All-Party Parliamentary Group on Science & Technology in Agriculture

Notes of a meeting held on Tuesday 16 July 2013, Committee Room 17, Palace of Westminster

Digital Farming: The Next Agricultural Revolution

Present:

Members
Mark Spencer MP (Chair)
Lord Haskins
Bill Wiggin MP
Lord Curry of Kirkharle
Lord Lindsay
Duke of Montrose
Baroness Byford
Corina Cheung (pp. Huw Irranca-Davies MP)

Guest Speakers:
James Hallett, Chief Executive, British Growers Association
Professor Simon Blackmore, Head of Engineering, Harper Adams University
Simon Griffin, Technical Manager, SOYL Precision Farming
Mark Pettigrew, Agricultural Sustainability Manager, PepsiCo
Shradha Singh, SYield Project Leader, Syngenta
Derek Scuffell, Information Domain Specialist, Syngenta

Stakeholders
Gordon Jamieson, John Innes Centre; Paul Rooke, AIC; Martin Collison, Collison Associates; Fay Jones, NFU; Helen Ferrier, NFU; Rosana Verza, Embassy of Brazil; Andrew Manfield, Stockbridge Technology Centre; Anthony Marlowe, Edelman; Martin Savage, nabim; Chris Atkinson, Natural Resources Institute; Calum Murray, Technology Strategy Board; Stewart Gore, Cultura; Glynn Harris, Cultura; Debbie Riley, Cultura; Barry Hackett, Farmwise; Mark Barlow, Gransden CFC Ltd; Caroline O'Leary, nabim; Mark Charlton, ABF; Tony Pexton, farmer; David Leaver, BIAC; Luke Gibbs, Syngenta; Paul Biscoe, AFCP; Andrew Jones, BASF; Mark Buckingham, Monsanto; Neil Hipps, consultant; Tina Barsby, NIAB; Colin West, MAGB; Dougal Goodman, Foundation for Science & Technology; Ian Crute, AHDB; Simon Leeds, British Sugar; Ed Barker, CLA; Daniel Pearsall, Group Co-ordinator

1. Welcome & Introduction
Mark Spencer MP welcomed Members and stakeholders to the meeting, which provided a very timely opportunity to consider the role of precision agriculture in helping farmers respond to the 'sustainable intensification' agenda of delivering increased yields using fewer inputs and with reduced GHG emissions and other environmental impacts. He noted that this was a diverse and rapidly advancing field, with applications ranging from satellite mapping and precision engineering to robotics, remote sensing and data modelling. This diversity was indeed reflected in the speaker-line-up for the meeting, whose expertise ranged across a number of different technologies, production systems and scientific disciplines.

2. Guest speakers

[Please note that full copies of speakers' slide presentations are available to download via the Meetings section of the All-Party Group web-site at www.appg-agscience.org.uk]

James Hallett, British Growers Association (BGA)

Highlighting the economic significance of the £3.7bn UK fresh produce sector – accounting for 21% of ex-farm sales value on just 4% of the cropped area - James Hallett (JH) described the key role of precision farming techniques within the horticulture sector in responding to 'sustainable intensification' agenda and containing costs in all aspects of the production process. As an early adopter of such practices, JH described the overriding benefit of precision techniques to horticulture as the combined and aggregated effect of marginal gains – for example in terms of input use, time, labour, soil health, timeliness of operations and optimising marketability of produce.

JH used a series of images to illustrate the current application of precision farming techniques within the horticulture sector, from satellite-guided tractor and implement control operating to within 2cm accuracy, variable rate fertiliser spreaders capable of covering up to 30 ha per hour, and camera-operated robotic hoeing of lettuce plants. JH noted that with European, Russian and US satellite technology now accessible, the improved definition and accuracy of satellite-based systems provided increased scope to optimise the repeatability and minimise the variation of in-field operations.

The use of unmanned aerial vehicles (UAVs) within the horticulture sector provided a key opportunity to improve the spatial accuracy and detail of aerial imaging – moving from 20-30m resolution in the case of satellites and 10-20m for aircraft to a resolution of 5-10cm for UAVs flying at 400 feet above the ground. Such definition allowed for more precise assessment of crop emergence and canopy cover to predict yields, plan more efficient input use in different areas of the field, and allow more careful targeting of in-field operations such as weed control.

Moving from the field to the development of indoor horticulture systems, JH highlighted the work taking place at Stockbridge Technology Centre to harness the sun's rays using photovoltaic cells then transferred into carefully controlled LED lighting targeted at precisely the wavelength needed to optimise plant growth in as short a time as possible. When combined with closed loop irrigation, complete automation of the growing process, and contained use of accelerated breeding techniques, this offered a glimpse of the near to medium term future for precision techniques in horticulture.

In the longer-term, JH suggested that the future lay in 'precision precision' – integrating and interpreting the necessary data to explain more precisely why crop rotations work, understanding the interactions between different crop types and the soil rhizosphere. This in turn would lead to the development of tailored and crop-specific production plans to suit different fields, rotations, soil types and locations, optimising the balance between productivity, input use and environmental impact.

