

“ We’re not just looking at a fourth agricultural revolution anymore – I believe we’ve started it.”

The revolution begins

Automation and AI in the world of agriculture are progressing at a jaw-dropping rate – with all signs pointing towards such tech becoming an imperative part of farming systems in the not-too-distant future. CPM finds out more.

By Charlotte Cunningham

Technical shows and events have long been the traditional place to debut new technology and kit in agriculture, and though COVID has prevented these launches during the majority of 2020, it hasn't stemmed the thirst for progression.

However, there are often questions over how we take the technology from the show stand to the farm, and when it gets there, just how useful is it really going to be?

For Lincs grower, Andrew Ward, integrating new technology into his business has proved to be critical from both a crop production point of view, and financially.

Over the past few years, Andrew has been making use of a number of technologies, including on-farm weather stations to capture rainfall, humidity, and soil temperature, as well as GPS to help with tasks such

as soil mapping. “When we look at the rainfall data we’ve gathered, it’s obvious that there’s a huge amount of variation, meaning this data is invaluable when it comes to planning on-farm activity.

“Looking at GPS, it’s not just for straight lines and making driving easier anymore — it does actually have real potential to improve productivity and machinery capabilities. On farm, we’ve been mapping soil to GPS for the past eight years and it’s shown that we have incredibly variable soil. This data is then used to make decisions around cropping, so it’s crucial that we have access to this information.”

In conjunction with this, Andrew has also been making use of Bayer’s Climate FieldView system. “The software highlights which areas are lower yielding so we can investigate why this might be. Having data like this at our fingertips means we can take continuously lower yielding areas out of production and put it into more profitable environmental schemes.”

Though the investment in GPS can be costly, the value has proved to be colossal, with savings on Andrew’s wheat crop alone estimated at approximately £4800. “This is through savings from chemicals, fertiliser and seed by the reduced overlaps from using GPS on the sprayer — instead of the operators own eyes judging when to switch on and off. The savings are far more if you include fuel in the cultivations and establishment, again because of less overlaps.”

So that’s where we are now with making use of the available technology, but where are we headed? Andrew believes the answer is simple — robotics

and automation. “We’re not just looking at a fourth agricultural revolution anymore — I believe we’ve started it.”

It’s Andrew’s belief that the industry as a whole will have to become a lot less reliance on plant protection products over the coming years — regardless of whether that’s due to resistance or legislation.

And while cultural techniques will help fill the gap, he reckons that making use of robotics will be game-changing.



Andrew Ward believes the UK will become less reliant on chemistry and more so on robotics in the not too distant future.

Satellite drought insurance solution

As growers continue to battle summer droughts that seem to have become a regular feature in the arable calendar, Mantle Labs — a remote sensing company — has signed up to the national SPRINT (Space Research and Innovation Network for Technology) business support programme to complete a major project to measure soil moisture in crop fields.

SPRINT funding will enable Mantle Labs to collaborate with the University of Surrey on a project that will integrate Earth observation satellite data and hydrological modelling to inform on field-specific soil moisture.

The University of Surrey will provide Mantle Labs with research expertise on hydrological models to complement the company's Earth observation measurements. This soil moisture information will be integrated into Mantle Labs' existing insurance platform to develop a new soil moisture-based drought insurance product.

The hope is that this will enable Mantle Labs to

become the first remote sensing company in the world to offer end-to-end parametric index insurance products — covering the entire spectrum of the agriculture industry, right from pre-sowing to harvest.

As a result, Mantle Labs will be able to provide insurers with historical satellite data, complemented by near real-time in season analysis, giving greater clarity of crop conditions on the ground.

Subsequently this will enable insurance companies to offer extremely cost-effective and affordable index-based insurance to small holder farmers.

The project will be funded by a grant from the £4.8M SPRINT programme that provides access to the University of Surrey's space expertise and facilities.

"Through SPRINT, we are collaborating with leading researchers from the University of Surrey's space programme," says Jon Pierre, chief business officer at Mantle Labs. "Their expertise, enabled by the SPRINT funding, will help us to facilitate a unique



A new project by Mantle Labs looks set to provide a drought insurance solution through the use of satellite data.

and innovative insurance product, a real market first.

