a conference about agronomy. Furthermore, there was a common view that climate change mitigation, rather than adaptation, has been the focus of most research funding in the area. After quite some additional effort a shortened

(one and a half day) programme was put together.

At a very practical level, it became apparent that farmers can adopt practices that protect their businesses from extremes of weather. For example, it was reported that inter-ridge micro dams established on a hillside sown with maize can reduce soil erosion and pesticide runoff associated with spring and summer storm rainfall by more than 90%. This not only protects the topsoil and crop, it also reduces contamination of adjacent waterways. A session on pollinators emphasised the importance of this group, including moths, to agronomy, and highlighted the vulnerability of pollinators to climate related abiotic stress. A number of practical management options to protect and enhance local pollinator populations were discussed. While such practical measures are not necessarily seen as adaptation to a changing climate, they clearly make for a more robust agro-environment and, importantly, they are feasible at farm level.

In a first for AAB, the introductory presentation, by Roger Street of the Environmental Change Institute, was given by video link from North America. Even though the one-way video did not allow Roger to see the screen as he was presenting, this worked surprisingly well. Not only did the talk cover future risks to agriculture, it also highlighted the need to take account of increasing climatic uncertainty when developing adaptive strategies.

In another first, all of the presentations were recorded on video and these will be made available via the AAB website in the near future. Overall, the conference was well received and, despite the initial difficulties building a coherent programme, it was clear that this is a subject which is worthy of further activity.

Rob Carlton
Convener, CATE Group



For the latest news from the society of Biology - go to link below:

ADVANCES IN IPM 2014

The AAB has organised eight IPM related conferences since 2006 and there can be no doubt that they have become the foremost annual events for consultants, practitioners and researchers who are seriously committed to this sustainable approach to pest control in the UK. IPM is knowledge-based and these conferences have become popular because they have provided a forum for policy makers, experienced researchers, young scientists and practitioners to detach themselves from their usual day-to-day pressures and share information. The events have been described as annual tribal gatherings of the UK's IPM community – but there is nothing wrong with that if it leads to co-operation and collaboration on a national scale! Chris Wallwork (Horticulture Technical Manager, Agrii) summed up the feelings of delegates when he commented “the chance to discuss with scientists, policy makers and practitioners provides a unique perspective on this developing area”.

As in recent years, the 2014 conference was spread over two days with the option to stay overnight and enjoy an informal conference dinner. The programme was broken down into a series of important subject areas covering policy matters, topical issues that impact on IPM, practical implementation of IPM programmes and specific technical subjects. The technical sessions were comprised of short papers selected from those offered by delegates. In order to involve as many people and topics as possible, speakers were restricted to slots of 15 minutes. This has proven to be a very successful formula over the years. Delegates provide carefully prepared and succinct presentations to outline what they do and the progress they are making. More detail can be obtained in the bar or after the conference. It is to the credit of participants that not a single session at the 2014 event overran the allocated time!

The EU's Sustainable Use Directive (SUD) will impact on everyone involved with crop production and crop protection in the UK over the next few years. The overall objective of the Directive is to ensure that pesticides are used sustainably by reducing the risks and impacts of use on human health and the environment and encouraging the development

and introduction of IPM. In short, this will mean the replacement of broad spectrum pesticides with alternative approaches and techniques. This could offer a great opportunity for IPM practitioners if the way is properly prepared. However, if the necessary knowledge and techniques are not yet in place, then it could result in a lack of confidence among end-users which could set back the implementation of IPM by many years.

Adrian Dixon, Head of Policy Implementation at CRD, provided the conference with an update on the UK's National Action Plan (NAP) for the implementation of the SUD and drew comparisons with the approaches being taken by other EU member states. It is important to understand that there is not a common NAP – each state has submitted what it thinks is achievable and there is huge variation. The UK was already well ahead of the game when the SUD was announced and this is now reflected in the depth of our NAP compared to some other countries. Nonetheless, other member states such as the Netherlands and Denmark are showing greater ambition and clarity. Dr Paul Sopp, who is Chairman of the International Biocontrol Manufacturers' Association UK, provided the manufacturers' perspective on the UK's NAP. Dr Sopp highlighted the slow progress of the registration of alternatives to synthetic chemical pesticides in the UK and drew comparisons with the US IR4 programme which has facilitated the approval of many more products. Don Pendergrast (NFU lead on Plant Health issues) provided delegates with a serious reality check. He pointed out that international food production companies may shift their activities out of Europe if production becomes either too difficult or too expensive. Delegates recognised the obvious conflict with 'food miles' and questioned the lack of 'joined up thinking' in the EU parliament.