In conclusion, JH suggested that these new technologies marked the start of a new 20-year Green Revolution, and that the full potential of precision farming techniques had yet to be realised.

Professor Simon Blackmore, Harper Adams University

As the founding director of the National Centre for Precision Farming, Simon Blackmore (SB) indicated that his research interests were looking beyond the precision farming technology currently in use to innovations with the potential to deliver even more dramatic efficiency gains.

For example, advances in robotic engineering were opening up opportunities to develop machines smart enough to manage crop production processes without operators. SB also highlighted work to develop a microdot sprayer which used sophisticated image recognition technology to detect 26 different weed species in terms of their size, shape, biomass, growth habit etc. By spraying the required amount of herbicide directly onto the weed leaf, SB estimated that microdot technology could reduce input use by as much as 99.9%.

According to SB, advances in precision agriculture offered the potential for a radical re-think of agricultural production, which was currently based on the availability of relatively cheap energy allowing widespread use of synthetic fertilisers and pesticides. The future would require food production based on clean technology, such as weed control using robotic engineering rather than developing chemicals capable of selecting which weeds to kill.

But SB noted that the UK did not have adequate resources directed towards R&D in this area, and was missing out on opportunities to bring these technologies to the market place quicker than at present. With properly targeted support, SB suggested that Britain's farmers could enjoy access to a new wave of smart machines and technologies to help deliver the 'sustainable intensification' agenda by improving production efficiency and reducing input use.

Simon Griffin, SOYL

Introducing SOYL as a specialist precision farming company established 20 years ago, Simon Griffin (SG) explained that the business was not involved in selling chemicals or other inputs, but was focused on providing satellite-based solutions throughout the farming calendar - from ploughing and drilling to spray and fertiliser application, harvest and yield mapping – to deliver efficiency gains and cost savings across all aspects of crop production. The company's turnover and customer base was increasing by 20% per year, with precision farming services now covering more than 1 million hectares.

SG described three specific precision farming applications:

Precision nutrient management – involving the GPS-based modelling of soil samples typically taken every 100m to generate a map showing the status of key soil nutrients across the field. This in turn provides the basis for a computer-guided application schedule to help target fertiliser use only where needed on a field-by-field basis.

Crop sensing – using satellite technology to develop a biomass map of the growing crop based on the green area and reflectance. Applying remote sensing technology in this way allows variation in crop canopy development to be identified, inspected and then managed using variable rate applications of nitrogen. This in turn leads to improved crop performance and more efficient input use.

Soil sensing – soil electrical conductivity is measured to assess the physical characteristics of the soil and how its composition changes across the field – heavier, more clay, stonier, lighter etc. Since soil composition can affect seed survival and the quality of the seed bed, the soil conductivity map is converted into a seed rate application schedule to drill more or less seed into different parts of the field to optimise productivity.

SG added that other precision farming applications were also in development to meet the multiple drivers of yield, efficiency, traceability and environmental responsibility. Soil compaction, for example, could be a major factor in preventing proper root establishment, and using the latest satellite imaging technology it was now possible to measure the variable rate and depth of soil compaction across an individual field. This could then be used to control the depth of cultivations required to remove compaction effectively but without using more fuel than necessary.

SG concluded that UK farmers were innovative and keen to adopt new technology. The renewed drive to produce more using fewer inputs and with reduced environmental impact offered scope for a significant increase in uptake of precision farming techniques.

Mark Pettigrew, PepsiCo
As a major buyer of agricultural products (potatoes, oats, corn, peanuts and apples), Mark Pettigrew (MP) explained that PepsiCo was dependent on sustainable agriculture for the continuity of its raw material supply. In potatoes for example, a recognition that by 2030 there would be a 75% decline in rain-fed land available for UK potato production led in 2010 to the launch of PepsiCo's 50 in 5 programme – a partnership with British farmers to reduce the carbon and water footprints of core crops by 50% in five years.

For potatoes, the 50 in 5 programme comprised four key platforms:

New Varieties – investment via the company's own potato breeding programme in Wisconsin, and partnership with UK-based breeders at the James Hutton Institute, to develop varieties with better yields, solid matter, lower defects and improved water and nitrogen use efficiency.

Modified Agronomy – applying advances in drip-irrigation to optimise water use, specifying only low carbon or organic sources of fertiliser and applying the latest precision farming techniques to ensure efficiency of fertiliser use and application.

i-crop Precision Agronomy
Developed in partnership with researchers at Cambridge University Farm, MP explained that the i-crop system used soil moisture probes (currently 100+ sites using 3 probes per field) linked to local weather stations to provide potato growers with access to real time data and decision support on the water needs of individual fields. This system was supported by an i-phone app allowing growers to take photos of the crop canopy to help predict yield, identify disease or nutrient requirements etc.

Cool Farm Tool – initially developed by Unilever and Aberdeen University, the Cool Farm Tool was now available as a free-to-use online resource for individual growers to assess the carbon footprint of their farming operations. Designed to be simple to use but scientifically robust, ADAS was further developing the use of data from the Cool Farm Tool to produce carbon management plans for individual potato growers supplying PepsiCo.