"Previously, due to a lack of historical agriculture data, crop failures caused by different perils were not covered by insurers in a cost-effective manner. This meant that the estimated 500M smallholder farmers throughout the world couldn't get access to insurance. We will now be able to access soil moisture readings at a very granular level, helping farmers to access more affordable insurance and credit."

Andrew has been working alongside the Small Robot Company, as part of the farmer advisory board, and has trialled the "Tom" bot on farm. "We've had both version one and version two out on farm, capturing data and placing that data on a map.

"What's great about SRC is that they're looking at things on a per-plant basis, meaning these bots could

become a really important part of the system."

Providing this "per-plant intelligence" is SRC's Wilma bot, which was recently launched in its commercial form at Agri-TechE's REAP (Realising Economic Agricultural Potential) conference.

Wilma works by using the information collected by Tom, the scouting robot, on the health of the plant.

If she identifies the plant as a weed, then Dick — a non-chemical robotic weeder — is dispatched to zap it.

Ben Scott-Robinson, CEO and co-founder of SRC, says that the robots are being trialled on three farms and their success is creating excitement among farmers that have invested in the technology. ▶



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innovation showcase



New AI is now able to interpret drone imagery to help farmers analyse broadacre crops.

► “Wilma creates a per-plant crop map and is then AI-enabled to recognise disease and the nutrient status of the plant, enabling precision weeding by the farmbots and, in the future, application of water, nutrients or fungicide as appropriate — cutting chemical use and emissions.

“Wilma can direct Dick on the most effective course across the field. The robot then kills the weeds using the Rootwave technology, which is electric so there’s no problem with resistance.”

In a post-glyphosate world the ability to quickly kill pernicious weeds as they appear means that farmers don’t need to wait to drill and can take the opportunity to get crops started in the better weather in early autumn, he adds. “Our lightweight farmbot Harry will also be equipped to precision drill without damaging the soil.”

And it’s not just on the ground that robotics and AI is gaining traction, with new AI now able to interpret drone imagery to help farmers analyse broadacre crops.

Skippy Scout version 2.5, the mobile phone app created by Drone Ag, has been developed with unique AI to interpret images taken by a drone. “It was always our intention to develop the software to this stage and we are thrilled to have it ready for users to take advantage of this season,” says Drone Ag

Good vibrations

As arable production continues to expand — encompassing not only growing crops, but also protecting the wider environment, including pollinators — a unique agri-tech start up is using IoT to monitor bee health.

By tapping into vibrations in the hive, the BeeSecure software able to listen into “conversations” ensuring that the bees are happy, healthy, and performing well.

Co-founder Roberto Pasi says the company can understand 10 main topics, quickly identifying issues.

BeeSecure is based in Italy and currently supports thousands of beehives across mainland Europe. It’s part of the European Institute of Innovation and Technology Food Accelerator Programme and has just started working with beekeeper associations and farmers in the UK.

Roberto inherited his passion for bees from his grandfather, who left him 20 hives a decade ago.

“It started as a hobby, but then we got thinking bees are so important so why is there no technology to support beekeepers? There’s been a massive loss of bees in recent years and no one really knows the reason for this.”

BeeSecure uses IoT devices such as sensors to monitor the temperature, humidity, and sound. “We have a little microphone that is able to translate vibrations within the bee hive; it can’t pick up the individual conversations, but just like sitting in Old Trafford watching Manchester United, if somebody scores a goal, you’re really going to hear it,” explains Roberto.

“At the moment we can understand the 10 most important topics, from ‘the Queen is dead’ to ‘there are not enough flowers nearby’ and this is sufficient to determine a problem with the hive and understand the size of the colony.

“Additionally, bees maintain a constant temperature of 35°C; if that suddenly changes



By tapping into vibrations in the hive, BeeSecure is a unique software able to listen into “conversations” ensuring that the bees are happy, healthy, and performing well.

that is a real alarm that something is wrong.”

Data from the hives can be viewed in real-time by the farmer and keeper via a secure app.

As the software begins to make its way to the UK, Roberto is keen to talk to UK farmers about the rental of beehives and the BeeSecure system and to find partners with specialist knowledge of bumblebees.

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founder, Jack Wrangham.

Automated analysis of drone imagery can detect the percentage of weeds compared to healthy crop, and count the number of plants/m². By analysing the images, the app can also detect disease and is capable of interpreting holes in leaves to highlight insect damage. "This is the most advanced crop scouting tool we have produced and is the culmination of years of development work," says Jack.