The second session at the conference looked at the vulnerability of crops to attack by pests, diseases and weeds, and the continued requirement for effective crop protection products. Prof Toby Bruce set the scene with an excellent summary of the current situation worldwide. Prof Keith Walters then considered whether the call to terminate

the use of certain neonicotinoid insecticides was a help or hindrance to IPM. He reviewed the factors that have contributed to a lack of agreement in this area and considered the broader consequences of the loss of some or all of these products. It would seem that neonicotinoids could have an important role in IPM programmes and their withdrawal may lead to a return to older chemistry with greater detrimental effects on non-target species and poorer resistance management strategies. Dr Tom Pope then looked at the evidence that had been used to consider whether neonicotinoids were affecting populations of pollinators. This excellent balanced review drew heavily on the restatement of the natural science evidence base concerning neonicotinoid insecticides and insect pollinators which had been compiled by Prof Charles Godfray (Oxford University). Most of the published work was based on laboratory studies which used high doses of neonicotinoids that would not be encountered in field crops. It was concluded that further work was urgently required and this should be conducted in the field and with neonicotinoid doses that are relevant to commercial applications. This session ended with a description of the use of commercially produced bumblebees in protected crops in the UK. This is also a controversial issue with Natural England being on the verge of preventing further use of non-native sub-species in the UK despite the potential serious economic consequences for the British tomato and soft fruit industries. Non-native bumble bees have been used in the UK since 1988 without establishment of colonies being detected outside the protected structures or any known hybridisation with native sub-species. A recent consultation instigated by Natural England had provided the public with inaccurate information despite those inaccuracies being highlighted to them by both the bumblebee producers and end-users. A common theme continued throughout this entire session; i.e. the need for more robust scientific data and impartial scientific review of available knowledge to underpin the UK government's policy decisions!

The third session of the conference considered

the practical implementation of whole IPM programmes. Neil Helyer (Fargro Ltd) provided practical tips for successful IPM. Dr Rob Jacobson (RJC Ltd) described the development of a robust IPM programme for the recently arrived and highly destructive pest, *Tuta absoluta*. The new programme had been developed from a blank sheet of paper and successfully implemented by industry within 4 years, which was believed to be unprecedented speed for publicly funded research in the UK. Dr Neal Ward of Cantelo Nurseries Ltd described their IPM programme for organic peppers. He explained the complexity of the overall programme and the difficulties encountered in maintaining aphid populations below economic damage thresholds. Dr Ward stressed the need for future research. The session concluded with a presentation about the management of western flower thrips (*Frankliniella occidentalis*) on protected strawberry. Work is in progress to improve the efficacy of biological control and trapping techniques.

The remaining sessions of the conference were devoted to technical developments. The papers were grouped into three categories:

- Cultural and environmental manipulation
- Biology and compatibility of control agents
- Monitoring systems and specific control measures

Abstracts of all the 21 technical papers and posters will be available via the AAB and HDC websites.

Planning for the 2015 AAB IPM conference is already underway and this was discussed with delegates before the end of the 2014 conference. The theme will be “IPM: The 10 year plan” and we intend to incorporate the GCRI Trust's Bewley Lecture which will celebrate 100 years of research in UK protected crops. Details will be announced shortly. The IPM conferences have been over subscribed in recent years and we strongly advise you to register your interest with the AAB office as quickly as possible to secure your place.

Rob Jacobson
Biological Control & IPM Group

Food and Energy Security

Note reduced fees for AAB members £500 publish open access

Food and Energy Security, the Association's latest online open access journal, in conjunction with Wiley-Blackwell seeks to publish high quality and high impact original research on agricultural crop and forest productivity to improve food and energy security. Primary research articles should report hypothesis driven investigations that provide new insights into mechanisms and processes that determine productivity and properties for exploitation. Review articles are welcome but they must be critical in approach and provide particularly novel and far reaching insights.