With two years completed of the 50 in 5 programme, MP reported that a 65% reduction in water use had been achieved, alongside a 12% carbon reduction. Had weather-hit yields in 2012 not suffered a 20% reduction, however, the progress in carbon reduction would have been closer to 29%.

Shradha Singh / Derek Scuffell, Syngenta
Shradha Singh (SS) described the background to the SYield consortium project to develop remote disease detection methods and risk prediction models for *Sclerotinia* in oilseed rape. Led by Syngenta in partnership with Manchester University, Rothamsted Research and a number of other commercial partners, SYield was a three-year integrated project with £1.3m funding from TSB and a further £1.3m from Syngenta and other industry partners.

SS explained that *Sclerotinia* infestation in oilseed rape – a key crop in the arable rotation - causes stem rot and can lead to yield losses of up to 35%. But controlling *Sclerotinia* is extremely difficult, because it is a sporadic, multi-factorial disease capable of surviving in the soil for many years and whose outbreak is hard to predict. Available treatment methods are preventative rather than curative, so the timing of sprays is critical in ensuring effective control.

SS briefly described the biochemical science involved in the detection and catalysis of oxalic acid produced by the incubating Sclerotinia spores. The approach was similar to the enzyme technology found in blood glucose sensors used for diabetics. Air-borne spores captured from the oilseed rape field were grown on and tested using this simple protein chemistry and then converted into a risk prediction signal for the grower.

Derek Scuffell (DS) explained how this sensor technology could be integrated with a wide range of farm-level and wider public and private data sources – eg cropping history, topography, environment, humidity, wind, temperature – to develop effective prediction models for *Sclerotinia* in oilseed rape. This was intended help growers to predict disease risk and from that to form an accurate assessment of likely outcomes or control options.

Now in its final year with field trials taking place in six UK locations, DS highlighted the wide range of disciplines, skills and data components involved in the SYield project, from protein chemistry and sensor technology to environmental modelling, bioinformatics and hi-tech engineering. While a number of companies were involved in the development of sensor technology, the key to its effective on-farm application lay in the integration and interpretation of available data sources within a single hub to provide the most sophisticated decision support tool for growers.

3. Questions and Discussion

The following key points arose during discussion:

In response to Barry Hackett, SB confirmed that the primary focus of precision farming techniques was to reduce costs and improve input use efficiency rather than to increase physical crop yields.

David Leaver asked whether enough research was being done to measure the outcomes of precision farming rather than simply managing the process. SG acknowledged that little had been done to measure the outcomes of applying precision farming techniques or to use the data generated to question the agronomic approaches applied because it simply involved replicating established, field-scale practices at the square metre level.

In response to Chris Atkinson, JH noted that more research was needed into the benefits of applying precision farming techniques to conservation agriculture. SB added that 90% of the energy used in cultivations was to repair the damage caused by ploughing in the first place, and that precision engineering solutions offered the potential to manage seed beds at the micro-level so avoiding the need for deep inversion ploughing.

Tony Pexton asked about the compatibility of the various systems used for precision farming. SG agreed that a major gripe among farmers was why different pieces of equipment would not talk to each other. SB suggested that this issue alone could put farmers off investing in the technology. DS added that a common definition of data standards for interchange and integration was also lacking, and that this was preventing proper exploitation and application of the vast amounts of on-farm data being generated.

Martin Collison noted that precision agriculture was the true definition of ‘green farming’ – in the long term sustainability was about increasing production while reducing input use.

Lord Haskins suggested that many large farms had invested in precision farming technology but were only half using it – SOYL's evidence base of more than 1 million hectares should be providing compelling data of the benefits. SG responded that with a customer base growing at 20% a year his company no longer needed to provide cost-comparisons because farmers simply saw it as the right way to farm.

Calum Murray informed the meeting that on 23 September the Technology Strategy Board would be launching a new £13m funding round on precision agriculture. A number of consortium building workshops were scheduled over the summer in advance of the call.

Lord Curry questioned whether the best use was being made of soil nutrients even if soil analysis showed them to be there, and asked how the next phase in the development of precision farming would make better use of the available data. SG acknowledged that the UK soil research for P, N and K recommendations was 50 years old and in need of updating, but it remained the best source of advice available. He noted that other countries were ahead of the UK in at least trying to incorporate factors such as root structure, moisture uptake efficiency and soil structure into their research and recommendations.

Gordon Jamieson suggested that the sector was drowning in data and reaching the point of collecting yet more data with no utility. Like others, he highlighted the need to simplify and co-ordinate the collection and integration of available information to make better use of it.

Mark Charlton highlighted a key issue for the flour milling industry which was how to achieve consistency of wheat quality through foliar nitrogen applications to get the right protein levels. This was also a major factor in the carbon footprint of wheat production. SG suggested that it was possible through satellite-based imaging to manipulate protein levels in the growing crop.

Concluding the meeting, Mark Spencer MP thanked guest speakers, Members and stakeholders for their contribution to an informative and thought-provoking session. He noted that the meeting had highlighted in particular the need for better integration, analysis and application of the large amounts of raw data being generated by the increased uptake of IT and precision farming systems.