The new version of the software will automatically fly a drone to scout fields five times faster than conventional methods. Using AI and satellite data it can then analyse the images to offer data and advice to the user. "Skippy can now count plants, measure healthy crop cover compared to weed cover, report on damaged crops and highlight insect damage," he explains.

Satellite data is being fed to the app up to three times a week and appears on the user's phone as a layer of information. "Users can import their own maps too, giving each a name so that year on year data can be compiled and compared," says Jack. "The AI in Skippy is able to take all of this information to offer analysis and advice based on the data collected from the drone images," he adds.

The data is subsequently presented in PDF reports that are automatically created by the app. "The reports are easy to understand and can be saved for future benchmarking and comparison," he concludes.

Also honing in on the benefits of drone imagery is Hummingbird Technologies, who discussed the role tech can play in verifying sustainability activities — for the purpose of carbon trading, regulatory reporting, and even premium pricing — in a recent online webinar.

"As growers look to lower their inputs, we've become increasingly interested in measuring sustainability itself," explains Will Wells, founder. "We can't measure carbon from space yet, but there are all sorts of things we can do in the meantime."

Hummingbird's expertise is in imagery analysis, meaning it's unable to measure factors such as diesel quantities used, so by connecting to other software platforms, users can extract that data. "We're very much of the view that growers won't have to log in individually to all of these platforms in the very near future, maybe in under a year. API integration between software will be able to do that for you. Backend integration unlocks value."

On the sustainability front, Hummingbird are focusing on its "sustainability triad" which looks at:

- Facilitating optimised inputs: Microanalytic products to provide actionable insights to reduce agrochemical applications, mitigating run-off and leaching without affecting yields.
- Verifying sustainable practices: Detecting sustainable practices such as tillage and cover cropping can provide scalable and affordable verification — subsequently unlocking carbon or supply chain credits.
- Automating sustainability reporting: Harmonising and digitalising a sustainability framework in order to improve transparency and disclosure as well as enhancing the ►



Small Robot Company's Wilma bot creates a per-plant crop map and is then AI-enabled to recognise disease and the nutrient status of the plant.

An advertisement for OPICO mechanical weeding machinery. The top section features the OPICO logo and the text "MECHANICAL WEEDING Back to the future!". Below this is a photograph of a green tractor pulling a red and blue mechanical weeding implement in a field. The bottom section contains text about the political and environmental agenda pushing farmers towards mechanical weeding, and lists two types of machinery: INTER-ROW CULTIVATOR and COMB HARROW, each with a brief description and a list of features.

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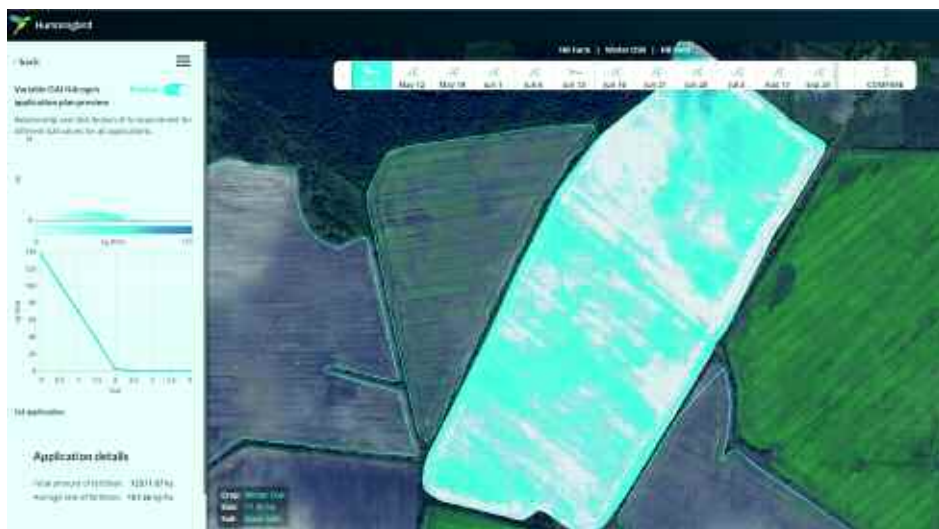
"On average, we facilitate about a 20% reduction in chemical applications and we're working closely with the Sustainable Food Trust and LEAF on a project to automate modelling and sustainability reporting, using AI to benchmark outcomes."