Article Publication Charges

All articles published by *Food and Energy Security* are fully open access: immediately freely available to read, download and share. To cover the cost of publishing, *Food and Energy Security* charges a publication fee

Pricing category	Fee (\$)	Fee (£)	Fee (€)
Regular ("full price")	2,400	1,500	1,750
Limited time offer for AAB members	800	500	585

Automatic Article Publication Charge waivers and discounts will be given to authors from countries on the Waivers and Discounts List. Authors should submit a waiver or discount request during the submission of their article.

Authors who receive funding from an agency or institution with a Wiley Open

Access Account do not pay directly. The charge is paid by the institution or funder. Authors whose institutions have paid the Wiley Open Access partner fee are eligible for a discount on the publication charge and on acceptance a discounted fee is payable by the author.

AAB Food Systems Group Vacancy for a Convener and Group members

We currently have a vacancy for the Convener of the AAB Food Systems Group, as well as some new group members. Contact the Executive Officer, Carol Millman (carol@aab.org.uk) or Programme Secretary, Nigel Halford (Nigel.Halford@rothamsted.ac.uk) if you are interested in either of these positions.

5th International Symposium of Biofumigation



The 5th International Symposium of Biofumigation – Delegates at the field demonstration

The 5th International Symposium of Biofumigation was held at Harper Adams University on the 9-12th September 2014. Biofumigation is a crop management method that utilises brassica species with high glucosinolate content for the suppression of pests, weeds and diseases. The event brought together a variety of crop consultants, academics and industry experts to discuss specific topics on biofumigation. Each session was successful in capturing specific areas of research associated with the technique such as the measurement of isothiocyanates, impact on soil ecology and specific approaches for the management of weeds, nematodes, insects and soil borne pathogens.

A practical session was held to demonstrate 30 different field plots of biofumigant species, cultivars and blends. Seed

suppliers were on hand to discuss their cultivars and blends and delegates were able to see practical demonstrations of sowing and brassica incorporation. This section of the event was made all the better with some late summer sunshine and an enjoyable barbeque to finish the day.

Overall, the event had a great atmosphere and was successful in sharing the latest developments and encouraging stimulating discussions. The delegates represented 17 different countries, making this a truly international symposium. Previous symposia have taken place in Italy, USA, Australia and Canada.

Matthew Back
Convener, AAB Nematology Group



Chief Agronomist - Per Gummer Andersen

On Thursday 31 July 2014, the respirator which Per Gummer had been dependant on for the last 1½ years of his life, was shut down on his own initiative. In spite of the aggressive illness, ALS, that tied Per to a wheelchair, and communication due to his increasing paralysis became more and more difficult, Per was active even during his last hours, socially and professionally, still sending his usual emails, when he was waiting together with his close family, for his respirator to be shut down.

As a young agronomist, Per was employed at Hartvig Jensen and Co, later Hardi International. Here he built a department, the Application Technology Group, that for years was a working place for 4-5 agronomists, one biologist and a technician.

The tasks were widely varying, but all originated from the goal to make plant protection as efficient and safe for users and the environment as possible, and to inspire and support development of better spraying equipment for the business benefits.

Once each year the department hosted a week-long seminar with participation of internationally recognised spraying experts and staff in Hardi's different companies over the world – the famous ATC-Application Technology Course, with 25-30 international participants each year. These included a mixture of researchers, authorities and hands-on people who worked together. Several parts of this course can be found in other courses for sprayer inspectors, in TOPPS courses, and in courses for developing countries. That was so typical for Per, an unorthodox mixture of experts from the University world and experts with great hands-on experience. The course was a great success for a long period, and gave all participants a wider perspective on efficient spraying. The experts expanded their international network, and Hardi sprayers and nozzles were placed on the equipment list in trials around the world.

Per had a passion for training – advisors, sales people, sprayer operators and he held many many courses around the world. He had a special passion for those who work in the most risky environment; operators of knapsack sprayers in developing countries. He arranged his last course just two months before his death. The topic was, as always, safety and efficient plant protection, via a.o. certification and inspection of sprayers and training of operators and advisors. Mostly he was way ahead of the rest of us in discussions, thinking of details that he knew were important, but had to wait until the rest of us reached the same level...

About 10 years ago Per founded his own expert consultancy, Better-Spraying, where he continued work in standardisation, authored scientific papers and as consultant made practical test-work, arranged courses and produced training material.

Per was for decades, a member of European and International standardisation committees. He was a member of many Working Groups and also for some time, Chairman for the Working Group – Application Technology. He was also chairman for the Danish group for standardisation of sprayers, and a member of the AAB Pesticide Application group.

He had a strong belief in the importance of international standards for the industry. He often said that it is a lot better to have a standard to relate to that is not perfect, than being an actor on the market in a world with different conditions in different countries.

Via his work Per, throughout the years, developed an extraordinary knowledge, for example, in the phasing of implementation of the EU directive on sustainable use of pesticides, that was greatly requested. Work meant a lot to Per. In spite of his increasing handicap, he took part in the work of standardisation till the end. During the last two years he hosted a number of WG meetings in his home, the last just 2 weeks before his death.

Colleagues and friends of Per remember Per's energetic, inspiring and almost contagious engagement. He was often very impatient and got excited, and was sometimes very irritating when he pushed development by sending emails and making telephone calls around the clock! He was also very impatient with the bureaucratic procedures that sometimes slow down the processes, but he also had the ability to end hard and frustrated discussions with a joke and a smile. In the middle of a strict regulated test procedure he could suddenly make a totally unexpected operation causing some confusion – we called it the Per-factor!

It is clear that it was also very hard for us to see him during this time. But this was nothing compared to his own situation. Per was a good friend to his many colleagues in the world of sprayers. We are grateful for a great colleague and friend who now is missed a lot.

Eskil Nilsson



John Michael Thresh, aged 84 years old, died on Thursday 12 February 2015 at the Pembury Hospital Tunbridge Wells in the UK following his battle with cancer. He leaves his wife, Peggy, four sons, four grandsons and four grand-daughters. Known as Mike Thresh to family and peers, the career of Professor Thresh spanned more than 60 years.

Mike came from a farming background in the north of England and spent much of his childhood on the family farm during World War II (1939–1945). This was before the days of full mechanisations and he can claim to have ploughed with horses and harvested cereals for threshing by steam power. His mother harboured ideas of having a "blood and guts" veterinarian in the family but a career in agricultural research was always the preferred option!

Mike took a first degree in botany at Imperial College, University of London, in 1952, in the days of Professors W. Brown and F. G. Gregory. In the university vacations, he worked as a student at the East Malling Research Station and walked in the Yorkshire Dales. He spent a year with plant virologists in the Plant Pathology Department at Rothamsted Experimental Station as a Colonial Research Scholar. During this period there was an opportunity for fieldwork in East Anglia on the control of sugar beet yellowing viruses, using one of the first organophosphate insecticides to be made available for use in agriculture.

His first assignment overseas was in Ghana and Nigeria (1953–1960) on the epidemiology and control of cocoa swollen shoot disease as one of the team of virologists at the West African Cocoa Research Institute. After seven years in West Africa, he returned to England, bringing with him a wife and baby, and followed a similar career focussing on virus diseases of hop, blackcurrant, and other fruit crop species at East Malling Research Station. These studies and contributions on general epidemiological concepts led to a University of London PhD and DSc, as well as a Queen's Award for Technological Achievement to East Malling and the Department of Hop Research, Wye College. This was for the development and deployment of virus-free clones of improved hop varieties.

While Mike was a staff member at East Malling, a 3-month assignment to Ethiopia in 1971 for FAO was

followed by other consultancies and advisory visits on behalf of FAO, the British Council, Overseas Development Administration (ODA), and several international agricultural research centres. These led to a renewed acquaintance on cocoa swollen shoot disease and the Cocoa Research Institute of Ghana through a project funded by ODA, and then to a UK-based appointment as plant virologist with the ODA Corps of Specialists. East Malling continued to be the base for many overseas forays into Africa and Asia until plant pathology was included in the remit of the Natural Resources Institute (NRI) and the transfer was then made to Chatham Maritime and the University of Greenwich. Quasi-retirement and an honorary position as Professorial Research