Through remote sensing and data analytics, Hummingbird's goal is to facilitate, measure and monitor sustainability in food production, and has tools such as tillage and crop residue detection — as well as benchmarking biomass and performance analytics — in

its armoury already. "Within the tillage and crop residue detection algorithm, we're able to measure the centimetres of crop residue left on the surface after a tillage event, meaning we're able to distinguish between conservational tillage, min-till or no-till and we're able to pinpoint the event.

"We're doing this in the US and Australia at the moment where they have mature carbon credits available to anyone who can prove they've switched tillage intensity, retrospectively.

"The environment is changing a lot — we've got one eye on Defra and ELMs and another on what's happening in the US and Australia, knowing that markets follow each other.



Hummingbird Technologies are working closely with the Sustainable Food Trust and LEAF on a project to automate modelling and sustainability reporting, using AI to benchmark outcomes.

"We're learning every season, and it doesn't matter as much where the initial analysis work is done, but it's about creating a better understanding and looking at what can be done objectively, cost-effectively and remotely."

Collaboration to accelerate smart farming solutions

Some time since the initial collaboration was announced, last month Bosch and BASF signed a joint venture agreement to market and sell smart farming solutions from a single source — helping farmers to benefit from automated, agronomic solutions.

The first two products to be launched will be a version of the Intelligent Planting Solution (IPS) system, with enhanced digital intelligence for seeding and fertiliser rates, and Smart Spraying.

The Smart Spraying solution combines Bosch's camera sensor technology and software with xarvio's crop optimisation platform. Both products have been tested extensively in real growing conditions.

Depending on the local conditions this may lead to a reduced need for crop protection products in specific applications, with Smart Spraying showing up herbicide reductions of up to 70% herbicide in the experimental stage.

The solution is expected to be launched with a limited number of machines in 2021.

Autonomous hydroponics

Though hydroponics divide opinions, the benefits of such systems have been raised time and time again as part of the solution to feeding a growing population.

And the technological advances in this area of the market are truly remarkable, including the recent launch of a new project to develop an autonomous, hydroponic system centered around a novel hydrogel growing media.

The GelPonics project is a collaboration between start-up AEH Innovative Hydrogel, robotics experts Labman Automation and Crop Health and Protection (CHAP), supported by the Graphene Engineering and Innovation Centre of Manchester University, Grobotic Systems, and Stockbridge Technology Centre.

The project is funded by Innovate UK's Transforming Food Production challenge: 'Science and Technology into Practice' and is planned to run for 26 months — commencing on 1 Sept this year.

In place of soil, hydroponic systems generally use a substrate, such as rock wool, coir, or peat, to support plant roots and facilitate water and nutrient uptake.

However, as all these substrate options are unsustainable, they tend to be the largest contributor to the carbon footprint of vertical farming or glasshouse production.

With global controlled environment production expanding significantly, it's essential that alternatives are sought that can decarbonise agriculture — while meeting grower specifications — and, crucially, competing on price, says CHAP.

GelPonics technology is claimed to improve the sustainability of production and, by optimising inputs and crop resilience, cut operational expenditure.

As well as being recyclable, the hydrogel product can be reused locally as a soil amendment to help sequester carbon. It also has substantial export potential in dry form to countries with water scarcity.

According to CHAP, the project will be delivered in three principal phases:

Phase 1 will optimise the hydrogel formulation and shift-changer nutrient delivery system, encompassing a "state-of-the-art" graphene

membrane, alongside industry analysis.

Phase 2 will focus on prototyping trials in CHAP's Vertical Farming Development Centre, and STC's LED Tomato Glasshouse, to optimise plant growth within the GelPonics system. System development will combine sensors with automation to create a fully automated rig for the hydrogel substrate, integrated with renewable energy.

Phase 3 will deliver a full, semi-commercial trial of the GelPonics system for both leafy green and tomato production, as well as demonstrating the technology and its potential for low-carbon horticulture.

"There's a significant market demand for more sustainable hydroponic substrates," says CHAP innovation network lead, Dr Harry Langford. "This project is an exciting opportunity to optimise and scale-up a novel hydrogel product and demonstrate this product directly to the end-user, within an automated production system".

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