Cassava plants infected by whitefly transmitted mosaic virus

Mike's overseas experience spanned more than 40 countries, but he was especially knowledgeable on the virus problems of crops in Africa, where his experience was second to none. He published more than 200 papers, reviews, and book chapters. Many relate to his own research on the epidemiology and control of viruses of specific crops. These include cacao, hop, temperate fruits, cassava, and a wide range of other tropical crops. Mike had a special love for cassava and he was undoubtedly the best epidemiologist for cassava viruses. He had the chance to work with pioneer cassava virologists and cassava breeders in Africa, who played a key role for a better control of cassava viruses in Africa. Forty or so of his publications are concerned with general epidemiological principles, including several chapters in *Annual Review of Plant Pathology* and *Advances in Virus Research*. There has also been the series of special issues of the Elsevier journal *Virus Research*, which contain papers based on material presented at previous International Plant Virus Epidemiology (IPVE) Symposia and edited by Mike together with conference organisers. Mike was described as an 'editorial genius' for his ability to take drafts of papers and shorten them in half whilst adding invaluable additional points. Mike contributed much to our knowledge of plant virology, both within the UK and overseas, and was a tireless advocate, supporter, and promoter of plant pathology.

Mike stressed the importance of field work and a 'hands on' approach to research and he deplored the lack of it among so many scientists. He emphasized it was essential to see crops and plants *in situ* to get a holistic

Fellow at the University of Greenwich came in 1998 after a 5-year contract as senior virologist at NRI.

Mike was an active member of several scientific societies: he served on committees and councils of the Society for General Microbiology, the Biological Council, the Association of Applied Biologists (AAB), the Federation of British Plant Pathologists, the British Society for Plant Pathology (BSPP), and the International Society for Plant Pathology (ISPP). He edited/co-edited eleven books/conference proceedings and was Programme Secretary of the AAB (1973–1980), President of BSPP (1990), and Chairman of the International Committee on Plant Virus Epidemiology (ICPVE) of ISPP from its inception in 1979 until 1999. Mike was elected as Honorary Member of BSPP in 2005, and in 2012 became the second recipient of the Golden Cassava Award of the Global Cassava Partnership (GCP) for the 21st Century.

understanding of the epidemiology. However, he was pleased to be responsible for establishing the ISPP Plant Virus Epidemiology Committee at the Munich Congress in 1979 at a time when the more "biological" aspects of



Cassava plants grown from an infected stem cutting showing severe mosaic symptom and no root yield



Professor Mike Thresh discussing with a farmer the meagre production from a household planting totally affected by CMD.

plant virology were in danger of being swamped by those with a more biochemical approach. This initiative led to the organisation of 12 IPVE international conferences and the series continues with a 13th conference to be held in France in 2016.

Mike dedicated his life for helping the poor in developing countries. He worked tirelessly to bring about a deeper understanding and control of several plant virus diseases such as cocoa swollen shoot virus in West Africa, rice tungro and yellow mottle viruses in Asia and cassava mosaic disease pandemic in East Africa. His work in Uganda led to the understanding and control of cassava mosaic virus pandemic, which had devastated crops and induced widespread famine in Uganda in the 1980s-1990s. Ugandans remember him for his remarkable contribution in controlling the epidemic and restoring food security.

Mike and his wife, Peggy, a physiotherapist, have over the years "accumulated" four sons, four grandsons and four grand-daughters. They had a wide range of outside interests including sport, the countryside, music and travel. Several of their trips have been linked with assignments or conferences abroad, including some in Ethiopia, Costa Rica, Malaysia, Ghana, Ivory Coast, the US, and North Yemen.

Mike had no special 'words of wisdom' to impart as the recipe for personal happiness and fulfilment.

However, he did stress the value of having a supportive wife and family and the merits of a long and exciting career in research without the necessity of taking on the burdens and distractions of administration

A memorial service took place on 18 March at 12 pm at St. Michael's Church in Maidstone for family, friends and colleagues to say a final goodbye to superstar plant virologist Mike, who worked tirelessly to increase the food security of African farmers.

Updated from an original article published on the occasion of Honours to Professor Mike Thresh, on 29th Feb 2012, during the 12th IPVE Symposium in Arusha, Tanzania.

CENTENARY OF THE ANNALS OF APPLIED BIOLOGY CHALLENGES FOR CROP PRODUCTION AND QUALITY

A two day conference was held at Rothamsted Research, Harpenden, UK on the 9-10 December 2014 to mark the Centenary of the Annals of Applied Biology. The Association of Applied Biologists has played a major role in furthering the application of biology to agriculture and this conference was both appropriate and timely in reviewing how science has contributed to agriculture over the past 100 years and in considering future directions in the context of the challenges ahead. This international conference focused on one of the greatest challenges facing mankind in the 21st century: the “Challenges for Crop Production and Quality” in meeting the requirements of an increasing global population against the background of a changing climate, limiting resources and increased awareness of the environmental footprint of man. Serious challenges have to be faced during the next four decades: resources including water, land, energy and crop nutrients are limited but production must increase to meet rising demand. Even now demand for agricultural produce is at an unprecedented high level due to increasing population and consumption per capita. It is estimated that during the next 40 years as much food has to be produced as in the previous 8000 years. Sustainable agricultural systems are needed to maintain food security but at the same time minimise environmental damage.

In the 1960s the first green revolution took place utilising crop cultivars which gave good yield responses when supplied with fertilisers, irrigated and protected with pesticides and herbicides. The challenge ahead is to develop crops and agronomic systems that will yield well with fewer inputs to improve the eco-efficiency of agriculture. The conference addressed the application of science to this enormous challenge by considering four themes: Maximising Yield Potential; Protecting Crop Potential (biotic and abiotic stresses); Agriculture and the Environment; and Diet and Health. In all, more than 25 oral presentations and 29 posters were included with well over 100 delegates attending. All the presentations are to be published in the *Annals of Applied Biology* and the abstracts may be obtained on line.

It is not an easy task to write a brief report of such an important and interesting conference which attracted so many high quality papers and posters. Space permits that only a few representative publications can be selected for review. Below therefore is a brief account of a number of papers that it is hoped should provide “a flavour” of the meeting and encouragement for the reader at least to look at the remaining abstracts.

The Conference was introduced by Professor Jari Valkonen of the University of Helsinki, Finland and Editor-in-Chief for the *Annals of Applied Biology*. This was followed by two inaugural presentations. The first was given by Ian Crute CBE (Director, Agriculture and Horticulture Development Board, Stoneleigh Park, Warwickshire, UK) on “The sustainable intensification of European crop production: illusion or balancing act?” The second was presented by the recently appointed Director of Rothamsted, Achim Dobermann, who spoke on “Agriculture in the post-2015 sustainable development agenda”. These two stimulating presentations set the scene for the papers which followed, directed towards the four themes of the meeting.

In relation to maximising yield potential, photosynthesis is among the best known plant processes that falls far below its theoretical efficiency in modern crops and this was the theme of Stephen Long FRS (Director, Bill and Melinda Gates Foundation RIPE Project, Institute of Genomic Biology, Departments of Crop Science and of Plant Biology, University of Illinois, Urbana, USA) who spoke on “Maximising yield potential in the face of global atmospheric change”. There is now evidence that at a number of points of organisation from metabolism to crop canopy structure, the process could be improved particularly in the context of global atmospheric change. Such transformations have begun to validate these suggestions with greater production in the field. The same theme was continued by Christine Raines (School of Biological Sciences, University of Essex Colchester, UK) whose paper “Metabolic engineering to enhance photosynthesis and increase crop yield”, provided compelling evidence that manipulation of the Calvin cycle can increase crop yield and

Estimates of yield potential set expectations of feasible yield progress. This theme was taken up by Roger Sylvester-Bradley *et al.* (ADAS Boxworth Cambridge) in their paper “Mapping a route towards enhanced crop productivity in the UK”. In setting up a yield enhancement network (YEN) they considered in their paper the various ongoing improvements including breeding, innovative management of resources and farming system technologies. From this approach it was concluded that in the UK, the potential cereal yield was around 20 t ha⁻¹ and that of oilseeds 9 t ha⁻¹. The 20:20 Wheat programme at Rothamsted Research similarly aims to provide the knowledge base and tools to the wheat breeding industry to increase wheat yields to 20 t ha⁻¹ in the UK within the next 20 years as discussed by Malcolm Hawkesford (Rothamsted Research, Harpenden, Herts, UK), who spoke on “Sustainably achieving 20:20 wheat”. Much work is still to be done to minimise the gap between the current 8 t ha⁻¹ farm gate yield by addressing both abiotic and biotic stress limitations in the canopy and the roots and by optimizing nutritional inputs as well as increasing the resilience of the crop to extreme weather events. Increased input use including fertilisers and water must also be considered for sustainability.

In the section on Agriculture and the Environment, a number of papers argued that agricultural production had become more disconnected from the environment and that this process had caused significant environmental damage. In their paper “Future food: reconnecting agriculture and the environment”, Iain Gordon and Scott Ramsay (The James Hutton Institute, Invergowrie and Aberdeen) suggest a reconnection between agriculture and the environment to create a substantial food supply. They point out that to feed the increase in population meat production has to double and crop production to increase by almost 50%. Protection of the environment can be of great benefit but this will have to be achieved in the face of increasing costs of fuel and fertilizers and a scarcity of resources (soil and water) and increasing legislation affecting food biosecurity and pesticides.

A very well received paper by the Conference was that of Ismail Cakmak (Sabanci University, Faculty of Engineering and Natural Sciences, Istanbul, Turkey), “Agricultural strategies in the fight against micronutrient malnutrition”. About 30% of world population is estimated to suffer from micronutrient deficiencies particularly iron (Fe) and zinc (Zn). These deficiencies occur mainly in human populations of the developing world and are associated with low dietary intake where cereal based foods represent major daily calorie intake and are inherently low in bioavailable Fe and Zn. Moreover, crop acquisition of these two micronutrients can also be extremely low particularly when growing in calcareous soils, low in soil moisture and organic matter. There are, however, various well established agronomic techniques to boost cereal Fe and Zn concentrations. These include soil and/or foliar applications of micronutrient containing fertilizers as well as the generation of new genotypes rich in bioavailable Fe and Zn. Eradication of Fe and Zn micronutrient deficiencies is therefore an achievable aim. In this respect previous field experiments directed by Ismail Cakmak in the 1990s on Zn fertilization in Turkey has already had an enormous impact in enhancing wheat yields. These, in some cases as much as tenfold, are part of a great success story of wheat cultivation in 4.5 million hectares of Central Anatolia.

A valuable contribution was made by Peter Shewry and colleagues (Rothamsted Research) on “Improving the contribution of wheat to human health”. It is well recognized that wheat is an important component of a healthy diet. As well as providing vitamins, minerals and phytochemicals with bioactive properties it is one of the most important sources of dietary fibre (DF). The work of this group centres on arabinoxylan (AX) which is the major component of dietary fibre in whole grain and white flour and which can vary considerably in content of flour obtained from different sources of wheat. Work was discussed in relation breeding new wheat varieties and additionally using bioinformatics and transcriptomics to identify candidate genes encoding key enzymes in the synthesis of AX. The research also includes collaborative studies to relate the structure and properties of AX to specific health benefits.

Following all the presentations, time was set aside for general discussion which was chaired by Martin Parry (Rothamsted Research). A wide range of views were expressed and it was generally agreed that it had been a very worthwhile meeting. All those attending from diverse backgrounds recognized the huge challenges ahead to achieve a doubling in human food requirements by 2050. Considering the breadth of conference contributions, it was perhaps somewhat surprising that only a very few papers dealt specifically with the major plant nutrients and these were devoted to N with scarcely a mention of P or K. In 2012 Mueller *et al.* reported in *Nature* (490:254-257) a global study of fertilizer and irrigation needs to close yield gaps for the three most important world cereals - maize, wheat and rice - in relation to doubling the human food requirements by 2050. Their findings showed that in 73% of the underachieving areas worldwide, yield gaps could be closed with acceptable yields obtained (a 29% global increase) solely by focusing on the nutrient inputs. The required increases in nitrogen (N), phosphorus (P), and potassium (K) application relative to baseline global consumption were evaluated as 18, 16 and 35% respectively. This higher requirement of K is of interest. Adequate K supply ensures the efficient use of both N and P fertilizers. Additionally in crop nutrition it plays a fundamental role in photosynthesis, protein synthesis, plant-water relations, carbohydrate transport within the plant, protection against reactive oxygen species (ROS) and mitigating abiotic and biotic stresses.

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GROWING LANDSCAPES- CULTIVATING INNOVATIVE AGRICULTURAL SYSTEMS



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